



Roorkey 1999 Chemistry Question Paper and Solution



Simplified Knowledge Management Classes Bangalore

My name is [Subhashish Chattopadhyay](#). I have been teaching for IIT-JEE, Various International Exams (such as IMO [International Mathematics Olympiad], IPhO [International Physics Olympiad], IChO [International Chemistry Olympiad]), IGCSE (IB), CBSE, I.Sc, Indian State Board exams such as WB-Board, Karnataka PU-II etc since 1989. As I write this book in 2016, it is my 27 th year of teaching. I was a Visiting Professor to BARC Mankhurd, Chembur, Mumbai, Homi Bhabha Centre for Science Education (HBCSE) Physics Olympics camp BARC Campus.

I am Life Member of ...

- [IAPT \(Indian Association of Physics Teachers \)](#)
- [IPA \(Indian Physics Association \)](#)
- [AMTI \(Association of Mathematics Teachers of India \)](#)
- [National Human Rights Association](#)
- [Men's Rights Movement \(India and International \)](#)
- [MGTOW Movement \(India and International \)](#)

And also of

[IACT \(Indian Association of Chemistry Teachers \)](#)



The selection for National Camp (for Official Science Olympiads – Physics, Chemistry, Biology, Astronomy) happens in the following steps

1) NSEP (National Standard Exam in Physics) and NSEC (National Standard Exam in Chemistry) held around 24 rth November. Approx 35,000 students appear for these exams every year. The exam fees is Rs 100 each. Since 1998 the IIT JEE toppers have been topping these exams and they get to know their rank / performance ahead of others.

2) INPhO (Indian National Physics Olympiad) and INChO (Indian National Chemistry Olympiad). Around 300 students in each subject are allowed to take these exams. Students coming from outside cities are paid fair from the Govt of India.

3) The Top 35 students of each subject are invited at HBCSE (Homi Bhabha Center for Science Education) Mankhurd, near Chembur, BARC, Mumbai. After a 2–3 weeks camp the top 5 are selected to represent India. The flight tickets and many other expenses are taken care by Govt of India.

Since last 50 years there has been no dearth of “Good Books”. Those who are interested in studies have been always doing well. This e–Book does not intend to replace any standard text book. These topics are very old and already standardized.

There are 3 kinds of Text Books

- The thin Books — Good students who want more details are not happy with these. Average students who need more examples are not happy with these. Most students who want to “Cram” quickly and pass somehow find the thin books “good” as they have to read less !!
- The Thick Books — Most students do not like these, as they want to read as less as possible. Average students are “busy” with many other things and have no time to read all these.
- The Average sized Books — Good students do not get all details in any one book. Most bad students do not want to read books of “this much thickness“ also !!

We know there can be no shoe that's fits in all.

Printed books are not e–Books! Can't be downloaded and kept in hard–disc for reading “later”

.....

So if you read this book later, you will get all kinds of examples in a single place. This becomes a very good “Reference Material”. I sincerely wish that all find this “very useful”.

Students who do not practice lots of problems, do not do well. The rules of “doing well” had never changed Will never change !

After 2016 CBSE Mathematics exam, lots of students complained that the paper was tough!

Updated 8:47 am Mar 22, 2016

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CBSE assures remedial measures for tricky and tough Class XII Math paper

Posted on: 12:17 PM IST Mar 17, 2016 | Updated on: 12:20 pm,Mar 17,2016 IST

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After several students claimed that the Central Board of Secondary Education (CBSE) Class XII board Mathematics examination paper was 'tricky' and tough, the board has issued a clarification on remedial measures which are likely to be taken before evaluation.

The CBSE says that feedback received from various stakeholders like students, subject teachers and examiners will be put before the committee of subject experts.

On 21 st May 2016 the CBSE standard 12 result was declared. [I loved the headline](#)

INDIATODAY.IN NEW DELHI, MAY 21, 2016 | UPDATED 16:40 IST

CBSE Class 12 Results out: No leniency in Maths paper, high paper standard to be maintained in future

The CBSE Class 12 Mathematics board exam on March 14 reduced many students to tears as they found the paper quite lengthy and tough and many couldn't finish it on time. The results show an overall lowering of marks received in the Maths paper.



RELATED STORIES

- CBSE Board result 2016 declared! Thiruvananthapuram obtains the highest part percentage, check how your region scored
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- CBSE results declared at www.cbse.nic.in: Steps to check online
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The CBSE (Central Board of Secondary Education) Class 12 Board exam results have been announced today, i.e on May 21, around 10:30 am ahead of time. Students may check their scores at the official website, www.cbseresults.nic.in. (**Read: CBSE Class 12 Boards 2016: Results announced ahead of time! Check your score at cbseresults.nic.in**)

In 2015 also the same complain was there by many students

The screenshot shows a news article from Zee News. At the top, there is a navigation bar with the Zee News logo, language options (Hindi, Marathi, English), and social media icons for Apple, Android, and Facebook. Below the navigation bar is a secondary menu with links for Home, INDIA, STATES, WORLD, S ASIA, BIZ, SPORTS, CRICKET, SCI-TECH, SHOWBIZ, HEALTH, BLOG, and EXCLUSIVE. The main headline reads "CBSE Class 12 exam: Issue of tough maths paper raised in Parliament". A sub-headline below it states: "A senior Congress member on Thursday raised the issue of the tough mathematics question paper in the ongoing CBSE board examinations and asked the government to consider the issue "seriously". The article was last updated on Thursday, March 19, 2015, at 14:41. There are social sharing buttons for Facebook, Twitter, and Google+, and a comment section with 33 comments. A follow button for @ZeeNews is also present.

Last Updated: Thursday, March 19, 2015 - 14:41

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New Delhi: A senior Congress member on Thursday raised the issue of the tough **mathematics** question paper in the ongoing **CBSE** board examinations and asked the government to consider the issue "seriously".

So we see that by raising frivolous requests, even upto parliament, actually does not help. Many times requests from several quarters have been put to CBSE, or Parliament etc for easy Math Paper. These kinds of requests actually can—not be entertained, never will be.

In March 2016, students of Karnataka PU-II also complained the same, regarding standard 12 (PU-II Mathematics Exam). Even though the Math Paper was identical to previous year, most students had not even solved the 2015 Question Paper.

Friday, March 25, 2016 - 13:28

The NEWS Minute

HOME NEWS ANDHRA KARNATAKA KERALA TAMIL NADU TELANGANA CULTURE MEDIA BLOG

Exams

Online petition for lenient evaluation of K'taka II PU math paper gets over 8000 supporters

The campaign, which was launched on Monday, has garnered over 8000 supporters

TNM Staff | Wednesday, March 16, 2016 - 09:32
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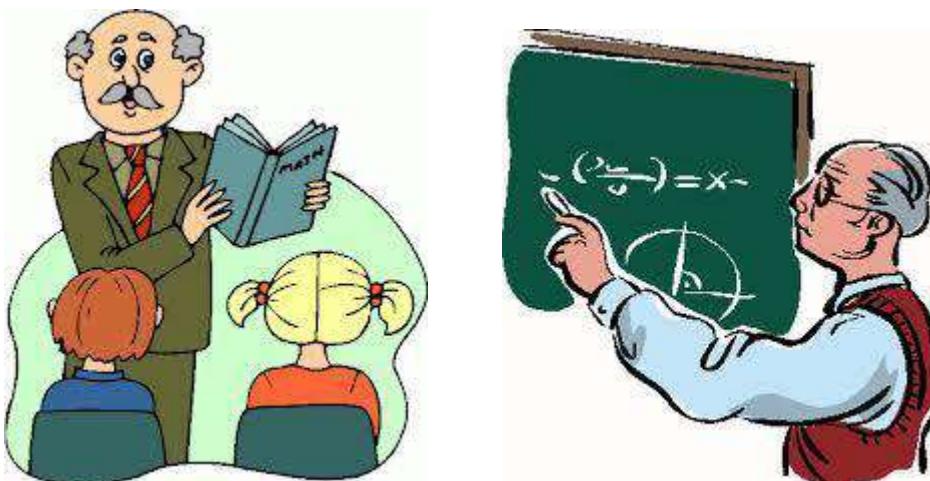
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Following a "very tough" math paper that left many II PU students in tears, Saket Ravindran a student launched an online campaign demanding lenient evaluation.

These complains are not new. **In fact since last 40 years, (since my childhood), I always see this; every year the same setback, same complain!**

In this e-Book I am trying to solve this problem. Those students who practice can learn.

No one can help those who are not studying, or practicing.



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A very polite request :

I wish these e-Books are read only by Boys and Men. Girls and Women, better read something else; learn from somewhere else.



Foreword for the Book, by Dr. Navsky Gupta

Director and Consultant, Shankar Netrika Eye Center, Mumbai

Studied at University of California, Irvine, and Volgograd Medical Academy

On human apes by the storytelling chimpanzee

My view of human apes

Let me be clear at the onset of my view. **I am not proud of my species which calls itself *Homo sapiens*.**

You just need to look our **sorry history of violence, warring and massacres over power, resources and religion.**



SARASWATI PRATIMAS IN WEST BENGAL

I think, for the most part, the human ape thinks, acts and reproduces as do his great ape cousins. (they mate, have family, have culture etc. as shown by studies of Jane Goodall, Desmond Morris and many more)

Our evolution of higher faculties

Yet, for an ape, we have come a long way forward. The journey has been slow and arduous.

The first ape like humans probably arose (quiet literally) on their two feet some 5 to 7 million years ago (that is 50,000 to 70,000 centuries ago).

The great apes as a family go back 15 million years.

Somewhere down the line we developed imagination, curiosity, and the ability to consider “What if ?”

These qualities of imagination, curiosity and abstract thinking are vital components of storytelling so that when developed, a mere mention or even the thought of a word can evoke artificial, imaginative or real worlds in the mind.

Other animals too have traits of intelligence

We are not certain if our cousin great apes have it or not, and if they have, to what extent it is developed.

Curiosity is certainly very common in animal kingdom.

It is a human hubris to think that we are sole possessor of this facility.

Other animals are as curious as us including our cousin apes, cats, rodents to name a few?

Curiosity is an inquisitive thinking that involves observation, exploration, investigation, learning and finally changes in behavior.

Curiosity has survival and reproductive value which is essential for success of DNA transmission, the raison d'etre for any kind of life based on carbon and DNA.

Curiosity involves several neurological aspects such as motivation and reward, attention, memory and learning.

Our crippling shortcomings

The other thing that we humans need to be aware is that we are in the end apes and very flawed apes at that.

No doubt we have higher intelligence and contemplate abstract thinking.

Yet, our evolutionary mind uses principles that had served us well when we were hunter-gatherers in the African savannas but now do us grave injustice.

They are termed cognitive fallacies.

The list of these heuristics (mental shortcuts), biases, is devastatingly huge and long.

They become a fertile ground for the breeding of irrationality in human apes.

Worse, irrationality is highly contagious.

[Classification of cognitive biases](#)

These cognitive biases are divided into three categories:

1. Decision making and belief biases:

There are more than 80 of these.

One good example is the **bandwagon effect** or the **herd mentality**. This explains how easily a temple, or church or a statue gets tagged as “lucky”.

2. Social biases

There are at least 25 of these.

The classic one being, the just–world hypothesis also known as the moral luck. It is a belief that good stuff happens to virtuous and ill happens to the diabolical, deservedly of course.

Another good example is the **Barnum effect** (closely related to subjective validation) wherein an individual considers a general and a vague statement highly specific to his or her own personality.

Example: Disciplined and self controlled outside, you tend to be worrisome and insecure inside.

[Entire chicanery of astrology, palmistry and astrology are based on this one bias.](#)

3. Memory errors and biases

There are at least 60 of them

The peak–end rule is a suitable example. It is the assessment of any experience by an individual largely on how they felt it at its peak and at its termination. This has a special significance for medical procedures and surgeries.

[Limitations of curiosity, logic and abstract thinking](#)

You will realize that just being curious and having the ability of abstract thinking is not enough.

These two generally end up in giving rise to either philosophy or worse, religion.

These traits alone would very likely have us end up in creating a world view that is largely hopeful, helpful and endearing but factually incorrect.

This in fact did happen for most of the time in human history.

Added with these two, if one begins to apply logic and proofs, the brain is capable of generating powerful mathematics.

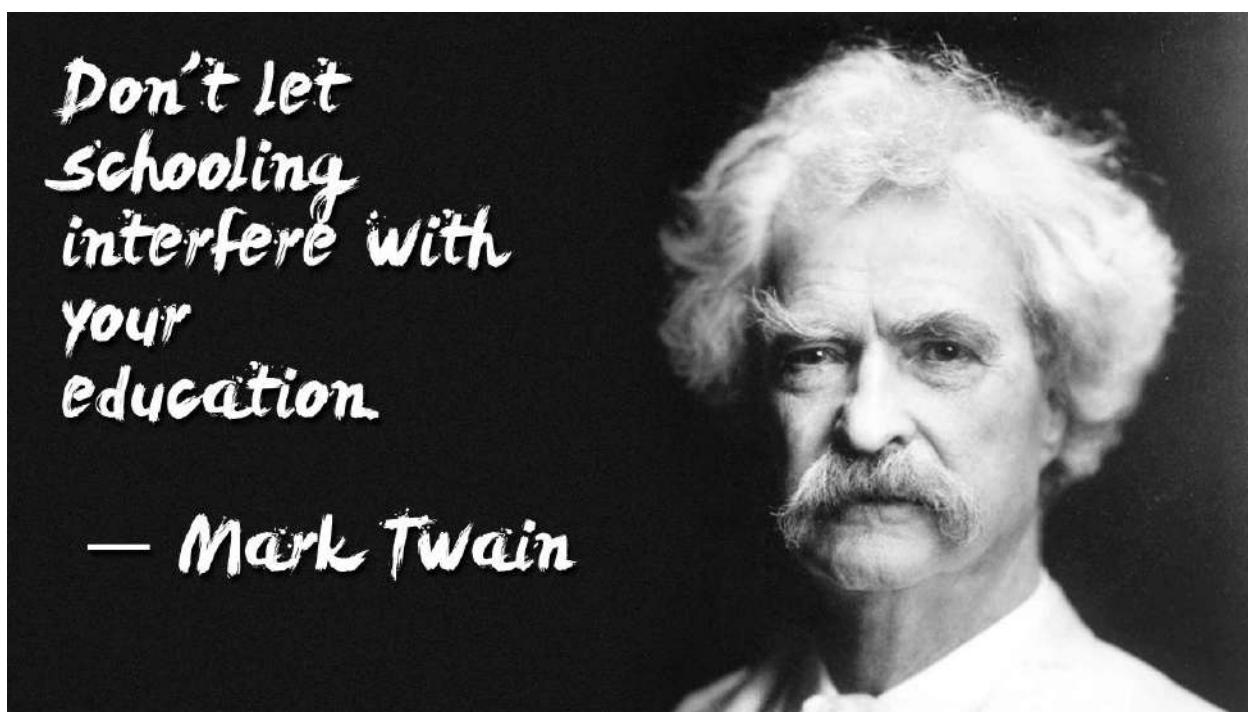
Yet, all these devices and tools namely curiosity, imagination, logic and mathematical proofs have proved themselves deficient in curbing our remarkable ability to fool ourselves.

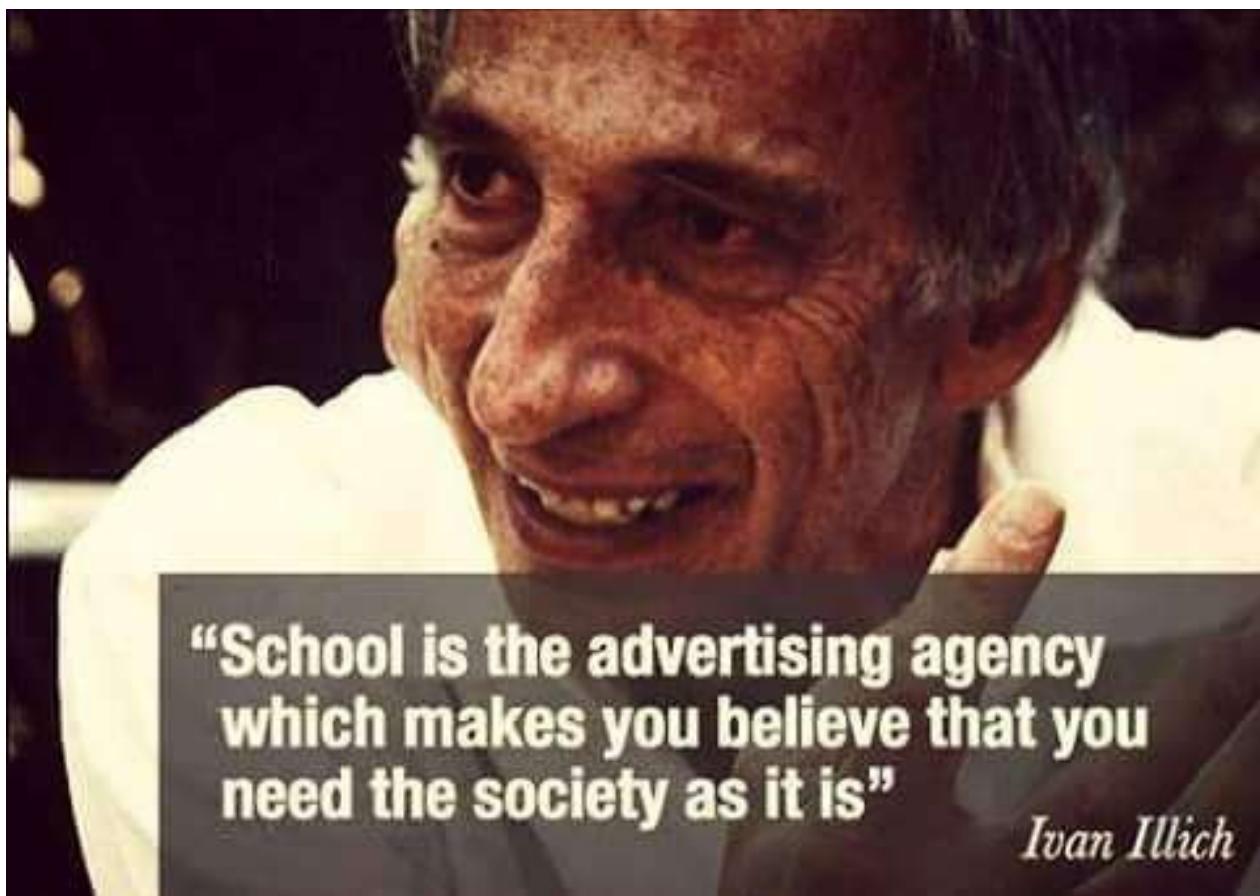
Experimental Science is the best tool ever devised to understand reality

The only tool and the best method that we humans came up with understanding reality is experimentation, particularly well controlled, repeatable verifiable experiments that can minimize the experimenter's bias.

In medicine, the gold standard of drug testing for its efficacy and safety is the placebo controlled double blind clinical trial.

It is not an easy task to conduct an original experiment.





[Education's Biggest Failure](#)

Our school education's profoundest failure is exactly this.

It does not inculcate either questioning or original thinking or more specifically critical thinking.

We fail to teach our students the idea of how to propose a hypothesis and go about testing it.

Our schooling fails to provide to even the best outgoing student the notion of conceiving an original experiment to prove or disprove an idea.

Only few people are good experimentalists, meaning they take care to isolate their study from events that can undue influence its outcome.

The most important aspect about the experimental findings is that it should be repeatable, verifiable by other people who repeat them under similar conditions in other places.

It is the one biggest universal failure of education system all over the world.

Education is currently seen as a way to attain professional career and job security which is not bad per se.

But something very important has been lost.

Do we encourage a student to write an original paper?

Do we encourage a student to ever lay out a plan for considering an original experiment?

In fact, in our education, do we even mention that so many unknown things remain to discover.

May be it is so that there is now so much to know that it overwhelms a young mind.

At least most young minds.

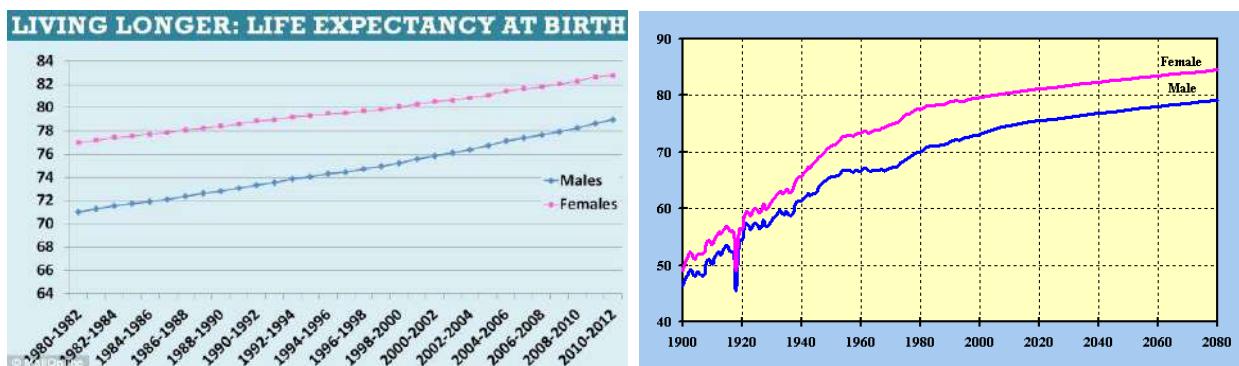


The reason for the failure of education

What prevents us from imparting the type of education we often know about, speak about but fail to carry out?

You will be surprised at the answer.

It is overpopulation; too many of us human apes.



(Did you notice Female Life expectancy is always higher than Men ! Do you know why ?)

If someone were to ask me what is the key problem today, I would say that we are simply too many of us today.

India or South Asia is an extreme example but almost all the nations face this hideous calamity.

Are nation states able to provide clean air and water to their citizens?

Are they able to provide a basic housing to their citizens?

Are they able to provide even basic level healthcare to their citizens?

What about jobs?

Many argue between capitalism, socialism, mixed system and so on and so forth.

I think they keep missing the key issue.

Denial is probably the right word.

Such a populace simply cannot be given the fundamental rights as enshrined in the constitutions of most nation states.

Most would not sit to listen to this and may get up and leave in protest.

Stating the problem

But let me make my case.

Just feeding, giving clean water and jobs is not the way we should be looking at the citizens of the world; though even that itself is a herculean task and even the most developed nation states are grappling with the problem.

I want to go beyond this.

Why has education, the process of acquiring knowledge become such a painful task for most young people?

Let us see this step by step.

For starters, every child right from a day she is born needs a decent health care and nutrition.

The idea is to get very good schooling.

Good schools are few and the race starts right here.



Only very few percentage of humans born will get good schooling.

Second step, after the school, it is the college.



The idea of scoring top percentages is to get into the best colleges.

We all know that in general in any country, including the United States, only a tiny percentage of colleges or universities offer a life enhancing and transforming program.

Good education needs great teachers.

Great and dedicated teachers are a rarity as a society can afford to pay and reward only a handful of good teachers, professors.



Following that, we have the problem of jobs or a professional career.

Here again one encounters a cut throat competition and only a few will land up with a satisfactory job.

As it is, most of us humans are average and really not very productive for a society.

In fact, most of us can be or turn out to be a burden for the society.

A planet that has fewer people, can be better educated, can be given better lives, and can be given better policing /security and a speedier and effective justice.

Crime itself will come down.

The lesser we are, the more we will care for each other.

Moreover, more productive and educated people are more likely to contribute funds not only for the resources needed to run a society but to higher pursuits of sciences and mathematics.

This idea is extremely repulsive and disgusting to nearly everybody as it goes against our biological drive, our most primal instinct.

But what needs to be done must be done.

Otherwise we will be doomed to mediocrity and worse, nightmarish suffering that is visible all around us.

Someone asked me the one biggest mistake we have made.

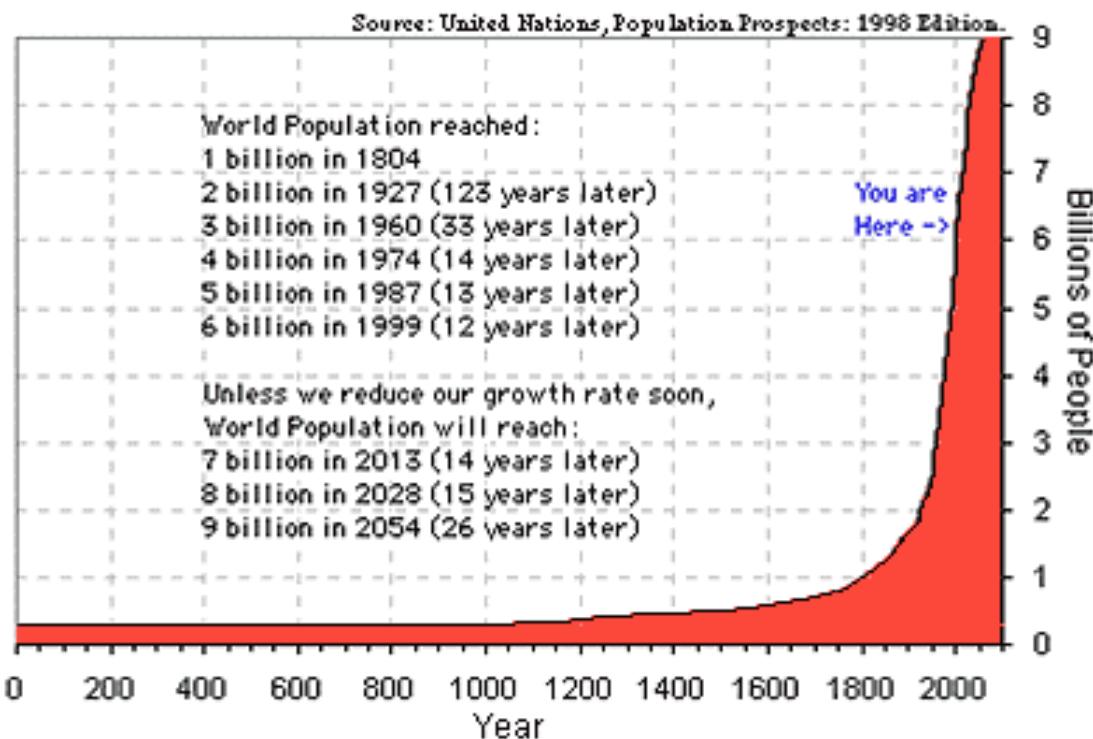
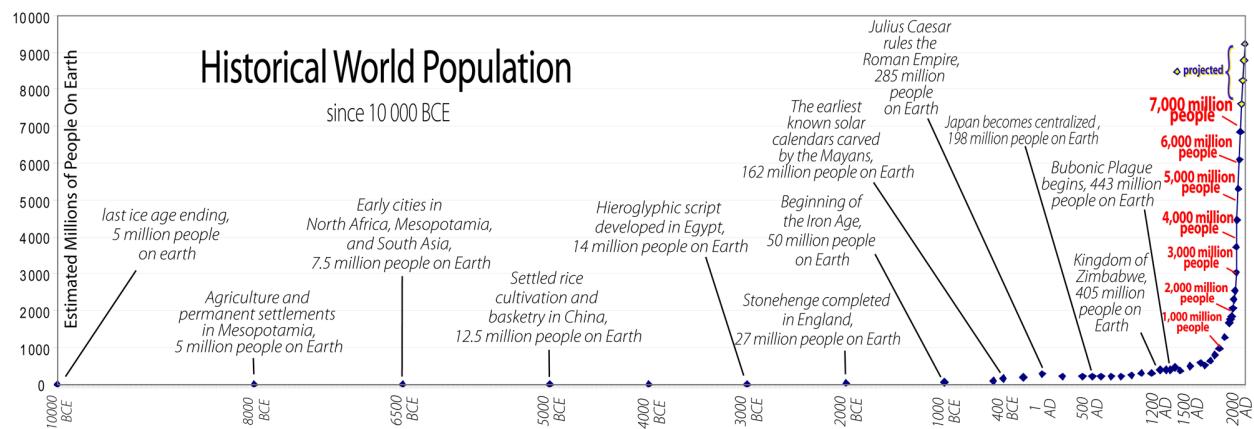
I think it is this.

We have allowed runaway breeding of ourselves.



If we wish all schools to impart scientific teaching and inculcate scientific methods, we need to have fewer of them very good ones with better facilities with fewer pupils to care after.

Just being a few would increase love and tolerance for each other and further our cooperation.



Going one step further

In this context, another important pops up.

We are aware that resources are scarce, may it be for education, for health, for research, for fuels, for energy.

We, if are intelligent, and rational enough; must plan our death once we realize that our contribution to the society is nil.

After that, we become a parasite and a hindrance for the younger generation who exist and who are to come.

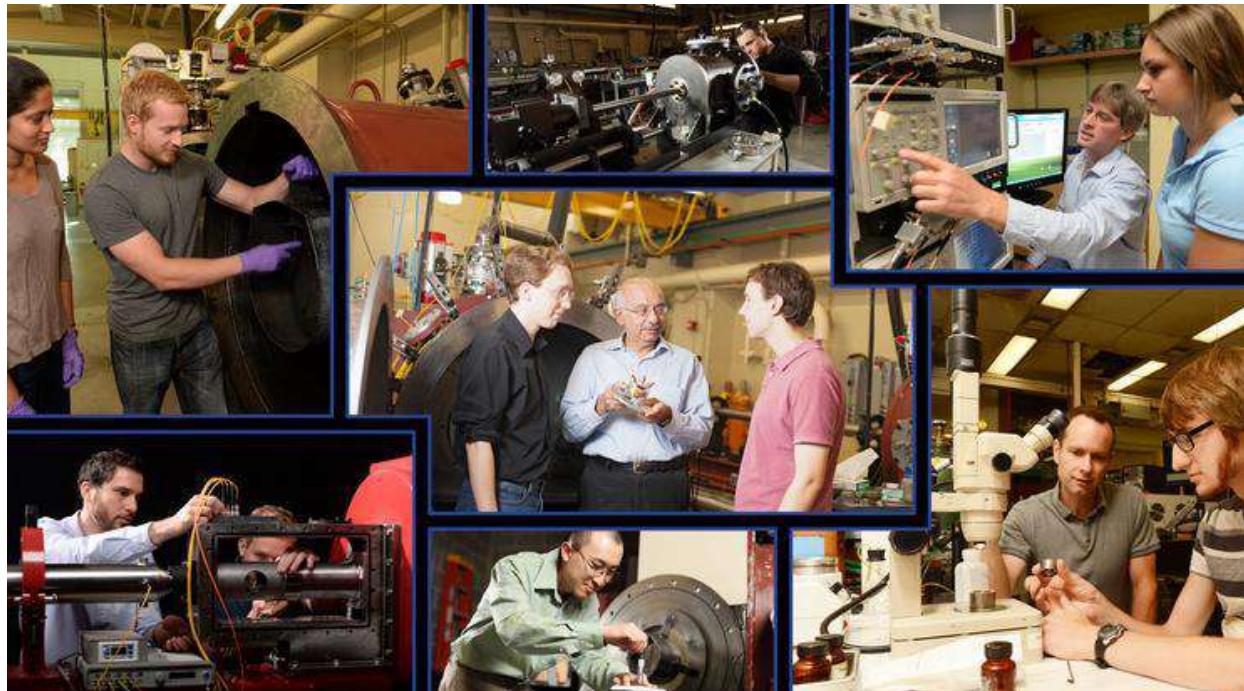
This is one of the biggest prices we are paying for the success of medicine.

Ageing and geriatric diseases are taking a huge toll on the national economies, especially of the developed world where the state bears the expenses of the elderly to a large extent.

Finally when the time comes, one needs to embrace death by making death peaceful, planned and curbing our greedy desire to go on and on.

Story Telling Chimpanzee

See <http://panarrans.blogspot.in/>



A Dose on Teaching Methodologies

Often Ideas, opinion, concepts and / or "Point of views" are better explained by contrasting examples. Here I will explain "Teaching Methodologies" with contrasting facts, to invoke logic and thoughts.

Thought Provoke 1 -

Certain facts about Stock Market are known to many, but not to all. The "Blue Chip and / or Large cap" stocks are traded the most. More people want to own pieces of these Big / Successful companies. The high trading volume, and the Lots of money into these stocks confirm this. Next in interest are Medium Sized companies, followed by Mid Caps, Small caps, Penny stocks ... so on.

Even in Mutual Funds, more money is in Large Cap Funds or Blue chip Funds. The least is in Penny stocks. Most days there is no trading in Penny stocks. To buy stocks that are not being traded, someone has to contact and request brokers specifically. There are millions of examples where someone 's money got "locked" into non-traded stocked and became very difficult to exit.

Now think why is this ? Market as overall is "extremely intelligent". The Market as a whole rewards or punishes performance, trends, future Growth / Profit / Prospects Ruthlessly. People in general want Stability, Liquidity, Quicker and Steady Profit. Investing in trees which will grow and give you return after 25 years is hardly acceptable in the world where computers trade in seconds for every arbitrage advantage. Blue chip, Big companies are huge, are around for long time with lots of data with their ups and downs, so many performance analysis and graphs ... in contrast to IPOs or startups! **Is it interesting that 90% startups Vanish within 5 years ?**

Replace Companies with students, in the above discussion. Which is more riskier to bet on (for future results / Success in life / Results / Money Earned etc) on toddlers ? or on students in Standard 8 ? Or on Students of Standard 10 ? students of standard 12 ? Students in Famous colleges ? (such as NITs or IITs etc) ? Guys with IIT + IIM combination ? etc. **If you or someone else meets 10,000 students of age 4 to 6 years, what can be concluded about any individuals performance ? What can we guess about group performance ? What can we predict about all of them ?**

[I expect people to know that NOTHING can be predicted with any group or individuals. Read Nassim Taleb's book The Black Swan]

Thought Provoke 2 -

Meet a random group of people and tell them to name some Famous Physicists. (Doesn't Matter Alive or Dead). Most probably you will get the names Albert Einstein, Newton, Galileo Galilei, (You can have fun assuming that I don't know any other names !). Well ... You

will get some names say take atleast 10 – 15 names. [Most probably the list will not have names of John Stewart Bell, Alain Aspect, William George Unruh, John Bardeen or say Hendrik Casimir in the list. Even though these guys are best of the bests, general People do not know their names !]

Next tell the random group to name some (at least 15) Famous Chemistry Guys ... This is will tough. Most probably the names you will get are Mendeleev, Dalton, Lavoisier, Joseph Priestly, Fritz Haber, Frederick Sanger, etc. I am sure this list will vary widely, from group to group. Most people will not know that Frederick Sanger is the only Person with Two Nobel Prizes in Chemistry, and Linus Pauling once in Chemistry and once in Peace. Almost everyone knows that Marie Curie got Nobel Prize once in Physics and once in Chemistry. While most people will not know that John Bardeen is the only Person to Nobel Physics Prize twice !

If you tell the group to make a list of top 10 (or famous) Botanists ? or Zoologists ? ... Hardly any group will able to tell you a few names.

What about name of 10 Psychologists ? Most probably the only name you ever get is Sigmund Freud. No one will tell you names of Gordon Allport and S. Odber.

[All explanations given by Freud are wrong, and crap. Modern Psychologists, call Freud worst than a quack. See how Professor Bloom, from Yale laugh at Freud, (and I agree with Prof. Bloom), in the class...]

<https://www.youtube.com/watch?v=P3FKHH2RzjI&list=PL6A08EB4EEFF3E91F>

If the random group is told to make a list of 10 Famous Persons in general, then most will try to put names of movie Stars or say Music Legends. I have conducted these discussions with many groups, and seen that if Movie Stars, or Music stars are not allowed to be named, then it really becomes difficult for the guys in the group to name 10 Famous persons. Though some will simply say ... "There are too many " ... start with Mahatma Gandhi

What about a list of Famous Atheists ? Will people in India readily name Nobel Laureates C. V. Raman, Subrahmanyan Chandrasekhar etc as Atheists ?

My Personal list of Famous and Successful people is Nicholas Winton, Dean Radin, Luca Turin, Satyen Bose, Gertrude Elion, Dr. Harrison Schmitt, Emmy Noether, Kurt Godel, Desmond Morris, Alan Turing, Irena Sendler, Andreas Vesalius, Richard Stallman, Roman Polanski, Christopher Alexander, Carl Sagan, Perelman, Arno Penzias, Ilya Prigogine, Nadia Comaneci, Marcel Marceau, Augusto Boal, Anthony nesty, Pele, Roger Milla, Vaclav Havel, Jim Jarmusch etc. This is because of various reasons, and with lot of searching, thoughts, pondering ...

By now it is already 2–3 minutes of long boring harangue ... is it ? So the Bomb Question ...

Which schools were all these guys from ?

Do you realize that success of each of these guys are due to huge randomness, lots of hard work, luck, and time specific. Do you realize that thousands of Billionaires, Millions

of Millionaires have revealed all details of their hard work, but the "Success sequence" can not be repeated.

Go to any school which is say 60 or 70 years old; you will find 1 or 2 ex students as scientists in NASA, very senior guy in some large cap company etc. [My school KMPM High School Bistupur also "boasts" of 3–4 guys in Nasa etc. Personally I have never heard any school talking of ex-student being in ISRO. I wonder does ISRO have Scientists ? Are Schools happy about them ? Is it more prestigious to be in NASA or in ISRO ? Does guys from NIT or IIT join ISRO ? Why does "Prestigious Schools" in India send students for "Summer Tour" to NASA but NOT to ISRO ?

So many interesting questions ... No answers. No one agrees with any answers ! These were only thought provoking discussions ...

When there is NO consensus about "Good Schools" then is there any consensus on "Teaching Methodology" ?

What are various Teaching Methodologies ?

— —

Thought Provoke 3 -

Behind my Home, in an Independent House, a Lady has put up a board. She runs a toddler play-school. In the Board about her, and about the school, she says ... "Montessori education Certified from Europe From some 'Famous' certification agency ". Well around my home, within 3 km there are more than 15 toddler playschools. Each distinguish themselves from "others" in some way or other. Each say they are better because of some Certification, or some teaching methodology.

Now no one talks of teaching Methodology of "Famous Educationist", the first Nobel Laureate of Asia, Robindranath Thakur. Surely what ever Robindranath had said or advocated is "very old" and should be scrapped ! Who cares of old things ? [except of course if it is Vintage car or painting selling opportunity !]

I personally don't care about what Robindranath had advocated. I did not try to find out. I am busy with many other things. These will the words of many or most people!

One of the drawbacks of common Human beings is "not to search and compare" but to get influenced by many Marketing / advertisement methods. People get influenced by suggestions, word of mouth, advices, and Modern Technical experiences such as Mobile Apps. These are huge business opportunities.

We have vedanta way of teaching by Swami Dayananda Saraswati. Very big group of institutions, who are convinced that "their method of teaching" is the best.

PSBB Millennium Group of Schools, say in their website ... combined strength of over a decade of 'thought leadership' in best pedagogic practices of the Learning Leadership Foundation and more than five decades of academic excellence...

BGS group of schools say in their website ... Fostering independent thinking, thoughtful decision-making, critical analysis, appreciation with intellectual humility to accept difference in opinion. Helping the student to discover what it is to live and grow with clarity of thought, with harmony in Nature, with beauty and freedom in the world. **Inculcating the best of Indian culture and tradition among the pupils**. Creating responsible, disciplined and secular citizens, who are fully aware of their social, moral and cultural obligations and commitments, with a desire for unbounded service to humanity.

Aurobindo schools, Ashrams, follow Integral Education regards the child as a growing soul and helps him to bring out all that is best, most powerful, most innate and living in his nature. It helps the child develop all facets of his personality and awaken his latent possibilities so that he acquires. They say ... Rupantar, one of our special initiatives, is a strategically designed initiative that targets the highest impact areas in Education with innovative solutions to transform an entire state education system in India.

A guy named **Gadadhar Chattopadhyay** (not related to me), became very Famous. Or should I say, yet he is famous ? I see his photograph in many houses, randomly; as I visit. There are many ashrams, in various parts of the world ... even in Bangalore, named as Ramkrishna Ashram, or **Ramkrishna Paramhansa Ashram** ... He also tried something on education reforms. His advice were also there for those who want to listen. The Ramkrishna Schools do follow their own "Teaching methodologies". Bhakti, Love, Kritya, Yoga the list is long.

Lots of kids go to **Abacus classes**. All the above techniques were surely enough, for teaching Maths. To become "good at Maths" the parents donate in Abacus classes.

Since when did you start assuming that **Vedic Maths**, and **Abacus** is enough to make all students good ?

Kumon, created by Toru Kumon, is a private tutoring organization. The Kumon Method is the mathematics and reading educational method which is practiced in franchised **Kumon centers**. Lots of Parents are donating in this method as well, so that Children can become whiz kids in Maths.

Little Einsteins Pre–School Branding is another money making venture. They also claim to be better than others. They use "Multiple Intelligence" framework. Now this is a framework; while others were using mere methodologies. Howard Gardner's theory of Multiple Intelligences utilizes aspects of cognitive and developmental psychology, anthropology, and sociology to explain the human intellect. Although Gardner had been working towards the concept of Multiple Intelligence's for many years prior, the theory was introduced in 1983, with Gardner's book, *Frames of Mind*. These are Research Backed theories. **In contrast Indian**

Gurus never talk of any research backing. Gardner's theory challenges traditional, narrower views of intelligence. Previously accepted ideas of human intellectual capacity contend that an individual's intelligence is a fixed entity throughout his lifetime and that intelligence can be measured through an individual's logical and language abilities. According to Gardner's theory, an intelligence encompasses the ability to create and solve problems, create products or provide services that are valued within a culture or society. Originally, the theory accounted for seven separate intelligence's. Subsequently, with the publishing of Gardner's *Intelligence Re-framed* in 1999, two more intelligence's were added to the list.

Curry's onion model (Curry, 1983) was developed with four layers — personality learning theories, information processing theories, social learning theories, and multidimensional and instructional theories.

Personality learning theories define the influences of basic personality on preferences to acquiring and integrating information. Models used in this theory include **Myers–Briggs Type Indicator**, which measures personality in dichotomous terms — extroversion versus introversion, sensing versus intuition, thinking versus feeling, and judging versus perception, and the **Keirsey Temperament Sorter**, which classifies people as rationals, idealists, artisans, or guardians.

Information processing theories encompass individuals' preferred intellectual approach to assimilating information, and includes David Kolb's model of information processing, which identifies two separate learning activities: perception and processing.

Social learning theories determine how students interact in the classroom and include Reichmann's and Grasha's types of learners: independent, dependent, collaborative, competitive, participant, and avoidant.

Multidimensional and instructional theories address the student's environmental preference for learning and includes the Learning Style Model of Dunn and Dunn and the **multiple intelligence's theory of Howard Gardner**.

The World with 7 Billion people, and growing, gives opportunity to so many, to make their own share of money.

Kidzee another revolution in branded schools, say ... Regular seminars and workshops are held to align parents with Kidzee's approach and enable them to develop a safe, healthy, hygienic and developmentally appropriate environment, even at home. **iLLUME kit**, which is a part of every Kidzee, is chosen by Kidzee team of experts to ensure that it stimulates all the intelligence's of a child and provides her with multiple pathways to enhance learning. The focus is on providing learning aids that help the child to explore and learn in ways that interest her. Feedback is shared with the parents on regular intervals wherein areas for further development are identified and mutually agreed upon, thereby supporting the child in multiple ways.

ICF.com provides program and policy services designed to enable positive student and teacher outcomes in early childhood, K-12, postsecondary, and adult education. They say ... ICF provides training and technical assistance on education initiatives that drive positive and long-lasting change at the national, state, and local level. **ICF specializes in their own methodology or approach of MDA (Multiple Dimension Approach).**

cfrce.com Centre for Fundamental Research and Creative Education, says in their website ...

(CFRCE) is an organization dedicated to positive change and self–actualization and is at once a platform for untrammelled Inquiry and Research and a Talent Hotspot espousing Accelerated Learning in its deepest sense.

CFRCE levels the playing field for individuals and students by empowering them to take active and independent, systemic and systematic charge of their learning and education, inquiry and research, entrepreneurial and financial potential, driven primarily by intrinsic motivation, meaning and purpose, irrespective of extrinsic incentives or patronage.

CFRCE challenges the status quo in educational theory and practice –that narrowly classifies individuals as achievers or failures, bright or dull, talented or non–talented –and leverages individual learning to an extraordinary level of deep practice, mastery and creativity. It thrives in making learning a tremendously evocative, exhilarating and ennobling optimal experience or flow. Thereby, learning resolves itself into its natural role as an instinct, or more precisely, as an implicate order or neuro–cognitive potential that develops and expresses itself by spontaneous self–organization once the hindrances and obstacles to its unfoldment are dissolved, removed or overcome.

In the CFRCE programs earnest students and inquiring individuals at diverse stages starting from primary through high school, undergraduate and postgraduate levels are empowered to take years and sometimes even decades, off their learning curve by a unique combination of personal development, domain mastery and professional eminence, and attain world class levels of excellence and achievement.

Tablet and Mobile Apps teaching methodology ...revolution... by idiots, for the Idiots. In this methodology every parent presenting the student a Tablet, a smart Phone (Dumb phones wont do !); transforms every kid to a whiz–kid. Costlier Tablets, and Jazzy Phones will make a better Whiz–kid! Just by press of a button (sorry the icon of the App), the Whiz–kids can learn any subject in the world. By chance if they come to know that something is missing, they can google it !

Dr. Rajendra Prasad topped in Many subjects in various schools and colleges. What was the teaching methodology in the schools and colleges ?

We yet enjoy leave on Birthday of Dr Sarvepalli Radhakrishnan. He also gave his take in Teaching methodologies. If someone who is not bothered about his "teachings" then should he be allowed to celebrate Teachers Day ?

[<http://www.researchinformation.org/files/Dr.-Santosh-Kumar-Behera.pdf>]

Never ask which school did Srinivasa Ramanujan go ? What teaching methodology did his teachers follow ?

I have read many articles which argue that ability to Play Chess; is the best measure for IQ. If I believe in these kind of crap; should I reject students who do not play chess, or say doesn't play well ? When a student approaches me, should I ask the first question... "Did you go to Abacus classes in childhood" ? "Do you play chess well" ?

Let us assume only top 100 rank holders of IIT–JEE are only smart guys in this world. So in 60 years we got only $60 \times 100 = 6000$ unknowns. Let it be loud and clear that from every random school and colleges rarely a smart guy shines, we only get Millions of Unknowns. There is no point in asking what happened to school batch-mates or college friends of Erwin Schrödinger.

I can write many more pages on these "Teaching Methodologies". Better I ask some hard questions

When we were naming Famous / Successful people did we name any India or IITan ? IIT Kharagpur is around since 1951. How many guys from IIT could become famous ?

[Now don't jump and quickly tell me names of Sundar Pichai, Nandan Nilekani, or Narayana Murthy. Sundar is famous since very recently. What happened to all the IIT guys since last 60 years ? Also Nandan or Narayana are famous for Business reasons or for Money; NOT for technical reasons, or any inventions. Bjarne Stroustrup, James Gosling are more important; more famous than Nandan or Murthy.]

Vinod Dham famously known as Father of Pentium Chip was randomly from DCE Delhi College of Engineering.

It is well known that Professors at IIT are 100 times smarter than the students. Most IIT students find it difficult to cope up at college. A large percent (someone told me close to 50%) of the IIT students get a back in some subject some year.

Well if the Professors are so smart, then how many famous Professors were named in the above discussions ?

In contrast it is well known widely discussed opinion that Students in IIM are far better / superior than the IIM Professors. So no question of naming any famous professor of IIM as Sucessful or role model. We never named any ... did we ?

I shouldn't ask how many IIM Alumni became famous in so many decades.

China has 568 billionaires versus the United States 535 as of 2016. Had seen a headline in Bloomberg ... "Chinese eat so much pork that the sellers are Billionaires!"

Does each and every Billionaire become my role model ?

Just because they made lot of money, each of my students should venerate them ?

How many People know name of Aliko Dangote - Net worth: \$15.7 Billion – The Richest Man of Africa ?

Which school were these people from ? If we do not care of Aliko Dangote's school, then why should we bother about Nandan's School ? Did Mr. Murthy go to school ? I don't think everyone is eager to go to that school !

The United States has had the most Nobel Prize winners, with 336 winners overall. It has been most successful in the area of Physiology or Medicine, with 94 laureates since 1901. Similarly, the United Kingdom that majority of its 117 Nobel laureates winning in Chemistry and Physiology or Medicine. The top five countries with the most Nobel laureates are all western nations – with the United States, the United Kingdom, Germany, France and Sweden topping the rankings for the best minds in peace, literature, science and economics.

Recall the concepts of Determinism vs Predictability. Randomly as I meet my ex-Students, each say some story of their life or other. Someone is a Doctor from some college, so someone is in Navy. Someone is an Engineer, while someone is running his own business, or studied "Hotel Management". In general people want to feel good of themselves, and justify the outcome as "good". Each and every person see his own outcome as the "very good". Whatever he is doing is termed as success, and achievement. No one believes or agrees with external definitions of success or achievement given by someone else!

Who is more successful ... or achieved more ... amongst Sam Walton and Anjezë Gonxhe Bojaxhiu ?

[Now most people will say Apples and Oranges can not and should not be compared ... Well we could have asked Potatoes and Pomegranates, which are better ? Though I named Sam because he wrote a book regarding success mantras; how to make money!]

Did the parents, friends or close associates knew that the guy will become Billionaire ?

What about Reading Books, Being Humble, Ready to learn, Choose a Mentor, Understand your Dreams clearly, Persevere, Seeing Videos

https://www.youtube.com/watch?v=7bB_fVDlvhc

What "Teaching Methodologies" were followed in the schools in which all these guys went ?

Let it be Loud and clear ... School or College does not matter. Now how can the teaching methodology of the School and College matter ? which methodology for what ?

There is no consensus regarding "Thinking Techniques" or Should I say, "methods". Now a days we have to do "out of the Box thinking", normal thinking, or just "thinking" is undefined. Someone who is not doing "out of the box thinking" is termed as, not so smart. Edward De Bono taught us Po, 6 Thinking Hats, Lateral Thinking ... etc. I am not sure if my Boss will appreciate me if I say I am trying these methods. For most Bosses, "out of the Box ... " is

enough and only acceptable technique. How are the Gurus, and Practitioners of Mind Mapping, "The Checklist", Picture Association, Change Perspective, "Get Up and Go Out", Brainstorming, Random Input, Reversal, SCAMPER, Reframing, Morphological Analysis, Storyboarding, Syneetics, Metaphorical thinking, Lotus Blossum Technique, NLP (Neuro–Linguistic Programming) Techniques, Assumption Smashing, LARC Method, Simplex, TRIZ method, Fuzzy Thinking, Breakthrough Thinking ... doing ?

For some people now a days, plan is known as Hack. Growth Plan is Growth Hack. Coding is Hacking ...

Is there any consensus on Management Techniques ? Management by Goal Setting, Management by Objective, Management by Profit Centers, Management by Micro Profit, Management by exception, Management by Tactics, Management by Quality Control, Management by Total Quality, Management by Customer Focus, Management by Customer Delight, Management by Planning, Management by Forecasting, Management by Organizing, Management by Commanding, Management by "coordinating", Management by cost benefit Analysis, Management by Zero Base budgeting, Management by Log–Frame Analysis, Management by Current State Assessment, ...

All these are most commonly replaced with "Management by Meetings", Management by Wondering Around, Management by Shouting, Management by Con–calls, Management by Continuous Reminders, Management by Bribing ... Actually all these are Management by ... "the technique and terms the Boss wants ! "

Moms use only one technique ... Management by continuous Nagging, Chiding, Scolding, Pushing, Threatening, Ashaming, Beating ...

Key Concepts in Science as Recommended by Professor Subhashish Chattopadhyay

In youtube we have several thousand videos; where Science is discussed at sufficiently higher levels, than normally educated Engineers know. I have seen thousands of these Science videos because of my Bias towards spending time with Science (or my Hobby being Science). The information density; meaning the new things taught or discussed in the Video is very low in general. So if I tell any student or friend to see these thousands of videos, surely they will not see. Really all of us do not have so much time. Every person has different priorities, and truthfully so many things to do. While these words may be known to many; I also observed that in Panel discussions the reverent Persons are unaware of quite a few proven / well understood facts. Lot of time is wasted when a Panel member makes wrong statement or uses wrong words, and another member corrects him to say the right words. A Scientist as a Panel member sitting in the dais, in Science talk shows; is expected to know all the facts and use exact right words which should not be wrong or have any multiple meaning.

Let me quote some examples ...

1) Einstein 100 years ago was not aware of Dark Matter, Dark Energy, or say "expansion of Universe is accelerating". In the context of stars, Galaxies, Celestial events (such as a Supernova explosion) he correctly said that if someone travels at a very high speed towards a Galaxy he will see the events earlier than the people who remain back on Earth. The word "now" has different meanings in different parts of the world. With respect to People at Earth we can travel into the future, at very long distances. **So an Astronaut can see a Supernova explosion before People in Earth see it.**

But yet we see Panelists / Scientists changing this context to near distances, in Earth; and confused about flow of time from Past to future.

2) Since last 80 years (Approx) of Quantum Mechanics it is well known, (well understood, and Mathematically well formulated; Backed up or confirmed by several experiments) that smaller Particles can tunnel easily. So an electron or Neutrino can tunnel more easily than a Proton, Neutron or Mesons. As we have group of Particles or as Complexity increases such as a Folded Protein or a Ball in the Macro world, then the Wave Phases randomly cancel out. The Properties of Tunneling, Interference, Diffraction etc does not hold. So Balls thrown through bars in a cage will bounce or pass through. Diffraction of a Ball or Interference of Balls is a meaningless Question or Waste of time to be discussed. We don't have to take such big objects as Balls or Human Beings. **If we take Molecules or Amino Acids; the Quantum World discussions are not relevant any more.** In the Quantum World "Calculations"; we only have Probabilities, not Deterministic or Predictable. The Quantum state collapses; when observed. The entangled particles also get affected. These Quantum world concepts are not needed or not extendable to macro world.

But yet we see Panelists / Scientists changing this context to Bigger Objects and discussing about time reversal, Time Travel etc.

3) Second Law of Thermodynamics is understood well since Last 100 years. According to the Laws of Thermodynamics, entropy, the measure of the disorder in a closed system. It is about Statistical Laws of Randomness, Organization, elastic collisions, Entropy, Temperature etc. The Entropy of the Universe is almost always increasing, because the Universe is expanding. **There can be small local fluctuations in Entropy and disorderliness randomly and due to attractive forces such as Gravity or Strong force etc.** Photosynthesis, formation of Molecules, formation of Polymers or sugars or Proteins from monomers, Secondary Structures, Tertiary structures such as folded Proteins joining up mechanically and increasing order are understood in context of "open systems" and stability Laws which are more prevailing than second law. In an open system, there can be an influx of energy into the system capable of reinvigorating the structure; in full accord with the Second Law of Thermodynamics. Energy input can decrease entropy, and can simultaneously increase order. So a tree can grow by "bunching up" carbohydrates, Animals can grow by digesting carbohydrate chains, etc. Self-organization is a natural property of complex genetic systems. There is a spontaneous crystallization of order out of complex systems, and that this spontaneity can occur with no need for natural selection or any other external force. Dynamic systems, have a tendency to become more concentrated and heterogeneous as they evolve.

But yet we see Panelists / Scientists changes this context and tries to apply a lower version of 2nd law of thermodynamics only; in every situation. Seeing the holistic picture is not in the

good habit of many. It is expected Thermodynamic Asymmetry in Time; should be well known and well understood by everyone.

[May be, I am assuming a world where the Panelists of Science Discussion forums will not contradict or correct one another in Public. They can argue and compromise in private discussions, and in public all say the same correct words.]

I recommend students to know the following Key Concepts

- The paradox of predictability
- Kolmogorov complexity
- Chaos Versus Complexity
- Dynamic networks or complex systems
- Concept of emergence
- Patterns Amid Complexity
- Red Queen effect
- Determinism VS Predictability
- Poincare fluctuations
- epistemic uncertainty
- Aumann's agreement theorem
- LQG (Loop Quantum Gravity)
- Occam's Razor
- Ology
- Ontology
- Nomology
- Bohmian quantum theories or Bohmian mechanics
- Planck length, Space, time etc
- Stability of Solar System
- Thermodynamic Asymmetry in Time
- How Probability is distorted in Human Mind by Prospect Theory
- Anna Karenina principle

Many years ago Laplace made an error. Laplace assumed an Universe, in which all of the rules of the are fixed. In this type of universe, as Laplace pointed out, if we knew enough information about the current state of the universe in addition to all of its fundamental and unchanging laws, we would be able both to calculate the entire history of the universe and to predict its entire future. There would be no room for free will, which would be seen merely as an illusion. The actual solar system contains eight planets, six of which were known to Newton, Millions of Asteroids and each planet and rock exerts small, periodically varying, gravitational forces on all the other. The puzzle posed by Newton is whether the net effect of these periodic forces on the planetary orbits averages to zero over long times, so that the planets continue to follow orbits similar to the ones they have today, or whether these small mutual interactions gradually degrade the regular arrangement of the orbits in the solar system, leading eventually to a collision between two planets, the ejection of a planet to interstellar space, or perhaps the incineration of a planet by the Sun. Even though, the interplanetary gravitational interactions are very small, the force on Earth from Jupiter, the largest planet, is only about ten parts per million of the force from the Sun—but the time available for their effects to accumulate is even longer: over four billion years since the solar

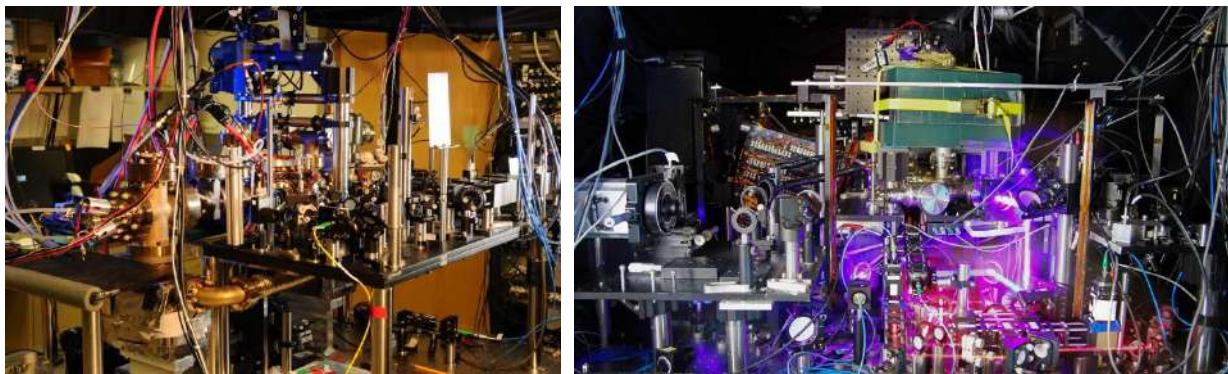
system was formed, and almost eight billion years until the death of the Sun. The effects of various forces, stability or instability with various possible random initial conditions, were tried in computers.

[Compound Pendulum with LED showing Chaotic movement is shown at

<https://www.youtube.com/watch?v=GFxPMMkhHuA>]

BUT ... Chaos theory studies these mechanistic types of systems but it tends to emphasise the principle of feedback whereby two variables are influenced by each other: this can lead to non-linearity and the variables behaving in seemingly chaotic ways. An important insight of Chaos Theory is the sensitivity of a chaotic system to initial conditions due to the non-linearity of the system. What this means is that if the initial conditions of a chaotic system were changed microscopically, then over a long enough period of time the outcome of the whole system will be completely different. This is often referred to as The Butterfly Effect. However, it is important to emphasize that if the initial conditions of the chaotic system were unchanged between two simulations to an infinite degree of precision, the outcome of the two will be the same over any period of time. So the butterfly effect really only serves to contrast the outcomes in two marginally different systems that are still deterministic i.e. machine-like. In one simulation, the butterfly flapped its wings, in the other it did not.

The science of Complexity happens somewhere between totally ordered and totally random systems. Complex systems are denoted by the fact that they may be generated by a relatively simple set of subprocesses; a few things interacting, but producing tremendously divergent behaviour. As Nobel laureate Murray Gell–Mann phrased it: "Surface complexity arising out of deep simplicity." One might also call this: deterministic chaos; in other words, it appears random but isn't. In complex systems, there is a concept known as a global cascade, which is similar to what people often mean by the butterfly effect but it is in fact fundamentally different. A global cascade is basically a network-wide domino effect that occurs in a dynamic network, made famous by Duncan Watts in 2002. Watts showed that sometimes a complex system proved robust in the face of a modest shock (it might just wobble slightly); but in other instances, the same shock might cascade across the system, showing it to be fragile.



Whatever we measure, there is a factor of error. Atomic clocks measuring time interval upto 17 decimal places, have error factors at the 18 th place. We know "time interval" ticks slower

near more gravity, compared to less gravitational field. So time interval at the roof of the lab will tick quicker, and record more number of ticks, compared to ground floor of the Lab. The atomic clocks with 17 decimal places Precision, can see the difference in Time interval ticks with a height difference of 40 cms. Now in normal real world we hardly work or do things with 2 to 3 decimal places of Precision. Meaning things are not exactly repeatable. If we keep hitting a ball with 2.345 Newton force repeatedly, at a decided angle, each time there will be a different ball, different angle, different value of the force, within various error factors. If we imagine a slightly different initial direction, the trajectory will at first be only slightly different. And collisions with the straight walls will not tend to increase very rapidly the difference between trajectories. But collisions with the convex object will have the effect of amplifying the differences. After several collisions with the convex body or bodies, trajectories that started out very close to one another will have become wildly different. So a student should know that the future is not repeatable. With a ball itself if so much of Chaos, complexity etc, then imagine what happens for people, future, success and fame of persons, Careers, accidents, disease, lottery Nothing is predictable in the Trillion random incidences.

In Quantum world the complexity or chaos of repeating is more. Diffraction, entangled particles, Interference, interaction with virtual particles that pop up, various decays and transformations, etc creates a probability soup. At the microscopic level the world is ultimately mysterious and chancy.

So both in micro world and macro world events are not repeatable. Further it goes, with more interactions, outcomes may or may not fall into boundaries, or envelopes. In some cases there are fractal outcomes, some cases Gaussian, some cases long tail, the list can go on.

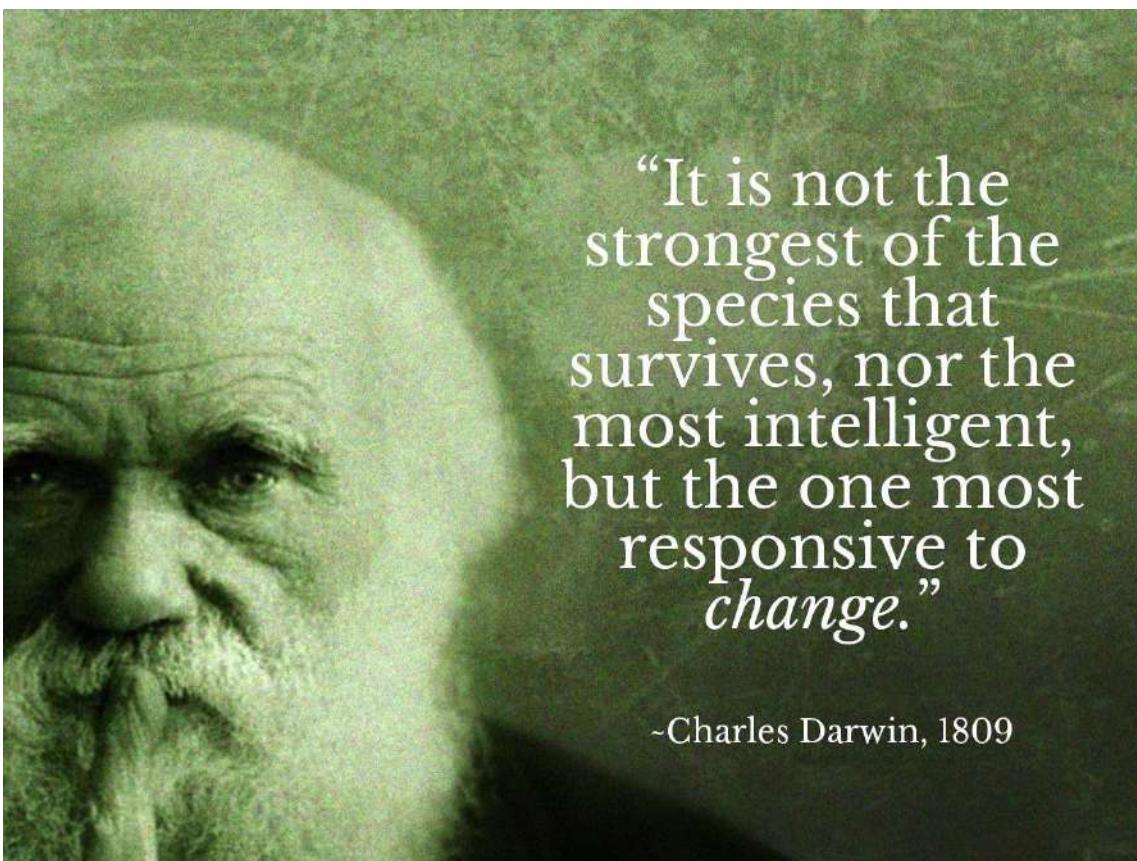
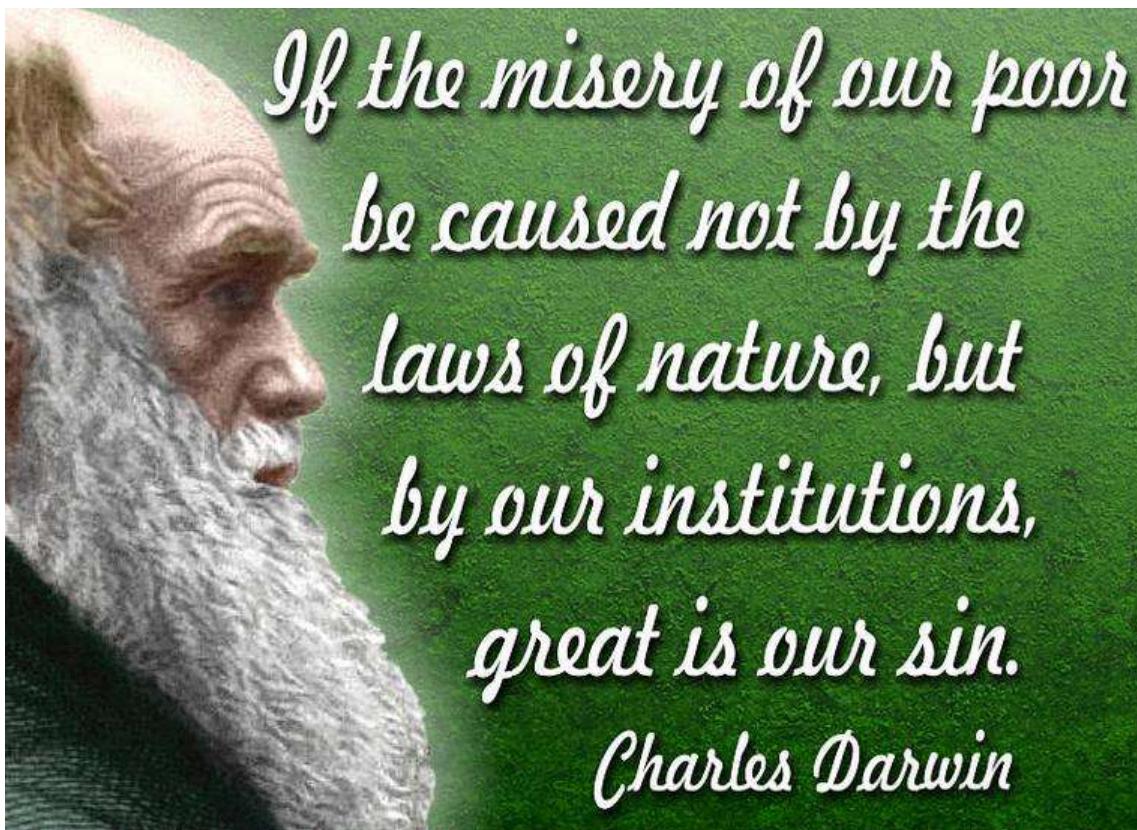
In chaotic dynamical systems come in a great variety of types: discrete and continuous, 2–dimensional, 3–dimensional and higher, particle–based and fluid–flow–based, and so on. Mathematically, we may suppose all of these systems share SDIC (Sensitive dependence on initial conditions). But generally they will also display properties such as unpredictability, non–computability, Kolmogorov–random behaviour, and so on—at least when looked at in the right way, or at the right level of detail.

Also laws of Physics are different in different parts of the world. Near or at Singularities, such as near Blackhole, the known laws breakdown. We do have concepts of Planck length, Planck space, Planck time etc. The maximum temperature that we can theoretically have is the temperature where photons are emitted with wavelength of Planck length. At that high temperature more particles, and virtual particles are created. The energy starts getting converted to mass, and thus temperature can't increase any more.

Country	Deployed warheads*	Other warheads†	Total 2014	Year of first nuclear test
USA	1920	5380	7300	1945
Russia	1600	6400	8000	1949
UK	160	65	225	1952
France	290	10	300	1960
China		250	250	1964
India		90–110	90–110	1974
Pakistan		100–120	100–120	1998
Israel		80	80	..
North Korea		6–8	6–8	2006
Total	3970	12 350	16 300	

* 'Deployed' means warheads placed on missiles or located on bases with operational forces.
All estimates are approximate and are as of January 2014.

† Warheads that are in reserve, awaiting dismantlement or that require some preparation (e.g. assembly or loading on launchers) before they become fully operationally available.



The Rich and Poor divide is very huge in this world. Privileged are those who have the luxury to sue someone or other for slightest “discomfort”. In some cases “mental discomfort” is sighted as the cause for suing

Larksville woman sues county over son's injuries at park

ERIC MARK / PUBLISHED: OCTOBER 24, 2014

A Larksville woman whose son was injured at Seven Tubs Nature Area in Bear Creek Township has sued Luzerne County, claiming negligence.

Melissa Moser, in a suit filed in Luzerne County Court on Thursday, claims that her 14-year-old son was badly hurt when a concrete barrier fell on him and trapped him during a family outing to the county-owned park on May 13. The boy was playing near a parking lot with his siblings when the traffic-control barrier tipped and fell on him, according to court papers.

We do not have the same rules or facilities for all in this world. See the images below and think who these poor men can sue? Can they sue anyone? Do they have money to sue anyone?



These poor men can't afford hearse service. Nor there is any Public help or support. Can they sue anyone for “mental discomfort” and / or agony ? Society has pampered rich women with privileged laws and facilities. **Who cares for poor Man 's Feelings ?**

In contrast poor boys and Men are always left to fend themselves.

You should be horrified to see how much important the feelings of Rich Feminists are ...

THE UN WANTS TO CENSOR THE ENTIRE INTERNET TO SAVE FEMINISTS' FEELINGS

f SHARE

24346

E MAIL

g+ SHARE

191

TWEET



UN Women/Ryan Brown

See

<http://www.breitbart.com/big-government/2015/09/25/u-n-womens-group-calls-for-web-censorship/>



County in UK makes it a hate crime to upset women

If you talk to a woman in Nottinghamshire, East Midlands in the United Kingdom and she doesn't want to be spoken to by you, prepare to get a call from the police. In an effort to crack down on the alleged tidal wave of abuse and harassment...

WASHINGTONEXAMINER.COM

If you talk to a woman in Nottinghamshire, East Midlands in the United Kingdom and she doesn't want to be spoken to by you, prepare to get a call from the police.

(How dare Men, talk to rich women ?)

<http://www.washingtonexaminer.com/county-in-uk-makes-it-a-hate-crime-to-upset-women/article/2596356#!>

[Who saves and helps Savvy, Rich, Painted faced, Wearing high heels, Women with Manicured and Pedicured nails ? Dirty hands ... and White Knights ...]



I can only say that ... “Poverty is very sad ! ”



**A MAN DOES ALL THE
HARD WORK ONLY TO MAKE HIS
WOMAN LIKE A PRINCESS...!!**

This book is dedicated to the following greats who **died in Poverty**, yet did their best in the subjects, they were passionate in. I couldn't achieve infinitesimal part of their passion even being so well to do!

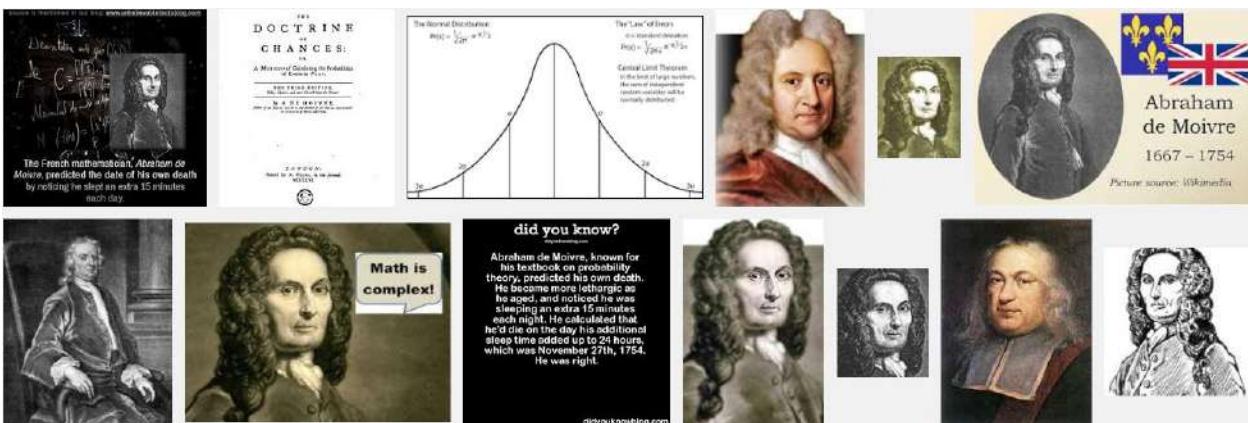


1) **Nikolai Ivanovich Lobachevsky** (Kazan, Russia) 1823 – known primarily for his work on hyperbolic geometry, otherwise known as Lobachevskian geometry. William Kingdon Clifford called Lobachevsky the "Copernicus of Geometry" due to the revolutionary character of his work. He was dismissed from the university in 1846, ostensibly due to his deteriorating health: by the early 1850s, he was nearly blind and unable to walk. He died in poverty in 1856.

Nikolai was an atheist.



2) **Egon Schiele** – Prolific artist Egon Schiele succumbed to the Spanish Influenza that took 20,000,000 lives in Europe in 1918. Schiele's wife Edith (who was six months pregnant at the time) died three days before him in their tiny apartment in Vienna. They were **broke and hungry**, and Schiele spent as much time as he could drawing. He was only 28 years old and spent his last moments alone drawing his wife's body before his own untimely death.

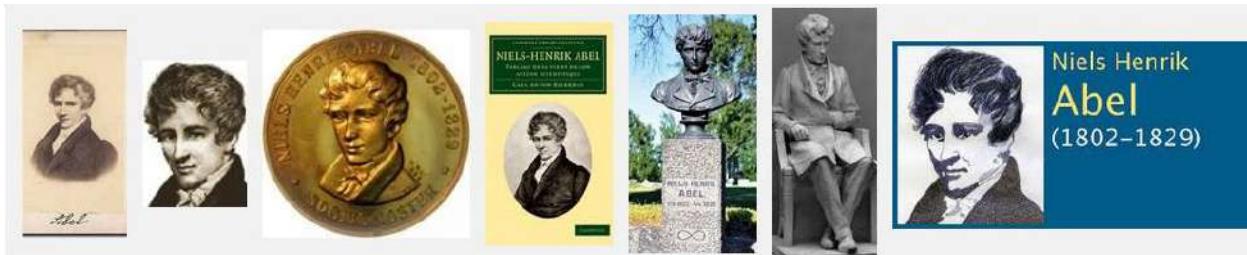


3) **Abraham de Moivre** 1667–1754 (87, natural causes) Despite being a gifted and renowned mathematician in France, de Moivre spent much of his life in poverty. He was a Calvinist, and when the Edict of Nantes was revoked in 1685 (a decision that is unequivocally considered to have damaged France), de Moivre left France for England. He remained virtually destitute, de Moivre was unable to secure employment and was often known to play chess for money in order to afford sustenance. Eventually succumbing to the **ravages of poverty** and old age, de Moivre predicted the day of his own death using a simple arithmetic progression in the number of hours he slept per day. The day he predicted 24 hours of sleep was the day he died.



4) **Domenikos Theotokopoulos AKA El Greco** — Master of the Spanish Renaissance who studied under Titian, El Greco was known for his contorted figures in his paintings. Born in 1541, El Greco as he came to be known, studied in Rome before moving to Spain. What he wasn't known for was being a huge ladies man, or family man, as he followed various studios and painting masters across Europe. Some of his best known works were created for the Spanish royal family. El Greco was able to make a living as an artist for some time before he fell out of favor and became the subject of ridicule. He served as an inspiration for painters that brought forth the Expressionist and Cubist movements. Unfortunately after his work was scorned and laughed at he was unable to continue to make a living as a painter. It wasn't until 250 years after he died that the rest of the art world noticed his paintings. He was a big

careerist and was described in letters in 1563 as a “maestro Domenigo” a “master” when he was just 22 years old. He **died unrecognised and alone in Toledo**, Spain on the 7th of April 1614.



5) **Niels Abel** (1802–1829 Age – 26, pneumonia) **Plagued by poverty** and a lack of renown, Abel and his work went unrecognized during his lifetime. He spent time in Paris hoping to gain recognition and publish his work, but was unable to afford adequate means to sustain his health. In addition to being underfed, Abel contracted pneumonia. His pneumonia worsened on a trip to visit his fiancée for Christmas. He soon died, only two days before a letter arrived indicating that a friend had managed to find secure him a place as a professor in Paris. He never saw his work take root, nor did he ever secure a paying job as a mathematician, nor did he have opportunity to marry his fiancée.



6) **Oscar Wilde** – His famous last words really set the tone for Oscar Wilde’s end, “My wallpaper and I are fighting a duel to the death. Though Wilde was a celebrity of the age and his works sold well, he was known to have extravagant spending habits. One or other of us has got to go.” After his imprisonment he had been given a very small yearly allowance from the estate of his deceased wife, and was not helped at all by his former lover Lord Alfred Douglas, who had at that time just inherited a large sum. Living essentially **in poverty** in Paris, he was known to wander, bumping into old friends and spending what little cash remained on alcohol. Reportedly, when a doctor attending to him during his last days asked to be paid for his services, Wilde joked that he would die as he had lived – beyond his means. He passed away in a hotel room in Paris **completely bankrupt** from paying legal fees for his arrest and imprisonment for the crime of homosexuality. If that wasn’t bleak and cruel enough, it was during this period that his works were becoming extremely popular. Unnnfairrrrrrr.



7) **Frank Ramsey** 1903–1930 (26, jaundice) Ramsey is known for his work in mathematics, specifically combinatorics and logic/foundations, but is also remembered as a gifted philosopher and economist. Ramsey suffered from lifelong liver problems, and was often unable to focus on work for more than a few hours a day. In spite of this, he gained renown as a promising young philosopher and mathematician, until a severe attack of jaundice hospitalized him in 1930. He died during an operation meant to alleviate the problem.



8) **Claude Monet** - As the founder of French Impressionism, Monet's paintings usually dealt with landscape scenes in a moment. While his seminal work "Impression, Sunrise" is now studied and appreciated in art colleges around the world, it was widely derided by critics when it was first revealed. Monet received little but abuse from public and critics alike, who complained that the paintings were formless, unfinished, and ugly. He and his family **endured abject poverty**. By the 1880s, however, his paintings started selling.



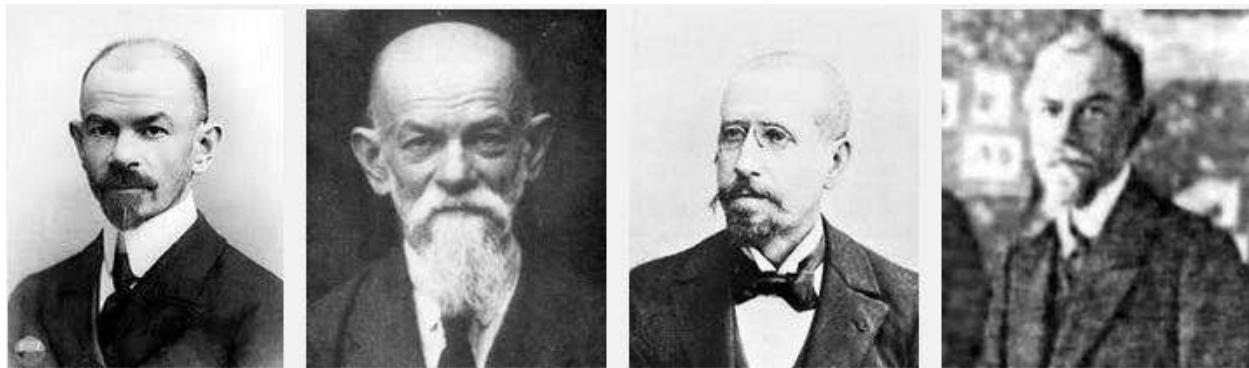
9) **Srinivasa Ramanujan** 1887–1920 (32, malnutrition/hepatitis amebiasis) The story of Ramanujan is well known among mathematicians, if not in general. Described as a prodigy, savant, genius, etc., Ramanujan taught himself mathematics as a youth and began to devise results in analytical number theory and other areas of mathematics in isolation. **He was quite poor and unable to afford school**, and his exclusive devotion to mathematics precluded him from scholarship funding. He spent much of his life seriously ill, and spent a fair amount of time unable to secure any position as a scholar or mathematician. Eventually, he came to England to work with G.H. Hardy. Sadly, his long-term illness continued, and he succumbed to a combination of malnutrition and a parasitic liver infection.



10) **Vincent Van Gogh** - It is hard not to think of tragedy when considers the life of Vincent Van Gogh. If there was ever a fine line between madness and genius, Vincent Van Gogh crossed it quite early in his career. Without his time in insane asylums and self-inflicted ear mutilation, the world would have never had “The Starry Night” and “The Potato Eaters.” Despite his countless post-Impressionist chefs-d’oeuvres, Van Gogh only sold one painting in his lifetime. It sold for the equivalent of approximately \$109 dollars. Although he is famous for his works such as “The Starry Night” this artist battled mental illness most of his life. Unfortunately he finally lost this battle and cut his ear off in 1888, committing suicide not long after that by shooting himself in the chest. His last words were, “The sadness will last forever.” **He died broke and destitute.**

See

<https://zookeepersblog.wordpress.com/vincent-van-gogh-who-preferred-to-paint-without-eating/>

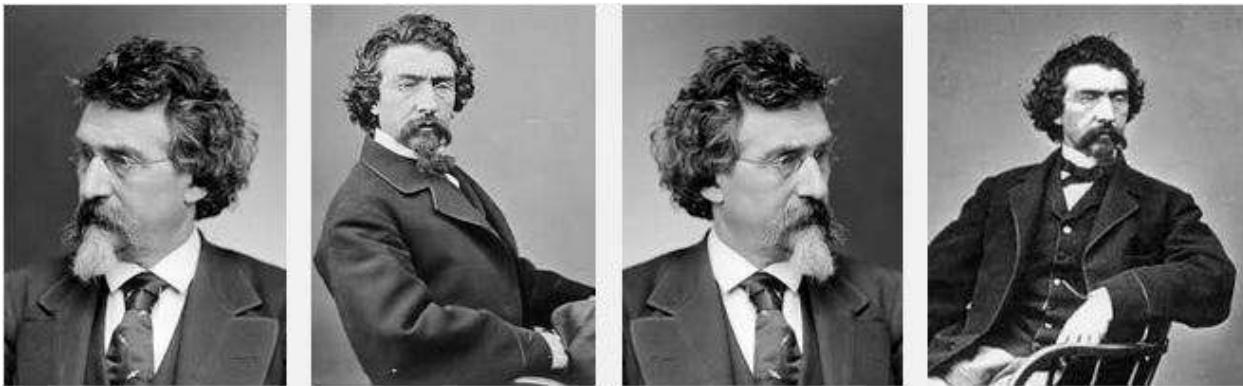


11) **Dmitri Egorov** 1869–1931 (61, starvation) Egorov made important contributions in the areas of analysis, differential geometry, and integral equations, including a fundamental result named for him in real analysis. Luzin was Egorov's first student, and was one member of a school that developed under Egorov to study real functions. Egorov became a leader and administrator in the Moscow Mathematical Society and at the Institute for Mechanics and Mathematics at Moscow State University. Egorov became a vocal opponent to the anti-religious persecution in the time following the Russian revolution, and was dismissed from the IMM. However, he remained active and well-respected in his position in the MMS, supported by his peers in the organization. Outside influences began to manipulate the society, and within a year, Egorov was dismissed from his position and arrested. **He went on a hunger strike in prison and died in the prison hospital** (or, as some reports state, at a colleague's home).

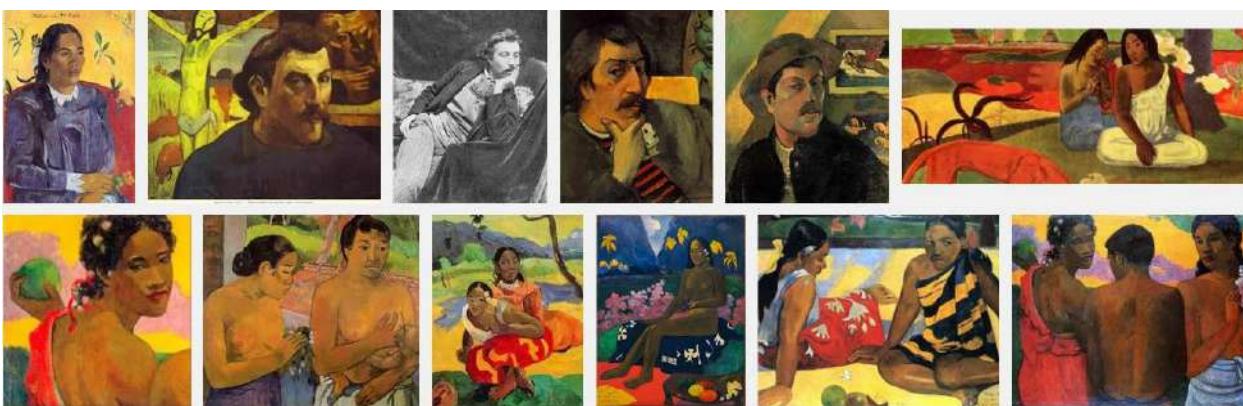


12) **Johannes Vermeer** - Vermeer was a 17th-century painter with eleven children, massive debt and a habit of working very slowly and painstakingly on his paintings. While Vermeer painted the "Girl with a Pearl Earring," he certainly was not draped in them during his life. Instead of having the elite or nobility commission works, Vermeer's genre of painting was catered to the provincial middle class. After the French invaded the Netherlands in 1672, the Dutch economy suffered terribly and Vermeer was left **in hopeless debt**. He suffered from a number of physical afflictions as well as mental illness. In 1675 Vermeer borrowed money in Amsterdam, using his mother-in-law as a surety. Soon after, the Dutch genre painter actually left his family in debt upon his death. After his death some of his paintings (he created about 40 in his lifetime) were sold with the names of other artists on them to make them more valuable. It took three centuries for Vermeer to be recognized as a master painter of the Dutch Golden Age for his use of light, tranquility and the unusual subject matter of

peasants that populated his works. Though he did have patrons who paid him, he never made much and lived on the verge of poverty much of his life, eventually leaving his family in debt when he died at age 43.



13) **Mathew Brady** – The "Father of Photojournalism" is best known for his invaluable photographs of the American Civil War. Though he was a successful and well-known portrait photographer before the war began (Abraham Lincoln's likeness on the \$5 bill is modeled after Brady's portrait of him), he spent around \$100,000 during the war on his photographs, which numbered in the thousands. The pictures brought the truth and grotesque horror of the war to the doorsteps of all Americans – a marked change from the propaganda and half-truths coming from print journalists at the time. Unfortunately, after the war no one wanted to be reminded of the horrors of it, and Brady was unable to sell his photographs or recoup his losses. Eventually Congress bought his collection for a mere \$2,840, but Brady's life had already been **ruined by poverty and alcoholism**, and he died in relative obscurity in 1896.

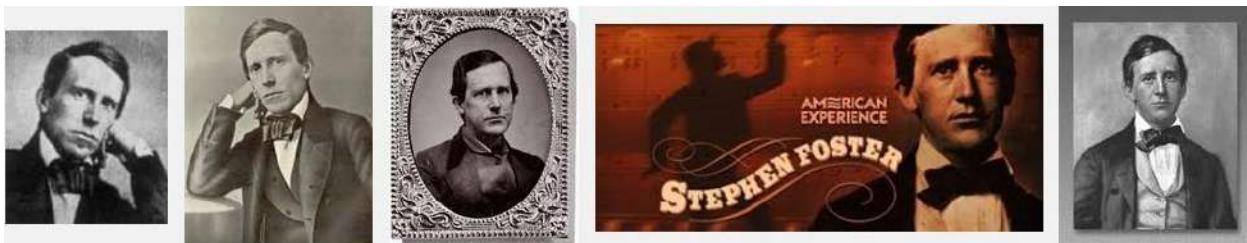


14) **Paul Gauguin** - Poverty became Gauguin's reality. Then his favorite daughter Aline died of pneumonia and Clovis, his son, died from a blood infection. Gauguin's escapades were far more exotic than his peers which eventually landed him in French Polynesia. There, he produced masterpieces like "Spirit of the Dead Watching," which largely inspired primitivism

- an important art movement of the 19th century. After many years of poverty and sickness, Gauguin died from heart failure, alone and unaware of the mark his art would later make on the 20th century.



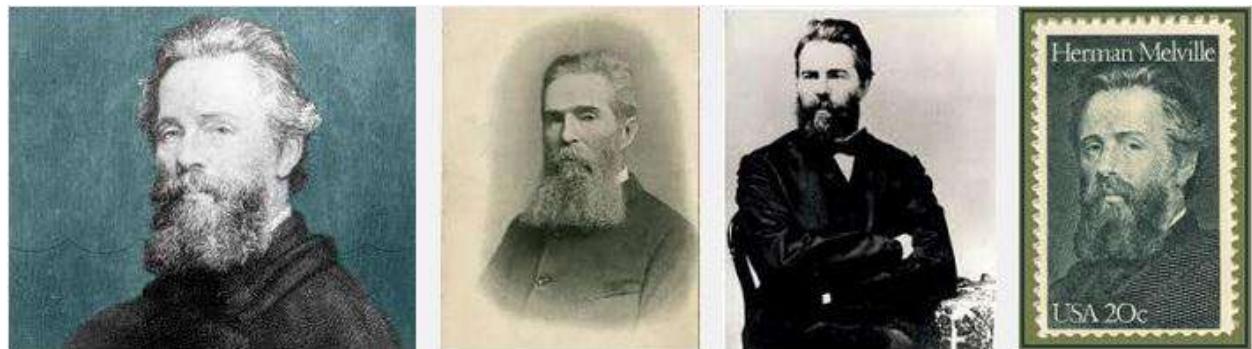
15) **Nikola Tesla** – Early in the 20th century, brilliant scientist Nikola Tesla was a world-famous inventor and regular headline news-maker. As for genius, we have Tesla to thank for alternating current, radio, wireless technology, neon lamps, and X-rays. Sadly, Tesla's life was a series of run-ins with guys like Thomas Edison, who famously stiffed Tesla out of \$50,000, and Guglielmo Marconi, who stole the credit for the invention of the radio by using 17 of Tesla's patents. Tesla died penniless in 1943 in the New Yorker Hotel, where he had lived for 10 years after being evicted from another hotel for not paying his bill.



16) **Stephen Foster** – Though you may not be familiar with Stephen Foster's name, you undoubtedly know his songs. Foster is considered the "Father of American Music," penning the works "Camptown Races," "Swanee River," "Jeanie With the Light Brown Hair," "Beautiful Dreamer" and "Oh! Susanna" among many others, some of which function as current state songs. Foster's melodies were popular in his time (and remain so today, despite some controversy), and he wished to make a living as a professional songwriter. Unfortunately, the lack of copyright laws or a structure for the payment of royalties meant Foster made very little to nothing on performances and reprints of his work. Foster died at the age of 37 with 38 cents in his pocket.



17) **Jean–Honore Fragonard** – Jean–Honore Fragonard was born in Grasse, Provencal in 1732 and became one of the most famous painters of the Rococo period. His family moved to France in 1738, where he was heavily influenced by the Baroque style. His art career started out promisingly enough, having attended the Ecole Royale des Eleves Protégés in Paris. Fragonard was then sent to Italy, where he spent time at the French academy in Rome. He had some success after returning to France, preferring to do private commissioned work. Some of his best known pieces were “Coresus and Callirhoe” and “The Swing”. He was well–known for his sensual and erotic style, complimented by his sense of whimsy and fantasy. Unfortunately, Fragonard was unable to adapt to the new style that eventually came into popularity over “Rococo” called “Neo–classical”. That ended his career and he died in relative obscurity and **poverty** in 1806.



18) **Herman Melville** – The celebration of the Moby Dick author's genius did not begin until well after he could enjoy – or profit from – the recognition. It took a solid 30 years after Herman Melville's death before his epic whaling novel was recognized as a masterpiece of American literature. By then he had long since abandoned any hopes of living off his writing, instead working as a customs inspector for 19 years. When he died of a heart attack in 1891, he **was broke and virtually unknown**. The only paper to mention his passing referred to him as a "long forgotten" author.



19) **James Barry** – James Barry born in Ireland in 1741 was a self-taught artist. He's best known for his six part series of paintings, “The Progress of Human Culture”. He completed these for the Great Room of the Royal Society of Arts. He became a member of the Royal Academy in 1773 and taught as a Professor there from 1782 to 1799. Barry was one of the earliest of the “romantic” painters in Britain and although he died in **poverty** in 1806 he was thought to be the most important Irish Neoclassical artist.



20) **Joseph Gandy** – Reviews for a 2006 book on the life of Joseph Gandy referred to him as a "stifled genius" and "our greatest architectural artist." But history has mainly forgotten the genius that was Gandy, who lived and worked in Britain in the early 1800s. Despite being a major figure in Romantic culture and creating some of the best architectural drawings of all time, he was a commercial failure and was thrown into debtor's prison. **He died in a windowless asylum** that his family had him committed to, and the whereabouts of his grave are unknown.



21) **Henri de Toulouse** – Lautrec was born in France in 1864. He was a close friend of Vincent Van Gogh, even using him as a subject for his painting. Toulouse–Lautrec is considered one of the great painters of the Post–Impressionist period. He favored painting the theatrical life of Paris in the 1800's, giving his audiences personal and provocative peeks inside the Moulin Rouge. Unfortunately, Toulouse–Lautrec suffered from a variety of health issues including pycnodysostosis (a disease that causes very short brittle bones). This may have been the culprit that caused his short stature. Depression caused Toulouse–Lautrec to begin drinking and he died in poverty in 1901 from complications of alcoholism as well as syphilis.



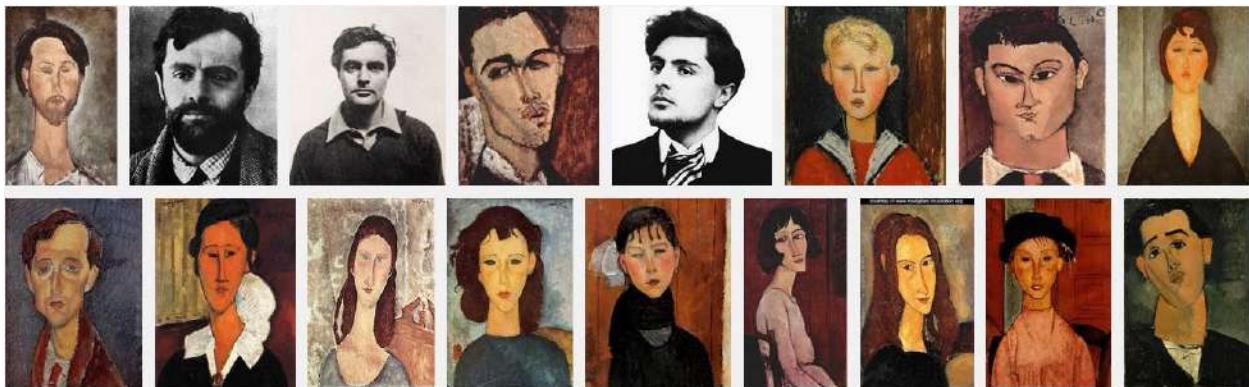
22) **Richard Heck** – 2010 Nobel Chemistry prizewinner died aged 84 in Manila. **He was Penniless**. Famous for his Heck reaction that he discovered in the late 1960s and then spent three decades refining, he won the Nobel for it along with two Japanese chemists working in a similar field.



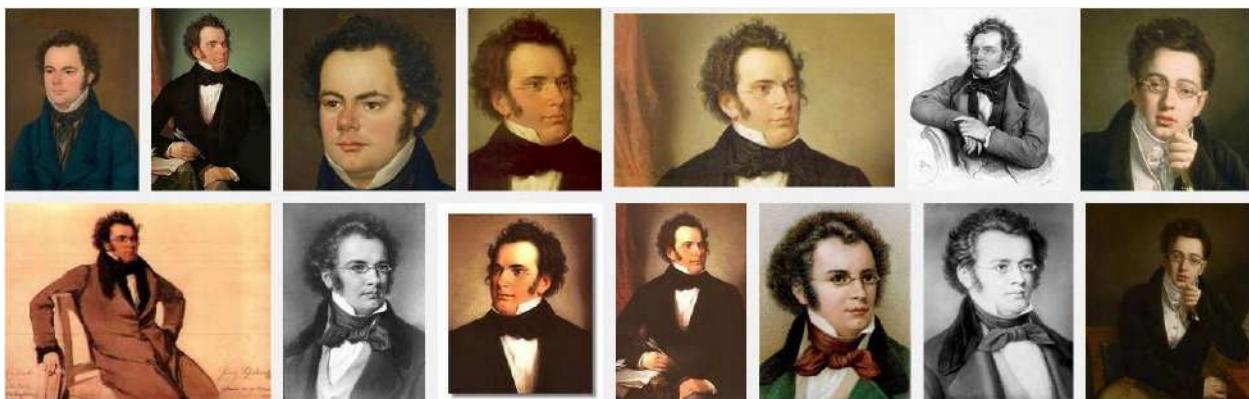
23) **Gustave C. Langenberg** Born in 1859 in Germany this painter became known as “The Painter on Horseback”. He painted many portraits including a portrait of Queen Wilhelmina, which hangs even today at the Royal Palace at The Hague. Langenberg fought in the Boer War as a member of the British Army. He painted many battle scenes of his time there. Afterward spending time in Mexico, Langenberg painted Mexican scenes including the Hill Indians and Mexican natives. Although he toured much of the world and spent time with Kings and Queens, he died alone and **penniless** in 1915.



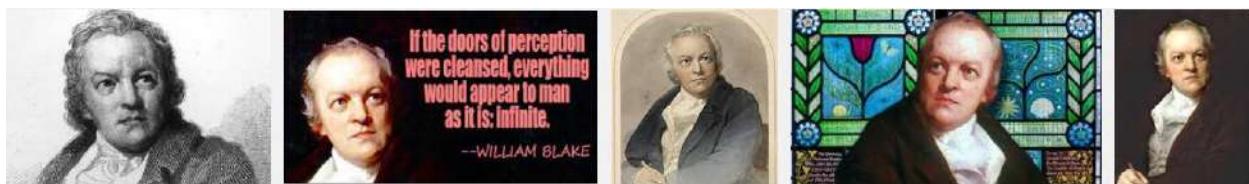
24) **Rembrandt Harmenszoon van Rijn** was born in 1606 and he became one of the greatest painters of all time and certainly the most important in Dutch history. Historians credit him with bringing on the “Dutch Golden Age”. He was best known for his portraits. Rembrandt also painted many biblical scenes. He was credited with having great empathy into the human condition, which helped him to capture his subjects in a way no one else could seem to manage. Unfortunately his life was fraught with tragedy and after his wife died and his friends deserted him, he was pushed into bankruptcy and unable to find any more work. He died in obscurity and poverty in 1669.



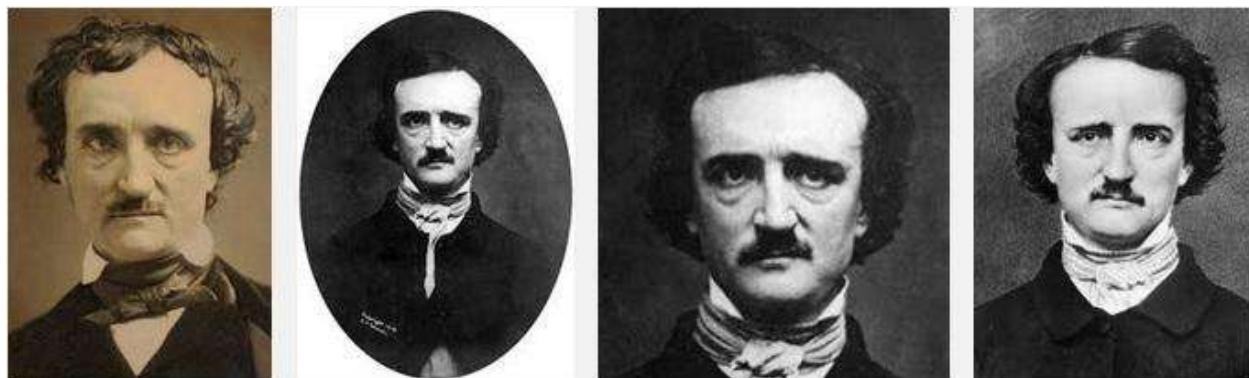
25) **Amedeo Modigliani** – Born in 1884, Modigliani was an Italian artist. He painted and sculpted, spending most of his career in France. He was known for his unique portraits and lush nudes. Modigliani's family was very poor and tragedy followed him from an early age. He was a true bohemian, drinking absinthe, smoking hashish, and attending wild parties. Modigliani lived fast and hard and died of tubercular meningitis at the age of 35, leaving his nine-month pregnant wife behind. She was so distraught over his death she committed suicide the very next day jumping five stories to her death.



26) **Franz Schubert** – Like van Gogh, Schubert was exceptionally prolific in his short life as a classical composer (he died at the age of 31, just one year after the death of his contemporary, Beethoven). Also similarly to van Gogh, Schubert's works were of little interest to those of his age, and considered inferior to Bach and Beethoven. Because of his financial difficulties, Schubert often lead a rather bohemian and at time nomadic lifestyle, but it did not slow down his production. His music influenced later composers such as Brahms and Mendelssohn, and the complexity and beauty of his melodies are now thought to be on par with Mozart (you may recognize one little song of his called "Ave Maria"), solidifying his place in the canon of neglected geniuses who died in obscurity.



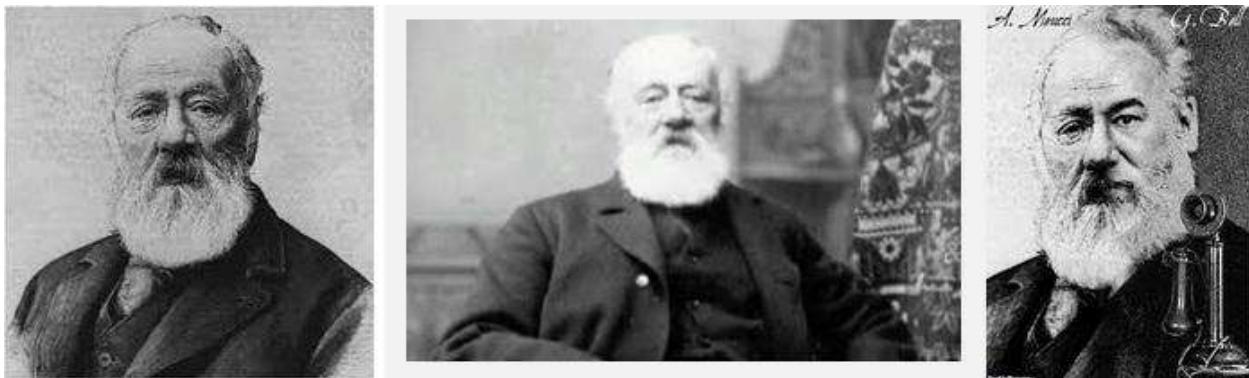
27) **William Blake** – William Blake was another artistic luminary working in obscurity in his day. Though he died poor and unknown, he did not have any debts. Blake was one of the first artists of the 18th century to rebel against Rationalism and move forward into the Romantic Age, and was unsurprisingly considered "mad" because of it. At the time of his death Wordsworth wrote of him, "There was no doubt that this poor man was mad, but there is something in the madness of this man which interests me more than the sanity of Lord Byron and Walter Scott." Blake was known not only for his paintings but also for his fantastic engravings that illustrated his poetry. Despite attempts at exhibitions of his works, no interest was attracted at the time, which did not deter (thankfully) Blake from continuing to produce. He was buried in an **unmarked grave** at Bunhill Fields in 1827.



28) **Edgar Allan Poe** – Without a doubt now one of the most recognizable names in literature, Edgar Allan Allan Poe was one of the first writers to attempt to make a living on just that, and unfortunately embodied the Romantic notion of life as a starving artist because of it. Facing a myriad of rejections early in his career, even after Poe was published (in 1839 with a volume of short stories, "Tales of the Grotesque and Arabesque") he initially received no money for his work. Despite the relative success of stories such as "The Gold Bug," **Poe was unable to make enough money to support his family**. Whether attempting to start his own magazines or simply working at journals that ultimately failed, Poe's revenue stream seem to have a life-long curse of bad luck. His beloved wife died in 1847, and two years later Poe was hospitalized and died in utter poverty under famously mysterious circumstances.



29) **Sammy Davis, Jr.** – The famous Rat Pack singer is reported to have made over \$50 million in his lifetime, but died in 1990 \$15 million in debt (much of it, like in the case of Joe Louis, was owed to the IRS). Though he made around \$1 million a year at the height of his career, the notorious "swinging world" of the Rat Pack nearly bankrupted Davis. According to Matt Birkbeck's book "Deconstructing Sammy," Davis actually rejected surgery in 1989 on his throat that may have saved him, because of his dismal finances. He reasoned that without his voice he couldn't sing and therefore couldn't make any more money. Birkbeck spoke to NPR in 2008 to talk about Sammy's regrettable decline from superstardom to poverty.



30) **Antonio Meucci** – At least in the United States, Alexander Graham Bell has enjoyed far more acclaim than Antonio Meucci, whose name likely invokes a resounding "Who?" from most Americans. But in 2002, Congress gave Meucci his just credit for the invention of the telephone, or the "telefono" as he had called it. Bell simply called it "mine" when he stole the idea from Meucci's papers, which he had sent to Bell's company in the hopes of securing financial backing. Meucci sued him but **died, penniless**, in 1889, never having been able to profit from his genius.

See

<http://www.kellenmyers.org/deaths.html>

<http://blog.redbubble.com/2014/02/6-famous-artists-who-died-poor-and-alone/>

http://www.realclearscience.com/blog/2015/02/mathematicians_die_in_horrible_ways.html

<http://www.finearttips.com/2011/10/10-famous-artists-who-died-before-their-art-was-recognized/>

<http://www.therichest.com/rich-list/poorest-list/10-famous-artists-that-died-penniless/>

Did you notice that these great passionate Men, **did not quit** from their work or Passion. They did not switch to some other means of “ **making money** ” even in abject Poverty! Men are in Love (war) with their Work, Creations, Problems, Research, Search of new Knowledge ...

Kamikaze Pilots can only be Men. Passionate great men doesn't know “how to quit” or simply Can't quit.



It is quite expected that, the advice for quitting will come from women ...

<https://www.youtube.com/watch?v=6MBaFL7sCb8>

<https://www.youtube.com/watch?v=wfNX1cHk-fE>

In case of calamity there are broadly “Two Ways” to survive. **Women prefer to runaway**, hide (change jobs / change family / change Protector). This is a very valid way, a very intelligent / safe way, to continue living. **Running away ensures Survival.**

But the Second Way, which most Men Prefer, **is to fight it out!** It is to “**Solve the Problem**” to survive! This is a very valid way, but bit foolish / unsafe way ! This ensures living. **After the problem is solved it ensures Survival.**

This book is for young students say around the age of 13 to Max 20 years. So to elaborate the above survival techniques, let us see some very simple or common example.

If there is a fire then all **women rush out to extinguish the fire**, risking whatever While Men are hardly seen, as **every Man has taken reclusive in some far away safe place** ...



Am I saying or seeing something wrong ?



This book is dedicated to Hardworking Men who solve Problems ...

Preface

We all know that in the species “Homo Sapiens”, males are bigger than females. The reasons are explained in standard 10, or 11 (high school) Biology texts. **This shapes or size, influences all of our culture.** Before we recall / understand the reasons once again, let us see some random examples of the influence

Random – 1

If there is a Road rage, then who all fight ? (generally ?). Imagine two cars driven by adult drivers. Each car has a woman of similar age as that of the Man. The cars “ touch ” or “ some issue happens ”. Who all comes out and fights ? Who all are most probable to drive the cars ?



(Men are eager to fight, eager to rule, eager for war. Men want to drive. Men want to win)

Random – 2

Heavy metal music artists are all Men. Metallica, Black Sabbath, Motley Crue, Megadeth, Motorhead, AC/DC, Deep Purple, Slayer, Guns & Roses, Led Zeppelin, Aerosmith [the list can be in thousands](#). All these are grown-up Boys, known as Men.



(Men strive for perfection. Men are eager to excel. Men work hard. Men want to win.)



Random – 3

Apart from Marie Curie, only one more woman got Nobel Prize in Physics. (Maria Goeppert Mayer – 1963). So, ... almost all are men.



(Men want to excel. Men strive for perfection. Men want to win. Men work hard. Men do better than women.)

Random – 4

The best Tabla Players are all Men.



(Men want to excel. Men strive for perfection. Men want to win. Men work hard. Men do better than women.)

Random – 5

History is all about, which all Kings ruled. Kings, their men, and Soldiers went for wars. History is all about wars, fights, and killings by men. Who won, and who controlled !



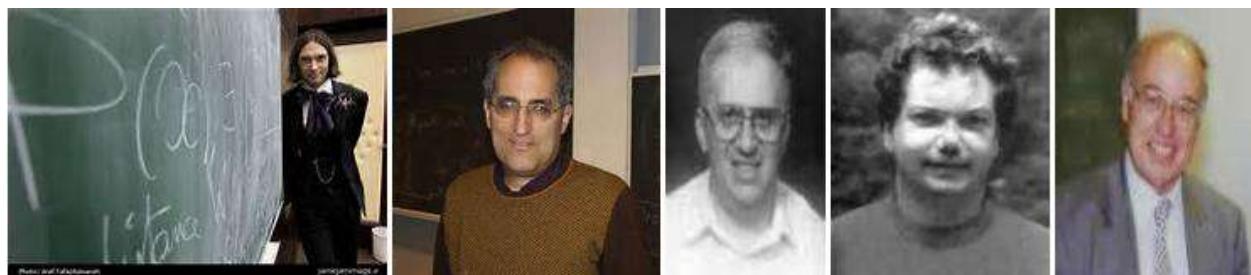
Boys start fighting from school days. Girls do not fight like this



(Men are eager to fight, eager to rule, eager for war. Men want to drive. Men want to win.)

Random – 6

The highest award in Mathematics, the “ Fields Medal “ is around since decades. Till date only one woman could get that. (Maryam Mirzakhani – 2014). So, ... almost all are men.



(Men want to excel. Men strive for perfection. Men want to win. Men work hard. Men do better than women.)

Random – 7

Actor is a gender neutral word. Could the movie like “ Top Gun “ be made with Female actors ? [The best pilots, astronauts, Fighters are all Men.](#)



Random – 8

In my childhood had seen a movie named “ The Tower in Inferno “. In the movie when the tall tower is in fire, [women were being saved first](#), as only one lift was working....



Many decades later another movie is made. A box office hit. “The Titanic”. In this also **As the ship is sinking women are being saved. Men are disposable.** Men may get their turn later... (never) !!



Movies are not training programs. Movies do not teach people what to do, or not to do.
Movies only reflect the prevalent culture. Men are disposable; is the culture in the society. **Knowingly, unknowingly, the culture is depicted in Movies, Theaters, Stories, Poems, Rituals, etc.** I or you can't write a story, or make a movie in which after a minor car accident the Male passengers keep seating in the back seat, while the both the women drivers come out of the car and start fighting very bitterly on the road. **There has been no story in this world, or no movie made, where after an accident or calamity, Men are being helped for safety first, and women are told to wait.**

Random – 9

Artists generally follow the prevalent culture of the Society. In paintings, sculptures, stories, poems, movies, cartoon, Caricatures, knowingly / unknowingly, “**the prevalent Reality**” is depicted. **The opposite will not go well with people.** If deliberately “ the opposite ” is shown then it may only become a special art, considered as a special mockery.

पत्नी (सल्टू से): मुझे
नई साड़ी ला दो प्लीज।
सल्टू : पर तुम्हारी
दो-दो अलमारियां साँ
डयों से ही तो भरी हैं।
पत्नी - वह सारी तो
पूरे मोहल्ले वालों ने
देख रखी हैं।
सल्टू - तो साड़ी लेने
के बजाए मोहल्ला
बदल लेते हैं।



Random – 10

Men go to “girl / woman’s house” to marry / win, and bring her to his home. That is a sort of winning her. When a boy gets a “ Girl–Friend “, generally he and his friends consider that as an achievement. The boy who “ got / won “ a girl–friend feels proud. His male friends feel, jealous, competitive and envious. Millions of stories have been written on these themes. Lakhs of movies show this. Boys / Men go for “ bike race “, or say “ Car Race “, where the winner “ gets “ the most beautiful girl of the college.



([Men want to excel. Men are eager to fight, eager to rule, eager for war. Men want to drive. Men want to win.](#))

Prithviraj Chauhan ‘ [went](#) ‘ to “ [pickup](#) “ or “ [abduct](#) “ or “ [win](#) “ or “ [bring](#) “ his love. There was a Hindi movie (hit) song ... “ [Pasand ho jaye, to ghar se utha laye](#) “. It is not other way round. Girls do not go to Boy’s house or man’s house to marry. Nor the girls go in a gang to “ [pick-up](#) “ the boy / man and bring him to their home / place / den.

Random – 11

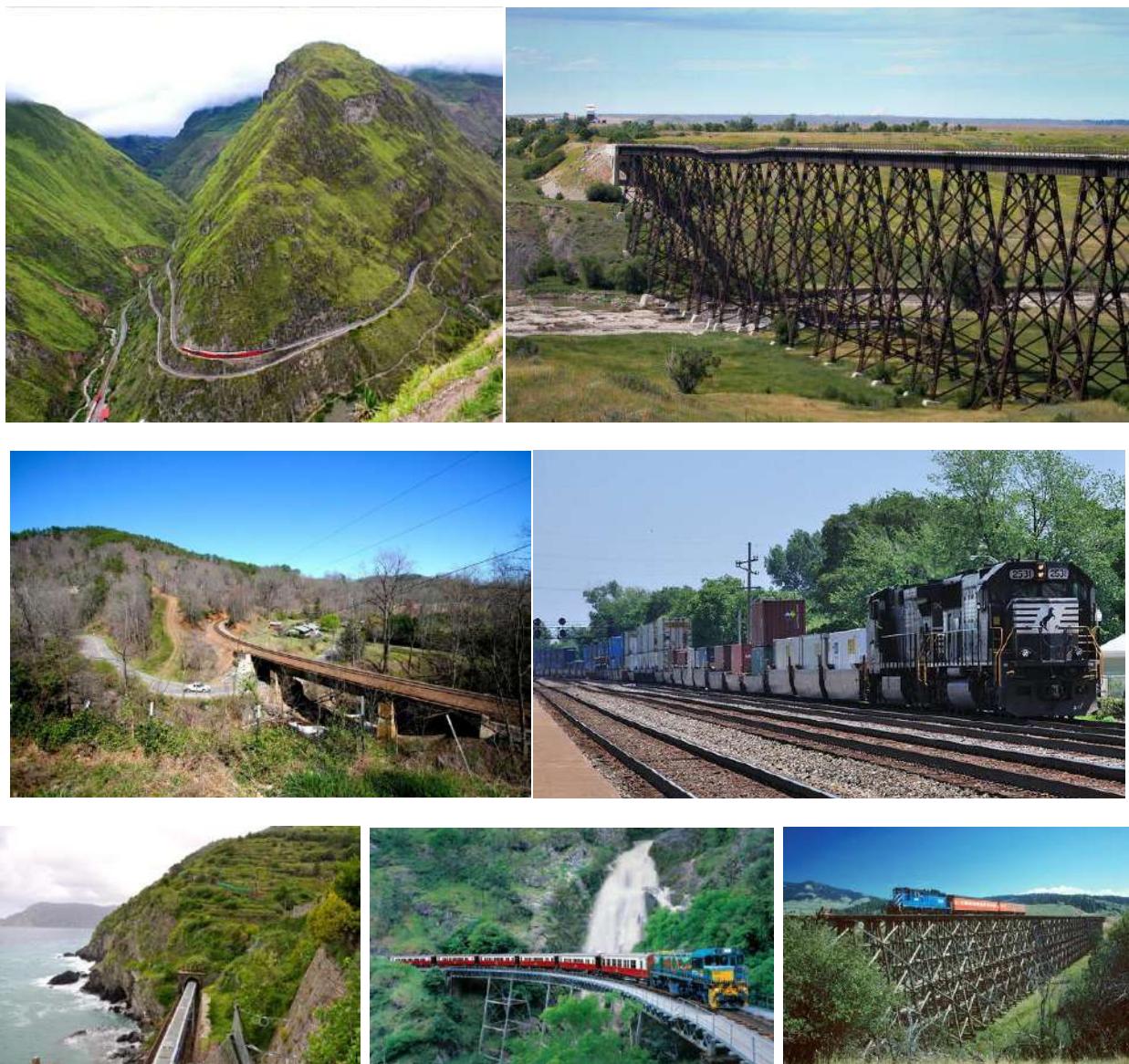
We have the word "ice cold". While, when it snows heavily, the cleaning of the roads is done by Men. Ice avalanche is cleared by Guns, by Men.



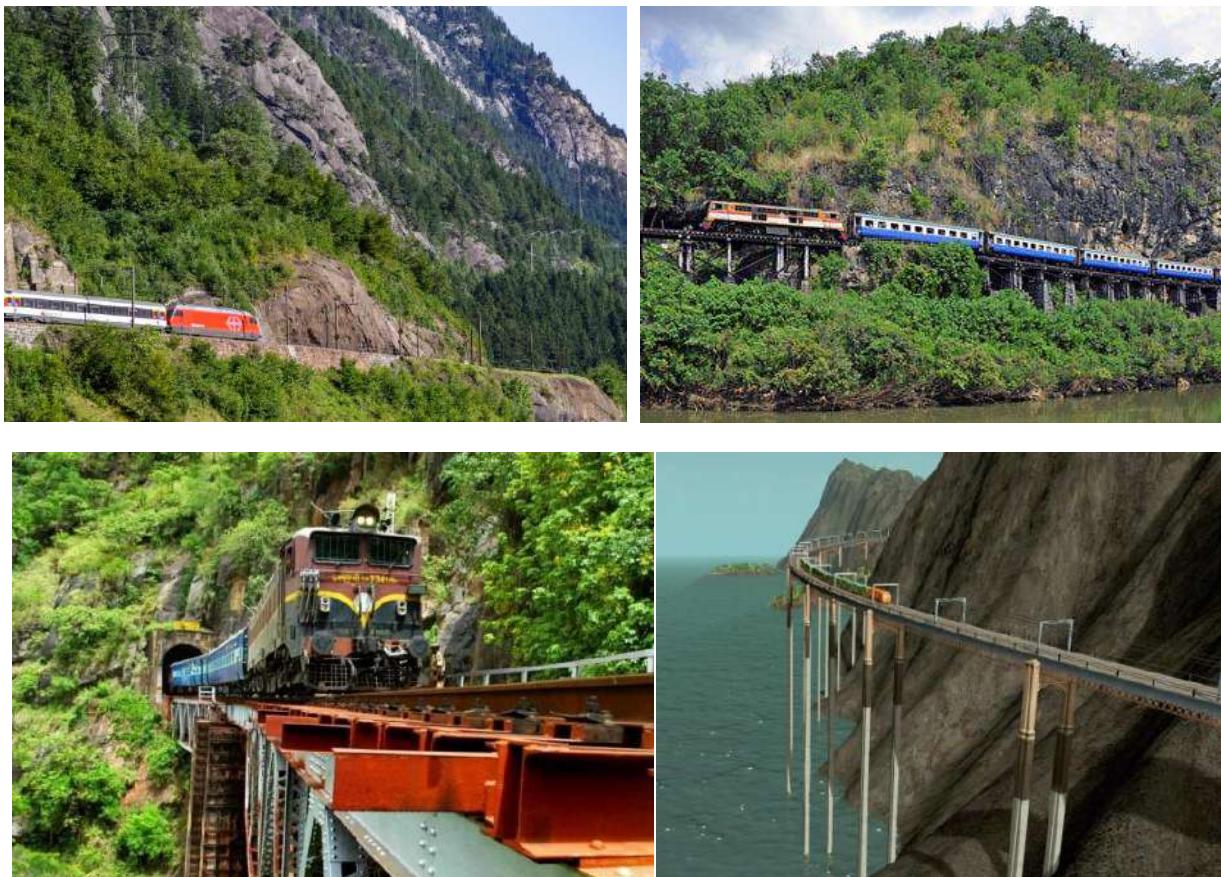
Can women do this please ?



Random – 12



There are many remote mines in this world which are connected by rails through Hilly regions. These railroads move through steep ups and downs. Optimum speed of the train has to be maintained !! The expert driver has to ensure that the brakes do not burn out, if driven too slow. The speed should be enough so that next climbing can be done. Sudden braking is not possible ! ; as the load of the wagons will derail the train, and that will mean huge loss and deaths. The **Drivers are Men** who risk their lives in every journey.



Fukushima Daiichi nuclear disaster happened on March 11, 2011. This was primarily by the tsunami following the Tōhoku earthquake (magnitude 9.0). Lots of radioactive materials were scattered in the environment thorough “vent” to reduce the internal pressure and the hydroponic explosions of the nuclear reactors.

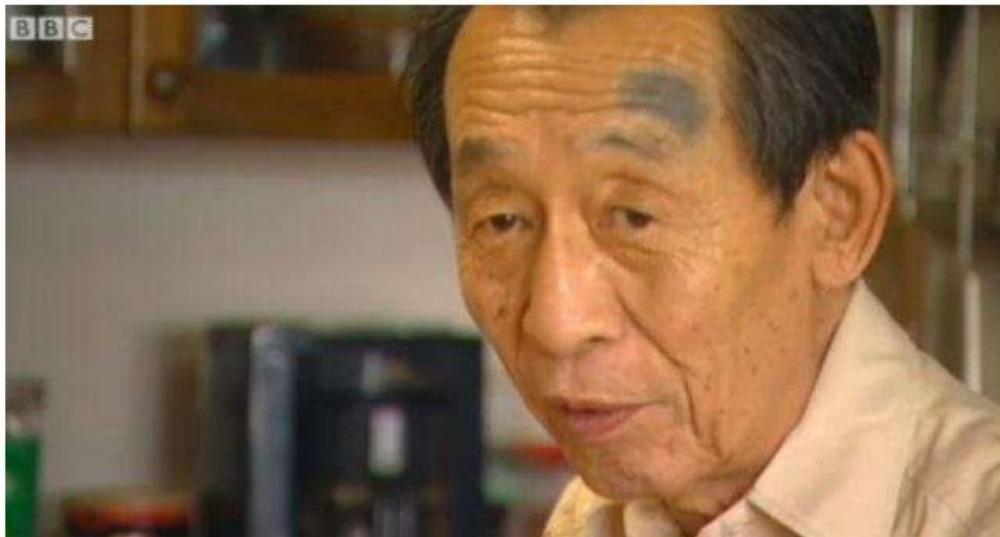
Old Men, Pensioners, Seniors offered to cleanup the Nuclear damage as '**suicide corps**' See <http://edition.cnn.com/2011/WORLD/asiapcf/05/31/japan.nuclear.suicide/>

Old People Line Up To Clean Radiation in Japan



kelly

5/31/11 10:00pm - Filed to: JAPAN



I deeply appreciate such gesture to "Save" the society. While I wish to draw your attention to a much deeper/important questions !!

Why old women did not Volunteer to clean the Nuclear site ?

Old women are not pregnant ! Women get menopause sometime in their early 40s. Why is it so common in the Society to "Save" older women as well, and "spare" or "deprive" old men ?

Why old men are treated so badly ? Why are Men eager to fight every war ?

[Climbing Everest or any Mountain Peak, or say crossing Atlantic solo, or reaching the North Pole / South Pole; Almost ALL are Men isn't it Researching into technology, inventing and discovering new frontiers of Science is also a war! In every case it is Almost ALL Men]

Very Sad, bad habit of Million years, is driving the world for so much of "Good" and "BAD" !

The reader / student should not assume that I have not read enough Philosophy; where it is taught that GOOD or BAD are only individual's mental interpretations. I am mature enough to say the above words as ' Million years of Good Habit of "Fighting to Win and Survive" has led Men to all sorts of difficulties, accidents, discomforts, loss '

Most women are just Thankless to Men, and their efforts. Women just use Men like parasite or Leeches. They see all the facilities' and benefits as their right !

(Unfortunately most men submit themselves to be used / exploited like this ! MGTOW s are one of the exceptions.)

In all countries the Laws / Traditions / Customs / Society norms etc have been systematically twisted in favor of women to ensure that Women get "everything". While Nothing is available for Men !



For example Money, Job, Certificate, Facilities etc are given to Widow and (may be Mom) of the deceased MAN; who died 'fighting' ! The Law or norm is not for the father of the Soldier. [Think ... who is dying ? Who is surviving ? Who is getting the benefits ? who is being deprived ?]

(These images are a few amongst Millions of images which are available. All make the same point)

Home > India > India News > Paternity leave will be just a holiday for men, says Maneka Gandhi

Paternity leave will be just a holiday for men, says Maneka Gandhi

The legislation would mean that India would join the ranks of Eastern European and Nordic countries that have the longest fully paid maternity leave.

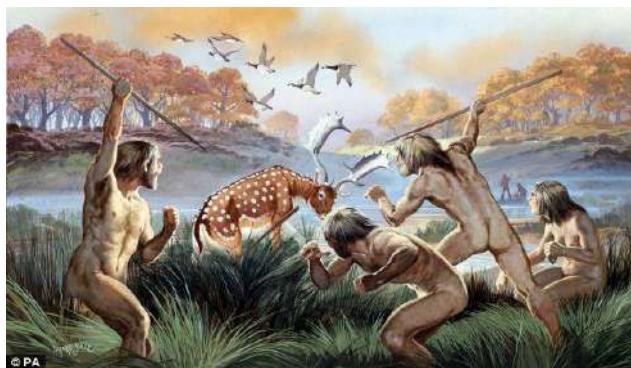
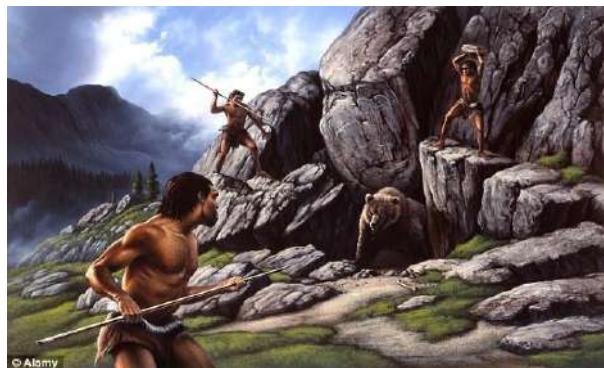
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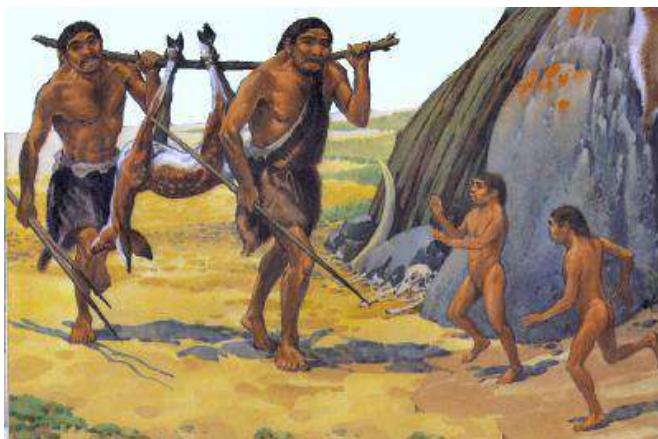
[Facebook](#) [Twitter](#) [G+ Google+](#) [Email](#)

Written by [Shalini Nair](#) | New Delhi | Updated: August 25, 2016 10:50 am



Men are only for working ! ([sorry, hunting !](#)) always ... that's what most people think !





Every woman has a womb. The women (rather their Wombs) were protected / kept safe, so that children are born. That was the survival method to continue the species...

Let us name the best of the Mathematicians ...

Leonhard Euler, Isaac Newton, Carl Gauss, Fermat, Henri Poincaré, Lagrange, David Hilbert, G.W. Leibniz ...

(See <http://fabpedigree.com/james/mathmen.htm>)

Why all these great names are of Men ? Why women could not contribute, in the cozy safe home ?

A newly married couple goes out in car ... and if there is a flat tire (known as puncture in India) then who opens the wheels ? **who replaces from the stepney ?**



Womb being protected ? Why women don't help ?

How much is the Society or Men paying for wombs ? This penance is till which age ?

People in the domestic violence field say that 'it's all about the victims.' Well, most of the times, the victim is the one arrested. Current laws are pure misandry.

Domestic violence facts:

- Women are far more likely to instigate violence
- In non reciprocal violence, in 70% cases, Women are the aggressors
 - In reciprocal violence, Women tend to hit first
- Women are more likely to physically abuse or kill their children



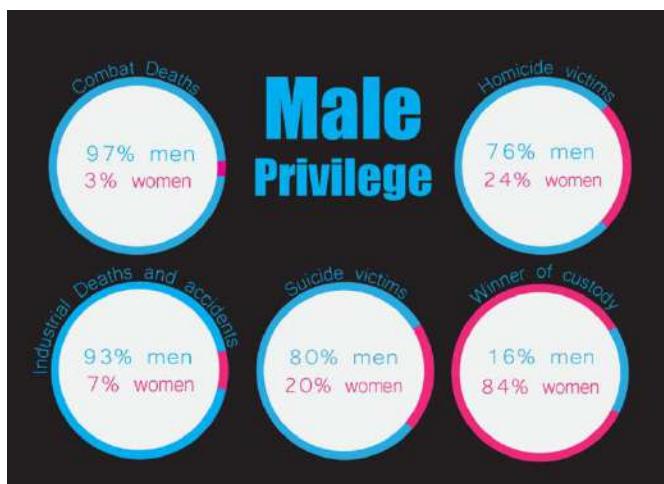
Sources: - Daniel Whitaker, Ph.D., et al., American Journal of Public Health, May 2007

- Journal [Partner Abuse](#), an unparalleled three-year research project, conducted by 42 scholars at 20 universities and research centers, and including information on 17 areas of domestic violence research - John Hamel, LCSW Editor-in-Chief
- <http://www.domesticviolenceresearch.org>

STOP MALE BLAMING ! STOP THE FEMINIST LIES !

Domestic Violence is NOT gender based and is NOT violence against Women !

No woman works for “ Male Suicide ” issues. Even-though, the rate of suicide in men are many times higher, than that of women. Women are never bothered about Men. Some women work only for “women issues”.



"It's so cool! If you use your imagination, you can blame men for everything!"

<http://www.telegraph.co.uk/men/the-filter/11965029/Middle-aged-male-suicide-rate-rises-by-40-per-cent-since-2008.html>

<http://scroll.in/article/669061/married-men-are-most-likely-to-commit-suicide-in-india>



Texas woman who fatally shot her two daughters on her husband's birthday "wanted him to suffer"

- Yes, mental illness was involved
- Yes, many women commit Domestic Violence
- Yes, this is an extreme case. However, many are vindictive and will use their own children against a former partner in countless other ways, over the course of many years of the child's life
- Yes, many look and act *normal* in everyday life
- Yes, too many Judges believe their theatrics

The Fathers' Rights Movement
facebook.com/fathersrights
ftrm.us

"Happy Daughter's Day to my amazing, sweet, kind, beautiful, intelligent girls. I love and treasure you both more than you could ever possibly know." -Christy Sheets

Meet the Woman Who Shot Her Son with the Same Gun She Used to Kill Her Husband 20 Years Earlier

By Afarin Majidi - August 3, 2015



1. Katherine Knight – Kills Husband and Eats Him.



This lady, Katherine Knight stabbed his poor husband 37 times with a butcher's knife then skinned him and hanged his body with a meat hook in their lounge room. Katherine, the first Australian woman to be sentenced to a natural life term without parole. She had a history of violence in relationships. She mashed the dentures of one of her ex-husbands and slashed the throat of another husband's eight-week-old puppy before his eyes. A heated relationship with John Charles

3. Stacey Castor, poisoned husband with antifreeze and then framed her daughter.



Stacy Castor staged a scene to make her dead husband appeared to have committed suicide but getting the cops suspicious then investigated her past only to found out that her former husband was dead from a 'heart attack'. suspicious, the cops enquire an autopsy of the former husband and found ethylene glycol substance same like the second husband's autopsy.

10. The woman who cheated on her husband after he had donated his own kidney to her.



4. Omaima Aree Nelson, Killed, Chopped Up, Cooked and Ate Husband.



Model Omaima Aree Nelson tried to grind her husband up in the garbage disposal. But she just couldn't get rid of all of 6-foot-4, 230 lbs. of him so she boiled, breaded, deep-fried and ate body parts. ([Link](#)).

5. Angry Wife Cuts Off Husband's Balls While He is Sleeping.



An angry Chinese woman in Xiaoxian, Jiangxi province, China, sliced off her husband's testicles while he was sleeping, in order to protect her marriage.

8. 76-year-old lady who is suspected of murdering four of her five husbands.



Jeff Carstensen was spooked when he learned his grandmother planned to buy him a \$100,000 life insurance policy — and name herself the beneficiary. As he and many others who came into Betty Neumar's orbit have learned, bad things tend to happen to the people around her.

Human beings are in general not comfortable with New ideas or New Paradigms or say new doctrines. New ideas take time to shape up !

(I am aware of Hundredth monkey effect ... scientists were conducting a study of macaque monkeys on the Japanese island of Koshima in 1952. These scientists observed that some of these monkeys learned to wash sweet potatoes, and gradually this new behavior spread through the younger generation of monkeys—in the usual fashion, through observation and repetition. Watson then concluded that the researchers observed that once a critical number of monkeys was reached, i.e., the hundredth monkey, this previously learned behavior instantly spread across the water to monkeys on nearby islands.

https://en.wikipedia.org/wiki/Hundredth_monkey_effect)

<http://www.dailymail.co.uk/sciencetech/article-3317316/Monkeys-food-hygiene-Macaque-clean-potatoes-grain-eating-fewer-parasites.html>

Robindranath Thakur, the first Nobel Laureate of Asia, was follower / believer of Brahmo. His father Debendranath Thakur, (As son of Dwarkanath Tagore, a close friend of Ram Mohan Roy) philosopher and religious reformer, active in the Brahmo Samaj ("Society of Brahmā," also translated as "Society of God"), which aimed to reform the Hindu religion and way of life. He

was one of the founders in 1848 of the Brahmo religion, which today is synonymous with Brahmoism.

When Robindronath wanted to open a school in Calcutta, many people did not want to send their children to a "Brahmo Teacher". So In 1901 Tagore moved to Santiniketan to found an ashram.



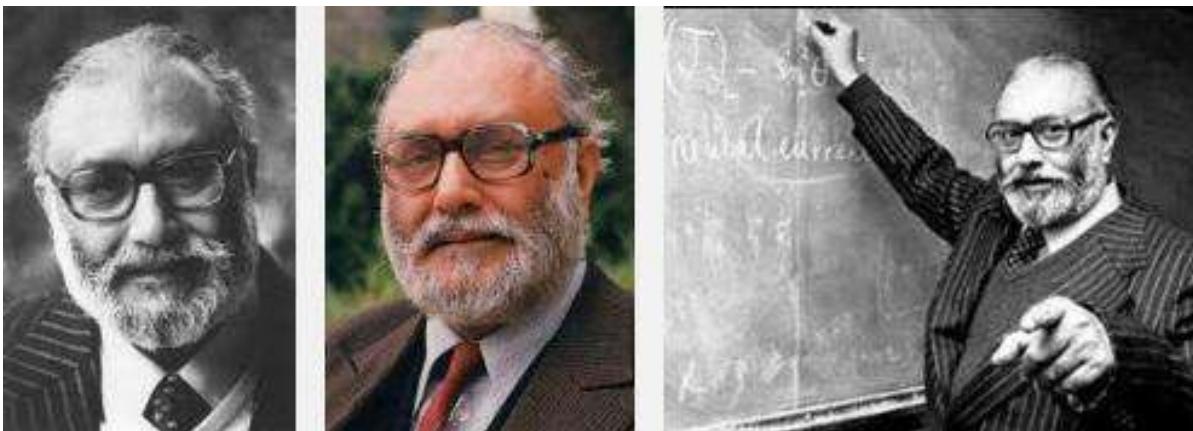
Chatimtala Kaanch Ghor the Bramho Mandir, at Santiniketan

[English People could not pronounce Thakur. They used to distort it as Tagore Over time the family name is called as Tagore by most non-Bengalis]



Abdus Salam the only Physics Nobel Laureate of Pakistan was an Ahmadiyya; by faith. Ahmadiyya religion is not accepted in Pakistan. [The theological amendment in the constitution of Pakistan does not allow members of the Ahmadiyya faith to call themselves

Muslims.] Abdus Salam had to shift to Trieste, Italy. Salam was buried in Bahishti Maqbara, a cemetery established by the Ahmadiyya Community at Rabwah, Punjab, Pakistan, next to his parents' graves. The epitaph on his tomb initially read "**First Muslim Nobel Laureate**". The Pakistani government removed "Muslim" and left only his name on the headstone. The word "Muslim" was initially obscured on the orders of a local magistrate before moving to the national level.



<http://blogs.tribune.com.pk/story/19695/we-are-sorry-dr-abdus-salam/>

<http://blogs.tribune.com.pk/story/31969/dr-abdus-salam-and-all-the-wrong-choices-pakistan-made/>

http://www.nobelprize.org/nobel_prizes/physics/laureates/1979/salam-bio.html

In some cases accepting the Truth takes very long time....

Pope John Paul II apologised on behalf of the Catholic Church for the mistreatment of Galileo in the 17th century. The dispute between the Church and Galileo has long stood as one of history's great emblems of conflict between reason and dogma, science and faith. At the time of his condemnation, Galileo had won fame and the patronage of leading Italian powers like the Medicis and Barberinis for discoveries he had made with the astronomical telescope he had built. But when his observations led him to proof of the Copernican theory of the solar system, in which the sun and not the earth is the center, and which the Church regarded as heresy, Galileo was summoned to Rome by the Inquisition. **Forced to Recant**. Galileo took back his statement, but still lived under house arrest for the rest of his life. It took 359 years and the leadership of Pope John Paul II (left) to recognize the wrong. On October 31, 1992, he formally apologized for the "Galileo Case" in the first of many famous apologies during his papacy.

<https://www.youtube.com/watch?v=JUAsLcFPeNw>

History of Gravity ...

Galileo to Einstein https://www.youtube.com/watch?v=2H_zvoENNxo

<https://www.youtube.com/watch?v=QGQq2aB3cWE>

<https://www.youtube.com/watch?v=mPxwgyJtJXI>

The New York Times

World

WORLD	U.S.	N.Y. / REGION	BUSINESS	TECHNOLOGY	SCIENCE	HEALTH	SPORTS	OPINION
AFRICA	AMERICAS	ASIA PACIFIC	EUROPE	MIDDLE EAST				

After 350 Years, Vatican Says Galileo Was Right: It Moves

By ALAN COWELL,
Published: October 31, 1992

ROME, Oct. 30— More than 350 years after the Roman Catholic Church condemned Galileo, Pope John Paul II is poised to rectify one of the Church's most infamous wrongs -- the persecution of the Italian astronomer and physicist for proving the Earth moves around the Sun.

With a formal statement at the Pontifical Academy of Sciences on Saturday, Vatican officials said the Pope will formally close a 13-year investigation into the Church's condemnation of Galileo in 1633. The condemnation, which forced the astronomer and physicist to recant his discoveries, led to Galileo's house arrest for eight years before his death in 1642 at the age of 77.

The dispute between the Church and Galileo has long stood as one of history's great emblems of conflict between reason and dogma, science and faith. The Vatican's formal acknowledgement of an error, moreover, is a rarity in an institution built over centuries on the belief that the Church is the final arbiter in matters of faith.

<http://www.nytimes.com/1992/10/31/world/after-350-years-vatican-says-galileo-was-right-it-moves.html>

For new ideas See ...

http://www.slate.com/articles/news_and_politics/foreigners/2009/06/the_herbivores_dilemma.html

<http://www.wisedup.org/antiphysical-men-giving-sex-relationships/>

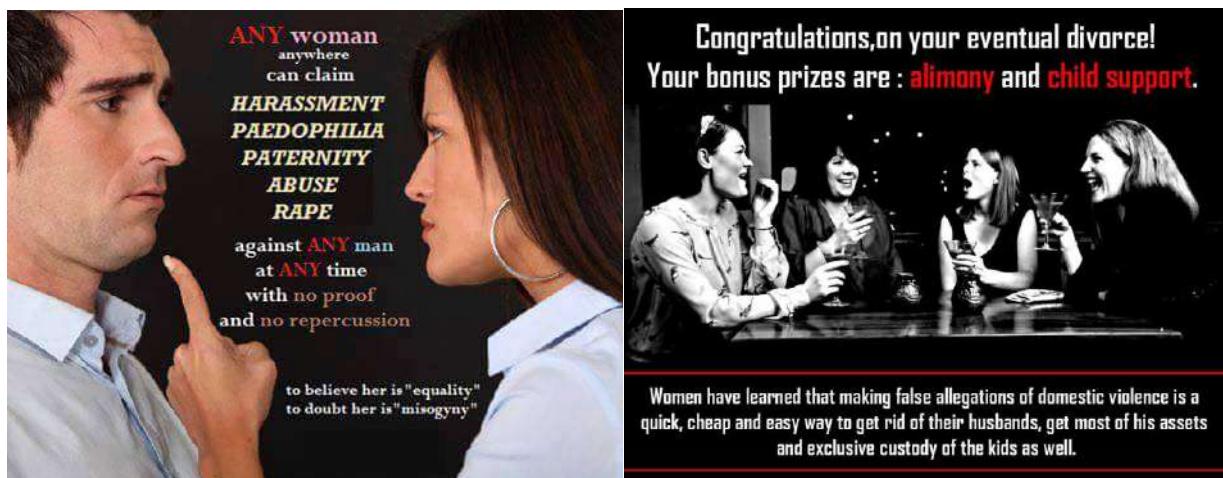
<https://pairedlife.com/dating/Dating-10-Things-Men-Dont-Do-Anymore>

Random - 13 (will you be comfortable with new ideas ?)

Almost all of us are very biased. Instead of asking some questions; see the following images

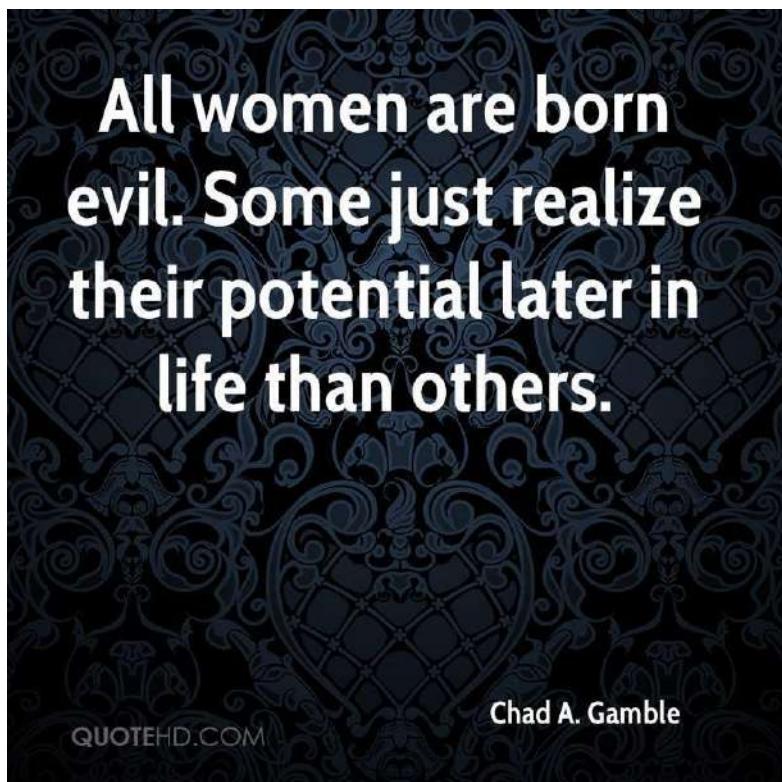


<http://www.independent.co.uk/life-style/love-sex/women-are-genetically-programmed-to-have-affairs-evolution-university-texas-scientists-suggest-a7203501.html>



In all cultures the onus of Proving himself not guilty, lies on the Man; while it is enough for the woman just to accuse, and cry. Tears are taken as proof of Crime !





TOO MANY MALE PROGRAMMERS

AMOUNT OF MALE TRUCK DRIVERS,
COAL MINERS, CONSTRUCTION WORKERS,
AND GARBAGE COLLECTORS IS JUST FINE

Like · Reply · 10 · September 25 at 10:41pm

 Jessie because they're horrible jobs, women should NOT be working those kind of jobs. We deserve better jobs and higher pay... the men can settle for the scraps for all I care.

Like · 15 hours ago

Proof that girls are evil

First we state that girls require time and money.

$$\text{GIRLS} = \text{TIME} \times \text{MONEY}$$

And as we all know "time is money"

$$\text{TIME} = \text{MONEY}$$

Therefore:

$$\text{GIRLS} = \text{MONEY} \times \text{MONEY} = (\text{MONEY})^2$$

And because "money is the root of all evil":

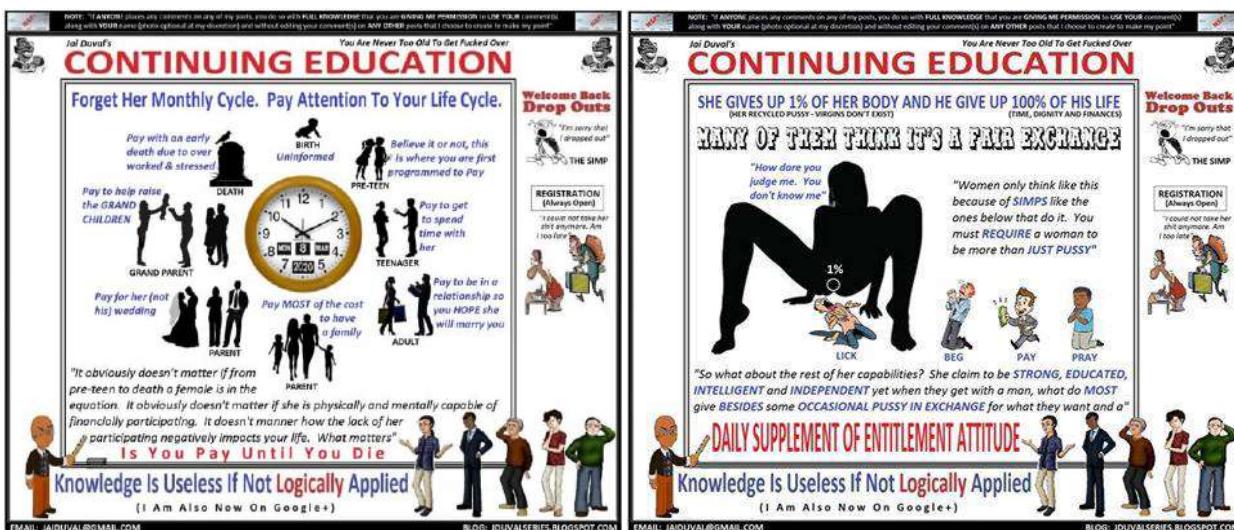
$$\text{MONEY} = \sqrt{\text{EVIL}}$$

Therefore:

$$\text{GIRLS} = (\sqrt{\text{EVIL}})^2$$

We are forced to conclude that:

$$\text{GIRLS} = \text{EVIL}$$



Random – 14

Rich people; often are very hard working. Successful business men, establish their business (empire), amass lot of wealth, with lot of difficulty. Lots of sacrifice, lots of hard work, gets into this. **Rich people's wives had no contribution in this wealth creation.** Women are smart, and successful upto the extent to choose the right/rich man to marry. So generally what happens in case of Divorces ? Search the net on “ most costly divorces ” and you will know. The women;(who had no contribution at all, in setting up the business / empire), often gets in Billions, or several Millions in divorce settlements. [Just because the wife has womb]

Number 1

Rupert & Anna Murdoch -- \$1.7 billion

One of the richest men in the world, **Rupert Murdoch** developed his worldwide media empire when he inherited his father's Australian newspaper in 1952. He married Anne Murdoch in the '60s and they remained together for 32 years, springing off three children.

They split amicably in 1998 but soon Rupert forced Anna off the board of News Corp and the gloves came off. The divorce was finalized in June 1999 when Rupert agreed to let his ex-wife leave with \$1.7 billion worth of his assets, \$110 million of it in cash. Seventeen days later, Rupert mated Wendi Deng, one of his employees.



Ted Danson & Casey Coates -- \$30 million

Ted Danson's claim to fame is undoubtedly his decade-long stint as Sam Malone on NBC's celebrated sitcom Cheers . While he did other TV shows and movies, he will always be known as the bartender of that place where everybody knows your name. He met his future first bride Casey, a designer, in 1976 while doing Erhard Seminars Training.

Ten years his senior, she suffered a paralyzing stroke while giving birth to their first child in 1979. In order to nurse her back to health, Danson took a break from acting for six months. But after two children and 15 years of marriage, the infatuation fell to pieces. Danson had started seeing Whoopi Goldberg while filming the comedy, Made in America and this precipitated the 1992 divorce. Casey got \$30 million for her trouble.

See

<https://zookeepersblog.wordpress.com/misandry-and-men-issues-a-short-summary-at-single-place/>

See <http://skmclasses.kinja.com/save-the-male-1761788732>

It was Boys and Men, who brought the girls / women home. The Laws are biased, completely favoring women. The men are paying for their own mistakes.

See <https://zookeepersblog.wordpress.com/biased-laws/>

(Man brings the Woman home. When she leaves, takes away her share of big fortune!)

<http://www.uplifting-love.com/2013/08/80-percent-of-divorces-are-filed-by.html>



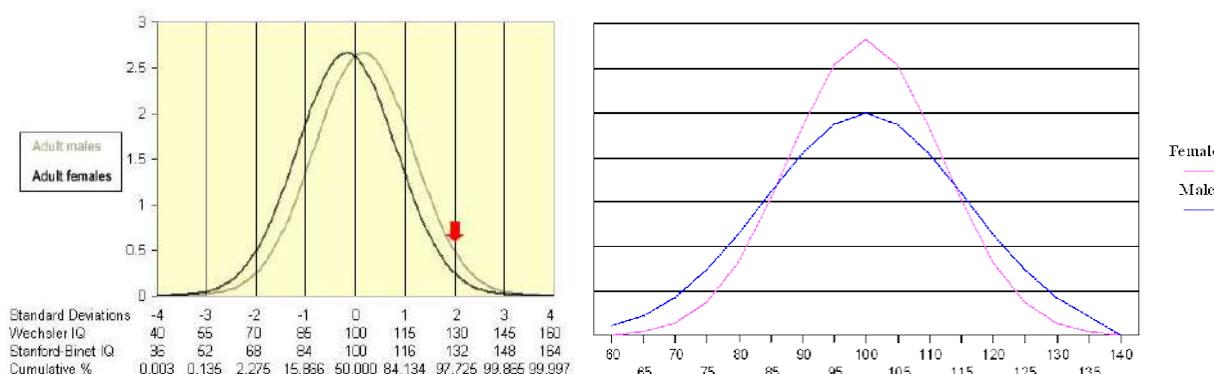
Mileva Marić wife of Albert Einstein; was the only woman among Albert Einstein's fellow students at the Zurich Polytechnic. They got married in 1903, they had two sons, Hans Albert and Eduard. They separated in 1914, with Marić taking the boys and returning to Zurich from Berlin. They divorced in 1919. Albert Einstein was confident or rather sure of winning the Nobel Prize. He had agreed to pay the prize money (after he gets it), to Mileva, for the separation and Divorce. After Einstein received the Nobel Prize in 1921, he transferred the money to Marić.

Just see how bad it has been ... Nobel Prize Money for Separation and Divorce!

—

Random – 15

A standardized test of Intelligence will never be possible. It never happened before, nor ever will happen in future. No IQ test results will be acceptable by all. In the net there are thousands of charts which show that the intelligence scores of girls / women are lesser. Debates of Trillion words, does not improve performance of Girls.



I am not wasting a single second debating or discussing with anyone, on this. **I am simply accepting ALL the results.** IQ is only one of the variables which is required for success in life. Thousands of books have been written on “ Networking Skills ”, EQ (Emotional Quotient), Drive, Dedication, Focus, “ Tenacity towards the end goal ” ... etc. In each criteria, and in all together, women (in general) do far worse than men. Bangalore is known as “ capital of India ”. [Fill in the blanks]. The blanks are generally filled as “ Software Capital ”, “ IT Capital ”, “ Startup Capital ”, etc. I am member in several startup eco-systems / groups.

I have attended hundreds of meetings, regarding “ technology startups ”, or “ idea startups ”. These meetings have very few women. (Generally in most meetings there are no women at all !). Starting up new companies are all “ Men’s Game ” / “ Men’s business ”. Only in Divorce settlements women will take their goodies, due to Biased laws. There is no dedication, towards wealth creation, by women. Women want easy money.



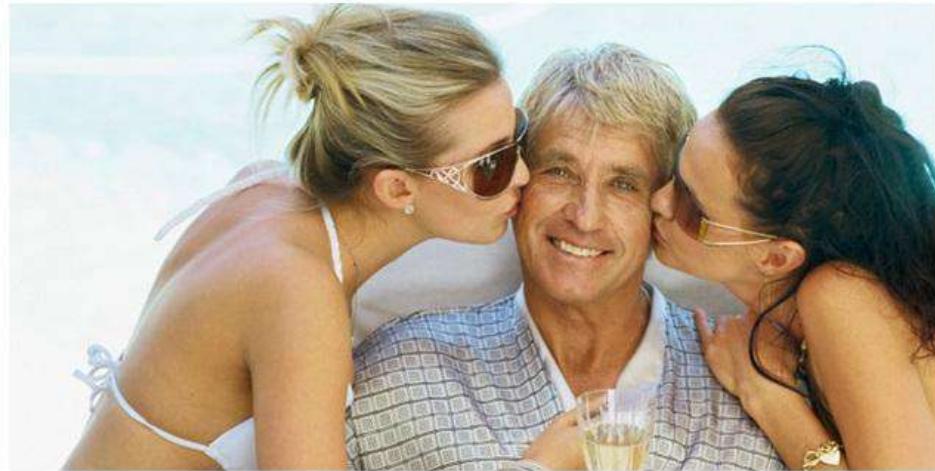
Max Roscoe

is an aspiring philosopher king, living the dream, travelling the world, hoarding FRNs and ignoring American cunts. He is a European at heart, lover of Latinas, and currently residing in the USA.

July 8, 2016

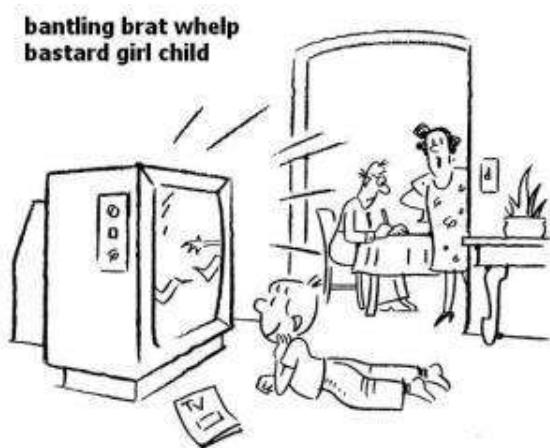
Culture

Women Who Sell Their Bodies For Money Don't Want To Be Called Prostitutes



Random – 16

Many men, as fathers, very unfortunately treat their daughters as “ Princess ”. Every “ non-performing ” woman / wife was “ princess daughter ” of some loving father. Pampering the girls, in name of “ equal opportunity ”, or “ women empowerment ”, have led to nothing.



"Please turn it down - Daddy is trying to do your homework."



See <http://skmclasses.kinja.com/progressively-daughters-become-monsters-1764484338>

See <http://skmclasses.kinja.com/vivacious-vixens-1764483974>

There can be thousands of more such random examples, where “ Bigger Shape / size “ of males have influenced our culture, our Society. Let us recall the reasons, that we already learned in standard 10 – 11, Biology text Books. In humans, women have a long gestation period, and also spends many years (almost a decade) to grow, nourish, and stabilize the child. (Million years of habit) Due to survival instinct Males want to inseminate. Boys and Men fight for the “ facility (of womb + care) “ the girl / woman may provide. Bigger size for males, has a winning advantage. Whoever wins, gets the “ woman / womb / facility “. **The male who is of “ Bigger Size “, has an advantage to win....** Leading to Natural selection over millions of years. In general “ Bigger Males “; the “ fighting instinct “ in men; have led to wars, and solving tough problems (Mathematics, Physics, Technology, startups of new businesses, Wealth creation, Unreasonable attempts to make things [such as planes / Flying Machines], Hard work)

So let us see the IIT–JEE results of girls. Statistics of several years show that there are around 17, (or less than 20) girls in top 1000 ranks, at all India level. Some people will yet not understand the performance, till it is said that ... **year after year we have around 980 boys in top 1000 ranks.** Generally we see only 4 to 5 girls in top 500. **In last 50 years not once any girl topped in IIT–JEE advanced.** Forget about Single digit ranks, double digit ranks by girls have been extremely rare. It is all about “ good boys “, “ hard working “, “ focused “, “Bel–esprit “ boys.

In 2015, Only 2.6% of total candidates who qualified are girls (upto around 12,000 rank). while 20% of the Boys, amongst all candidates qualified. The Total number of students who appeared for the exam were around 1.4 million for IIT–JEE main. Subsequently 1.2 lakh (around 120 thousands) appeared for IIT–JEE advanced.

IIT–JEE results and analysis, of many years is given at

<https://zookeepersblog.wordpress.com/iit-jee-isheet-main-and-advanced-results/>

In Bangalore it is rare to see a girl with rank better than 1000 in IIT–JEE advanced. We hardly see 6–7 boys with rank better than 1000. Hardly 2–3 boys get a rank better than 500.

See <http://skmclasses.weebly.com/everybody-knows-so-you-should-also-know.html>

So what “ some women “ are doing ?

Thousands of people are exposing the heinous crimes that Motherly Women are doing, or Female Teachers are committing. See <https://www.facebook.com/WomenCriminals/>

Some Random Examples must be known by all

It is extremely unfortunate that the "woman empowerment" has created. This is the kind of society and women we have now. I and many other sensible Men hate such women. Be away from such women, be aware of reality.



Mother Admits On Facebook to Sleeping with 15 Yr Old Son, They Have a Baby Together - Alwayzturntup

Sometimes it hard to believe w From Alwayzturntup

ALWAYZTURNTUP.ME



'Sex with my son is incredible - we're in love and we want a baby'

Ben Ford, who ditched his wife when he met his mother Kim West after 30 years, claims what the couple are doing isn't incest'

MIRROR.CO.UK

Woman sent to jail for the rest of her life after raping her four grandchildren is described as the 'most evil person' the judge has ever seen

Edwina Louis rape...

See More



Former Shelbyville ISD teacher who had sex with underage student gets 3 years in prison

After a two day break over the weekend, A Shelby County jury was back in the courtroom looking to conclude the trial of a former Shelbyville ISD teacher who had...

KLTV.COM | BY CALEB BEAMES



Woman sent to jail for raping her four grandchildren

A Ohio grandmother has been sentenced to four consecutive life terms after being found guilty of the rape of her own grandchildren. Edwina Louis, 53, will spend the rest of her life behind bars.

DAILYMAIL.CO.UK

<http://www.thenativecanadian.com/.../eastern-ontario-teacher-...>



The N.C. Chronicles.: Eastern Ontario teacher charged with 36 sexual offences

anti feminism, Child abuse, children's rights, Feminist hypocrisy,
THENATIVECANADIAN.COM | BY BLACKWOLF



Hyd woman kills newborn boy as she wanted daughter - Times of India

Having failed to bear a daughter for the third time, a shopkeeper's wife slit the throat of her 24-day-old son with a shaving blade and left him to die in a street on Tuesday night. Purnima's first child was a stillborn boy, followed by another boy born five years ago.

TIMESOFINDIA.INDIATIMES.COM

Montgomery's son, Alan Vonn Webb, took the stand and was a key witness in her conviction.

"I want to see her placed somewhere she can never do that to children

...

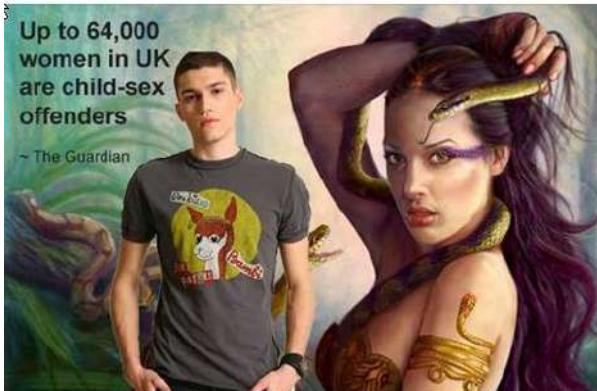
See More



Woman sentenced to 40 years in prison for raping her children

A Murfreesboro mother found guilty of raping her own children learned her fate on Wednesday.

WAFF.COM | BY DENNIS FERRIER



Women, the gentler sex? Violence against men.
April 8 at 1:38am · 4

Like Page

In fact, the past decade has seen a dramatic increase in the number of incidents of women raping and sexually assaulting boys and men. On May 2014, Jezebel repo...

In Facebook, and internet + whatsapp etc we have unending number of posts describing frustration of men / husbands on naughty unreasonable women. Most women are very illogical, Punic, perfidious, treacherous, naughty, gamey bitches.

We also see zillions of Jokes which basically describe how unreasonable women / girls are. How stupid they are, making life of Boys / Men / Husband a hell.

While each of these girls was someones daughter. Millions of foolish Dads are into Fathers rights movement, who want their daughter back for pampering.

Most girls are being cockered, coddled, cosseted, mollycoddled, featherbedded, spoilt into brats.

Foolish fathers are breeding Monsters who are filing false rape cases. Enacting Biased Laws. Filing False domestic violence cases. Filing false sexual assault cases. Asking for alimony, and taking custody of the Daughter, not allowing the " monster " to meet dad. The cycle goes on and on and on.

Foolish men keep pampering future demons who make other Men's life a hell. (Now read this again from beginning). Every day we see the same posts of frustration.



**When I grow up
I will beat my
husband
No one will care
No one will stop me**

**53% of Domestic Violence
Victims are Men
Stop the Silence
Stop the Violence**



FUNNY.

NOT FUNNY.

**DOUBLE STANDARDS HURT
EVERYONE.**

<https://nicewemen.wordpress.com/>

Each women as described below was someone's Pampered Princess ...

End violence against women



North Carolina Grandma Eats Her Daughter's New Born Baby After Smoking Bath Salts

Henderson, North Carolina—A North Carolina grandmother of 4 and recovering drug addict, is now in custody after she allegedly ate her daughter's newborn baby...

AZ-365 TOP



28-Year-Old Texas Teacher Accused of Sending Nude Picture to 14-Year-Old Former Student

BREITBART.COM

<http://latest.com/.../attractive-girl-gang-lured-men-alleywa.../>



Attractive Girl Gang Lured Men Into Alleyways Where Female Body Builder Would Attack Them

A Mexican street gang made up entirely of women has been accused of using their feminine wiles to lure men into alleyways and then beating them up and...

LATEST.COM

<http://www.wfmj.com/.../youngstown-woman-convicted-of-raping-.../>



Youngstown woman convicted of raping a 1 year old is back in jail

A Youngstown woman who went to prison for raping a 1-year-old boy fifteen years ago is in trouble with the law again.

WFMJ.COM

End violence against women [www.endvaw.org](#)



Women are raping boys and young men

Rape advocacy has been maligned and twisted into a political agenda controlled by radicalized activists. Tim Patten takes a razor keen and well supported look into the manufactured rape culture and...

AVoiceForMen.COM | BY TIM PATTEN

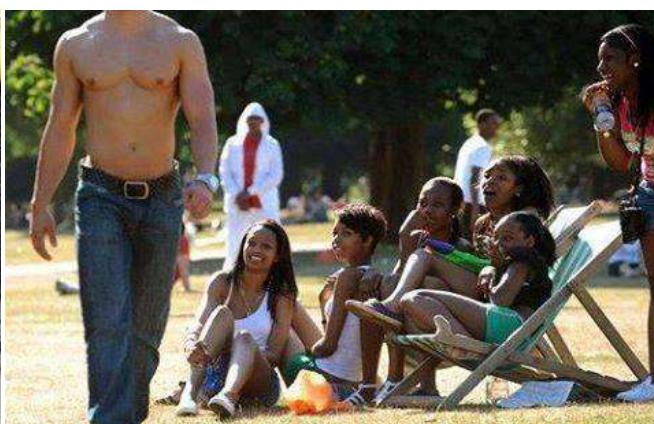


Bronx Woman Convicted of Poisoning and Drowning Her Children

Lisette Barnenga researched methods on the Internet before she killed her son and daughter in 2012.

NYTIMES.COM | BY MARC SANTORA

Monster women have very easy and cozy life. Easy to demand anything and get law in favor !



If the lawmakers submit to these strange demands of say ... “ Stare Rape ! ”; then we can easily see what kind of havoc that will create.

55%
of Biological Parents
Who Kill Their Children are
Mothers

Homicidal Encounters: A Study of Homicide in Australia 1989-1990, Australian Institute of Criminology (Brisbane), 2000, p. 142, Fig. 74.

Mankind

Woman charged with killing baby also had previous infant die

Woman charged with killing baby also had previous infant die

ABC7.COM | BY ROB MCMILLAN

JOSHUA TREE EYEWITNESS NEWS

abc7.com 4:35 77°

Female Sex Predators: A Crime Epidemic shared a link.
Yesterday at 12:40am ·

WTVA.com | Woman pleads guilty to having sex with a dog

PITTSBORO, Miss. (WTVA) -- A Calhoun County woman has pleaded guilty to charges she had unnatural intercourse with a dog. Sheriff Greg Poll

WTVA.COM

Like Comment Share

1 Like 2 Comments 31 others · Top Comments

Oklahoma Teacher Receives 15-Year Prison Sentence For Sex With 15-Year-Old Boy

A former Oklahoma middle school teacher has pleaded guilty to 6 counts of rape, child enticement...

THREEPERCENTNATION.COM

A Russian-born newlywed slowly butchered her German husband — feeding strips of his flesh to their dog until he took his last breath. Svetlana Batukova, 46, was...

See More



She killed her husband and then fed him to her dog: police

A Russian-born newlywed butchered her German hubby — and fed strips of his flesh to her pooch, authorities said. Svetlana Batukova ofed Horst Hans Henkels attheir...

NYPPOST.COM

April 4 at 4:48am



Female prison officers commit 90pc of sex assaults on male teens in US juvenile detention centres

Lawsuit in Idaho highlights the prevalence of sexual victimization of juvenile offenders.

IBTIMES.CO.UK | BY NICOLE ROJAS

Daily Mail
January 15, 2015

Mother charged with rape and sodomy of her son's 12-year-old friend



Mom, 30, 'raped and had oral sex with her son's 12-year-old friend'

Nicole Marie Smith, 30, (pictured) of St Charles County, Missouri, has been jailed after she allegedly targeted the 12-year-old boy at her home.

DAILYMAIL

This mother filmed herself raping her own son and then sold it to a man for \$300. The courts just decide her fate. When you see what she got, you're going to be outraged.



Mother Who Filmed Herself Raping Her 1-Year-Old Son Receives Shocking Sentence

"...then used the money to buy herself a laptop..."

AMERICANNEWS.COM

In several countries or rather in several regions of the world, family system has collapsed, due to bad nature and naughty acts of women. Particularly in Britain, and America, almost 50% people are alone, lonely, separated, divorced or failed marriages. In 2013, 48% children were born out of wedlock. **It was projected that by 2016, more than 51% children will be born, to unmarried mothers.** In these developed countries " paternity fraud " by women, are close to 20%. You can see several articles in the net, and in wikipedia etc. This means 1 out of 5 children are calling a wrong man as dad. The lonely, alone " mothers " are frustrated. They see the children as burden. Love in the Society in general is lost, long time ago. The types of " Mothers " and " Women " we have now

This is the type of women we have in this world. These kind of women were also someones daughter



Mother Stabs Her Baby 90 Times With Scissors After He Bit Her While Breastfeeding Him!

Eight-month-old Xiao Bao was discovered by his uncle in a pool of blood Needed 100 stitches after the incident; he is now recovering in hospital Reports say his...

MOMMABUZZ.COM



Not All Feminist Theory is Equal

Christina Hoff Sommers
Factual and Equity Feminist



"That is the corrosive paradox of gender feminism's misandrist stance: no group of women can wage war on men without at the same time denigrating the women who respect those men."

ManKind
Equality Network

WILLFUL BLINDNESS

Andrea Dworkin
Radical and Gender Feminist



"Under patriarchy, every woman's son is her potential betrayer and also the inevitable rapist or exploiter of another woman"

I am a feminist because it bothers me that a woman gets killed by her male partner every single week, and somehow that doesn't qualify as a tools-down national crisis even though if a man got killed by a shark every week we'd probably arrange to have the ocean drained.

Annabel Crabb

United Nations Office of Drugs and Alcohol, Global Study on Homicide (2013, p. 18)
https://en.wikipedia.org/wiki/Willful_ignorance

ManKind
Equality Network

Not All Feminist Theory is Equal

Christina Hoff Sommers
Equity Feminist



Want to close wage gap? Step one: Change your major from feminist dance therapy to electrical engineering.

ManKind
Equality Network



"To call a man an animal is to flatter him; he's a machine, a walking dildo"

a.b. Some Feminists

Muslim Woman Caught RAPING Her Own Son - Gives Disgusting Excuse to Judge | John Hawkins' Right Wing News

RIGHTWINGNEWS.COM

By now if you have assumed that Indian women are not doing any crime then please become friends with MRA Guri <https://www.facebook.com/profile.php?id=100004138754180>

He has dedicated his life to expose Indian Criminals



Delhi Woman Who Tried To Rape An Auto Driver, While Her Friend Filmed The Act, Has Been Arrested
Men are raped too!

MENSXP.COM | BY NIKITA MUKHERJEE



Muslim mother, 43, jailed for sex offences against girl, nine

Raheela Dar, 43, from Middlesbrough, has been jailed for seven years for carrying out a string of sex offences against a nine-year-old girl.

DAILYMAIL.CO.UK

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Mother who had been forced into an arranged marriage is jailed for filming herself having sex with her 14-year-old son and sending the clips to relatives in Pakistan

- Vile mother filmed having sex with her teenage son in sick porn video
- Clips sent to cousin in Pakistan who allegedly asked her to make film
- She also sent her relative indecent images of her three-year-old daughter

By ALEX MATTHEWS FOR MAILONLINE

PUBLISHED: 12:44 GMT, 1 August 2016 | UPDATED: 11:23 GMT, 2 August 2016



Wife Stabs Husband And Runs Away After He Stops Her From Gambling

The husband said his wife had become a habitual gambler who was also addicted to liquor.

INDIATIMES.COM



Teacher learns fate for 6 months of sex with boy

(CBS8) — SAN DIEGO (CNS) — A Crawford High School teacher and coach who carried on a six-month sexual relationship with a 15-year-old male student was sentenced Friday to a two-year prison term. Toni Nicole Sutton, 38, pleaded guilty...
WND.COM



Mom jailed for 40 years after body of daughter, 9, found in fridge

Amber Keyes, 37, was sentenced in the death of Ayahna Comb in Houston on Friday. Ayahna, who had cerebral palsy, had been in the fridge for six months...

DAILYMAIL.CO.UK

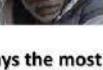
HURT FEMINISM BY DOING NOTHING

- ✗ DON'T HELP WOMEN
- ✗ DON'T FIX THINGS FOR WOMEN
- ✗ DON'T SUPPORT WOMEN'S ISSUES
- ✗ DON'T COME TO WOMEN'S DEFENSE¹
- ✗ DON'T SPEAK FOR WOMEN
- ✗ DON'T VALUE WOMEN'S FEELINGS
- ✗ DON'T PORTRAY WOMEN AS VICTIMS
- ✗ DON'T PROTECT WOMEN²

✓ WITHOUT WHITE KNIGHTS
FEMINISM WOULD END TODAY

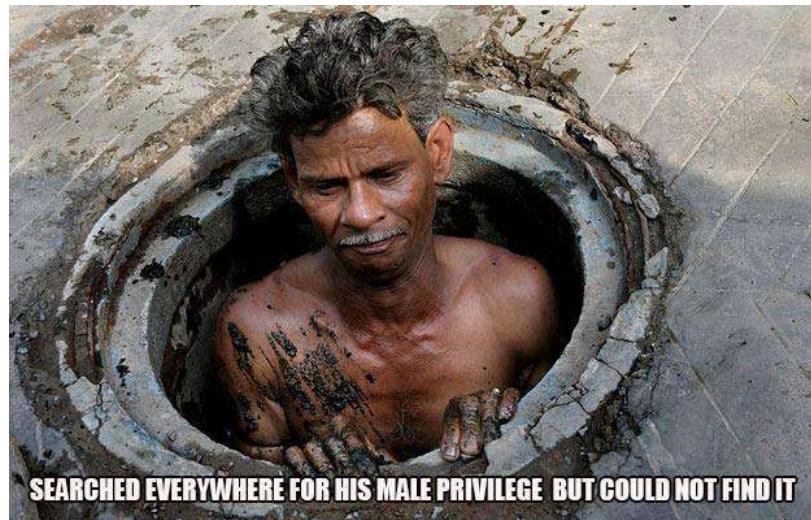
¹Don't even nawalt ("Not All Women Are Like That")
²For example from criticism or insults

How Society prioritize Men

High Priority ↑	Rich women		They can get away with murder.
Women		They get all the rights with no responsibility and Shelters for Homeless women.	
Rich Men		They get tax bail outs and short prison sentence.	
Girls		They get educational benefits but no violence against kids Act.	
Boys		They have some support but don't have any education that fits boys.	
Animals		They have animal rights and PETĀ.	
Prisoners		They get conjugal visits and 3 squares and a root.	
Men		Paid slaves.	
Poor Men		Nothing.	

Who pays the most Taxes?
This is why MGTOW exist.

MGTOW



Professor Subhashish Chattopadhyay



Read <http://www.warrenfarrell.org/TheBook/index.html>



HISTORY & HEADLINES

On February 11, 1968, Memphis Tennessee African-American garbage collection and sewer workers went on strike, prompted by the horrible death of two garbage men crushed in the back of a garbage truck.

Read http://www.pdfarchive.info/pdf/S/Sm/Smith_Helen_-_Men_on_strike.pdf



What would happen if no men showed up for work today?

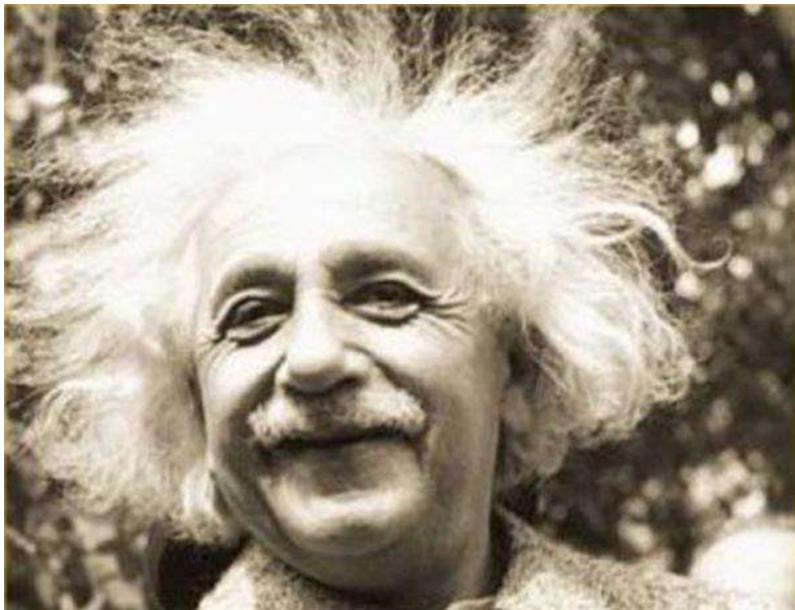
Yesterday's post got me thinking about what would happen if no men showed up to work today. For certain, the trains would stop running. But before we get into that....

JUDGYBITCH.COM | BY JANET BLOOMFIELD (AKA JUDGYBITCH)

Read

<http://judgybitch.com/2013/09/17/what-would-happen-if-no-men-showed-up-for-work-today/>

Preface for Science



Imagination is
more important than
knowledge.
Knowledge is limited.
Imagination encircles
the world.

-Albert Einstein

Many Scientists have made, very good TV programs; to teach Science. Carl Sagan, Desmond Morris, Jacques Cousteau, Neil deGrass Tyson, James Burke, Jacob Bronowski, Bill Nye, Andrew Pontzen, Sean Carroll, Michio Kaku, Brian Cox, Brian Greene, Freeman Dyson, Dr. Don Lincoln ... the list is long. BBC, Discovery Channel, Nova, Nature, Science Planet the list of good Channels is big.

Even though these programs are being delivered free, (add education programs of Govt. of India, which are also very good); not sure how many are correctly learning.

<https://www.youtube.com/watch?v=4sLGCEEa1UI&list=PLaMjJl9Tuw7HoCo8wzzNwMC7jj03nrEvx>

As I randomly talk to lots of students ... I find ...

The Science understanding of Urban, Rich children, in general; is abysmal.

The Science fiction movies, showing Aliens; or winning war with Aliens are more popular and influential. Doraemon making "time machine" so easily, and doing "time travel" so often intrigues children more. (for General Knowledge see <http://skmclasses.weebly.com>)

India is an uniquely peculiar country; has 1.3 Billion people, obsessed with thousands of stupid things. Superstitious Religious Rituals, Hundreds of festivals, 'What to do' and 'what not to do' [on a full moon day, on a No Moon day, on 11 th day of Lunar month], before and after an eclipse, what to eat and what not to eat, what to wear and what not to wear, Caste, Gotra, "methods and steps" for Puja or Prayer, **hundreds of ways to control or restrict or influence others** etc... ; keeps people busy.

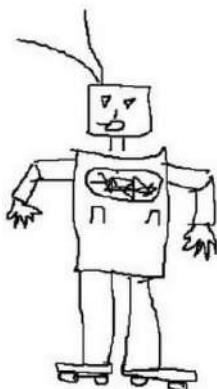
Students have major influence and learning's from these superstitious life style, and fiction / 'stupid movies' rather than from good Science TV shows.

[if you ask any Science Question to any student, first reaction is "Ye to course mein nahi hai"!]

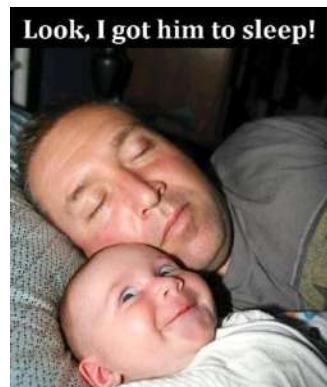
Another most important obsession of Indians is to become Engineers; well somehow 14 Lakh (1.4 million) students appear for IIT JEE exam. (Not about IITs or NITs etc) Almost all are stark idiots; study "Engineering" in some college or other the story goes on.

In general students / people in India do not know or understand the following ...

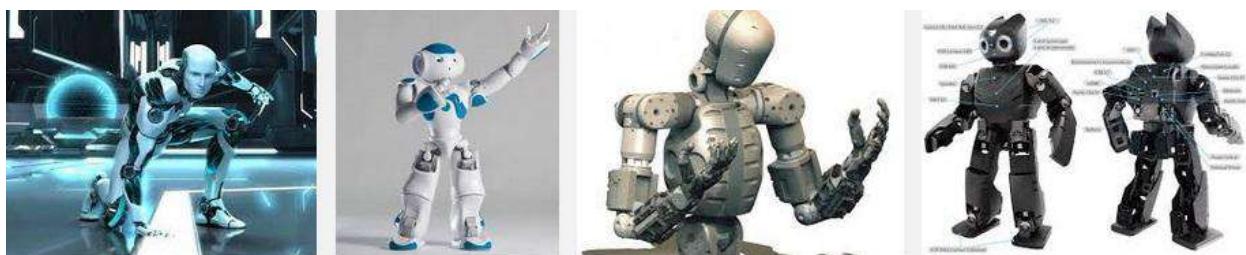
One of the most important drawbacks of Human beings is Anthropophilia. We love to imagine that ... God, Aliens, Robots etc, are similar to us. Tell a small child to draw a Robot, and almost 100% cases you see a Humanoid being drawn. It is not about the child being intelligent or smart. It is a fundamental 'mental block' that we harbor in general. [**when I was a kid, and if someone had told me to draw a Robot, I would have surely drawn a Humanoid**]



(if I tell you to draw a "Chemical Robot" then ?)



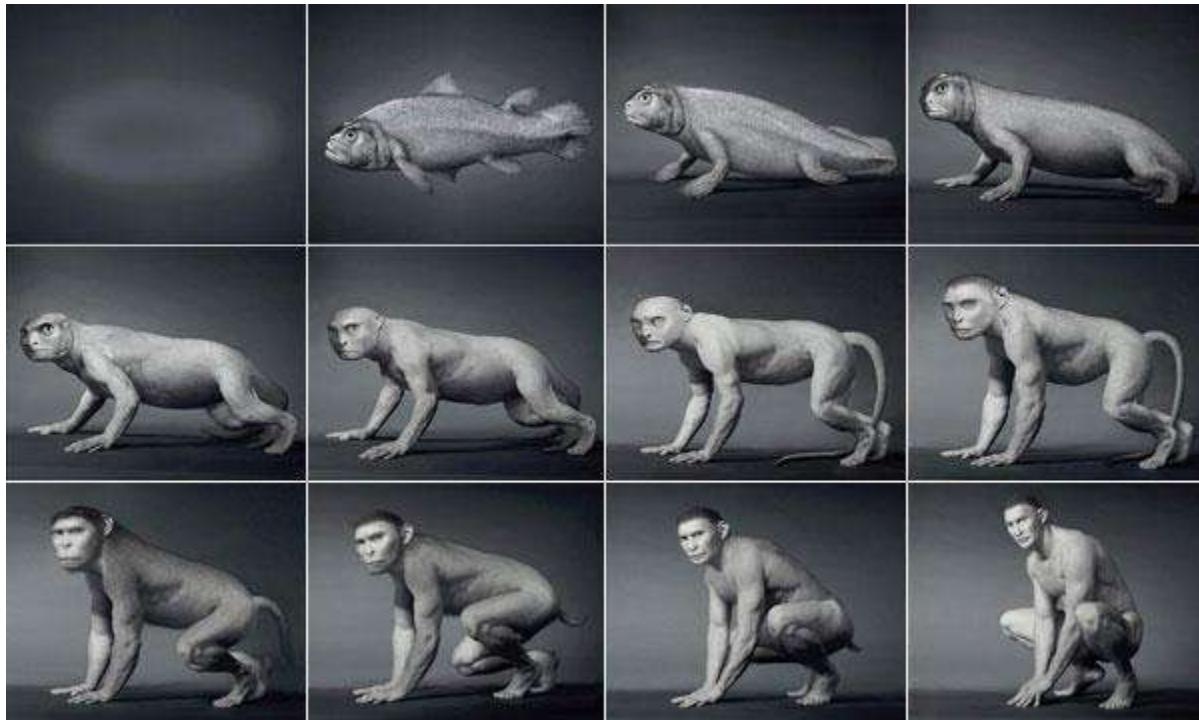
We feel comfortable with Humanoid Robots only



It takes lot of Training and maturity to understand that all machines are Robots. A car is a Robot. A crane is a Robot. Mars Rover is a Robot. Robots can be of any size and shape, serving a particular purpose.

Similarly Aliens do not have to look like us. We have five fingers in our hands, and five toes in our legs because Monkeys have the same. We all evolved step by step from some primitive fish, which had five bones / cartilages in its fins. The fish from which we all evolved had 2

pairs of fins. The pair of fins which was nearer to the head became hands, and the pair at the rear became legs.



Now imagine an Alien evolving from a fish, which had 3 pairs of fins ! or say 17 pairs ! then that may lead to

Some children will be quick to identify that Aliens may not evolve from fish, can be different pathways ... in that case they will look very different from us isn't it !

As I write all these in 2016, I say "Soon we will find various life-forms in Mars, Moons of Jupiter, Jupiter, and Asteroids !"

Back to Anthropophilia ... It is very difficult to get rid of this. Christiaan Huygens the great Dutch Scientist 'logically concluded' from observations as follows ...

Jupiter has Atmosphere, so it will rain in Jupiter, so Jupiter must have seas and Oceans, so the "life forms" in Jupiter must have boats, the boats need rope, and rope must be made from trees / fiber, so "they" should have hemp plants ...

Huygens was the first to make a submarine which could go down in water, by a few meters. In those days, around 1650 there was no plane, rocket or space travel. So do you see Huygens could not imagine Aliens in Jupiter flying in Planes or Rockets. While movies now show Aliens in Rockets!

[**Students must know about various limitations of Human beings.** Professor Daniel Kahneman (2002 Nobel Laureate) has long list of Human Limitations in his book.

see https://vk.com/doc23267904_175119602

I collected some limitations, and wrote an article. See <http://skmclasses.kinja.com/bias—we—all—are—biased—1761664826>

Scientists have advised a list of "must learn" for students, to appreciate / understand Science better.

See <http://edge.org/responses/what-scientific-concept-would-improve-everybodys-cognitive-toolkit> Read

It is mandatory for students; to know all the points given in the above links; whom I personally teach]

Chimps and Humans have 96 Percent common genes; Research and Gene Study Finds. **But Humans and Chimps can't communicate, or discuss.** Orangutans are our nearest relatives. We humans are 97% the same as orangutans, gene study shows. But we can't converse with any other species. A little bit of sign language of say 100 "words" or a Dog understanding "instructions" of his master is **not** what is being referred here. **Earth has several Million species, while observations as of now, does not show "communication" across two separate species.** Let us not bring in Symbiotic relationship into this. It is about intelligent communication, discussions, debate, learning from each other etc. Can Humans communicate with insects or birds chirping ?

Imagine a World where Lions were communicating with insects, or say Otters communicating with birds ! The ecosystem as we know, has all these staying together ... so close ! All like a family !!

<http://www.telegraph.co.uk/science/2016/09/11/dolphins-recorded-having-a-conversation-for-first-time/>

Simard discovered that [**different tree species are in contact with one another.**](#)

Some **birds** which fly very long distances; do that by sensing Magnetic fields. The eyes of the bird is sensing these feeble magnetic field of Earth by **Quantum entangled Particles**. As the light photons reach and "react" with various Chemicals, the entangled particles are released. These particles "enable" the birds brain to detect Magnetic fields. Does one bird communicate or Guide another with similar mechanisms ?

Trees, it turns out, have a completely different way of communicating: they use scent. It was found that acacias start pumping toxic substances into their leaves to rid themselves of the large herbivores, when being eaten. Beeches, spruce, and oaks all register pain as soon as some creature starts nibbling on them. When a caterpillar takes a hearty bite out of a leaf; the tissue around the site of the damage changes. In addition, the leaf tissue sends out electrical signals, just as human tissue does when it is hurt. However, the signal is not transmitted in milliseconds, as human signals are; instead, the plant signal travels at the slow speed of a third of an inch per minute. Accordingly, it takes an hour or so before defensive

compounds reach the leaves to spoil the pest's meal. Trees live their lives in the really slow lane, even when they are in danger. If the roots find themselves in trouble, this information is broadcast throughout the tree, which can trigger the leaves to release scent compounds. And not just any old scent compounds, but compounds that are specifically formulated for the task at hand. [Discussing more of this later in the book]

Now do we see the limitations about our obsession, with "communicating" with Aliens ?

The nearest stars are several light years away. Even if we improve the technology to travel 1000 times faster than the fastest rockets it will take thousands of years to travel to nearest "Earth like" planets. **I personally rule out any more discussions on travelling and meeting and communicating with Aliens.**

The life forms (which we will soon find) in Mars, Moons of Jupiter, Jupiter etc have to be analyzed for DNA. Will these life-forms have DNA ? Will these Aliens have molecules similar to what we see in organisms here in Earth ? These are important questions in Xenobiology, Astrobiology etc. We have to wait for data.

Science is study of data, experimental verification, logical conclusions.

We have made XNA. We have made various kinds of Artificial life, including Arsenic, Selenium based pathways. But extremeophiles also have the same kind of DNA or molecules that we see in all organisms. Same kinds of mRNA etc. Why didn't life grow and evolve multiple times ? We don't know as of now. Or did life evolve / grow multiple times in the same way ? Intelligent human beings will keep researching, and we will know the answers.

The only Sanskrit word in Standard 11–12 Science CBSE text books is Tincal (which is the word for Borax). The books (rightly) are full with German names. Students are unaware the Potassium was derived from an Arabic word Potash, ashes of (roots) of plant.

(not talking about last 50 or 100 years) **Not a single chemical element were purified / synthesized or discovered in India, by any Indian.** Indium (In = #49): Indicum (Latin) means indigo. The pigment indigo was named after indicon (Greek) in allusion for its coming from India. On August 18th, 1868 by French astronomer Jules Janssen. While in Guntur, India, Janssen observed a solar eclipse through a prism, whereupon he noticed a bright yellow spectral line (at 587.49 nanometers) emanating from the chromosphere of the Sun. This led to discovery of Helium. In 1937, Discovery of Astatine was reported by the chemist Rajendralal De. Working in Dacca in British India (now Dhaka in Bangladesh), he chose the name "**dakin**" for element 85, which he claimed to have isolated as the thorium series equivalent of radium F (polonium-210) in the radium series. The properties he reported for **dakin** do not correspond to those of astatine; moreover, astatine is not found in the thorium series, and the true identity of **dakin** is not known.

[not considering the ancient elements which were known to others also ... Supher, Zinc, Mercury and

<http://www.thehindu.com/sci-tech/science/indian-role-in-producing-superheavy-element-117/article5986191.ece>]

As a culture Indians preferred Ayurveda. Identify the trees, smash the leaves, take the bark and / or the roots, make a paste, in some cases add honey etc ... and this paste or potion cures everything. If we do not have a medicine for some disease, or if the medicine is not effective, then the argument is ... “we did not search the trees in the jungle enough !”. The belief being solution / medicine for every disease is out there in the jungle!

This culture is grossly opposite to get into the details, identify the molecules, find the reaction pathways. Modern techniques is not seen as good. In fact opposite ... **older things are considered better**. The claim often is “some grandfather’s grandfather was a great Ayurvedic Doctor, since several generations they are using some paste, and they now the best.

With this kind of a culture Indians cannot and did not find pharmacophores.

[see <http://www.eurekaselect.com/81348/article>

<http://www.ucdenver.edu/academics/colleges/medicalschool/departments/Pharmacology/Pages/history.aspx>

<http://adaptogens.org/adaptogen/history>]

An extremely superstitious culture, avoiding to get—into any details, easy way of “chalta hai” had its Dark effect. Indians are averages and poor, because hardly there was any value—add !

Most people in India; think in the following way ...



Let us see contribution of some Mathematicians and Scientists; who did great work but students generally don't know about them.

Eugene Wigner — After his sojourn in Berlin, Wigner returned to Budapest to work in his father's tannery. Somehow and somewhere from there, he returned to Berlin joining the

Kaiser Wilhelm Institute working first under Karl Weissenberg and later under Richard Becker. There he explored quantum mechanics of Erwin Schrödinger and group theory (founded by the genius Evariste Galois who was obsessed with polynomials equations and their solutions). At the age of 25, in 1927, in Germany somewhere he introduced the group theory into quantum mechanics. He published it formally in 1931 at the age of 29:

"Group Theory and Its Application to the Quantum Mechanics of Atomic Spectra."

He soon thereafter introduced symmetries (rotations, translations, and CPT – charge parity and time reversal symmetry) into quantum mechanics. He formulated and proved a theorem which became the cornerstone of the mathematical formulations of quantum mechanics. Eugene Wigner was so impressed with the usefulness of abstract mathematics in nuclear physics and quantum mechanics that he went on to write a landmark article in 1960 titled:

"The Unreasonable Effectiveness of Mathematics in the Natural Sciences".

In 1930, Princeton University recruited both Jeno Pal Wigner and Janos Von Neumann at 7 times the salary they were drawing in Europe. Both these geniuses anglicized their first names to "Eugene" and "John" respectively and soon thereafter became naturalized citizens of the United States.

—

Janos Bolyai (Transylvania, Hapsburg Empire) 1822 – one of the founders of non-Euclidean geometry – a geometry that differs from Euclidean geometry in its definition of parallel lines. The discovery of a consistent alternative geometry that might correspond to the structure of the universe helped to free mathematicians to study abstract concepts irrespective of any possible connection with the physical world.

Nikolai Ivanovich Lobachevsky (Kazan, Russia) 1823 – known primarily for his work on hyperbolic geometry, otherwise known as Lobachevskian geometry. William Kingdon Clifford called Lobachevsky the "Copernicus of Geometry" due to the revolutionary character of his work. He was dismissed from the university in 1846, ostensibly due to his deteriorating health: by the early 1850s, he was nearly blind and unable to walk. He died in poverty in 1856.

Nikolai was an atheist.

—

Bernhard Riemann (Breselenz, Jameln, Kingdom of Hanover) 1853: student of Gauss – Influential German mathematician who made lasting and revolutionary contributions to analysis, number theory, and differential geometry. In the field of real analysis, he is mostly known for the first rigorous formulation of the integral, the Riemann integral, and his work on Fourier series. His contributions to complex analysis include most notably the introduction of Riemann surfaces, breaking new ground in a natural, geometric treatment of complex analysis. His famous 1859 paper on the prime-counting function, containing the original

statement of the Riemann hypothesis, is regarded, although it is his only paper in the field, as one of the most influential papers in analytic number theory. Through his pioneering contributions to differential geometry, Riemann laid the foundations of the mathematics of general relativity.

Felix Klein (Düsseldorf, Prussia) 1870s – German mathematician and mathematics educator, known for his work in group theory, complex analysis, non–Euclidean geometry, and on the connections between geometry and group theory. His 1872 Erlangen Program, classifying geometries by their underlying symmetry groups, was a hugely influential synthesis of much of the mathematics of the day.

Marcel Grossman (Budapest) 1910s tutored Einstein on differential geometry and tensor calculus – mathematician and a friend and classmate of Albert Einstein. Grossmann was a member of an old Swiss family from Zurich. His father managed a textile factory. He became a Professor of Mathematics at the Federal Polytechnic Institute in Zurich, today the ETH Zurich, specializing in descriptive geometry.

Gregorio Ricci–Curbastro (Italy) 1880s – Italian mathematician born in Lugo di Romagna. He is most famous as the inventor of tensor calculus, but also published important works in other fields. With his former student Tullio Levi–Civita, he wrote his most famous single publication, a pioneering work on the calculus of tensors, signing it as Gregorio Ricci. This appears to be the only time that Ricci–Curbastro used the shortened form of his name in a publication, and continues to cause confusion. Ricci–Curbastro also published important works in other fields, including a book on higher algebra and infinitesimal analysis, and papers on the theory of real numbers, an area in which he extended the research begun by Richard Dedekind.

Ernst Mach (Moravia, Austrian Empire) 1900s who totally abhorred Newton's idea of absolute space and time – Austrian physicist and philosopher, noted for his contributions to physics such as study of shock waves. Quotient of one's speed to that of sound is named the Mach number in his honor. As a philosopher of science, he was a major influence on logical positivism, American pragmatism and through his criticism of Newton, a forerunner of Einstein's relativity.

Hendrik Lorentz (Netherlands) 1900s – Dutch physicist who shared the 1902 Nobel Prize in Physics with Pieter Zeeman for the discovery and theoretical explanation of the Zeeman effect. He also derived the transformation equations which formed the basis of the special

relativity theory of Albert Einstein. According to the biography published by the Nobel Foundation, "It may well be said that Lorentz was regarded by all theoretical physicists as the world's leading spirit, who completed what was left unfinished by his predecessors and prepared the ground for the fruitful reception of the new ideas based on the quantum theory." For this he received many honours and distinctions during his life, including—from 1925 to his death in 1928—the role of Chairman of the exclusive International Committee on Intellectual Cooperation.

Willem De Sitter (Netherlands) 1920s — Dutch mathematician, physicist, and astronomer. De Sitter made major contributions to the field of physical cosmology. He co-authored a paper with Albert Einstein in 1932 in which they discussed the implications of cosmological data for the curvature of the universe. He also came up with the concept of the de Sitter space and de Sitter universe, a solution for Einstein's general relativity in which there is no matter and a positive cosmological constant. This results in an exponentially expanding, empty universe. De Sitter was also famous for his research on the planet Jupiter.

Alexander Friedmann (St. Petersburg, Russian Empire) 1920s — was a Russian and Soviet physicist and mathematician. He is best known for his pioneering theory that the universe was expanding, governed by a set of equations he developed now known as the Friedmann equations.

Georges Lemaître (Belgium) 1920s — was a Belgian priest, astronomer and professor of physics at the Catholic University of Leuven. He proposed the theory of the expansion of the universe, widely misattributed to Edwin Hubble. He was the first to derive what is now known as Hubble's law and made the first estimation of what is now called the Hubble constant, which he published in 1927, two years before Hubble's article. Lemaître also proposed what became known as the Big Bang theory of the origin of the universe; which he called his "hypothesis of the primeval atom" or the "Cosmic Egg".

One of the greatest help we apes got; **was with the discovery or invention of mass spectrometry.**

The men who invented this device were (at least Two; as claimed by the Western English speaking world).

1. Englishman Francis William Aston in 1919
2. Canadian American Arthur Jeffrey Dempster in 1918.

Just imagine as Europe was involved in one of their bloodiest slaughter and carnage, these men were quietly working in their labs devising an instrument that could sort out atoms and ions based on their charge to mass ratio.

(I wish to emphasize yet again that even though atoms are a fact, we are using the term atomic theory till date.)

By 1919, Aston had achieved 2 feats:

1. He showed that atoms of a single element could have different isotopes thereby establishing as fact that even non radioactive elements have isotopes.
2. He had invented the first mass spectrometer.

The Canadian Dempster had greatly improved on it, greatly increasing its accuracy in identifying compounds by mass of elements in a sample. This was a gigantic step to our understanding of nature.

—

David Goldberg — David Edward Goldberg (born September 26, 1953) is an American computer scientist, civil engineer, and professor at the department of Industrial and Enterprise Systems Engineering (IESE) at the University of Illinois at Urbana–Champaign and is most noted for his work in the field of genetic algorithms. He is the director of the Illinois Genetic Algorithms Laboratory (IlliGAL) and the chief scientist of Nextumi Inc. He is the author of Genetic Algorithms in Search, Optimization and Machine Learning, one of the most cited books in computer science.

In computer science and operations research, a genetic algorithm (GA) is a metaheuristic inspired by the process of natural selection that belongs to the larger class of evolutionary algorithms (EA). Genetic algorithms are commonly used to generate high-quality solutions to optimization and search problems by relying on bio-inspired operators such as mutation, crossover and selection.

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Lotfi Zadeh — The term fuzzy logic was introduced with the 1965 proposal of fuzzy set theory by Lotfi Zadeh. Fuzzy logic had however been studied since the 1920s, as infinite-valued logic—notably by Łukasiewicz and Tarski. Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1, considered to be "fuzzy". By contrast, in Boolean logic, the truth values of variables may only be 0 or 1, often called "crisp" values. Fuzzy logic has been applied to many fields, from control theory to artificial intelligence.

—

Warren McCulloch and Walter Pitts – (1943) created a computational model for neural networks based on mathematics and algorithms called threshold logic. This model paved the way for neural network research to split into two distinct approaches. One approach focused on biological processes in the brain and the other focused on the application of neural networks to artificial intelligence.

In the late 1940s psychologist **Donald Hebb** created a hypothesis of learning based on the mechanism of neural plasticity that is now known as **Hebbian learning**. Hebbian learning is considered to be a 'typical' unsupervised learning rule and its later variants were early models for long term potentiation. Researchers started applying these ideas to computational models in 1948 with Turing's B-type machines.

Farley and Wesley A. Clark (1954) first used computational machines, then called "calculators," to simulate a Hebbian network at MIT. Other neural network computational machines were created by Rochester, Holland, Habit, and Duda (1956).

Frank Rosenblatt (1958) created the perceptron, an algorithm for pattern recognition based on a two-layer computer learning network using simple addition and subtraction. With mathematical notation, Rosenblatt also described circuitry not in the basic perceptron, such as the exclusive-or circuit, a circuit which could not be processed by neural networks until after the backpropagation algorithm was created by Paul Werbos (1975).

Neural network research stagnated after the publication of machine learning research by Marvin Minsky and **Seymour Papert** (1969), who discovered two key issues with the computational machines that processed neural networks. The first was that basic perceptrons were incapable of processing the exclusive-or circuit. The second significant issue was that computers didn't have enough processing power to effectively handle the long run time required by large neural networks. Neural network research slowed until computers achieved greater processing power.

Interval arithmetic, interval mathematics, interval analysis, or interval computation, is a method developed by mathematicians since the 1950s and 1960s, as an approach to putting bounds on rounding errors and measurement errors in mathematical computation and thus developing numerical methods that yield reliable results. Very simply put, it represents each value as a range of possibilities. For example, instead of estimating the height of someone using standard arithmetic as 2.0 meters, using interval arithmetic we might be certain that that person is somewhere between 1.97 and 2.03 meters. In mathematics, a (real) interval is a set of real numbers with the property that any number that lies between two numbers in the set is also included in the set. For example, the set of all numbers x satisfying $0 \leq x \leq 1$ is an interval which contains 0 and 1, as well as all numbers between them.

This concept is suitable for a variety of purposes. The most common use is to keep track of and handle rounding errors directly during the calculation and of uncertainties in the knowledge of the exact values of physical and technical parameters. The latter often arise

from measurement errors and tolerances for components or due to limits on computational accuracy. Interval arithmetic also helps find reliable and guaranteed solutions to equations and optimization problems.

Nassim Nicholas Taleb and Benoit Mandelbrot –

Nassim is a Lebanese–American essayist, scholar, statistician, former trader, and risk analyst, whose work focuses on problems of randomness, probability, and uncertainty. His 2007 book *The Black Swan* was described in a review by the *Sunday Times* as one of the twelve most influential books since World War II. He advocates what he calls a "black swan robust" society, meaning a society that can withstand difficult–to–predict events.

Benoit Mandelbrot was a Polish–born, French and American mathematician with broad interests in the practical sciences, especially regarding what he labeled as "the art of roughness" of physical phenomena and "the uncontrolled element in life." He referred to himself as a "fractalist". He is recognized for his contribution to the field of fractal geometry, which included coining the word "fractal", as well as developing a theory of "roughness and self–similarity" in nature. He spent most of his career in both the United States and France, having dual French and American citizenship. In 1958, he began a 35–year career at IBM, where he became an IBM Fellow, and periodically took leaves of absence to teach at Harvard University. Because of his access to IBM's computers, Mandelbrot was one of the first to use computer graphics to create and display fractal geometric images, leading to his discovering the Mandelbrot set in 1979. He showed how visual complexity can be created from simple rules. He said that things typically considered to be "rough", a "mess" or "chaotic", like clouds or shorelines, actually had a "degree of order." His math and geometry–centered research career included contributions to such fields as statistical physics, meteorology, hydrology, geomorphology, anatomy, taxonomy, neurology, linguistics, information technology, computer graphics, economics, geology, medicine, cosmology, engineering, chaos theory, econophysics, metallurgy, taxonomy and the social sciences.

[Nassim, Benoit Mandelbrot and many others showed that application of Fractals / Mandrelbot is better to predict several practical outcomes, in contrast to Gaussian distribution analysis.](#)

Charles Darwin told his friend that, he guesses; Life may have started in a shallow hot pond. Darwin was many hundred years ahead of his times.

The Murchison meteorite that fell near Murchison, Victoria, Australia in 1969 was found to contain over 90 different amino acids, nineteen of which are found in Earth life. Comets and other icy outer–solar–system bodies are thought to contain large amounts of complex carbon compounds (such as tholins) formed by these processes, darkening surfaces of these bodies.

The early Earth was bombarded heavily by comets, possibly providing a large supply of complex organic molecules along with the water and other volatiles they contributed.

The University of Waterloo and University of Colorado conducted simulations in 2005 that indicated that the early atmosphere of Earth could have contained up to 40 percent hydrogen—implying a much more hospitable environment for the formation of prebiotic organic molecules. The escape of hydrogen from Earth's atmosphere into space may have occurred at only one percent of the rate previously believed based on revised estimates of the upper atmosphere's temperature.

Researchers at the Rensselaer Polytechnic Institute in New York reported the possibility of oxygen available around 4.3 billion years ago. Their study reported in 2011 on the assessment of Hadean zircons from the earth's interior (magma) indicated the presence of oxygen traces similar to modern-day lavas.

700 Million years after Earth's origin, (around 3.8 Billion years ago), the Rocks have signatures of Microbe Life. Just 540 million year ago diversity of life happened (Cambrian Explosion). So for almost 3 Billion years Earth had only Microbes. The day was around 22 hours then, as Earth was rotating quicker.

Studies have been made of the amino acid composition of the products of "old" areas in "old" genes, defined as those that are found to be common to organisms from several widely separated species, assumed to share only the last universal ancestor (LUA) of all extant species. These studies found that the products of these areas are enriched in those amino acids that are also most readily produced in the Miller-Urey experiment. This suggests that the original genetic code was based on a smaller number of amino acids - only those available in prebiotic nature - than the current one.

Cyanobacteria are able to survive extreme conditions. They live in Antarctica as well as in mountain springs. One species was isolated even from polar bear hairs.

Cyanobacteria get their name from the bluish pigment phycocyanin, which they use to capture light for photosynthesis as they also contain chlorophyll. Their name comes from the Greek word for blue, cyanos. Cyanobacteria have been living on the Earth for more than 3 billion years. They alter genetically and develop various evolutionary lines. They have survived here for a uniquely long time. These are microscopic, they are rich in chemical diversity. the chloroplast in plants is a symbiotic cyanobacterium, taken up by a green algal ancestor of the plants sometime in the Precambrian. These bacteria are often found growing on greenhouse glass, or around sinks and drains. The Red Sea gets its name from occasional blooms of a reddish species of Oscillatoria, and African flamingos get their pink color from eating Spirulina.

The scientific community has gained a clearer understanding of the evolution of cyanobacteria of the Synechococcus group. It is one of the largest groups of cyanobacteria, widespread from the poles to the equator, in the sea as well as on land. Petr Dvorák, a phycologist from the Faculty of Science, has compared their genes and constructed, with the

help of molecular biology, the first complex phylogenetic tree of this group, an interpretation of its evolution.

It shows that; the beginning of life, coincides with a hypothetical event that occurred 4 billion to 3.85 billion years ago, known as the Late Heavy Bombardment, in which asteroids pummeled Earth and the solar system's other inner planets. These impacts may have provided the energy to jumpstart the chemistry of life.

Studies suggest that asteroid impacts may break down formamide – a molecule thought to be present in early Earth's atmosphere – into genetic building blocks of DNA and its cousin RNA, called nucleobases.

Chemist Svatopluk Civiš, of the Academy of Sciences of the Czech Republic, and his colleagues used a high-powered laser to break down ionized formamide gas, or plasma, to mimic an asteroid strike on early Earth. The reaction produced scalding temperatures of up to 4,230 degrees Celsius, sending out a shock wave and spewing intense ultraviolet and X-ray radiation. The chemical fireworks produced four of the nucleobases that collectively make up DNA and RNA: adenine, guanine, cytosine and uracil.

The Amino acids joinup to make various Proteins. These lead to microbes. Stromatolites produced Oxygen, and increased the Oxygen content in the atmosphere over Billion years. The Oxygen also made Iron oxide out of Iron dissolved in Water, which deposited as layers of Iron ore.

See about Trilobites at
<https://research.amnh.org/paleontology/trilobite-website/twenty-trilobite-fast-facts>

http://www.fossilmuseum.net/Tree_of_Life/Stromatolites.htm

<http://jrscience.wcp.muohio.edu/fieldcourses01/PapersMarineEcologyArticles/Stromatolites-TheLongestL.html>

Dvorák and his colleagues utilised also a genome sequence of a new genus of cyanobacteria found in a peatbog in Slovakia. It was named Neosynechococcus. Algology (from algae) is a branch of biology studying algae and cyanobacteria. It deals with the systematisation, phylogenesis, and ecology of these organisms. It also includes physiology, biochemistry, and genetics.

See <https://www.youtube.com/watch?v=SOGwoFkPtT8>

The Miller-Urey experiment was a chemical experiment that simulated the conditions thought at the time to be present on the early Earth, and tested the chemical origin of life under those conditions. Earth favoured chemical reactions that synthesized more complex organic compounds from simpler inorganic precursors. Considered to be the classic experiment investigating abiogenesis, it was conducted in 1952 by Stanley Miller, with assistance from Harold Urey, at the University of Chicago and later the University of California, San Diego. Scientists examining sealed vials preserved from the original experiments (of Stanley Miller)

were able to show that there were actually well over 20 different amino acids produced in Miller's original experiments.

See <https://www.youtube.com/watch?v=57merteLsBc>

In 1961, Joan Oró found that the nucleotide base adenine could be made from hydrogen cyanide (HCN) and ammonia in a water solution. His experiment produced a large amount of adenine, the molecules of which were formed from 5 molecules of HCN. Also, many amino acids are formed from HCN and ammonia under these conditions. Experiments conducted later showed that the other RNA and DNA nucleobases could be obtained through simulated prebiotic chemistry with a reducing atmosphere.

See <https://www.youtube.com/watch?v=xvhZcEY5PCQ>

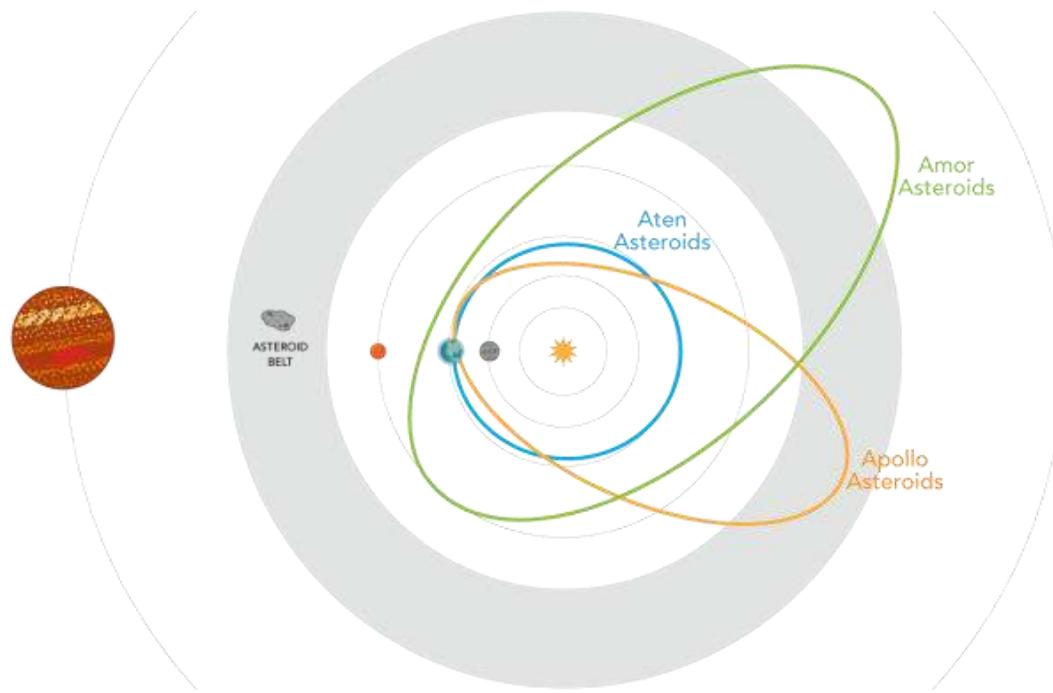
Next Study Evolution

– http://evolution.berkeley.edu/evolibrary/article/side_0_0/origsoflife_05

<https://www.youtube.com/watch?v=QqG01ihQjoo>

—

There are many near Earth Asteroids; that are being constantly monitored, since 1990s. This is to avoid any major impact that may wipeout life from Earth. International cooperation exists, to plan for destroying the Asteroid which is directed towards Earth. Near-Earth asteroids are in a different class than main belt asteroids, as they are much closer energetically to Earth.

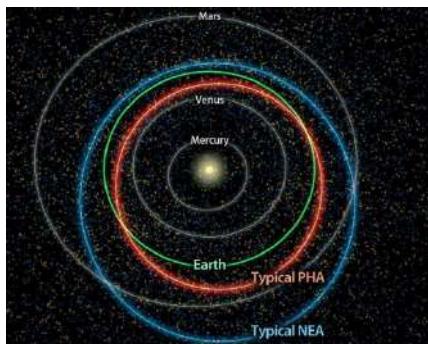


There are three main orbits of near-Earth asteroids: Amor, Aten, and Apollo.

Most intersect with the Earth's orbit at some point during their trip around the sun, making this the prime time to analyze them with a telescope, or even rendezvous with them on a prospecting mission with our Arkyd spacecraft.

See

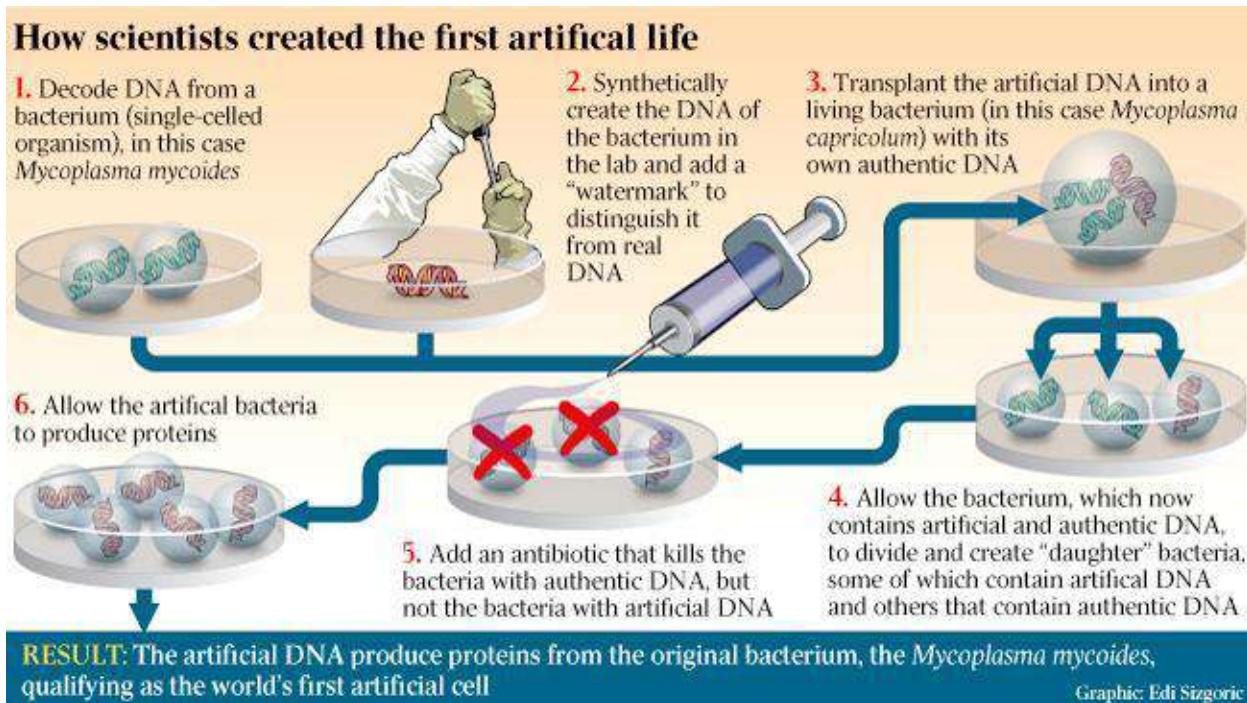
<http://www.planetaryresources.com/2015/10/studying-close-approaches-of-near-earth-asteroids/>



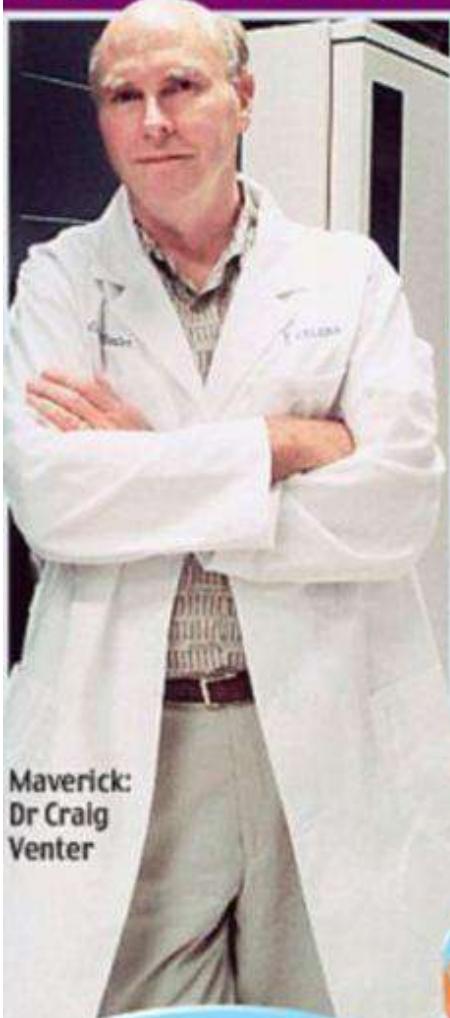
47,000 of the probable Asteroids have been listed.

<http://www.dailymail.co.uk/sciencetech/article-2145699/New-Nasa-sky-scan-reveals-47-000-hazardous-near-Earth-asteroids-330ft-wide--BIGGER.html>

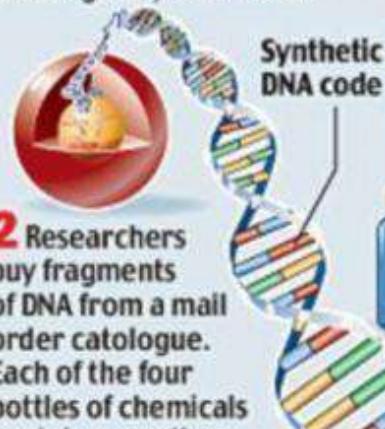
Craig Venter and his team of Nobel Laureates, and other very smart Scientists, have been working on Artificial or Synthetic life for long.



HOW TO MAKE ARTIFICIAL LIFE

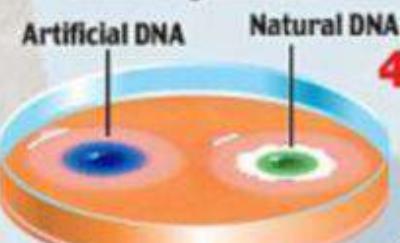


1 Entire DNA of Mycoplasma mycoides, a bug that usually infects goats, is decoded.



2 Researchers buy fragments of DNA from a mail order catalogue. Each of the four bottles of chemicals contains a section of the code.

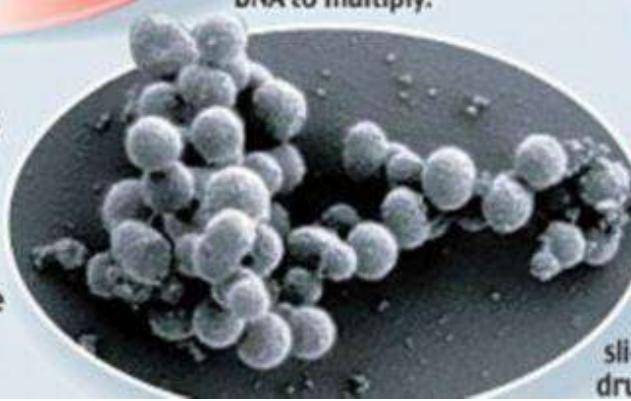
3 The fragments are put into yeast, which 'stitches' them together, gradually building a synthetic copy of the original DNA.



4 The artificial DNA is put into a recipient bacterium, which then grows and divides, creating two daughter cells, one with the artificial DNA and one with the natural DNA.



5 Antibiotics in the petri dish kill the bacterium with the natural DNA, leaving the one with the synthetic DNA to multiply.



6 Within just a few hours, all traces of the recipient bug are wiped out and bugs with artificial DNA thrive. New life has been created.

Graphic by John Lawson

7 Possible uses are bugs capable of producing clean fuels and sucking carbon dioxide out of the atmosphere. Also microbes capable of mopping up oil slicks (above) or generating drugs, including the flu vaccine.

See <https://www.youtube.com/watch?v=ayfF1v7rifw>

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Gordon Allport and S. Odber – The OCEAN model of "Big Five personality traits", rather modern Psychology was started by these two Men. The Big Five personality traits, also known as the five factor model (FFM), is a model based on common language descriptors of personality (lexical hypothesis). These descriptors are grouped together using a statistical technique called factor analysis (i.e. this model is not based on experiments). This widely examined theory suggests five broad dimensions used by some psychologists to describe the human personality and psyche. The five factors have been defined as openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism, often listed under the acronyms OCEAN or CANOE. Beneath each proposed global factor, a number of correlated and more specific primary factors are claimed. For example, extraversion is said to include such related qualities as gregariousness, assertiveness, excitement seeking, warmth, activity, and positive emotions.

In 1884, Sir Francis Galton was the first person who is known to have investigated the hypothesis that it is possible to derive a comprehensive taxonomy of human personality traits by sampling language: the lexical hypothesis. In 1936, Gordon Allport and S. Odber put Sir Francis Galton's hypothesis into practice by extracting 4,504 adjectives which they believed were descriptive of observable and relatively permanent traits from the dictionaries at that time. In 1940, Raymond Cattell retained the adjectives, and eliminated synonyms to reduce the total to 171. He constructed a self-report instrument for the clusters of personality traits he found from the adjectives, which he called the Sixteen Personality Factor Questionnaire. Based on a subset of only 20 of the 36 dimensions that Cattell had originally discovered, Ernest Tupes and Raymond Christal claimed to have found just five broad factors which they labeled: "urgency", "agreeableness", "dependability", "emotional stability", and "culture". Warren Norman subsequently relabeled "dependability" as "conscientiousness".

After "God, Puja & Prayer", being the 1st ; the 2nd worst illusion, that hampers Science; is "Gut feeling". The Havoc or mayhem of "Gut feeling" is very prominently seen regarding Psychology, or People skills (of most people). Close to 99% people conduct interviews and take 'people decisions', without caring anything about Psychology.

Long back I wrote "*Millions of Interviews are being conducted every day, where the interviewer knows nothing about Psychology, while believes that her gut feeling is guiding for correct decisions*". [the reader will have to agree with this, if he heard about OCEAN model for the first time, here]

<https://zookeepersblog.wordpress.com/interview-techniques-and-the-things-you-cannot-find/>

<https://zookeepersblog.wordpress.com/are-people-very-logical-and-rational-then-why-should-we-be-polite-with-all/>

<https://zookeepersblog.wordpress.com/correlated-adjectives-this-personality-trait-predicts-your-tendency-to-lie-and-cheat/>

Psychology stands on the conclusions drawn after experiments. Some most important experiments being Milgram Experiment, Stanford Prison experiment, Hawthorne experiment, Bad Samaritan experiment, Attractiveness experiments, Evolutionary Psychology experiment, Decoy experiments, Equity theory of Motivation experiments, etc ...

The experiments that I used to talk about while teaching Senior Corporate Managers are listed at

<https://zookeepersblog.wordpress.com/psychology-experiments-and-summary-of-the-subject/>

Is Economics a Branch of Science ?

Not discussing about Economists here, as my personal opinion about, "works and contribution of Economists" is very poor. All of them argue and fancy in disagreeing with each and every thing told by someone. Economics has no consensus, no agreed rules, driven more by politics, and / or dynamic situations. No prediction by any Economist comes Correct or True; consistently. Media interviews thousands of these "strange foolish guys", and tries to "understand" an average. Randomly someone's prediction matches the actual outcome, and Predictions of 999 of the other **morons** deviate. These guys are always busy, analyzing and confirming that in past what had happened was "**inevitable**", while in the same breath, they accept that "no clue about the future". **None** had predicted the "**inevitable**" though. The stupidest of all the doomsters is Thomas Malthus. He has a "world record" of its kind, as ALL his predictions came wrong.

[The second record holder will be of course Sigmund Freud. All explanations given by Freud are wrong, and crap. Modern Psychologists, call Freud worst than a quack. See how Professor Bloom, from Yale laugh at Freud, (and I agree with Prof. Bloom), in the class...
<https://www.youtube.com/watch?v=P3FKHH2Rzjl&list=PL6A08EB4EEFF3E91F>

even Aristotle did better than these stupids. See something what Aristotle said is true, given below in this book]

Personally I have read several books in Economics, and several thousand (may be more than 10,000) scholarly articles. All will call me a fool, for every prediction; I make on Economy, or anything in Economics. As usual no one will agree with me, I know. I never try to talk about Economics, as you all saw, here, just now! I agreed with Millions of others, '**to Not to**' believe in anything an Economist says or predicts.

A very small "summary" of what these 'idiots' have done is at

<https://zookeepersblog.wordpress.com/a-butcher-makes-kima-of-economics/>

[My friends occasionally say ... “**even Russia has Russian economists**” ...]

Nassim Taleb has called for cancellation of the Nobel Prize in Economics, saying that the damage from economic theories can be devastating. (and I agree with him).

<http://www.zerohedge.com/news/2016-11-06/economics-broken-and-there-no-internal-incentive-fix-it-5-reasons-smash-ivory-towers>

In contrast to economics, Finance Law/Rules and Marketing Tricks/Techniques are supreme. Very correctly Millions call these subjects as "Financial Science" and "Marketing Science".

The learning's here are generally not attributed to a particular person. There are many Key concepts, which are correct; and accurate! These enable people to take right decisions, to make money, be profitable, to generate employment, to avoid and reduce loss, to sale, and keep businesses going.

For whatever we do, we have to deal with people, and earn money or make profit. So the basic understanding of Psychology, the Laws of Finance, and the 'Tricks and trades' of Marketing (Science) are must for all. Human beings in general, harbor many limitations; which Economists disregard. One of the first assumptions of Economics, "The Rational Human beings" is wrong.

See the list of Biases at <http://skmclasses.kinja.com/bias—we—all—are—biased—1761664826>

Some of the key concepts of Finance are NPV (Net Present Value), ROI (Return on Investment), Risk/Return Tradeoff, Diversification, ROCE (Return on Capital Employed), Discounted Cash flow, Time value of Money, Liquidity, Budgeting etc. The list is big. It takes many months of correct studies, to understand and master these. Those who apply these rules and learning's well; are paid well. People in general do not disagree to fight with what Finance Gurus says.

It is extremely important for every student to know that everyone is not working or running after profit, or ROI. The world is full with Philanthropic acts. There are Billions of Altruists. Too much of priority towards money, makes people cold, cruel, isolated, un-helping, and in-human ...

See <https://zookeepersblog.wordpress.com/do—you—know—who—was—dashrath—manjhi/>

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Marketing Science is **Art**. Successful Marketing gurus are paid very well. I have not seen insults and fights, towards Marketing Gurus. **People just do not hate them like Economists**. There are some key concepts.

See <https://zookeepersblog.wordpress.com/25—points—on—brand—and—marketing/>

Personally I will always remain a toddler, regarding Tricks and details of Marketing.

When I was in Standard 9, my Aunt (Cousin sister of my Mom), started a very small chemical business. She was staying in a different city, and I “managed” the business affairs, in Jamshedpur. I had to meet lot of people at various offices, advertise, give sale pitches, sale, follow-up with people, get payments, and generate profit etc.

This gave me very interesting exposure to human behavior, organizations, processes, human nature and follies, greed etc. Much later I managed my own IIT JEE coaching / Business.

With this background, I am adding “**a Pinch of Salt**” in the **Ocean of Management**.

[meaning, I do not think, my words are going to teach or contribute anything]



Regarding advertisement, I have observed that people are in silos, or islands. Mostly unaware what is going on in other islands. People expect advertisement in their own silo, or island. So advertisement is required to be done in multiple mediums / channels. If I advertise in newspaper, ([say about Govt. of India, official Olympiads](#)), some people will say ... “school did not tell anything”. If I advertise in Google adwords, guys in Facebook will not know. Any amount of “Radio Messages” done, will not stop people saying ... “the CSR (corporate Social responsibility) department did not send any mailer ! ...



It is extremely costly to advertise in every island. Small businesses just cannot afford such expenditures. So advertisement always remains insufficient, as per my perception. Effectiveness of the advertisements, and success is always unknown. As per my perception, the young MBA's handling the budget randomly try various things, playing randomly with “others money”. Randomly there is some result/response, that is termed / “show cased” as

success. Gurus handling crores of advertisement budget will have their own “correct” experience. 99.99% people / small businesses are not relevant in that.

[Google adwords in my experience or observation; is very costly, and not at all effective.
Adwords is absolute waste of money. Facebook in contrast maintains lots of connections,
the visitors repeat of their own, so much more persistent.]

As per my perception; Advertisement is not a communication, at all. It is an enabler, so that if someone searches, then can find the links / details quickly. Only those who search, if they get some details, of something; earlier than another; the former has higher chance being considered.

[Did you notice that top 50 or 100 Management Gurus, and / or “Best selling Management Books“ are not Indian]

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Science is closely related to Technology. I personally cannot distinguish.

3D Printing was started by Chuck Hull



As of 2016 (apart from Lakhs of Industrial Applications) Body-parts are being 3D printed

See <https://www.youtube.com/watch?v=a1lkv3yHs0w>

And https://www.youtube.com/watch?v=_R05DSIB1GE

Xenotransplantation

<https://www.youtube.com/watch?v=6rKUBBjaa0g>

<https://www.youtube.com/watch?v=qFQo28AahAE>

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Artificial Blood

Since 1990s various kinds of Artificial Blood has been made. I read many reports! Research to improve is always on.

<https://www.youtube.com/watch?v=9I7oUuZBG4c>

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Artificial Photosynthesis or Chlorophyll

<https://www.youtube.com/watch?v=hU-T0ht2OdQ>

<https://www.youtube.com/watch?v=N8LHqoNber4>

—

Nanotechnology

<https://www.youtube.com/watch?v=xlYlex2TF5g>

<https://www.youtube.com/watch?v=7hRjhxi2uL0>

—

Metamaterials

<https://www.youtube.com/watch?v=taSfueSfmag>

https://www.youtube.com/watch?v=26J5n_8_6TQ

—

Molecular Motors

<https://www.youtube.com/watch?v=WH5rwsu5tzl>

—

Quantum Computer

<https://www.youtube.com/watch?v=0dXNmbiGPS4>

<https://www.youtube.com/watch?v=u9zx7QOKPno>

For list of emerging Technologies see

https://en.wikipedia.org/wiki/List_of_emerging_technologies

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Bio–batteries: creating energy from bacteria (or Microbial Fuel Cell)

Research reported by Dr Tom Clarke's team at the University of East Anglia's Department of Biological Sciences has shown how thousands of tiny molecular wires embedded in the surface of a bacterium called *Shewanella oneidensis* can directly transmit an electric current to inorganic minerals such as iron and manganese oxides, or the surface of electrodes. The phenomenon, known as direct extracellular electron transfer (DEET), occurs because of the way that some bacteria living in environments lacking oxygen export electrons that are generated through their respiratory cycle. Examples include *Shewanella*, and some species of another bacterium known as *Geobacter*.

See <http://eandt.theiet.org/magazine/2013/07/growing-power.cfm>

Regarding

Indian

Scientists

<https://journosdiary.com/2016/09/10/iisc-india-bacteria-power-tiny-engine/>

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Communication in trees

Trees, it turns out, have a completely different way of communicating: they use scent. Four decades ago, scientists noticed something on the African savannah. The giraffes there were feeding on umbrella thorn acacias, and the trees didn't like this one bit. It took the acacias mere minutes to start pumping toxic substances into their leaves to rid themselves of the large herbivores. The giraffes got the message and moved on to other trees in the vicinity. But did they move on to trees close by? No, for the time being, they walked right by a few trees and resumed their meal only when they had moved about 100 yards away.

The acacia trees that were being eaten gave off a warning gas (specifically, ethylene) that signaled to neighbouring trees of the same species that a crisis was at hand. Right away, all the forewarned trees also pumped toxins into their leaves to prepare themselves. The giraffes were wise to this game and therefore moved farther away to a part of the savannah where they could find trees that were oblivious to what was going on. Or else they moved upwind. For the scent messages were carried to nearby trees on the breeze, and if the animals walked upwind, they could find acacias close by that had no idea the giraffes were there.

This ability to produce different compounds is another feature that helps trees fend off attack for a while. When it comes to some species of insects, trees can accurately identify which bad guys they are up against. The saliva of each species is different, and the tree can match the saliva to the insect. Indeed, the match can be so precise that the tree can release pheromones that summon specific beneficial predators. The beneficial predators help the

tree by eagerly devouring the insects that are bothering them. For example, elms and pines call on small parasitic wasps that lay their eggs inside leaf–eating caterpillars. As the wasp larvae develop, they devour the larger caterpillars bit by bit from the inside out. Not a nice way to die. The result, however, is that the trees are saved from bothersome pests and can keep growing with no further damage. The fact that trees can recognize saliva is, incidentally, evidence for yet another skill they must have. For if they can identify saliva, they must also have a sense of taste.

A drawback of scent compounds is that they disperse quickly in the air. Often they can only be detected within a range of about 100 yards. Quick dispersal, however, also has advantages. As the transmission of signals inside the tree is very slow, a tree can cover long distances much more quickly through the air if it wants to warn distant parts of its own structure that danger lurks. A specialized distress call is not always necessary when a tree needs to mount a defence against insects. The animal world simply registers the tree's basic **chemical alarm call**. It then knows some kind of attack is taking place and predatory species should mobilize. Whoever is hungry for the kinds of critters that attack trees just can't stay away.

Trees can also mount their own defence. **Oaks, for example, carry bitter, toxic tannins in their bark and leaves.** These either kill chewing insects outright or at least affect the leaves' taste to such an extent that instead of being deliciously crunchy, they become biliously bitter. Willows produce the defensive compound salicylic acid, which works in much the same way. But not on us. Salicylic acid is a precursor of aspirin, and tea made from willow bark can relieve headaches and bring down fevers. Such defence mechanisms, of course, take time. Therefore, a combined approach is crucially important for arboreal early-warning systems.

Trees also warn each other using chemical signals sent through the fungal networks around their root tips. which operate no matter what the weather. Surprisingly, news bulletins are sent via the roots not only by means of chemical compounds but also by means of electrical impulses that travel at the speed of a third of an inch per second. In comparison with our bodies, it is, admittedly, extremely slow. However, there are species in the animal kingdom, such as jellyfish and worms, whose nervous systems conduct impulses at a similar speed. Once the latest news has been broadcast, all oaks in the area promptly pump tannins through their veins.

Tree roots extend a long way, more than twice the spread of the crown. So the root systems of neighbouring trees inevitably intersect and grow into one another—though there are always some exceptions. Even in a forest, there are loners, would-be hermits who want little to do with others. Can such antisocial trees block alarm calls simply by not participating? Luckily, they can't. For usually **there are fungi present that act as intermediaries to guarantee quick dissemination of news.** These fungi operate like fibre-optic Internet cables. Their thin filaments penetrate the ground, weaving through it in almost unbelievable density. One teaspoon of forest soil contains many miles of these 'hyphae'. Over centuries, a single fungus can cover many square miles and network an entire forest. The fungal connections transmit signals from one tree to the next, helping the trees exchange news about insects, drought,

and other dangers. Science has adopted a term first coined by the journal Nature for **Simard**'s discovery of the 'wood wide web' pervading our forests. What and how much information is exchanged are subjects we have only just begun to research. For instance, **Suzanne Simard** discovered that [different tree species are in contact with one another](#), even when they regard each other as competitors. And the fungi are pursuing their own agendas and appear to be very much in favour of conciliation and equitable distribution of information and resources.

If trees are weakened, it could be that they lose their conversational skills along with their ability to defend themselves. Otherwise, it's difficult to explain why insect pests specifically seek out trees whose health is already compromised. It's conceivable that to do this, insects listen to trees' urgent chemical warnings, and then test trees that don't pass the message on by taking a bite out of their leaves or bark. A tree's silence could be because of a serious illness or, perhaps, the loss of its fungal network, which would leave the tree completely cut off from the latest news. The tree no longer registers approaching disaster, and the doors are open for the caterpillar and beetle buffet. The loners I just mentioned are similarly susceptible—they might look healthy, but they have no idea what is going on around them.

In the symbiotic community of the forest, not only trees but also shrubs and grasses—and possibly all plant species—exchange information this way. However, when we step into farm fields, the vegetation becomes very quiet. Thanks to selective breeding, our cultivated plants have, for the most part, lost their ability to communicate above or below ground—you could say they are deaf and dumb—and therefore they are easy prey for insect pests. That is one reason why modern agriculture uses so many pesticides. Perhaps farmers can learn from the forests and breed a little more wildness back into their grain and potatoes so that they'll be more talkative in the future...

To decide if trees are silent ... researchers substitute grain seedlings because they are easier to handle. They started listening, and it didn't take them long to discover that their measuring apparatus was registering roots crackling quietly at a frequency of 220 hertz. Crackling roots? That doesn't necessarily mean anything. After all, even dead wood crackles when it's burned in a stove. But the noises discovered in the laboratory caused the researchers to sit up and pay attention. For the roots of seedlings not directly involved in the experiment reacted. Whenever the seedlings' roots were exposed to a crackling at 220 hertz, they oriented their tips in that direction. That means the grasses were registering this frequency, so it makes sense to say they 'heard' it.

[It is well known that Music Played near trees help them grow faster. There are many commercial products claiming quicker growth in farms.](#)

After reading all these some may imagine that this is what is happening in jungles

How trees are made



The list can go on forever. Students can read and learn more of their own...

Even though Indian Rocket could send 20 Satellites to space in one go, Indian prefer to do the following ...



[In February 2017 India launched 104 satellites]

Every Puja is remnant of “Caste System”. Think ... Who are performing the Pujas ? What is the Qualification of the Pujari ? What is his effectiveness ? How are the Pujaris chosen ?

Russian Dnepr rocket had sent 37 satellites to Space, without Pujas !

I have met lot of people who think, that “Global Warming” is happening due to Cars, or because of burning Plastics ...

In our atmosphere close to 1% is Argon, while only 0.04% in CO₂

Half of the world's oxygen is produced via phytoplankton photosynthesis. The other half is produced via photosynthesis on land by trees, shrubs, grasses, and other plants.

See http://news.nationalgeographic.com/news/2004/06/0607_040607_phytoplankton.html

See

<http://skmclasses.kinja.com/global-warming-is-not-due-to-human-activity-1761784651>

My students and the readers of this book must know that; over the past 250 years, humans have added just one part of CO₂ in 10,000 to the atmosphere. One volcanic cough can do this in a day. <https://www.skepticalscience.com/print.php?r=50>

<http://time.com/3698572/science-maya-tolstoy-geophysical-research-letters-volcanoes-climate-change/>

Temperature—Sea Levels—CO₂—etc always have been fluctuating over ages — Global Warming

See

<https://archive.org/details/TemperatureSeaLevelsCO2EtcAlwaysHaveBeenFluctuatingOverAgesGlobalWarming>

Know about the Giants of Science from Videos

<https://archive.org/details/CasimirPolderDaviesUnruhBELLAspectGalileoMosleyChadwickFeynmanSchrodinger>

<https://www.youtube.com/watch?v=ecQazN9Z24w>

Long back a Professor had advised me, to read all issues of Scientific American; say from 1920s, or as old as possible; to learn Physics. I did listen to him and read all old copies, that were available in the Library. Now in the net it is much easier for Students, to get the copies.

See <https://archive.org/search.php?query=Scientific%20American>

In 1999 there was a Special Issue on Men

See

<https://archive.org/stream/ScientificAmericanspEd-Vol10No2-Men-1999#page/n1/mode/2up>



Preface for Chemistry

Heat or Thermodynamics 1) So many exams including IIT JEE had questions on Polytropic processes. Apart from Professor N. N. Ghosh's books, hardly this is covered in Physics Books

I am surprised and **amused** to see so many coaching Institutes making errors in Polytropic Process Problems. In most cases the teachers are avoiding it, and in rare cases when it is being covered there are errors.

Let us do it here.

We assume ideal gas for Thermodynamics process problems. So $PV = nRT$ is taken as true regardless the process gas is taken through. So Isothermal (meaning constant Temperature), Isobaric (meaning const Pressure), Isochoric (meaning constant Volume) or even $PV^z = \text{Const}$ (P into V to the power z is constant) where z is a constant of the polytropic process, the expression $PV=nRT$ is taken as true. We do substitute that to exchange the variables in many problems.

Work done by system on boundary is:

$$W = \int_{V_1}^{V_2} p \, dV$$



This form is used for expansion and contraction of gases

Ideal Gases

Ideal (Perfect) Gas Law

$$pV = nRT$$

$$R = 8.314 \frac{\text{kJ}}{\text{kmol} \cdot \text{K}}$$

If the gas expands (often due to supply of heat) the work done by the gas is taken as positive.

Work done expression in Isothermal (or isotropic as some people say it) is given by

Isotropic (Constant Temp) Process or Isothermal process

- For a constant temperature process in a closed system (i.e. mass is constant) $-pV = mRT = C$. Where C is a constant. Note C can be written as p_1V_1 or as p_2V_2 .

$$\bullet \quad W = \int_{V_1}^{V_2} \frac{C}{V} dV = C \ln\left(\frac{V_2}{V_1}\right) = p_1V_1 \ln\left(\frac{V_2}{V_1}\right) = nRT \ln\left(\frac{V_f}{V_i}\right) = nRT \ln\left(\frac{P_i}{P_f}\right)$$

$$\text{Speed of Sound } v_s = \sqrt{\frac{\gamma RT}{M}} \quad \text{where as } v_{rms} = \sqrt{\frac{3RT}{M}} \quad \text{so } \frac{v_s}{v_{rms}} = \sqrt{\frac{\gamma}{3}}$$

Polytropic process - $pV^n = C$ where C is a constant.

These occur in ideal gases for various processes and the value of n changes depending on the type of process (e.g. $n = 1$ is an isothermal process).

Note that $p_1V_1^n = C \rightarrow p_1V_1 = \frac{C}{V_1^n} = CV_1^{1-n}$. This also holds for p_2V_2 .

$$W = \int_{V_1}^{V_2} \frac{C}{V^n} dV = \frac{C}{1-n} (V_2^{1-n} - V_1^{1-n}) = \frac{p_2V_2 - p_1V_1}{1-n}$$

In case of adiabatic process (where no heat exchange takes place), n is γ (gamma), so in the above expression replace n as γ

$$pV^\gamma = p_1V_1^\gamma = p_2V_2^\gamma = k$$

$$\text{Thus, } p = \frac{k}{V^\gamma}$$

The work done by the gas in the process is

$$W = \int_{V_1}^{V_2} pdV = \int_{V_1}^{V_2} \frac{k}{V^\gamma} dV = \frac{1}{1-\gamma} \left[\frac{k}{V_2^{\gamma-1}} - \frac{k}{V_1^{\gamma-1}} \right]$$

From equation (i),

$$\frac{k}{V_2^\gamma} = p_2 \text{ and } \frac{k}{V_1^\gamma} = p_1$$

$$\text{Thus, } W = -\frac{1}{\gamma-1} (p_2V_2 - p_1V_1) = \frac{p_1V_1 - p_2V_2}{\gamma-1}$$

There are other expressions which are handy (given for 1 mole of gas), for Heat supplied in Polytropic Process

$$\Delta H = C_P^0(T_2 - T_1) = \frac{\gamma R}{\gamma-1}(T_2 - T_1) = \frac{\gamma}{\gamma-1}(P_2V_2 - P_1V_1) = \frac{\gamma P_1V_1}{\gamma-1} \left[\left(\frac{P_2}{P_1} \right)^{1-\frac{1}{n}} - 1 \right]$$

$$\text{Heat Supplied in a process at constant Pressure is } \Delta H = C_P^0(T_2 - T_1)$$

Process	Work Done: (W)	Heat Exchanged (ΔQ)
Isothermal process	$W = 2303 nRT \log_{10} \frac{V_2}{V_1}$	$\Delta Q = 2.30 nRT \log \frac{V_2}{V_1}$
Adiabatic process	$W = \frac{p_1 V_1 - p_2 V_2}{\gamma - 1}$ $= \frac{nR(T_2 - T_1)}{\gamma - 1}$	$\Delta Q = 0$
Isochoric process	$W = 0$	$\Delta Q = nC_V \Delta T$ (use definition of C_V)
Isobaric process	$W = p\Delta V = p(V_2 - V_1)$ $W = nR(T_2 - T_1)$	$\Delta Q = nC_p \Delta T$ (use definition of C_p)

VdP expression in polytropic process

For a polytropic process $P_1 V_1^n = P V^n$

$$V = \left(\frac{P_1 V_1^n}{P} \right)^{\frac{1}{n}} = \left(\frac{P_1}{P} \right)^{\frac{1}{n}} V_1$$

$$\int V dP = P_1^{\frac{1}{n}} V_1 \int \frac{1}{P^{\frac{1}{n}}} dP$$

$$\int V dP = \frac{P_1^{\frac{1}{n}} V_1}{1 - \frac{1}{n}} \left(P_2^{1 - \frac{1}{n}} - P_1^{1 - \frac{1}{n}} \right)$$

$$\int V dP = \frac{n V_1}{n - 1} \left(P_1^{\frac{1}{n}} P_2^{1 - \frac{1}{n}} - P_1 \right)$$

$$P_2 \int_{P_1} V dP = \frac{n P_1 V_1}{n - 1} \left[\left(\frac{P_2}{P_1} \right)^{1 - \frac{1}{n}} - 1 \right]$$

$$- \int_{P_1}^P V dP = \frac{n P_1 V_1}{n - 1} \left[1 - \left(\frac{P_2}{P_1} \right)^{1 - \frac{1}{n}} \right]$$

Specific heat in case of Polytropic process and Cv in terms of gamma

$$\text{Specific Heat } C = \frac{R}{\gamma - 1} - \frac{R}{k - 1} \quad \text{Specific Heat } C_v = \frac{R}{\gamma - 1}$$

Example

One mole of Argon is heated using $PV^{3/2} = \text{const}$. Find the amount of heat obtained by the process when the temperature changes by $\Delta T = -26 \text{ K}$.

Solution :

Let p be the number of moles here $p = 1$

$$\text{then } C = \frac{R}{\gamma - 1} - \frac{R}{\eta - 1} = \frac{R}{\frac{5}{3} - 1} - \frac{R}{\frac{3}{2} - 1}$$

$$\Delta Q = pC\Delta T = 1 \left(\frac{3}{2}R - 2R \right) (-26)$$

$$= +26 \left(\frac{8.314}{2} \right) = 108 \text{ J}$$

You can also write $+ R / (1-k)$ in Specific heat expression so see an example

An ideal gas expands according to the law $PV^{3/2} = \text{const}$. We conclude ...

- (a) The adiabatic exponent of the gas $k = 1.5$
- (b) The molar heat capacity $C = C_v - 2R$
- (c) Temperature increases during the process
- (d) Such a process is not feasible

Answer :

(b) Molar heat capacity

$$C = C_v + \frac{R}{1-K} = C_v + \frac{R}{1 - \frac{3}{2}} = C_v - 2R$$

Question : Two moles of hydrogen are mixed with n moles of helium. The root mean square speed of gas molecules in the mixture is $\sqrt{2}$ times the speed of sound in the mixture. Then n is ?
NSEP 2017

- (a) 3 (b) 2 (c) 1.5 (d) 2.5

Solution :

We know $\gamma_{\text{Hydrogen}} = 1.4$ or $7/5$ while $\gamma_{\text{Helium}} = 1.667$ or $5/3$ Let us first find the equivalent γ of the gas mixture.

$$\text{We use } \frac{n_1 + n_2}{\gamma_{\text{equivalent}} - 1} = \frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1}$$

$$\text{So } \frac{2+n}{\gamma_{\text{equivalent}} - 1} = \frac{2}{(7/5) - 1} + \frac{n}{(5/3) - 1} = 5 + 3n/2 = (3n+10)/2$$

$$\text{So } \gamma - 1 = \frac{2(n+2)}{3n+10} \quad \text{or } \gamma = \frac{5n+14}{3n+10} \quad \text{while we know } \frac{v_s}{v_{\text{rms}}} = \sqrt{\frac{\gamma}{3}} \quad \text{and } v_{\text{rms}} \text{ is } \sqrt{2} v_s \text{ (given)}$$

$$\text{So } \sqrt{2} = \sqrt{\frac{3}{\gamma}} \quad \text{or } 2\gamma = 3 \quad \text{or } \gamma = 3/2 \quad \text{Thus } \frac{5n+14}{3n+10} = \frac{3}{2} \quad \text{this gives } n = 2$$

—

IIT JEE 1995 Polytropic Thermodynamics Process Problem

3 moles of a gas mixture having volume V and temperature T is compressed to $1/5$ th of the initial volume. Find the change in its adiabatic compressibility if the gas obeys $PV^{19/13} = \text{constant}$ [$R = 8.3 \text{ J/mol} - \text{K}$]
IIT JEE 1995

$$\text{Bulk modulus } B = \gamma P$$

$$\text{Compressibility } C = \left(\frac{1}{B} \right) = \frac{1}{\gamma P}$$

$$\text{and } \Delta C = C - C$$

$$\text{or } \Delta C = \frac{1}{\gamma} \left[\frac{1}{P'} - \frac{1}{P} \right]$$

$$PV^{\gamma} = P' \left(\frac{V}{5} \right)^{\gamma}$$

With $\gamma = \frac{19}{13}$ and $P' = 5P, n = 11$

$$\Delta C = \frac{1}{\gamma P} \left[\frac{1}{5^\gamma} - \frac{1}{1} \right] = \frac{13 \times 0.905}{19P}$$

But $PV = nRT$ or $P = \frac{nRT}{V}$

$$\Delta C = \frac{13(0.905)V}{19 \times 3 \times 8.317T} = \frac{-0.0248V}{T}$$

An ideal gas with adiabatic exponent γ , is expanded according to the law $P = \alpha V$ where α is a constant. The initial volume of the gas is V_0 . As a result volume increases η times. Find the increment in internal energy and work done.

Solution :

Let k be number of moles

$$P' = aV \text{ or } PV^{-1} = a$$

The process is polytropic with index $n = -1$

$$\therefore V_{\text{initial}} = V_0, V_{\text{final}} = \eta V_0$$

$$\text{and } P_{\text{initial}} = aV_0; P_{\text{final}} = a\eta V_0$$

$$\Delta U = \frac{kR}{\gamma-1} (T_{\text{final}} - T_{\text{initial}}), P_{\text{final}} V_{\text{final}} - P_{\text{initial}} V_{\text{initial}}$$

Work done,

$$W = \frac{P_{\text{initial}} V_{\text{initial}} - P_{\text{final}} V_{\text{final}}}{n-1} = \frac{\alpha V_0^2 [\eta^2 - 1]}{2}$$

In a polytropic process an ideal gas ($\gamma = 1.40$) was compressed from volume $V_1 = 10$ litres to $V_2 = 5$ litres. The pressure increased from $p_1 = 10^5$ Pa to $p_2 = 5 \times 10^5$ Pa. Determine: (a) the polytropic exponent n , (b) the molar heat capacity of the gas for the process.

Solution.

In a polytropic process $pV^n = k$ (a constant)

$$\therefore p_1 V_1^n = p_2 V_2^n \quad \text{or} \quad \left(\frac{V_1}{V_2}\right)^n = \frac{p_2}{p_1}$$

$$\text{or} \quad n = \frac{\ln p_2/p_1}{\ln V_1/V_2}$$

$$\text{Here} \quad n = \frac{\ln 5}{\ln 2} = \frac{1.6094}{0.6931} = 2.32$$

In a polytropic process

$$C = \frac{R}{\gamma-1} - \frac{R}{n-1} = \frac{R}{1.4-1} - \frac{R}{2.32-1} = 1.74 R$$

An ideal gas expands according to the law $pV^2 = \text{constant}$ (a) Is it heated or cooled ? (b) What is the molar heat capacity in the process ?

Solution :

This is a polytropic process of exponent $n = 2$. To find whether it is heated or cooled we have to examine whether ΔQ is +ve or -ve or whether T increases or decreases.

We have $pV^2 = \text{constant}$ But $pV = RT$ (always)

$$\therefore \frac{pV^2}{pV} = \frac{\text{constant}}{RT} \quad \text{or} \quad V \propto \frac{1}{T}$$

Thus when volume increases T decreases. Here the gas is cooled.

$$(b) \quad C = \frac{R}{\gamma - 1} - \frac{R}{n - 1} = C_V - R$$

Heat or Thermodynamics 2) Formula for equivalent gamma in mixture of gases. n1 moles of gas with γ_1 and n2 mole of gas with γ_2 are mixed, then what is equivalent gamma ?

Why $C_v = R / (\gamma - 1)$

Specific heat of a polytropic process. Derivation of work done in polytropic process.

$$\frac{n_1 + n_2}{\gamma_{\text{equivalent}} - 1} = \frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1}$$

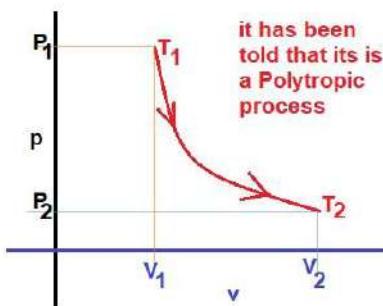
Equivalent γ of n_1 moles of γ_1 mixed with n_2 moles of γ_2

$$\text{We know } C_v = \frac{R}{\gamma - 1} \text{ as we have } C_p = C_v + R \text{ and } \gamma = \frac{C_p}{C_v} = 1 + \frac{R}{C_v}$$

Consider a polytropic process $PV^z = \text{Constant}$.

$$\text{Specific heat of Polytropic Process } C_{\text{poly}} = \frac{R}{\gamma - 1} + \frac{R}{1-z} \text{ or } \frac{R}{\gamma - 1} - \frac{R}{z - 1}$$

Derivation of work done in Polytropic Process ($PV^z = \text{Constant}$)



$$\text{we have } \Delta Q = n C_{\text{poly}} \Delta T$$

$$= n \left(\frac{R}{\gamma - 1} + \frac{R}{1-z} \right) \Delta T \text{ or } n \left(C_v + \frac{R}{1-z} \right) \Delta T = n C_v \Delta T + \frac{nR\Delta T}{1-z}$$

$= \Delta U$ (change in internal Energy) + ΔW (Work done)

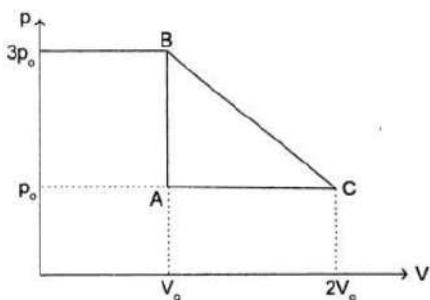
So Work done is $\Delta W = \frac{nR\Delta T}{1-z}$ where z is the exponent of the polytropic process

—

Heat or Thermodynamics 3) Work done calculations in various situations

One mole of an ideal gas is taken round the cyclic process ABCA as shown in the figure. Calculate:

- (i) The work done by the gas.
- (ii) The heat rejected by the gas in the path CA and the absorbed by the gas in the path BC.
- (iii) The net heat absorbed by the gas in the path BC.
- (iv) The maximum temperature attained by the gas during the cycle.



Solution

- (i) Work done by the gas during a cyclic process is equal to the area enclosed by its P-V diagram. In the present case,

$$W = \text{area of } \Delta ABC$$

$$\begin{aligned} &= \frac{1}{2}(AC)(AB) \\ &= \frac{1}{2}(2V_0 - V_0)(3p_0 - p_0) \\ &= p_0 V_0 \end{aligned}$$

- (ii) The path CA is an isobaric compression of one mole of an ideal gas from volume $2V_0$ to V_0 . The heat released in this path is

$$Q_1 = n C_p \Delta T$$

$$\begin{aligned} &= \left(\frac{3}{2} R \right) \left(\frac{p_0 \Delta V}{R} \right) \\ &= \left(\frac{5}{2} p_0 \right) (V_0 - 2V_0) = -\frac{5}{2} p_0 V_0 \end{aligned}$$

The path AB is an isochoric expression of one mole of an ideal gas from pressure p_0 to $3p_0$. The heat released in this process is

$$\begin{aligned} Q_2 &= n C_v \Delta T \\ &= \left(\frac{5}{2} R \right) \left(\frac{V_0 \Delta p}{R} \right) \\ &= \left(\frac{3}{2} V_0 \right) (3p_0 - p_0) = 3p_0 V_0 \end{aligned}$$

- (iii) In a cyclic process, the change in internal energy is zero. Hence

$$Q_{CA} + Q_{AB} + Q_{BC} = W$$

$$-\frac{5}{2}p_0V_0 + 3p_0V_0 + Q_{BC} = p_0V_0$$

This gives $Q_{BC} = \frac{1}{2}p_0V_0$

- (iv) The path BC is a straight line path. It is represented by the expression

$$p - p_0 = \left(\frac{3p_0 - p_0}{V_0 - 2V_0} \right) (V - 2V_0)$$

$$= \left(\frac{-2p_0}{V_0} \right) (V - 2V_0)$$

$$\text{or } p = \frac{-2p_0}{V_0}V + 5p_0$$

Replacing $p = \frac{RT}{V}$, we get

$$T = -2 \frac{p_0}{V_0 R} V^2 + \frac{5V_0}{R} V$$

To determine T_{\max} , we set $\frac{\partial T}{\partial V} = 0$

$$\text{i.e., } 0 = -\frac{2p_0}{V_0 R}(2V) + \frac{5p_0}{R}$$

which gives $V = \frac{5}{4}V_0$.

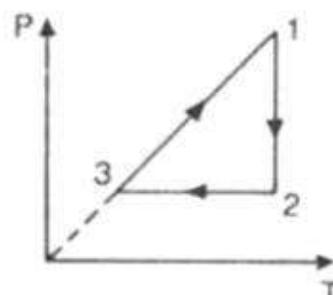
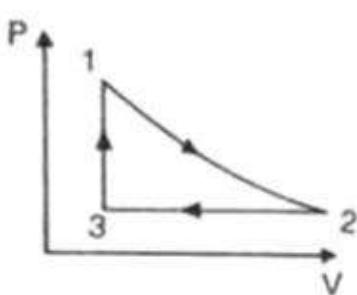
With this T_{\max} is given by

$$\begin{aligned}T_{\max} &= -\frac{2p_0}{V_0 R} \left(\frac{5}{4} V_0 \right)^2 + \left(\frac{5p_0}{R} \right) \left(\frac{5}{4} V_0 \right) \\&= \frac{p_0 V_0}{R} \left[-\frac{25}{8} + \frac{25}{4} \right] \\&= \frac{25}{8} \frac{p_0 V_0}{R}.\end{aligned}$$

Three moles of an ideal gas ($C_p = (7/2) R$) at pressure p_A and temperature T_A is isothermally expanded to twice its initial volume. It is then compressed at constant pressure to its original volume. Finally the gas is compressed at constant volume to its original pressure p_A . (i) Sketch p-V and p-T diagrams for the complete process. (b) Calculate the net work done by the gas and net heat supplied to the gas during the complete process. [IIT JEE 1991]

Solution :

(a)



(b) In the process $1 \rightarrow 2$ the state changes from (p_A, V, T_A) to $(p_2, 2V, T_A)$.

$$\text{Hence } p_2 = \frac{p_A}{2}$$

$$\text{Here } \Delta U = 0 \quad \Delta W = \int_V^{2V} pdV = 3RT_A \ln 2, \quad \Delta Q = \Delta U + \Delta W = \Delta W$$

In the process $2 \rightarrow 3$ the state changes from $\left(\frac{p_A}{2}, 2V, T_A\right)$ to

$$(p_A/2, V, T_3) \text{ so that } \frac{p_A}{2} \times \frac{2V}{T_A} = \frac{p_0/2 \times V}{T_3} \text{ or } T_3 = T_A/2$$

$$\gamma = \frac{C_p}{C_v} = \frac{C_p}{C_p - R} = \frac{\frac{7}{2}R}{\frac{7}{2}R - R} = \frac{7}{5}$$

$$\therefore \Delta U = -\frac{3RT_A}{\left(\frac{7}{5} - 1\right) \times 2} = -\frac{15RT_A}{4}$$

$$\Delta W = \int_{2V}^V p dV = \frac{p_A}{2} (V - 2V) = -\frac{p_A V}{2} = -\frac{3RT_A}{2}$$

$$\therefore \Delta Q = \Delta U + \Delta W = -\frac{15}{4} RT_A - \frac{3}{2} RT_A = -\frac{21RT_A}{4}$$

In the process $3 \rightarrow 1$, the state changes from $\left(\frac{p_A}{2}, V, \frac{T_A}{2}\right)$ to (p_A, V, T) that

$$\frac{p_A/2 \times V}{T_A/2} = \frac{p_A V}{T} \text{ or } T = T_A$$

$$\Delta U = 3C_V \left(T_A - \frac{T_A}{2}\right) = \frac{3R}{\frac{7}{5}-1} \times \frac{T_A}{2} = \frac{15}{4} RT_A$$

$$\Delta W = 0$$

$$\therefore \Delta Q = \Delta U = \frac{15}{4} RT_A$$

$$\therefore \text{Net } \Delta W = 3RT_A \ln 2 - \frac{3}{2} RT_A + 0 = 3RT_A \left(\ln 2 - \frac{1}{2}\right)$$

$$\text{Net } \Delta Q = 3RT_A \ln 2 - \frac{21RT_A}{4} + \frac{15RT_A}{4} = 3RT_A \left(\ln 2 - \frac{1}{2}\right)$$

A certain volume of a gas (diatomic) expands isothermally at 20°C until its volume is doubled and then adiabatically until its volume is again doubled. Find the final temperature of the gas, given $\gamma = 1.4$ and that there 0.1 mole of the gas. Also calculate the work done in the two cases. $R = 8.3 \text{ J mole}^{-1} \text{ K}^{-1}$

Solution :

We require T-V relation to calculate the final temperature.

We have $TV^{\gamma-1} = \text{constant} \therefore (273 + 20) \cdot V^{\gamma-1} = (273 + t)(2V)^{\gamma-1}$

$$\text{or } 273 + t = \frac{293}{2^{1.4-1}} = \frac{293}{2^{0.4}}$$

$$\begin{aligned} \log(273 + t) &= \log 293 - 0.4 \log 2 = \log 293 - 0.4 \times 0.3010 \\ &= 2.4669 - 0.1204 \end{aligned}$$

or $\log(273 + t) = 2.3465$

or $273 + t = \text{antilog } 2.3465$

or $273 + t = 222.1$

$\therefore t = -50.9^\circ\text{C}$

(i) Work done in isothermal process

$$\begin{aligned} &= nRT \log_e \frac{V_2}{V_1} = \frac{8.3}{10} \times 293 \log_e \frac{2V}{V} \quad \left(\because n = \frac{1}{10} \right) \\ &= 0.83 \times 293 \times 2.3 \log_{10} 2 \quad (\because \log_e x = 2.3 \log_{10} x) \\ &= 0.83 \times 293 \times 2.3 \times 0.3010 = 1.684 \times 10^2 \text{ J} \end{aligned}$$

(ii) Work done in adiabatic process

$$\begin{aligned} &= \frac{nR(T - T')}{\gamma - 1} = \frac{0.83(293 - 222.1)}{1.4 - 1} \\ &= \frac{0.83 \times 70.9}{0.4} = 1.47 \times 10^2 \text{ J} \end{aligned}$$

The volume of one mole of an ideal gas with the adiabatic exponent γ is changed according to the relation $V = a/T$, where a is a constant. Find the amount of heat absorbed by the gas in the process if the temperature is increased by ΔT .

Solution :

We have $\Delta W = \int pdV$ and $\Delta U = \int C_V dT$, for an ideal gas $pV = RT$,

$$\therefore \Delta W = \int_T^{T+\Delta T} \frac{RT}{V} dV = \int_T^{T+\Delta T} \frac{RT^2}{a} \left(-\frac{a}{T^2} dT \right) = -R\Delta T$$

$$\Delta U = \int_T^{T+\Delta T} \frac{R}{\gamma-1} dT = \frac{R\Delta T}{\gamma-1}$$

$$\therefore \Delta Q = \Delta U + \Delta W = \frac{R\Delta T}{\gamma-1} + (-R\Delta T) = \frac{(2-\gamma)R\Delta T}{\gamma-1}$$

Two moles an ideal mono-atomic gas initially at pressure p_1 and volume V_1 undergo an adiabatic compression until its volume is V_2 . Then, the gas is given heat Q at constant volume V_2 .

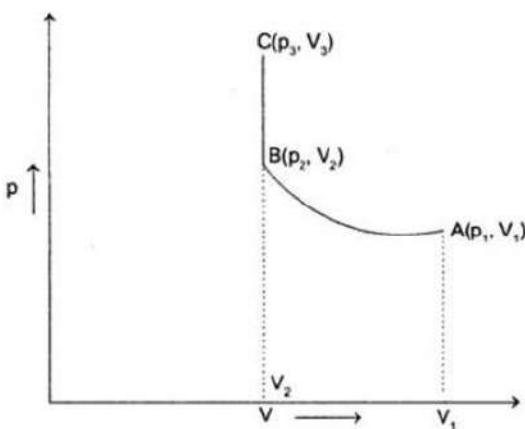
(i) Sketch the complete process on a p-V diagram.

(ii) Find the total work done by the gas, total change in its internal energy and the final temperature of the gas.

[Give your answer in terms of p_1 , V_1 , V_2 , Q and R]

Solution :

(i) Figure displays the p-V diagram of the gas undergone the given two processes.



The curve A to B represents the adiabatic compression of the gas from the volume V_1 to V_2 . In this process the pressure of the gas increases from p_1 to p_2 . The line B to C represents increase in pressure of the gas as a result of giving heat Q to the gas at constant volume. In this process, the pressure of the gas increases from p_2 to p_3 .

(ii) (a) Total work done by the gas

Work done by the gas in adiabatic compression.

In an adiabatic process, since $Q = 0$, therefore from the first law of thermodynamics

$$\Delta U_i = -W_i \\ \text{or } W_i = \Delta V_i = -C_v \Delta T$$

$$= -C_v (T_2 - T_1)$$

$$= -C_v \left(\frac{p_2 V_2}{nR} - \frac{p_1 V_1}{nR} \right)$$

$$= \frac{C_{v,m}}{R} (p_2 V_2 - p_1 V_1) \quad \dots(i)$$

For a gas undergoes adiabatic process

$$P_1 V_1^\gamma = P_2 V_2^\gamma$$

where $\gamma = \frac{C_p, m}{C_v, m}$.

From equation (i),

$$W_1 = \frac{C_{v,m}}{R} \left[\frac{p_1 V_1^\gamma}{V_2^\gamma} V_2 - p_1 V_1 \right]$$

$$= \frac{C_{v,m}}{R} p_1 V_1 \left[\left(\frac{V_1}{V_2} \right)^{\gamma-1} - 1 \right]$$

For a mono-atomic gas,

$$C_{v,m} = \frac{3}{2} R, \text{ and } C_{p,m} = \frac{5}{2} R$$

$$\therefore \gamma = \frac{5}{3}$$

$$\text{Hence, } W_1 = -\frac{3p_1 V_1}{2} \left[\left(\frac{V_1}{V_2} \right)^{\frac{2}{3}} - 1 \right]$$

Since the volume is held constant, work done by the gas on heating at constant volume, therefore

$$W_2 = 0$$

Total work done by the gas,

$$W = W_1 = W_2$$

$$= -\frac{3p_1V_1}{2} \left[\left(\frac{V_1}{V_2} \right)^{\frac{2}{3}} - 1 \right]$$

(b) Total change in internal Energy

Change in internal energy in adiabatic compression, as derived above,

$$\Delta U_1 = \frac{3p_1V_1}{2} \left[\left(\frac{V_1}{V_2} \right)^{\frac{2}{3}} - 1 \right]$$

Change in internal energy on heating the gas at constant volume

$$\Delta U_2 = Q$$

Total change in the internal energy of the gas

$$\Delta U = \Delta U_1 + \Delta U_2$$

$$= \frac{3p_1V_1}{2} \left[\left(\frac{V_1}{V_2} \right)^{\frac{2}{3}} - 1 \right] + Q.$$

(c) Final temperature of the gas

Change in temperature in adiabatic compression.

$$\text{Since, } \Delta U = C_V \Delta T$$

$$\text{therefore, } \Delta T = \frac{\Delta U_1}{C_V}$$

$$\text{or } T_2 - T_1 = \frac{3p_1V_1}{2C_V} \left[\left(\frac{V_1}{V_2} \right)^{2/3} - 1 \right]$$

$$T_2 - T_1 + \frac{3p_1V_1}{2\left(\frac{3}{2}nR\right)} \left[\left(\frac{V_1}{V_2} \right)^{2/3} - 1 \right]$$

$$= \frac{p_1V_1}{nR} + \frac{p_1V_1}{nR} \left[\left(\frac{V_1}{V_2} \right)^{2/3} - 1 \right]$$

$$= \frac{p_1V_1}{nR} \left(\frac{V_1}{V_2} \right)^{2/3}$$

Change in temperature on heating the
gas

$$Q = C_V \Delta T = C_V (T_3 - T_2)$$

$$\text{or } T_3 = \frac{Q}{C_V} + T_2 = \frac{Q}{\left(\frac{3}{2}nR\right)} + \frac{p_1V_1}{nR} \left(\frac{V_1}{V_2} \right)^{2/3}$$

Since $n = 2$, therefore

$$T_3 = \frac{Q}{(3 \text{ mole})R} + \frac{p_1V_1}{(2 \text{ mole})R} \left(\frac{V_1}{V_2} \right)^{2/3}.$$

Two moles of helium gas ($\gamma = 5/3$) are initially at temperature 27°C and occupy a volume of 20 litres. The gas is expanded at constant pressure until the volume is doubled. Then, it undergoes an adiabatic change until the temperature returns to its initial value.

- (i) Sketch the process on a p-V diagram.
- (ii) What are the final volume and pressure of the gas?
- (iii) What is the work done by the gas?

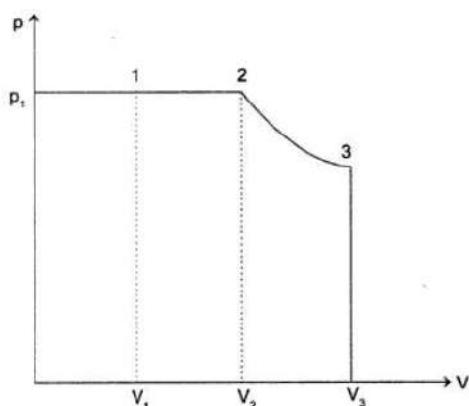
Solution :

(i) $V_1 = 20 \times 10^{-3} \text{ m}^3$

$T_1 = 300 \text{ K}$

$n = 2 \text{ moles}$

$$\gamma = \frac{5}{3}$$



Process 1 → 2 is isobaric expansion

$$p_1 V_1 = nRT_1$$

$$\begin{aligned}\therefore p_1 &= \frac{nRT_1}{V_1} \\ &= \frac{2 \times 8.3 \times 300}{20 \times 10^{-3}} = 2.49 \times 10^5 \text{ Nm}^{-2}\end{aligned}$$

Now, $V \propto T$

$$\therefore \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{or } T_2 = T_1 \times \frac{V_2}{V_1} = 300 \times \frac{2V_1}{V_1}$$

$$\therefore T_2 = 600 \text{ K}$$

$$V_2 = 40 \times 10^{-3} \text{ m}^3$$

Work done during process 1 → 2,

$$\begin{aligned}(W)_{1-2} &= p \times \Delta V \\ &= 2.49 \times 10^5 \times (40 - 20) \times 10^{-3} \\ &= 4980 \text{ J}\end{aligned}$$

Process 2 → 3 is adiabatic expansion

$$T_2 = 600 \text{ K}$$

$$p_2 = p_1 = 2.48 \times 10^5 \text{ N/m}^2$$

$$V_2 = 40 \times 10^{-3} \text{ m}^3$$

Given, $T_2 V_2^{\gamma-1} = T_3 V_3^{\gamma-1}$, $T_3 = T_1$

$$\therefore \left(\frac{V_3}{V_2} \right)^{\frac{\gamma}{\gamma-1}} = \frac{T_3}{T_1} = \frac{600}{300} = 2$$

$$\begin{aligned}\therefore V_3 &= V_2 \times (2)^{3/2} \\ &= 40 \times 10^{-3} (2)^{3/2} \\ &= 113.14 \times 10^{-3} \text{ m}^3\end{aligned}$$

$$\text{Now, } p_2 V_2^\gamma = P_3 V_3^\gamma$$

$$\therefore p_3 = p_2 \left(\frac{V_3}{V_2} \right)^\gamma$$

$$= 2.48 \times 10^5 \left(\frac{40}{113.14} \right)^{5/3} = 0.44 \times 10^5 \text{ N/m}^2$$

$$(W)_{2-3} = \frac{p_2 V_2 - p_3 V_3}{\gamma - 1}$$

$$= \frac{(2.49 \times 10^5)(40 \times 10^{-3}) - (0.44 \times 10^5)(113.14 \times 10^{-3})}{(5/3) - 1}$$

$$= 7472.8 \text{ J.}$$

(ii) Final volume, $V_3 = 113.14 \times 10^{-3} \text{ m}^3$

Final pressure, $p_3 = 0.44 \times 10^5 \text{ Nm}^{-2}$

(iii) Total work done by the gas = W =

$$(W)_{1-2} + (W)_{2-3}$$

$$= 4980 + 7472.8 = 12452.8 \text{ J.}$$

Work done example in Isothermal expansion

A gram mole of a gas at 127°C expands isothermally until its volume is doubled. Find the amount of work

- (a) 238 cal (b) 548 cal (c) 548 J (d) 238 J

$$(b) W = 2.303 RT \log \left(\frac{V_2}{V_1} \right)$$

$$= 2.303 \times 8.311 \times 400 \times \log 2$$

$$= 2310.1 \text{ J} = 548 \text{ cal.}$$

Example in Isothermal Expansion

How much work is done by an ideal gas in expanding isothermally from an initial volume of 3 litres of 20 atm to a final volume of 24 litres?

Solution :

In isothermal process at temperature T

$$\begin{aligned} W &= 2.303nRT \log \frac{V_2}{V_1} \\ \text{or } W &= 2.303(p_1 V_1) \log \frac{V_2}{V_1} \\ &\quad (\text{using } p_1 V_1 = nRT) \\ &= 2.303 (20 \times 3) \log \frac{p_1}{p_2} \text{ lt. atm} \\ &= 2.303 \times 60 \log 8 (101) \text{ J} \\ &= \mathbf{1.26 \times 10^4 \text{ J}} \end{aligned}$$

Work done by the gas

The ratio of work done by an ideal diatomic gas to the heat supplied by the gas in an isobaric process is

- (a) 5/7 (b) 3/5 (c) 2/7 (d) 5/3

Answer :

$$(c) \Delta U = nC_v \Delta T = n \frac{5}{2} R \Delta T$$

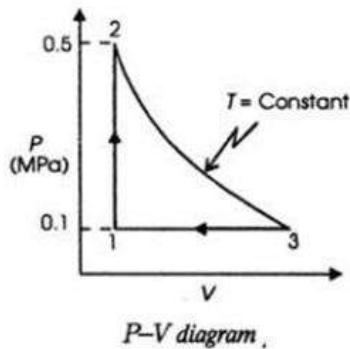
$$\Delta Q = nC_p \Delta T = n \frac{7}{2} R \Delta T$$

$$W = \Delta Q - \Delta U = \frac{n7}{2} R \Delta T = nR \Delta T$$

$$\frac{W}{Q} = \frac{2}{7}$$



One mole of a gas which obeys the relation $Pv = RT$, where $R = 8.314 \text{ J/mol K}$ is initially at 300 K and 0.1 MPa . The gas heated at constant volume till the pressure rises to 0.5 MPa and then allowed to expand at constant temperature till the pressure reduces to 0.1 MPa . Finally the gas is returned to its original state by compressing at constant pressure. Calculate the work done by the gas in each of the processes and also estimate the net work done by the gas.



Solution :

The process followed by the gas shown in Figure. Work done by the gas during process 1–2 is given by

$$W_{1-2} = \int_1^2 Pdv = 0 \quad (\text{since } dv = 0)$$

We know $P_1v_1 = RT_1$ and $P_2v_2 = RT_2$. Therefore

$$\frac{T_2}{T_1} = \frac{P_2v_2}{P_1v_1} = \frac{P_2}{P_1} = \frac{0.5 \times 10^6}{0.1 \times 10^6} = 5 \quad (\text{since } v_2 = v_1)$$

or $T_2 = 5T_1 = 5 \times 300 = 1500 \text{ K}$

Work done by the gas during process 2-3 is given by

$$W_{2-3} = \int_2^3 Pdv = \int_2^3 \frac{RT}{v} dv = RT_2 \ln \frac{v_3}{v_2}$$

We know $P_2v_2 = P_3v_3$ (since $T_2 = T_3$). Therefore

$$\frac{v_3}{v_2} = \frac{P_2}{P_3} = \frac{0.5 \times 10^6}{0.1 \times 10^6} = 5$$

Hence $W_{2-3} = RT_2 \ln 5 = 8.314 \times 1500 \times \ln 5 = 20.071 \text{ kJ}$. Work done during process 3-1 is given by

$$W_{3-1} = \int_3^1 Pdv = P_1(v_1 - v_3) = P_1v_1 \left(1 - \frac{v_3}{v_1}\right) = RT_1 \left(1 - \frac{v_3}{v_1}\right)$$

We know $P_1v_1 = RT_1$ and $P_3v_3 = RT_3$

$$\text{or } \frac{v_3}{v_1} = \frac{RT_3}{P_3} \cdot \frac{P_1}{RT_1} = \frac{T_3}{T_1} \quad (\text{since } P_1 = P_3). \text{ Therefore}$$

$$W_{3-1} = RT_1 \left(1 - \frac{v_3}{v_1}\right) = RT_1 \left(1 - \frac{T_3}{T_1}\right) = 8.314 \times 300 \left(1 - \frac{1500}{300}\right) = -9.977 \text{ kJ}$$

Net work done by the gas, $W = W_{1-2} + W_{2-3} + W_{3-1} = 0 + 20.071 - 9.977 = 10.094 \text{ kJ}$

Work done by the gas

A sample of ideal gas ($\gamma = 1.4$) is heated at constant pressure. If an amount of 140 J of heat is supplied to the gas, find:

- (i) The change in internal energy of the gas.
- (ii) The work done by the gas.

Solution :

Suppose, the sample contains n moles. Also, suppose the volume changes from V₁ to V₂ and the temperature changes from T₁ to T₂

The heat supplied is given by

$$\Delta Q = nC_p(T_2 - T_1)$$

(i) Change in internal energy

$$\Delta U = nC_v(T_2 - T_1)$$

$$= \frac{C_v}{C_p} nC_p(T_2 - T_1)$$

$$= \frac{C_v}{C_p} \Delta Q = \frac{140 \text{ J}}{1.4} = 100 \text{ J}$$

(ii) Work done by gas

$$\begin{aligned}\Delta W &= \Delta Q - \Delta U \\ &= 140 \text{ J} - 100 \text{ J} = 40 \text{ J}\end{aligned}$$

—

Work done by the gas

A sample of gas ($\gamma = 1.5$) is taken through an adiabatic process in which the volume is compressed from 1600 cm³ to 400 cm³

If the initial pressure is 150 kPa,

(i) What is the final pressure?

(ii) How much work is done by the gas in the process?

Solution :

(i) For an adiabatic process

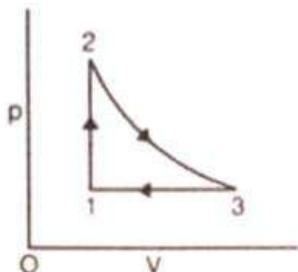
$$P_1 V_1^\gamma = P_2 V_2^\gamma$$

$$\begin{aligned} \text{Thus, } P_2 &= P_1 \left(\frac{V_1}{V_2} \right)^\gamma \\ &= (150 \text{ kPa}) \left(\frac{1600}{400} \right)^{\frac{3}{2}} \\ &= \mathbf{1200 \text{ kPa}} \end{aligned}$$

(ii) Work done by the gas in an adiabatic process

$$\begin{aligned} W &= \frac{P_1 V_1 - P_2 V_2}{\gamma - 1} \\ &= \frac{(150 \text{ kPa})(1600 \text{ cm}^3) - (1200 \text{ kPa})(400 \text{ cm}^3)}{1.5 - 1} \\ &= \frac{240 \text{ J} - 480 \text{ J}}{0.5} = \mathbf{-480 \text{ J}} \end{aligned}$$

A cyclic process for an ideal monatomic gas ($C_v = 12.5 \text{ J mole}^{-1} \text{ K}^{-1}$) is represented in the figure. The temperatures at 1, 2 and 3 are 300 K, 600 K and 455 K, respectively. Compute the values of ΔQ , ΔU and ΔW for each of the processes. The process from 2 to 3 is adiabatic.



Solution :

In the process from 1 to 2

$$\Delta W = \int pdV = 0 \text{ (volume remains constant)}$$

$$\Delta Q = \int C_V dT = C_V(T_2 - T_1)$$

$$= 12.5(600 - 300) = 3750 \text{ joules}$$

By the first law of thermodynamics

$$\begin{aligned}\Delta Q &= \Delta U + \Delta W \text{ or } \Delta U = \Delta Q - \Delta W \\ &= 3750 - 0 = 3750 \text{ joules}\end{aligned}$$

In the process 2 to 3 $\Delta Q = 0$

(since the process is adiabatic)

$$\Delta W = \frac{R(T_2 - T_3)}{\gamma - 1}$$

$$= C_V(T_2 - T_3) \quad \left(\because C_V = \frac{R}{\gamma - 1} \right)$$

$$= 12.5(600 - 455) = 12.5 \times 145 = 1812.5 \text{ joules}$$

$$\therefore \Delta U = \Delta Q - \Delta W = 0 - 1812.5 = -1812.5 \text{ joules}$$

$$\text{In the process from 3 to 1, } \Delta W = \int_V^{V_1} pdV = p(V_1 - V_3) = pV_1 - pV_2$$

$$\begin{aligned}\text{or } \Delta W &= R(T_1 - T_3) \quad (\because pV = RT) \\ &= 8.31(300 - 455) = -1288 \text{ joules}\end{aligned}$$

$$\Delta Q = \int_{T_3}^{T_1} C_p dT = C_p(T_1 - T_3) = 1.67 \times 12.5 \times (300 - 455) \quad \left(\because \gamma = \frac{C_p}{C_v} \right)$$

$$= -3235.6 \text{ joules.}$$

By the first law of thermodynamics

$$\Delta Q = \Delta U + \Delta W$$

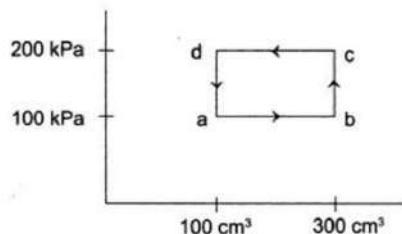
$$\therefore \Delta U = \Delta Q - \Delta W = (-3235.6) - (-1288) = 1989.1 \text{ joules}$$

—

Question on Total Heat rejected

A thermodynamic system is taken through the cycle a b c d a.

- (i) Calculate the work done by the gas during the parts ab, bc, cd and da.
- (ii) Find the total heat rejected by the gas during the process.



Solution :

$$(i) \text{ Work done during the part ab} = \int_a^b p dV$$

$$\begin{aligned}&= (100 \text{ Pa}) \int_a^b dV \\&= (100 \text{ kPa}) (300 \text{ cm}^3 - 100 \text{ cm}^3) \\&= 20 \text{ J}\end{aligned}$$

The work done during bc is zero as the volume does not change. The work done during cd ,

$$\begin{aligned}&= \int_d^c pdV \\&= (200 \text{ kPa}) (100 \text{ cm}^3 - 300 \text{ cm}^3) \\&= -40 \text{ J}\end{aligned}$$

The work done during da is zero as the volume does not change.

- (ii) Total work done by the system during the cycle a b c d a.

$$\Delta W = 20 \text{ J} - 40 \text{ J}$$

$$= -20 \text{ J}$$

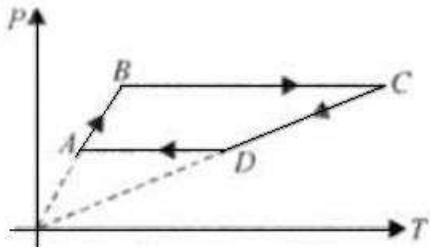
Change in the internal energy, $\Delta U = 0$, as the initial state is the same as the final state.

$$\begin{aligned}\text{Thus, } \Delta Q &= \Delta U + \Delta W \\&= -20 \text{ J}\end{aligned}$$

So, the system rejects **20 J** of heat during the cycle.

Question with P T diagram

3 moles of an ideal monoatomic gas perform a cycle shown in Figure. The gas temperatures $T_A = 400\text{ K}$, $T_B = 800\text{ K}$, $T_C = 2400\text{ K}$, $T_D = 1200\text{ K}$. Find the work done by the gas.



Solution :

$$W_{BC} = 3R(T_C - T_B)$$

$$W_{AB} = W_{CD} = 0$$

because the processes are isochoric

$$W_{DA} = 3R(T_A - T_D)$$

Total work done

$$W_{BC} + W_{DA} = 3R(T_A + T_C - T_B - T_D)$$

$$= 3R(400 + 2400 - 800 - 1200)$$

$$= 2400 R = 20\text{ kJ}$$

—

Work done by the gas

Two moles of Helium gas ($\gamma = 5/3$) are initially at 27°C and occupy a volume of 20 litres. The gas is first expanded at constant pressure until the volume is doubled. Then it undergoes an adiabatic change until the temperature returns to its initial value.

- (i) Sketch the process in a p-V diagram.
- (ii) What is the final volume and pressure of the gas?
- (iii) What is the work done by the gas?

Solution

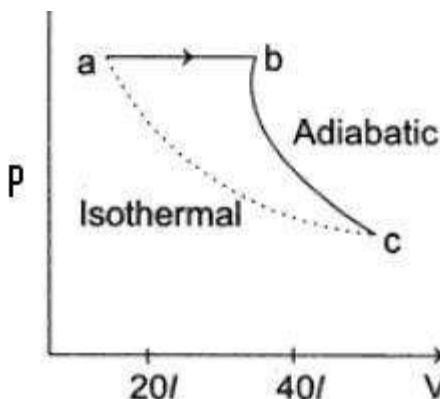
(i) The process is shown in the figure.

During the part ab , since the pressure is constant, we have

$$\frac{P_a V_a}{T_a} = \frac{P_b V_b}{T_b}$$

$$\text{or } T_b = \frac{V_b}{V_a} T_a$$

$$= 2aT_a = 600 \text{ K}$$



During the part bc , the gas is adiabatically returned to the temperature T_a . The point a and point c are on the same isothermal. Thus, we draw an adiabatic curve bc and an isothermal from a and look for the point of intersection c . That is the final state.

(ii) From the isothermal ac ,

$$p_a V_a = p_b V_b \quad \dots(i)$$

And from the adiabatic curve bc ,

$$p_b V_b^\gamma = p_c V_c^\gamma$$

$$\text{or } p_a (2V_a)^\gamma = p_c V_c^\gamma$$

Dividing equation (ii) by equation (i), we get

$$2^\gamma (V_a)^{\gamma-1} = (V_c)^{\gamma-1}$$

$$\text{or } V_c = 2^{\frac{\gamma}{\gamma-1}} V_a 4\sqrt{2} V_a$$

$$= 113 \text{ litres}$$

From equation (i),

$$p_c = \frac{p_a V_a}{V_c} = \frac{nRT}{V_c}$$

$$= \frac{2 \text{ mol} \times (8.3 \text{ J/mol-K}) (300 \text{ K})}{113 \times 10^{-3} \text{ m}^3}$$

$$= 4.4 \times 10^4 \text{ Pa}$$

(iii) Work done by the gas in the part ab

$$= p_a (V_b - V_a)$$

$$= p_a V_b - p_a V_a = nRT_2 - nRT_1$$

$$= 2 \text{ mole} \times (8.3 \text{ J/mol-K}) \times (600 \text{ K} - 300 \text{ K})$$

$$= 4980 \text{ J}$$

Work done in the adiabatic part bc

$$= \frac{p_b V_b - p_c V_c}{\gamma - 1}$$

$$= \frac{nR(T_2 - T_1)}{\gamma - 1} = \frac{4980}{\frac{5}{3} - 1} = 7470 \text{ J}$$

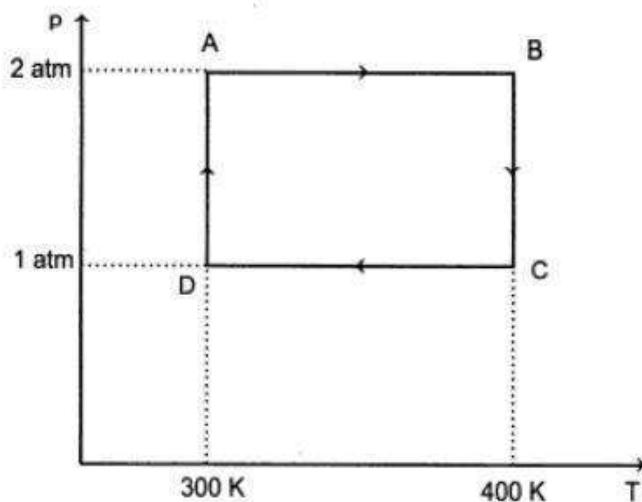
Net work done by the gas = 4980 J + 7470 J = **12450 J.**

—

Example of cycle given P T diagram

Two moles of helium gas undergo a cyclic process as shown in the figure. Assuming the gas to be ideal, calculate the following quantities in this process:

- (i) The net change in the heat energy.
- (ii) The net work done.
- (iii) The net change in internal energy. [$R = 8.32 \text{ J}/(\text{mol K})$]



Solution Number of moles, $n = 2$

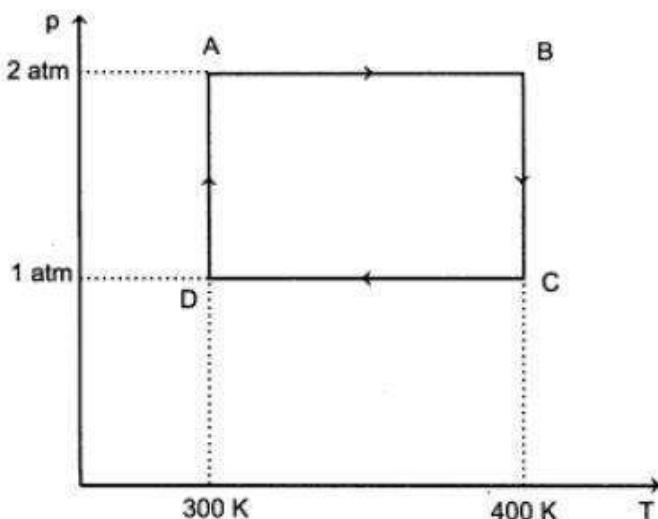
Helium is a mono-atomic gas.

$$\therefore C_V = \frac{3}{2} R$$

$$C_p = \frac{5}{2}R$$

The gas undergoes cyclic process.

Since, internal energy is property of the system, the net change in internal energy during the cyclic process is zero.



Hence, according to the first law of thermodynamics, the net change in the heat energy is equal to the net work done.

(i) $(\Delta Q)_{\text{Net}} = (\Delta Q)_{AB} + (\Delta Q)_{BC} + (\Delta Q)_{DA}$

$$\begin{aligned}(\Delta Q)_{AB} &= n \times C_p \times (T_B - T_A) \\&= 2 \times \frac{5}{2} \times 8.32(400 - 300) = 4160 \text{ J}\end{aligned}$$

Since Process BC is isothermal, therefore $\Delta U = 0$

$$\begin{aligned}(\Delta Q)_{BC} &= (\Delta W)_{BC} \\&= nRT \ln\left(\frac{V_C}{V_B}\right) = nRT \ln\left(\frac{P_B}{P_C}\right) \\&= 2 \times 8.32 \times 400 \ln\left(\frac{2}{1}\right) = 4613.6 \text{ J}\end{aligned}$$

$$\begin{aligned}(\Delta Q)_{DA} &= nRT \ln\left(\frac{P_D}{P_A}\right) \\&= 2 \times 8.32 \times 300 \ln\left(\frac{2}{1}\right) = -3460.2 \text{ J}\end{aligned}$$

$$\begin{aligned}\therefore (\Delta W)_{Net} &= 4160 + 4613.6 - 4160 \\&\quad - 3460.2 \\&= \mathbf{1153.4 \text{ J}}\end{aligned}$$

$$\begin{aligned}\text{(ii)} \quad (\Delta W)_{Net} &= (\Delta Q)_{Net} \\&= \mathbf{1153.4 \text{ J}}\end{aligned}$$

$$\text{(iii)} \quad (\Delta U)_{Net} = \mathbf{0}$$

Heat or Thermodynamics 4) Efficiency of Refrigerator and Refrigeration constant

Coefficient of Performance of a Refrigerator

$$\begin{aligned}\beta &= \frac{\text{Heat absorbed from cold reservoir}}{\text{Work done on refrigerator}} \\&= \frac{Q_2}{W} = \frac{Q_2}{Q_1 - Q_2} = \frac{1}{\frac{Q_1}{Q_2} - 1} \\&= \frac{1}{\frac{T_1}{T_2} - 1} = \frac{T_2}{T_1 - T_2}\end{aligned}$$

Coefficient of performance of refrigerator working between temperatures 30 and 0 deg centigrade

What is the approximate coefficient of performance of a Carnot refrigerator working between 30° C and 0° C

- (a) 0 (b) 1 (c) 9 (d) 10

Ans : c)

Coefficient of performance,

$$\beta = \frac{T_2}{T_1 - T_2} = \frac{273 + 0}{(273 + 30) - 273} = \frac{273}{30} = 9$$

Efficiency of Refrigerator is given by

Efficiency of Refrigerator

$$\eta = 1 - \frac{T_c}{T_h}$$

So in this case efficiency $\eta = 1 - (273 / 303) = 0.099 \approx (\text{approx}) 0.1 \text{ or } 10\%$

—

Refrigerator Problem

A refrigerator works between 0° C and 27° C. Heat is to be removed from the refrigerated space at the rate of 50 kCal/minute; then the power of the motor of the refrigerator needs to be ?

- (a) 0.346 kW (b) 3.46 kW (c) 34.6 kW (d) 346 kW

Ans : a) Efficiency $\eta = 1 - \frac{T(\text{cold})}{T(\text{Hot})} = 1 - \frac{273}{273+27} = 1 - \frac{273}{300} = 1 - 0.91 = 0.09 = \frac{W}{Q2}$

So $W = (Q2)(0.09) = (50,000)(0.09) = 4500 \text{ Cal} = 4500 \times (4.18) \text{ J} = 18,810 \text{ J}$

So Power = $18810/60 = 313 \text{ Watt or } .313 \text{ kWatt}$

Here in this case efficiency $\eta = 1 - (273 / 300) = 0.09 \approx \text{or } 9\%$

—

Refrigerator Problem

An ideal refrigerator has a freezer at temperature of -13°C . The coefficient of Performance of the engine is 5. The temperature of air (to which heat is rejected) is ?

- (a) 320 C (b) 39 C (c) 325 K (d) 325 C

Ans : b)

$$\begin{aligned} T_2 &= 273 - 13 = 260\text{ K} \quad \text{So Coefficient of performance } \beta = 5 = \frac{260}{T_1 - 260} \Rightarrow T_1 - 260 = 52 \\ \Rightarrow T_1 &= 312\text{ K} \quad \text{or } T_1 = 312 - 273 = 39\text{ C} \end{aligned}$$

Efficiency of Refrigerator

$$\eta = 1 - \frac{T_c}{T_h}$$

So in this case efficiency $\eta = 1 - (260 / 312) = 0.16666 \approx (\text{approx}) 0.16667 \text{ or } 16.67\%$

Refrigerator Problem

A Carnot's engine works as a refrigerator between 250 K and 300 K . If it receives 750 Calories of heat from the reservoir at the lower temperature, the amount of heat rejected at the higher temperature is ?

- (a) 900 Cal (b) 625 Cal (c) 750 Cal (d) 1000 Cal

Ans : a)

$$\text{Coefficient of performance } \beta = \frac{Q_2}{W} = \frac{T_2}{T_1 - T_2} \Rightarrow \frac{750}{W} = \frac{250}{300 - 250} = 5$$

So $W = 750/5 = 150$ Thus Heat rejected will be $750 + 150 = 900\text{ Cal}$

Efficiency of Refrigerator

$$\eta = 1 - \frac{T_c}{T_h}$$

So in this case efficiency $\eta = 1 - (250 / 300) = 0.1666666 \approx (\text{approx}) 0.16667 \text{ or } 16.67\%$

Refrigerator Problem

A refrigerator having a coefficient of performance of 5 is run by an electric motor of power 1.2 kW. How much is the mass of ice formed from water at 0°C per hour by the refrigerator?

- (a) nearly 6 kg (b) nearly 60 kg (c) nearly 25.2 kg (d) 252 kg

Ans : b)

$$\text{Coefficient of performance } \beta = \frac{Q_2}{W} = \frac{T_2}{T_1 - T_2} = 5 \quad \text{and Work} = \text{Power} \times \text{time}$$

$$Q_2 = 5 \times 1.2 \times 1000 \times 3600 \text{ J} = 21600000 / 4.18 \text{ Cal}$$

we know 1 Cal = 4.18 J and Latent heat of ice 80 Calorie per gram or 334400 J per kg

$Q_2 = 5167464 \text{ Cal}$ and ice produced is 64 kg

—

Refrigerator

Given :	T_H	1200 °C	T_C	200 °C
	T_H	1473.15 K	T_C	473.15 K
Find :	η	?	COP_R	?

Part a.) The thermal efficiency of a Carnot Cycle depends only on the temperatures of the reservoirs with which it interacts. The equation that defines this relationship is :

$$\eta = 1 - \frac{T_c}{T_h} \quad \text{Eqn 1}$$

Just be sure to use absolute temperature in Eqn 1 ! In this case, convert to Kelvin. Temperatures in Rankine will work also.

$$\eta = 67.9\%$$

part b.) The coefficient of performance of a Carnot Refrigeration Cycle also depends only on the temperatures of the reservoirs with which it interacts. The equation that defines this relationship is :

$$COP_R = \frac{1}{\frac{T_h}{T_c} - 1} = \frac{T_c}{T_h - T_c} \quad \text{Eqn 2}$$

Using T in Kelvin yields :

$$COP_R = 0.4732$$

This is an exceptionally **BAD COP_R** because it is less than 1. This isn't terribly surprising when you consider that the refrigerator must reject heat to a reservoir at **1200°C !!**

Carnot engine efficiency is covered in every book. But efficiency of refrigerator and Coefficient of Performance is rarely discussed.

Two engines are working in such a way that sink of one is source of the other. The efficiencies are equal. Find the temperature of the sink of the first if its source temperature is 927 C

The temperature of the Sink of the second engine is 27 C

- (a) 327 K (b) 327 C (c) 600 C (d) none of these

$$\text{Efficiency } \eta = 1 - (T_2/T_1) = 1 - (T_3/T_2) \text{ or } T_2^2 = T_1 \times T_3$$

$$\Rightarrow T_2 = \sqrt{1200 \times 300} = 600 \text{ K} = 327 \text{ C}$$

Heat or Thermodynamics 5) Concept of “free expansion”

Free expansion :

If a system (a gas), expands in such a way that no heat enters or leaves the system (adiabatic) process and also no work is done by or on the system, then the expansion called the free expansion. Consider an adiabatic vessel with rigid walls divided into two parts. One containing a gas and the other evacuated. When the partition is suddenly broken, the gas rushes into the vacuum and expands freely.

So Net change in internal energy $U_f - U_i = \Delta Q - W$ as $\Delta Q = 0$ and $W = 0$

Thus $U_f = U_i$

The initial and final internal energies are equal in free expansion

One mole an “ideal diatomic” gas underwent an adiabatic expansion from 298 K, 15.00 atm, 5.25 L to 2.50 atm against a constant external pressure 1.00 atm. What is the final temperature of the system?

Plan : This is an isobaric adiabatic expansion against constant external pressure, but overall pressure decreases (volume increases. gas expands). Final temperature T_2 is given by P–V–T relation as:

$$T_2 = T_1 \left(\frac{C_v + P_{ext} \frac{R}{P_1}}{C_v + P_{ext} \frac{R}{P_2}} \right)$$

Solution :

For diatomic gas $C_v = \frac{5R}{2}$, $T_1 = 298$ K, $T_2 = ?$ (need to find)

$$P_2 = 2.50 \text{ atm}, P_1 = 15.00 \text{ atm}, P_{ext} = 1.00 \text{ atm} \text{ So } T_2 = 298 \left(\frac{\frac{5}{2}R + \frac{R}{15}}{\frac{5}{2}R + \frac{R}{2.5}} \right) = 263.7 \text{ K}$$

—
One mole of a gas is put under a weight-less piston of a vertical cylinder at temperature T. The space over the piston is atmosphere. How much work should be performed to increase isothermally the volume under the piston to twice the volume (neglect friction of piston).

Solution :

Let A be the area of piston,
therefore

$$F + pA = p_0A$$

$$\text{or } F = (p_0 - p)A$$

Work done by agent is given by

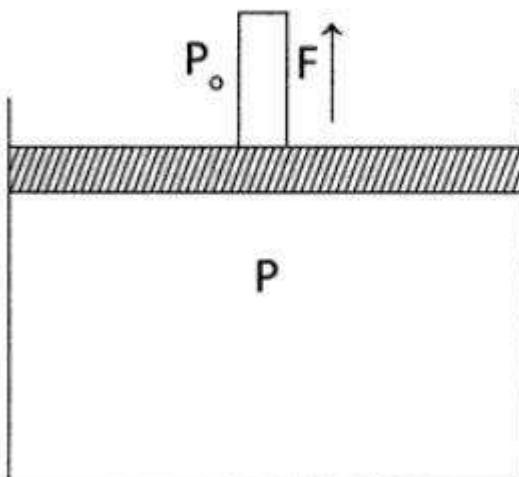
$$W = \int_v^{\eta V} (p_0 - p)Adx$$

$$= \int_v^{\eta V} (p_0 - p)dV$$

$$= \int_v^{\eta V} p_0 dV - \int_v^{\eta V} pdV$$

$$= p_0(\eta - 1)V - \int_v^{\eta V} nRT \frac{dV}{V}$$

(since $pV = nRT$)



$$= p_0(\eta - 1)V - nRT \log_e \eta$$

$$= nRT [(\eta - 1) \log_e \eta]$$

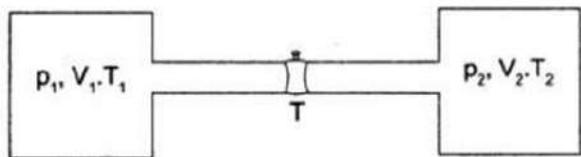
where, $\eta = 2$ and $n = 1$

$$W = RT [1 - \log_e 2]$$

Adiabatic free expansion

Two vessels of volume V_1 and V_2 contain the same ideal gas. The pressure in the vessels are p_1 and p_2 and the temperatures are T_1 and T_2 respectively. The two vessels are now connected to each other through a narrow tube. Assuming that no heat is exchanged between the surroundings and the vessels, find the common pressure and temperature attained after the connection.

Solution :



The amount of gas in vessel 1 is

$$n_1 = \frac{P_1 V_1}{R T_1}$$

If p' and T' are the common pressure and temperature after the connection is made, the amount are

$$n'_1 = \frac{p'V_1}{RT'}$$

$$\text{and } n'_2 = \frac{p'V_2}{RT'}$$

We have, $n_1 + n_2 = n'_1 + n'_2$

$$\text{or } \frac{p_1V_1}{RT_1} + \frac{p_2V_2}{RT_2} = \frac{p'V_1}{RT'} + \frac{p'V_2}{RT'}$$

$$\text{or } \frac{p'}{T'} = \frac{1}{V_1 + V_2} \left(\frac{p_1V_1}{T_1} + \frac{p_2V_2}{T_2} \right)$$

$$\text{or } \frac{T'}{P'} = \frac{T_1T_2(V_1 + V_2)}{p_1V_1T_2 + p_2V_2T_1}$$

As the vessels have fixed volume, no work done by the gas plus the vessels system. Also, no heat is exchanged with the surroundings.

Thus, the internal energy of the total system remains constant. The internal energy of an ideal gas is

$$U = nC_V T = C_V \frac{pV}{R}$$

Internal energy of the gases before the connection

$$= \frac{C_V p_1 V_1}{R} + \frac{C_V p_2 V_2}{R}$$

And Internal energy of the gas after the connection

$$= \frac{C_V p'(V_1 + V_2)}{R}$$

Neglecting the change in internal energy of the vessels (the heat capacity of the vessels is assumed negligible).

$$\frac{C_v p_1 V_1}{R} + \frac{C_v p_2 V_2}{R} = \frac{C_v p'(V_1 + V_2)}{R}$$

or $p' = \frac{p_1 V_1 + p_2 V_2}{V_1 + V_2}$

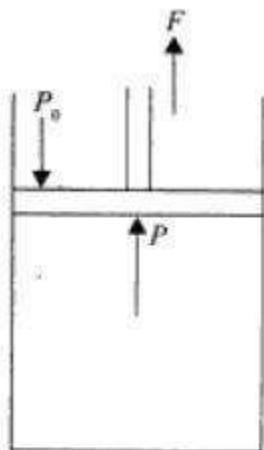
From equation (i), $T' = \frac{T_1 T_2 p_1 V_1 + p_2 V_2}{p_1 V_1 T_2 + p_2 V_2 T_1}$

Question on work done

1 mole of an ideal gas is contained under a weightless piston of a vertical cylinder at a temperature T . The space over the piston opens into Atmosphere. What work has to be performed in order to increase the gas volume isothermally under the piston by η times by slowly raising the piston ? Neglect friction.

Solution :

Let A be the area of cross section



$$F + PA = P_0 A$$

$$F = (P_0 - P) A$$

Work done by the agent

$$W = \int_V^{\eta V} F dx = \int_V^{\eta V} (P_0 - P) Adx$$

$$\begin{aligned}
 &= \int_V^{\eta V} (P_0 - P) dV \\
 &= P_0(\eta - 1)V - \int_V^{\eta V} nRT \frac{dV}{V} \\
 &= RT [(\eta - 1) - n \log_e \eta]
 \end{aligned}$$

Heat or Thermodynamics 6) Ingen Housz's experiment of identical rods

Ingen-Housz's experiment : Ingen Housz showed that if a number of identical rods of different metals are coated with wax and one of their ends is put in boiling water, then in steady State, the square Of length of the bar over which wax melts is directly proportional to the thermal conductivity of the metal. That is,

$$\frac{K}{L^2} = \text{constant}$$

Heat or Thermodynamics 7) Concept of Internal Energy at Room temperature

Find the internal energy of air in a room Of volume 40 m³ at 1 standard atmospheric pressure.

Solution :

We have $U = \frac{pV}{\gamma - 1}$ for a perfect gas. We consider air as diatomic therefore $\gamma = 1.4$

$$U = \frac{10^5 \times 40}{1.4 - 1} \quad (p = 1 \text{ atm} = 10^5 \text{ Nm}^{-2}) = 10^7 \text{ joules.}$$

Question in Internal Energy

The internal energy of a monoatomic ideal gas is $1.5 nRT$. One mole of Helium is kept in a cylinder of cross-section 8.5 cm². The cylinder is closed by a light frictionless piston. The gas is heated slowly in a process during which a total of 42 J Heat is given to the gas. If the temperature is raised by 2 C find the distance moved by the piston. Take Atmospheric pressure as 100 kPa

Solution :

$$\text{Change in internal energy } \Delta U = 1.5nRT = 1.5(1)(8.31)(2) = 24.9 \text{ J}$$

Heat given to gas is 43 J So work done $\Delta W = \Delta Q - \Delta U = 42 - 24.9 = 17.1 \text{ J}$

If the distance moved by piston is x then work done $\Delta W = (100\text{kPa})(8.5 \text{ cm}^2)(x) = 17.1 \text{ J}$

Thus $x = 0.2 \text{ m} = 20 \text{ cm}$

Heat or Thermodynamics 8) Saturated vapor pressure problems

A saturated water vapour ($M = 18$) is contained in a vessel fitted with a piston at a temperature $t = 100 \text{ C}$. As a result of slow introduction of the piston a small fraction of the vapour $\Delta m = 1 \text{ g}$ gets condensed. What amount of work is done over the gas?

Solution :

Work done = decrease in internal energy of the gas

$$\Delta U_i - U_f = \frac{m_i RT}{M} - \frac{m_f}{M} RT = \frac{\Delta m RT}{M}$$

∴ Here, $W = \frac{10^{-3} \times 8.3 \times (273 + 100)}{18 \times 10^{-3}} = 172 \text{ J}$.

Water of mass $m = 1 \text{ kg}$ and M (mol. mass) = 18 turns completely into saturated vapour at standard atmospheric pressure. Assuming the saturated vapour to be an ideal gas; find increment of internal energy of the system.

Specific latent heat of steam is $L = 2250 \text{ kJ/kg}$.

Solution :

$$\Delta Q = \text{heat added to the system} = mL$$

$$\Delta W = \text{work done by the system} = p_0(V_v - V_w)$$

$$= p_0 V_v = \frac{m}{M} RT$$

By the first law ($\Delta Q = \Delta U + \Delta W$),

$$\Delta U = mL - \frac{m}{M} RT = m \left(L - \frac{RT}{M} \right)$$

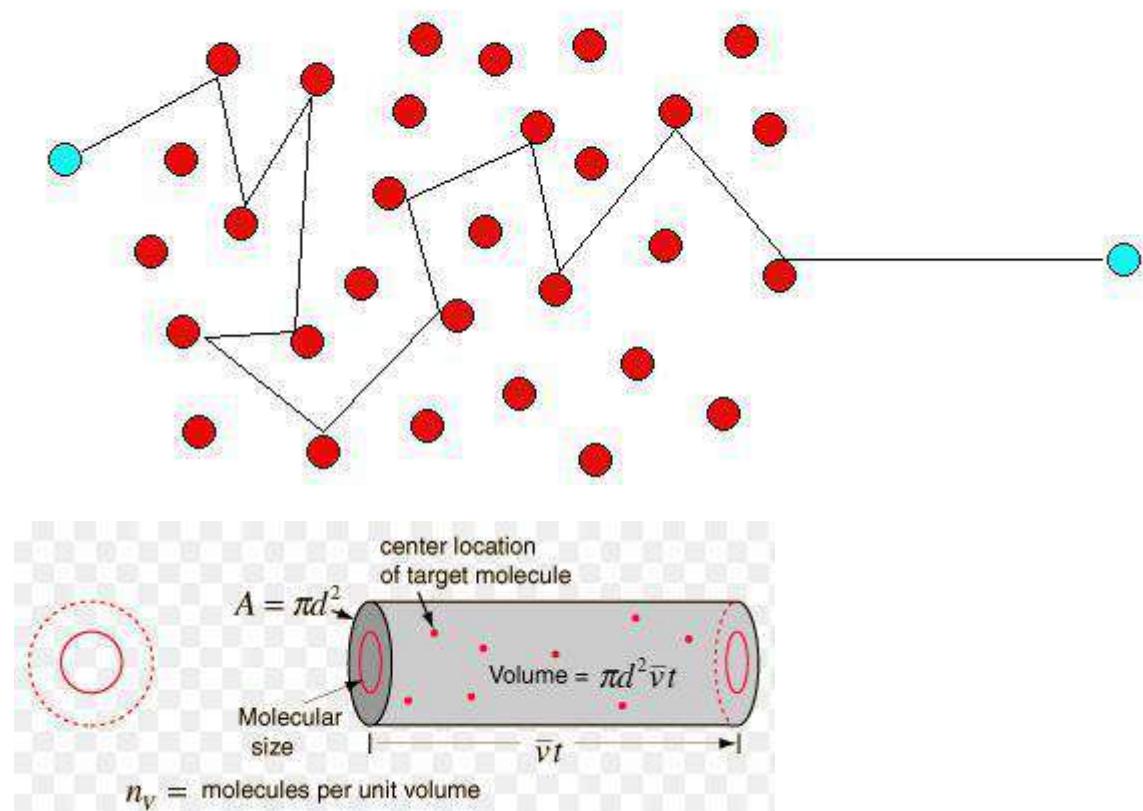
$$\Delta U = 1 \left(2250 \times 10^3 - \frac{8.3 \times 373}{18 \times 10^{-3}} \right) = 2.078 \times 10^6 \text{ J}$$

Heat or Thermodynamics 9) Mean free path

Mean free path of a gas molecule between 2 collisions

Mean Free Path

all particles, including photons, suffer from collisions with other particles such that their path through space is very short the higher the densities. This typical path length is called the mean free path.



mean free path λ (the average distance travelled by a particle between collisions) to determine the best values for number of particles N , rms velocity V_{rms} , and box length L ;

$$\lambda = \frac{k_B T}{\sqrt{2\pi d^2 p}}$$

where d is the diameter of the particle and p is the pressure.
which I can easily turn into:

$$\lambda = \frac{mv_{rms}^2}{2\sqrt{2\pi d^2 p}}$$

The average distance a particle can travel before colliding with another particle.

$$\lambda = \frac{1}{n\sigma}$$

Effect of pressure: $\lambda \propto \frac{1}{p}$

The average distance a particle can travel before colliding with another particle.

$$\lambda = \frac{1}{n\sigma}$$

Effect of pressure :

$$\lambda \propto \frac{1}{p}$$

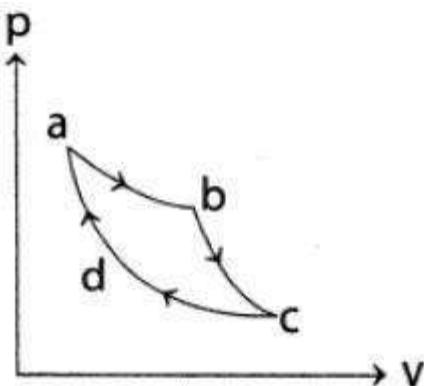
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Heat or Thermodynamics 10) Questions on efficiency of cycle

Suppose 0.2 mole of an ideal diatomic gas ($\gamma = 1.4$) undergoes cycle with temperature $T(H) = 400$ K and $T(C) = 300$ K. The initial pressure is $p_a = 10^6$ Pa and during isothermal expansion at temperature $T(H)$ the volume doubles.

(i) Find Q, W and ΔU from each step in the cycle.

(ii) Find the efficiency of this cycle.



Solution

$$(i) V_a = \frac{nRT_H}{pa} \\ = \frac{0.2 \times 8.314 \times 400}{10 \times 10^5} = 6.65 \times 10^{-4} \text{ m}^3$$

For isothermal expansion $a \rightarrow b$

$$p_a V_a = p_b V_b$$

$$\text{or } p_b = \frac{p_a V_a}{V_b} = 5 \times 10^5 p_a$$

For adiabatic expansion $b \rightarrow c$

$$T_H V_b^{\gamma-1} = T_c V_c^{\gamma-1} \\ \therefore V_c = V_b \left(\frac{T_H}{T_c} \right)^{\frac{1}{\gamma-1}} \\ = 13.3 \times 10^{-4} \times \left(\frac{4}{3} \right)^{2.5} = 27.3 \times 10^{-4} \text{ m}^3$$

$$p_c = \frac{nRT_c}{V_c} = \frac{0.2 \times 8.314 \times 300}{27.3 \times 10^{-4}} \\ = 1.83 \times 10^5 \text{ Pa}$$

For adiabatic compression $d \rightarrow a$

$$T_c V_d^{\gamma-1} = T_a V_a^{\gamma-1}$$

$$V_d = V_a \left(\frac{T_h}{T_c} \right)^{\frac{1}{r-1}} = 6.65 \times 10^{-4} \times \left(\frac{4}{3} \right)^{2.5}$$

$$= 13.65 \times 10^{-4} \quad p_d = \frac{nRT_c}{V_d}$$

$$= \frac{0.2 \times 8.314 \times 300}{13.65 \times 10^{-4}} = 3.65 \times 10^5 \text{ Pa}$$

For isothermal expansion $a \rightarrow b$

$$\Delta U = 0$$

$$\begin{aligned} \therefore W &= Q_h = nRT_h \cdot \log_e \frac{V_b}{V_a} \\ &= 0.2 \times 8.314 \times 400 \log_e 2 \\ &= 461 \text{ J} \end{aligned}$$

For adiabatic expansion $b \rightarrow c$

$$Q = 0$$

$$\begin{aligned} \therefore W &= -\Delta U = nC_v(T_h - T_c) \\ &= 0.2 \times 20.78 \times (400 - 300) \end{aligned}$$

$$= 415.7 \text{ J}$$

For isothermal compression $c \rightarrow d$

$$\Delta U = 0$$

$$\begin{aligned}\therefore W &= Q_c = nRT_c \log_e \frac{V_d}{V_c} \\ &= 0.2 \times 8.314 \times 300 \log_e \frac{13.65 \times 10^{-4}}{27.3 \times 10^{-4}} \\ &= -345.8 \text{ J}\end{aligned}$$

For adiabatic expansion $d \rightarrow a$

$$Q = 0$$

$$\begin{aligned}\therefore W &= -U \\ &= nC_v(T_c - T_a) \\ &= 0.2 \times 20.78 \times (300 - 400) \\ &= -415.7 \text{ J}\end{aligned}$$

The results may be tabulated as follows:

	Q	W	ΔU
$a \rightarrow b$	461 J	461 J	0 J
$b \rightarrow c$	0 J	415.7 J	-415.7 J
$c \rightarrow d$	-345.8 J	-345.8 J	0 J
$d \rightarrow a$	0 J	-415.7 J	415.7 J
Total	115.2 J	115.2 J	0 J

(ii) For entire cycle, $Q = W$

$$\Delta U = 0$$

Total work done = 115.2 J

$$Q_H = 461 \text{ J}$$

$$\therefore \eta = \frac{W}{Q_H} = \frac{115.2}{461} = 0.25$$

Efficiency of cycle example

One mole of a di-atomic ideal gas ($\gamma = 1.4$) is taken through a cyclic process starting from point A. The process A → B is an adiabatic compression, B → C isobaric expansion, C → D is an adiabatic expansion and D → A isochoric expansion. The volume ratios are $V_A/V_B = 16$ and $V_C/V_B = 2$ and the temperature at A is $T = 300 \text{ K}$. Calculate the temperature of gas at the points B and D and find the efficiency of the cycle.

Solution :

For an ideal gas undergoing adiabatic expansion or compression, we have $TV^{\gamma-1} = \text{constant}$

For the expansion at constant pressure, we have

$$\frac{V}{T} = \text{Constant}$$

With this information, temperature of the gas at different stages of the cyclic process may be determined as follows:

(i) Adiabatic compression from A to B

$$T_B V_B^{\gamma-1} = T_A V_A^{\gamma-1}$$

$$\text{or } T_B = \left(\frac{V_A}{V_B} \right)^{\gamma-1} T_A = (16)^{1.4-1} (300)$$

$$= (3.03) (300 \text{ K}) = 909 \text{ K}$$

(ii) Isobaric expansion from B to C

$$\frac{V_C}{T_C} = \frac{V_B}{T_B}$$

$$\text{or } T_C = \left(\frac{V_C}{V_B} \right) T_B = 2(909) = 1818 \text{ K}$$

(iii) Adiabatic expansion from C to D

$$T_D V_D^{\gamma-1} = T_C V_C^{\gamma-1}$$

$$\text{or } T_D = \left(\frac{V_C}{V_D} \right)^{\gamma-1} T_C$$

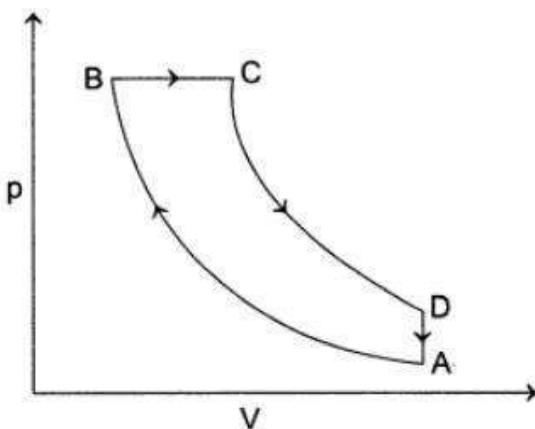
Since, $D \rightarrow A$ is isochoric process,
therefore

$$V_D = V_A$$

Hence,

$$\begin{aligned} T_D &= \left(\frac{V_C}{V_D} \right)^{\gamma-1} T_C = \left(\frac{V_C}{16 V_B} \right)^{\gamma-1} T_C \\ &= \left(\frac{2}{16} \right)^{1.4-1} (1818 \text{ K}) \\ &= (0.4353) (1818 \text{ K}) = 791.4 \text{ K} \end{aligned}$$

The given cyclic process is show in the figure.



Efficiency of the cycle is defined as

$$\eta = \frac{\text{Work obtained in one cycle}}{\text{Heat absorbed in the process } B \rightarrow C}$$

Now, the work obtained in one cycle is equal to the area within the cycle ABCDA. This

work is given as

$$\begin{aligned} W &= |W_{B \rightarrow C}| + |W_{C \rightarrow D}| + |W_{D \rightarrow A}| \\ &= RT_B + C_V(T_C - T_D) - C_V(T_B - T_A) \end{aligned}$$

For a di-atomic gas,

$$C_V = \frac{5}{2} \text{ and } C_P = \frac{7}{2}R.$$

Hence,

$$\begin{aligned} W &= R \left[T_B + \frac{5}{2}(T_C - T_D - T_B - T_A) \right] \\ &= (8.314 \text{ JK}^{-1} \text{ mol}^{-1}) \end{aligned}$$

$$\left[(909 \text{ K}) + \frac{5}{2}(1818 - 791.4 - 909 + 300) \text{ K} \right]$$

$$= 16237.2 \text{ Kelvin per mole}$$

Heat absorbed in the process $B \rightarrow C$ is given as

$$\begin{aligned} Q &= C_p (T_C - T_B) \\ &= \left(\frac{7}{2} R \right) (T_C - T_B) \\ &= \frac{7}{2} \times (8.314 \text{ J K}^{-1} \text{ mole}^{-1}) \\ &\quad (1818 \text{ K} - 909 \text{ K}) \\ &= 26451.0 \text{ J mole}^{-1} \end{aligned}$$

Hence, the efficiency of the cycle is

$$\eta = \frac{W}{Q} = \frac{16237.2}{26451.0} = 0.614$$

Example of Efficiency of a cycle

An ideal gas is taken through a cycle thermodynamic process through four steps. The amount of heat involved in these steps are $Q_1 = 5960 \text{ J}$, $Q_2 = -5585 \text{ J}$, $Q_3 = -2980 \text{ J}$ and $Q_4 = 3645 \text{ J}$ respectively. The corresponding worked involved are $W_1 = 2200 \text{ J}$, $W_2 = -825 \text{ J}$, $W_3 = -1100 \text{ J}$ and W_4 respectively.

- (i) Find the value of W_4
- (ii) What is the efficiency of the cycle?

Solution :

For a cyclic process

$$\Delta U = 0$$

(i) Cyclic $\int dQ = \int dW$

i.e., $Q_1 + Q_2 + Q_3 + Q_4$
 $= W_1 + W_2 + W_3 + W_4$

or $5960 - 5585 - 2980 + 3645$
 $= 2200 - 825 - 1100 + W_4$

or $W_4 = 765 \text{ J}$

(ii) Efficiency of the cycle,

$$\eta = \frac{\text{Net work output}}{\text{Total heat input}}$$

$$\begin{aligned}\text{Net work output} &= 5960 - 5585 \\ &\quad - 2980 + 3645 \\ &= 1040 \text{ J}\end{aligned}$$

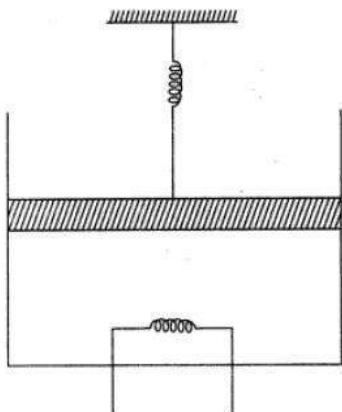
$$\begin{aligned}\text{Total heat input} &= Q_1 + Q_4 \\ &= 5960 + 3645 = 9605 \text{ J}\end{aligned}$$

$$\therefore \eta = \frac{1040}{9605} \times 100 = 10.83\%$$

Question on Cycle

2.00 mole of a mono-atomic ideal gas ($U = 1.5 nRT$) is enclosed in an adiabatic, vertical cylinder fitted with a smooth light adiabatic piston. The piston is connected to a vertical spring of spring constant 200 N/m as shown in the figure. The area of cross-section of the cylinder is 20.0 cm^2 . Initially, the spring is at its natural length and the temperature of the gas is 300 K. The atmospheric pressure is 100 kPa. The gas is heated slowly for some time by means of an electric heater so as to move the piston up through 10 cm. Find:

- (i) The work done by the gas.
- (ii) The final temperature of the gas.
- (iii) The heat supplied by the heater.



Solution

(i) Force by the gas on the piston is

$$F = p_0 A + kx$$

where, $P_0 = 100 \text{ kPa}$ is the atmospheric pressure.

$A = 20 \text{ cm}^2$ is the area of the cross-section,

$k = 200 \text{ N/m}$ is the spring constant, and

$x =$ the compression of spring.

Work done by the gas if the piston moves through $l = 10 \text{ cm}$ is

$$\begin{aligned} W &= \int_0^l F dx \\ &= P_0 A l + \frac{1}{2} k l^2 \\ &= (100 \times 10^3 \text{ Pa}) \end{aligned}$$

$$\begin{aligned}
 & (20 \times 10^{-4} \text{ m}^2) \times (10 \times 10^{-2} \text{ m}) \\
 & + \frac{1}{2} (200 \text{ N/m}) (100 \times 10^{-4} \text{ m}^2) \\
 & = 20 + 1 \text{ J} = \mathbf{21 \text{ J}}
 \end{aligned}$$

- (ii) Initial temperature, $T_1 = 300 \text{ K}$. Let the final temperature by T_2 , then

$$\begin{aligned}
 nRT_1 &= p_0 V_0 \\
 nRT &= pV_2 = \left(p_0 + \frac{kl}{A} \right) (V_0 + AI) \\
 &= nRT_1 + p_0 AI + kl^2 + \frac{kl nRT_1}{AP_0} \\
 \text{or } T_2 &= T_1 + \frac{p_0 AI + kl^2}{nR} + \frac{kl T_1}{AP_0}
 \end{aligned}$$

$$\begin{aligned}
 300 + \frac{20 \text{ J} + 2 \text{ J}}{20 \times 8.3} + \frac{200 \times 10 \times 10^{-2} \times 300}{20 \times 10^{-4} \times 100 \times 10^3 \text{ Pa}} \\
 = 300 \text{ K} + 1.325 \text{ K} + 30 \text{ K} \\
 = \mathbf{331 \text{ K}}
 \end{aligned}$$

- (iii) Internal energy, $U = 1.5 nRT$

$$\begin{aligned}
 \therefore \Delta U &= 1.5 nR\Delta T \\
 &= 1.5 \times 2.00 \times 8.3 \times 31 \\
 &= 772 \text{ J}
 \end{aligned}$$

From the first law,

$$\begin{aligned}
 \Delta Q &= \Delta U + \Delta W \\
 &= (772 + 21) \text{ J} = \mathbf{793 \text{ J}}
 \end{aligned}$$

Example where 2 vessels are connected

Two vessels contain in each of them one mole of mono-atomic gas. The initial volume of each vessel is $8.3 \times 10^{-3} \text{ m}^3$. Equal amount of heat is supplied to each vessel. In one vessel, the volume of gas is doubled without change in its internal energy whereas the volume of the gas is held constant in second vessel. The vessels are now connected to allow free mixing. Find the final temperature and pressure of the combined system.

Solution According to the first law of thermodynamics,

$$\Delta Q = \Delta U + \Delta W$$

For the first vessel: $\Delta U = 0$, (Since, no change in temperature)

$$\Delta Q = \Delta W$$

$$Q = \int_{V_1}^{V_2} p dV \\ = \int_{V_1}^{V_2} nRT \frac{dV}{V} \quad (\text{since, } pV = nRT)$$

Since $V_2 = 2 V_1$, therefore

$$Q = nRT \log_e 2, \quad \dots(i)$$

For the second vessel: $\Delta W = 0$, (volume is constant)

$$Q = nC_v \Delta T = n\left(\frac{3}{2}R\right) \Delta T \quad \dots(ii)$$

Since, for mono-atomic gas $C_v = \frac{3R}{2}$

From equations (i) and (ii), we get

$$nRT \log_e 2 = n\left(\frac{3}{2}R\right) \Delta T$$

$$\text{or } \Delta T = \frac{2}{3} \times 300 \times 0.693 = 138.6 \text{ K}$$

It is the change in temperature of the second vessel.

Now, temperature of the gas in second vessel

$$\begin{aligned} &= T + \Delta T \\ &= 300 + 138.6 = 438.6 \text{ K} \end{aligned}$$

Let after mixing T_f and p_f , be the final temperature and pressure, therefore

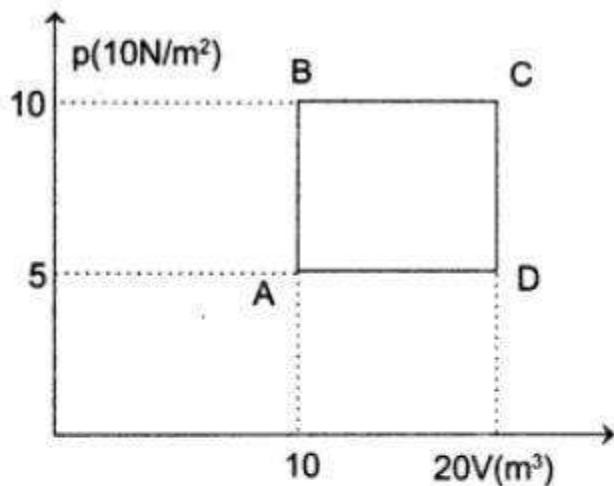
$$\begin{aligned} T_f &= \frac{T + (T + \Delta T)}{2} \\ &= \frac{300 + 438.6}{2} = 369.3 \text{ K} \end{aligned}$$

From the gas equation,

$$\begin{aligned} p_f V_f &= nRT_f \\ p_f &= \frac{nRT_f}{V_f} \\ &= \frac{2 \times 8.3 \times 369.3}{2 \times 8.3 \times 10^3 + 8.3 \times 10^{-3}} \\ &= 2.46 \times 10^5 \text{ N/m}^2 \end{aligned}$$

A sample of 2 kg of mono-atomic Helium (assumed ideal) is taken through the process ABC and another sample of 2 kg of the same gas is taken through the process ADC. Given relative molecular weight of Helium = 4.

- (i) What is the temperature of Helium in each of the states A, B, C and D?
- (ii) Is there any way of telling afterwards which sample of Helium went through the process ABC and which went through the process ADC? Write yes or no.
- (iii) How much heat is evolved in each of the processes ABC and ADC?



Solution

Amount of helium

$$= \frac{m}{M} = \frac{2 \times 10^3}{4 \text{ g mol}^{-1}} = 500 \text{ mole}$$

- (i) The temperature of gas at the states A, B, C and D are

$$T_A = \frac{PV}{nR}$$

$$= \frac{(5 \times 10^4 \text{ N/m}^2)(10 \text{ m}^3)}{(500 \text{ mole})(8.314 \text{ JK}^{-1} \text{ mole}^{-1})}$$

$$= \mathbf{120.28 \text{ K}}$$

$$T_B = \frac{(10 \times 10^4 \text{ N/m}^2)(10 \text{ m}^3)}{(500 \text{ mole})(8.314 \text{ JK}^{-1} \text{ mole}^{-1})}$$

$$= \mathbf{240.56 \text{ K}}$$

$$T_C = \frac{(10 \times 10^4 \text{ N/m}^2)(10 \text{ m}^3)}{(500 \text{ mole})(8.314 \text{ JK}^{-1} \text{ mole}^{-1})}$$

$$= \mathbf{481.12 \text{ K}}$$

$$T_D = \frac{(5 \times 10^4 \text{ N/m}^2)(20 \text{ m}^3)}{(500 \text{ mole})(8.314 \text{ JK}^{-1} \text{ mole}^{-1})}$$

$$= \mathbf{240.50 \text{ K}}$$

(ii) No.

(iii) For the process ABC, we have

$$Q_{AB} = nC_v\Delta T$$

$$= (500 \text{ mole})\left(\frac{3}{2} \times 8.314 \text{ JK}^{-1} \text{ mole}^{-1}\right)$$

$$(240.56 \text{ K} - 120.28 \text{ K})$$

$$= 7.5 \times 10^5 \text{ J}$$

$$Q_{BC} = nC_p\Delta T$$

$$= (500 \text{ mole}) \left(\frac{5}{2} \times 8.314 \text{ JK}^{-1} \text{ mole}^{-1} \right)$$

$$(481.12 \text{ K} - 240.56 \text{ K})$$

$$= 2.5 \times 10^6 \text{ J}$$

$$Q_{ABC} = Q_{AB} + Q_{BC}$$

$$= (7.5 \times 10^5 \text{ J} + 2.5 \times 10^6 \text{ J}) = \mathbf{3.25 \times 10^6 \text{ J}}$$

For the process ADC, we have

$$Q_{AD} = nC_p\Delta T$$

$$= (500 \text{ mole}) \left(\frac{5}{2} \times 8.314 \text{ JK}^{-1} \text{ mole}^{-1} \right)$$

$$(240.56 \text{ K} - 120.28 \text{ K})$$

$$= 1.25 \times 10^6 \text{ J}$$

$$Q_{DC} = nC_v\Delta T$$

$$= (500 \text{ mole}) \left(\frac{3}{2} \times 8.314 \text{ JK}^{-1} \text{ mole}^{-1} \right)$$

$$(481.12 \text{ K} - 240.56 \text{ K})$$

$$= 1.5 \times 10^6 \text{ J}$$

$$Q_{ADC} = Q_{AD} + Q_{DC}$$

$$= (1.25 \times 10^6 \text{ J} + 1.5 \times 10^6 \text{ J})$$

$$= \mathbf{2.75 \times 10^6 \text{ J}}$$

More example in Heat and Thermodynamics

A 1.00 mole sample of an ideal mono–atomic gas originally at a pressure of 1.00 atmosphere undergoes a three–step process:

- (i) It is expanded adiabatically from $T_1 = 550 \text{ K}$ and $T_2 = 389 \text{ K}$.
 - (ii) It is compressed at constant pressure until its temperature reaches T_3 .
 - (iii) It then returns to its original pressure and temperature by a constant–volume process.
- (a) Plot these processes on a p–V diagram.
- (b) Determine T_3 .
- (c) Calculate the change in integral energy the workdone by the gas, and heat added to gas for each process
- (d) For the complete cycle.

Solution :

First step Adiabatic Expansion

$$Q_1 = 0$$

$$\begin{aligned}W_1 &= n_1 C_v (T_2 - T_1) \\&= (1.00 \text{ mol}) \left(\frac{3}{2} \times 8.314 \text{ JK}^{-1} \text{ mole}^{-1} \right) \\&\quad \times (389 \text{ K} - 550 \text{ K}) \\&= -2007.8 \text{ J}\end{aligned}$$

For adiabatic expansion of an ideal gas

$$p_2 T_2^{(-C_p/R)g} = p_1 T_1^{(-C_p/R)g}$$

$$\text{Hence, } p_2 = p_1 \left(\frac{T_1}{T_2} \right)^{\frac{C_p}{R}} = (1.00 \text{ atm}) \left(\frac{389}{550} \right)^{\frac{5}{2}}$$

$$= 0.421 \text{ atm.}$$

$$V_2 = \frac{nRT_2}{p_2},$$

$$= \frac{(1.0 \text{ mole})(8.314 \text{ JK}^{-1} \text{ mole}^{-1})(550 \text{ K})}{(1.0 \times 101.325 \text{ kPa})}$$

$$= 45.1 \text{ dm}^3$$

$$\Delta U_1 = W_1 = -2007.8 \text{ J}$$

Second step compression at constant pressure:

The final volume in this process will be V_1 as in the third step, the system returns to the original state by constant volume process. Hence, in the second step,

$$T_2 = (389 \text{ K}) \text{ changes to } T_3$$

$$V_2 = (75.8 \text{ dm}^3) \text{ changes to } V_1$$

$$= 45.1 \text{ dm}^3$$

$$p_2 = \text{remains constant.}$$

Workdone in the process

$$W_2 = -p_2(V_1 - V_2)$$

$$= -(0.421 \times 101.325 \text{ kPa})(45.1 \text{ dm}^3 - 75.8 \text{ dm}^3)$$

$$= 1309.6 \text{ J}$$

$$T_3 = \left(\frac{V_1}{V_2} \right) T_2 = \left(\frac{45.1}{75.8} \right) (389 \text{ K}) = 231.4 \text{ K}$$

$$\begin{aligned} Q_2 &= n C_p (T_3 - T_2) \\ &= \left(\frac{5}{2} \times 8.314 \text{ JK}^{-1} \right) (231.4 \text{ K} - 389 \text{ K}) \\ &= -3275.7 \text{ J} \\ \Delta U_2 &= Q_2 + W_2 \\ &= -3275.7 \text{ J} + 1309.6 \text{ J} = -1966.1 \text{ J} \end{aligned}$$

Third step compression at constant volume in this process:

$$W_3 = 0$$

$$V_1 = (45.1 \text{ dm}^3) \text{ remains constant}$$

$$Q_3 = n C_v (T_1 - T_3)$$

$$= \left(\frac{3}{2} \times 8.314 \text{ JK}^{-1} \right) (550 \text{ K} - 231.4 \text{ K})$$

$$\Delta U = 3973.3 \text{ J}$$

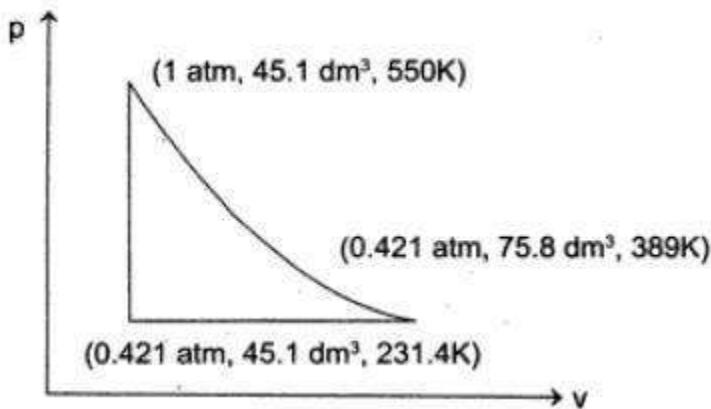
Since, the system return to its original state, we will have

$$\Delta U = Q + W = 0$$

$$\begin{aligned} \text{Now, } W &= W_1 + W_2 + W_3 \\ &= -2007.8 \text{ J} + 1309.6 \text{ J} + 0 \\ &= -698.2 \text{ J} \end{aligned}$$

$$\therefore Q = -W = 698.6 \text{ J}$$

The p - V plot of the given process is shown in the figure:



In the complete cycle

$$\Delta U = 0$$

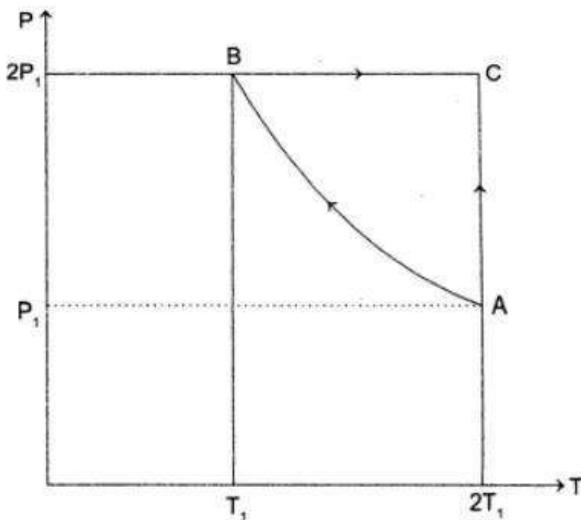
$$Q = Q_1 + Q_2 + Q_3 \\ = 0 - 3275.7 \text{ J} + 3973.3 \text{ J} = 697.6 \text{ J}$$

$$W = -Q = 697.6 \text{ J} (= W_1 + W_2 + W_3) \\ = -2007.8 + 1309.6 \text{ J} + 0 = \mathbf{698.2 \text{ J}}$$

Two mole of an ideal mono-atomic gas is taken through a cycle ABCA as shown in the $p - T$ diagram. During this process AB, pressure and temperature of the gas vary such that PT constant. If $T_1 = 300 \text{ K}$, calculate:

- (i) The work done on the gas in the process AB.
- (ii) The heat absorbed or released by the gas in each of the process.

Give answers in terms of the gas constant R .



Solution The volumes of the gas at three states A, B and C are as follows:

$$V_A = \frac{nRT_A}{P_A} = \frac{nR(2T_1)}{P_1} = \frac{2nRT_1}{P_1} \quad \dots(i)$$

$$V_B = \frac{nRT_B}{P_B} = \frac{nR(2T_1)}{P_1} = \frac{1}{2} \frac{nRT_1}{P_1} \quad \dots(ii)$$

$$V_C = \frac{nRT_C}{P_C} = \frac{nR(2T_1)}{2P_1} = \frac{nRT_1}{P_1} \quad \dots(iii)$$

It is given that during the process AB,

$$pT = K \quad \dots(iv)$$

where, K is constant and is given as

$$K = p_A T_A = (p_1)(2T_1) = 2 p_1 T_1 \quad \dots(v)$$

In the process AB, we will have

$$= \sqrt{nRk} \left[2\sqrt{V_B} - 2\sqrt{V_A} \right]$$

Using equations (i), (ii) and (v), we get

$$\begin{aligned} W_{AB} &= \sqrt{nR(2p_1T_1)} \left[2\sqrt{\frac{nRT_1}{2p_1}} - 2\sqrt{\frac{2nRT_1}{p_1}} \right] \\ &= (\sqrt{2} nRT_1)(2) \left[\frac{1}{2} - \sqrt{2} \right] \\ &= -2nT_1R \\ &= -2(2 \text{ mole})(200 \text{ K})R \\ &= -(1200 \text{ mole K})R \end{aligned}$$

The negative sign implies that the work is done on the gas.

Hence, work done on the gas

$$= \mathbf{(1200 \text{ mole K})R}$$

(ii) Change in energy of the gas in the process AB is

$$\begin{aligned}\Delta U_{AB} &= nC_v \Delta T \\ &= (2 \text{ mole}) \left(\frac{3}{2} R \right) (T_l - 2T_i) \\ &= -(3 \text{ mole}) T_i R \\ &= -(3 \text{ mole}) (300 \text{ K}) R \\ &= -(900 \text{ mole K}) R\end{aligned}$$

Now, from the first law of thermodynamics,

$$\begin{aligned}Q_{AB} &= \Delta U_{AB} + W_{AB} \\ &= -(1200 \text{ mole K}) \\ &\quad R - (900 \text{ mole K}) R \\ &= -(2100 \text{ mole K}) R\end{aligned}$$

The negative sign implies that the heat is released in the process AB. The pro-

cess BC takes place at constant pressure.

Hence,

$$\begin{aligned}W_{BC} &= p V \\ &= (2 p_i) (V_c - V_B) \\ &= (2 p_i) \left[\frac{nRT_l}{P_i} - \frac{nRT_l}{2P_i} \right] \\ &= nRT_l \\ &= (2 \text{ mole}) (300 \text{ K}) R \\ &= (600 \text{ mole K}) R\end{aligned}$$

Now, $\Delta U_{BC} = nC_v \Delta T$

$$= (2 \text{ mole}) \left(\frac{3}{2} R \right) (T_c - T_B)$$

$$\begin{aligned}
 &= (3 \text{ mole}) (R) (2 T_i - T_i) \\
 &= (3 \text{ mole}) (R) (300 \text{ K}) \\
 &= (900 \text{ mole K}) R \\
 Q_{BC} &= \Delta U_{BC} + W_{BC} \\
 &= (900 \text{ mole K}) R + (600 \text{ mole K}) \\
 &\quad R \\
 &= (1500 \text{ mole K}) R
 \end{aligned}$$

The positive sign implies that the heat is absorbed in the process BC.

The process CA takes place at constant temperature. Hence,

$$\begin{aligned}
 W_{CA} &= \int_{V_A}^{V_B} p dV \\
 &= \int_{V_A}^{V_B} \frac{nRT}{V} dV \\
 &= nRT \ln \frac{V_B}{V_A} \quad \dots (\text{where, } T = 2T_i) \\
 &= (2 \text{ mole}) (R) (2 \times 300 \text{ K}) \ln 2 \\
 &= (1200 \text{ mole K}) R \ln 2
 \end{aligned}$$

$$\Delta U_{CA} = 0$$

$$\begin{aligned}
 Q_{CA} &= \Delta U_{CA} + W_{CA} \\
 &= 0 + (1200 \text{ mole K}) R \ln 2
 \end{aligned}$$

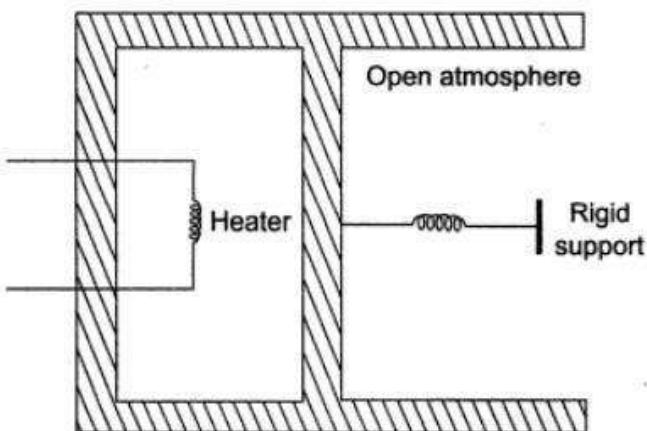
The positive sign implies that the heat is absorbed in the process CA.

An ideal mono-atomic gas is confined in a cylinder by a spring-loaded piston of cross-section $8 \times 10^{-3} \text{ m}^2$. Initially, the gas is at 300 K and occupies a volume of $2.4 \times 10^{-3} \text{ m}^3$ and the spring is in its relaxed (unstretched, uncompressed) state as shown in the figure. The gas is heated by a small electric heater until the piston moves out slowly by 0.1 m.

Calculate the final temperature of the gas and the heat supplied (in joules) by the heater. The force constant of the spring is 8000 Nm^{-1} and atmospheric pressure is $1 \times 10^5 \text{ Pascal}$. The cylinder and the piston are thermally insulated.

The piston is massless and there is no friction between the piston and cylinder. Neglect heat loss through the lead wires of the heater. The heat capacity of the heater coil is negligible.

(Assume the spring to be massless).



Solution Let p_0 be the atmospheric pressure.
Initially for the equilibrium of the piston, $p_L = p_R = p_0$
where p_L and p_R are the pressures on the left hand and right hand side of the piston.

Force exerted by the spring on the piston when it moves

$$F = kx = 8000 \times 0.1 \\ = 800 \text{ N}$$

∴ Pressure exerted on the piston by the spring

$$p_s = \frac{F}{A} = \frac{800 \text{ N}}{8 \times 10^{-3} \text{ m}^2} = 1 \times 10^5 \text{ Nm}^{-2}$$

∴ Total pressure acting on the right hand side

$$p'_R = p_0 + p_s \\ = 2 \times 10^5 \text{ N/m}^2$$

Under equilibrium $p'_L = p'_R$

$$\text{or } \frac{p_L V_L}{T_L} = \frac{p'_L V'_L}{T'_L} \\ = \frac{1 \times 10^5 \times 2.4 \times 10^{-3}}{300} \\ = \frac{2 \times 10^5 \times 3.2 \times 10^{-3}}{T'_L}$$

$$T'_L = 800 \text{ K}$$

$$\Delta U = nC_v \Delta T$$

$$\text{where, } n = \frac{p_L V_L}{R T_L} = \frac{1 \times 10^5 \times 2.4 \times 10^{-3}}{8.3 \times 300} \\ = 0.09638 \text{ mole}$$

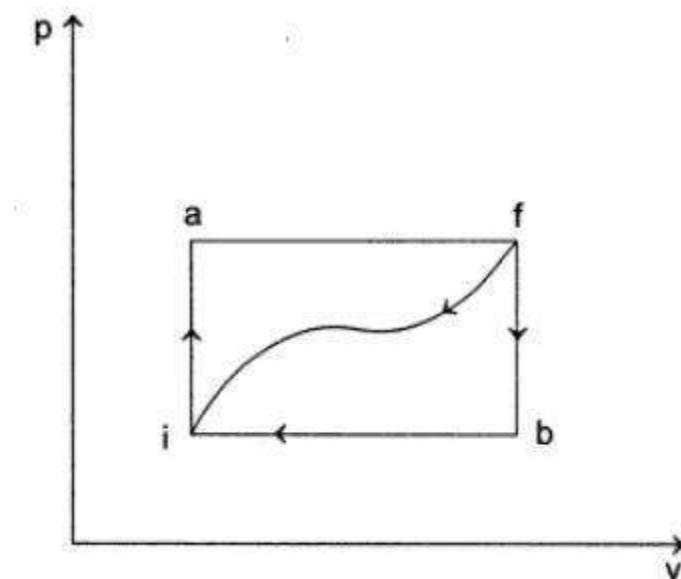
$$\therefore \Delta U = 0.09638 \times \frac{3}{2} \times 8.3 \times (800 - 300) = 600 \text{ J}$$

$$\begin{aligned}\Delta W &= \frac{1}{2}k \cdot x^2 + p_0 \cdot \Delta V \\ &= \frac{1}{2} \times 800 \times (0.1)^2 + 1 \times 10^5 \times 8 \times 10^{-4} \\ &= 120 \text{ J}\end{aligned}$$

$$\Delta Q = \Delta U + \Delta W = 600 + 120 = 720 \text{ J.}$$

A system is taken from state i to the state f (refer to the figure). Along path "iaf", it is found that $\Delta Q = 50 \text{ cal}$. $\Delta W = 20 \text{ cal}$. Along the path "ibf", $\Delta Q = 36 \text{ cal}$. Calculate:

- (i) ΔW along the path "ibf".
- (ii) If $\Delta W = -13 \text{ cal}$ for the curved path "fi", what is the ΔQ for this path?
- (iii) Taking $U_i = 10 \text{ cal}$, what is U_f ?
- (iv) If $U_b = 22 \text{ cal}$, what is ΔQ for the process "ib" and the process "bf"?



Solution Path “iaf” $\Delta Q = 50 \text{ cal}$

$$\Delta W = 20 \text{ cal}$$

$$\Rightarrow \Delta U = \Delta Q - \Delta W \\ = 50 - 20 = 30 \text{ cal}$$

$$\Rightarrow U_f - U_i = 30 \text{ cal}$$

As internal energy change is a state function.

ΔU will be same for any path from i to f .

(i) *Path “ibf”* $\Delta W = \Delta Q - \Delta U$
 $= 36 - (U_f - U_i)$
 $= 36 - 30 = 6 \text{ cal.}$

(ii) *Path “fi”* $\Delta Q = \Delta U + \Delta W$
 $= (U_f - U_i) + \Delta W$
 $= (-30) + (-13)$
 $= -43 \text{ cal}$

(iii) $U_f - U_i = 30 \text{ cal}$
 $U_f = U_i + 30 \quad \therefore = 40 \text{ cal.}$

(iv) *Process “ib”* $\Delta Q = \Delta U + \Delta W$
 $= (U_b - U_i) + (\Delta W)_{ibf}$
 $(\Delta W)_{ib} = (\Delta W)_{ibf}$
Because $(\Delta W)_{bf} = 0$
 $\Delta Q = (22 - 10) + 6$
 $= 18 \text{ cal.}$

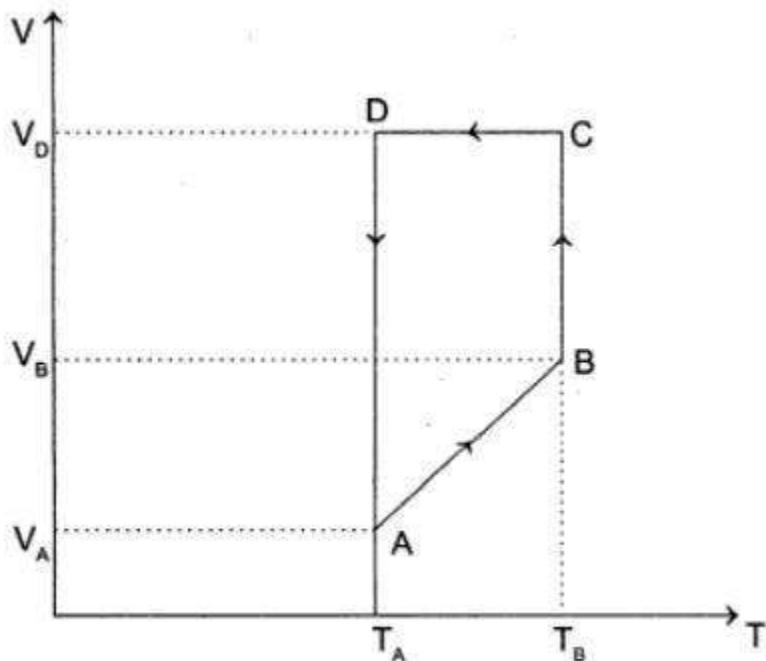
Process “bf” $\Delta Q = \Delta U + \Delta W$
 $= (U_f - U_b) + 0$
 $= (40 - 22)$
 $= 18 \text{ cal.}$

A mono-atomic ideal gas of two moles is taken through a cyclic process starting from A as shown in the figure. The volume ratios are $V_B/V_A = 2$ and $V_D/V_A = 4$. If the temperature T_A at A is 27°C ,

calculate:

- The temperature of the gas at point B.
- Heat absorbed or released by the gas in each process.
- The total work done by the gas during complete cycle.

Express your answer in terms of the gas constant R.



Solution

Given: $\frac{V_B}{V_A} = 2$ and $\frac{V_D}{V_A} = 4$

$$T_A = 27^\circ\text{C}$$

- (i) The process A → B in which the plot of V versus T is linear occurs at constant pressure condition.

$$\text{Hence } \frac{V_A}{T_A} = \frac{V_B}{T_B}$$

$$\text{or } T_B = \left(\frac{V_B}{V_A} \right) T_A = (2)(300 \text{ K})$$

$$= 600 \text{ K}$$

- (ii) The process A → B occurs at constant pressure. Hence,

$$\begin{aligned} Q_{A \rightarrow B} &= n C_p (T_B - T_A) \\ &= (2 \text{ mole}) \left(\frac{5}{2} R \right) (600 \text{ K} - 300 \text{ K}) \\ &= (1500 \text{ mole K}) R. \end{aligned}$$

The process B → C occurs at constant temperature. From first law of thermodynamics

$$dU = dQ - dW$$

Since, the internal energy of an ideal gas depends only on temperature, therefore

$$dU = 0 \text{ and } dQ = dW$$

$$Q_{B \rightarrow C} = W_{B \rightarrow C}$$

$$= \int p dV = n R T_B \int \frac{dV}{V}$$

$$= n R T_B \ln \frac{V_C}{V_B}$$

$$= n R T_B \ln \frac{V_D}{V_B} \dots \dots \text{(as } V_C = V_D)$$

$$\begin{aligned}
 &= nR T_B \ln \left(\frac{V_D}{V_A} \frac{V_A}{V_B} \right) \\
 &= (2 \text{ mole}) (R) (600 \text{ K}) \ln \left(\frac{4}{2} \right) \\
 &= (1200 \text{ mole K}) R \ln 2
 \end{aligned}$$

The process C → D occurs at constant volume. Hence,

$$\begin{aligned}
 Q_{C \rightarrow D} &= nC_v(T_A - T_B) \\
 &= (2 \text{ mole}) \left(\frac{3}{2} R \right) (300 \text{ K} - 600 \text{ K}) \\
 &= - (900 \text{ mole K}) R
 \end{aligned}$$

The process D → A occurs at constant temperature. Hence,

$$\begin{aligned}
 Q_{D \rightarrow A} = W_{D \rightarrow A} &= nRT_A \ln \frac{V_A}{V_D} \\
 &= (2 \text{ mole}) (R) (300 \text{ K}) \ln \left(\frac{1}{4} \right) \\
 &= - (1200 \text{ mole K}) R \ln 2.
 \end{aligned}$$

- (iii) Since, the process ABCDA is a cyclic process, therefore

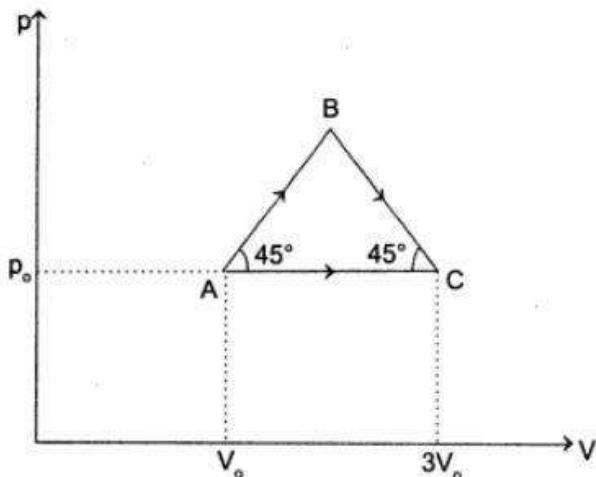
$$U = 0, W = Q$$

where,

$$\begin{aligned}
 Q &= Q_{A \rightarrow B} + Q_{B \rightarrow C} + Q_{C \rightarrow D} + Q_{D \rightarrow A} \\
 &= (1500 \text{ mole K}) R + (1200 \text{ mole K}) R \ln 2 - (900 \text{ mole K}) R - (1200 \text{ mole K}) R \ln 2 \\
 &= (600 \text{ mole K}) R.
 \end{aligned}$$

An ideal gas expands from a volume $V_0 = 1$ litre and pressure $p_0 = 1$ bar to volume 3 litre along two different paths ABC and AC as shown in figure. The heat added to the gas along the path ABC is 600 J.

- Sketch the process on p – T diagram.
- Find the work done by the gas along the paths ABC and AC.
- Find the heat transfer in the process along the path AC.



Solution

- Equation of line AB,

$$p - p_0 = \tan 45^\circ (V - V_0)$$

$$\text{Hence for ideal gas, } p = V$$

$$\text{Now } pV = KT$$

$$\Rightarrow p^2 = KT \text{ (parabola)} \\ \dots \text{(where K is constant.)}$$

At B $V_B = 2V_0$ and $p_B = 2p_0$

Equation of line BC, $p - 2p_0 = -\tan 45^\circ$

$(V - 2V_0)$

$$\therefore p = -V + 4$$

$$\Rightarrow p = -\frac{KT}{P} + 4$$

$$\therefore P^2 - 4p = -KT \text{ (Parabola)}$$

(ii) Workdone along path AC = $(\Delta W)_{AC}$

$$= p_0 (3V_0 - V_0)$$

$$= 2p_0 V_0$$

$$= 2 \times 1 \times 10^5 \times 1 \times 10^{-3}$$

$$= 200 \text{ J.}$$

(iii) For path ABC $(\Delta Q)_{ABC} = (\Delta U)_{AC} + (\Delta W)_{ABC}$

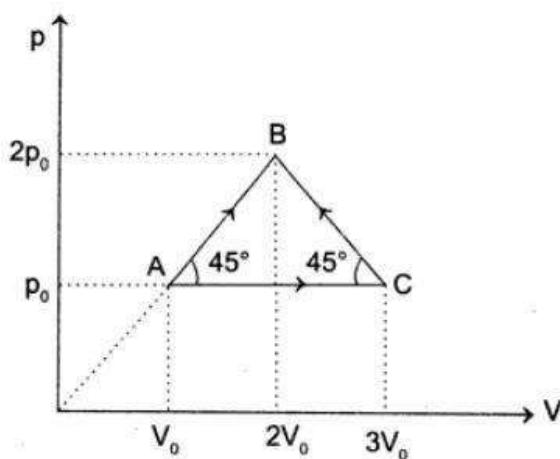
$$\Rightarrow (\Delta U)_{AC} = 600 - 300$$

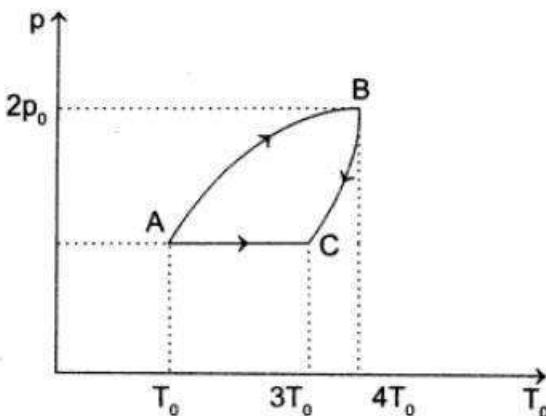
$$= 300 \text{ J.}$$

Heat transfer in the process along path AC,

$$(Q)_{AC} = (\Delta U)_{AC} + (\Delta W)_{AC}$$

$$= 300 + 200 = 500 \text{ J.}$$





A monatomic ideal gas, initially at temperature T_1 is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the lengths of the gas column before and after expansion respectively, then T_1/T_2 is given by

(a) $\left(\frac{L_1}{L_2}\right)^{2/3}$

(b) $\frac{L_1}{L_2}$

(c) $\frac{L_2}{L_1}$

(d) $\left(\frac{L_2}{L_1}\right)^{2/3}$

$$TV^{\gamma-1} = \text{constant}$$

$$\text{For monatomic gas } g = \frac{5}{3}$$

$$\Rightarrow TV^{2/3} = \text{constant}$$

Since volume is proportional to length, therefore,

$$\frac{T_1}{T_2} = \left(\frac{L_2}{L_1}\right)^{2/3}$$

Hence (d) is correct.

Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and the same volume V. The mass of gas contained in A is m_A and that in B is m_B . The gas in each cylinder is now allowed to expand isothermally to the same final volume $2V$. The change in the pressure in A and B are found to be Δp and $1.5 \Delta p$ respectively. Then

- (a) $4m_A = 9m_B$ (b) $2m_A = 3m_B$
 (c) $3m_A = 2m_B$ (d) $9m_A = 4m_B$

$$\text{For gas in A, } p_1 = \left(\frac{m_A}{M} \right) \frac{RT}{V_1}$$

$$p_2 = \left(\frac{m_A}{M} \right) \frac{RT}{V_2}$$

$$\therefore \Delta p = p_2 - p_1 = \left(\frac{RT}{M} \right) m_A \left(\frac{1}{V_1} - \frac{1}{V_2} \right)$$

Putting $V_1 = V$ and $V_2 = 2V$, we get

$$\Delta p = \left(\frac{RT}{M} \right) \frac{m_A}{2V}$$

$$\text{Similarly for Gas in B, } 1.5 \Delta p = \left(\frac{RT}{M} \right) \frac{m_B}{2V}$$

From equation (i) and (ii) we get

$$2m_B = 3m_A$$

Hence (c) is the correct.

Two insulating cylinders A and B fitted with pistons contain equal amounts of an ideal diatomic gas at temperature 300 K.

The piston A is free to move, while that of B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30 K. Then the rise in temperature of the gas in B is

- (a) 30 K
(c) 50 K

- (b) 18 K
(d) 42 K

For cylinder A For cylinder B

$$dQ = n C_p dT_1 \quad dQ = n CV dT_2 \\ = n (C_v + R) dT_1 \\ \therefore n C_v dT_2 = n(C_v + R) 30$$

$$\therefore dT_2 = \frac{(C_v + R) 30}{C_v}$$

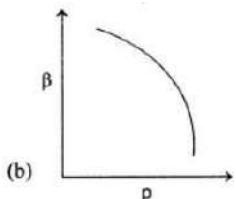
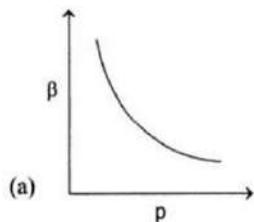
For diatomic gas $C_v = \frac{5}{2}R$

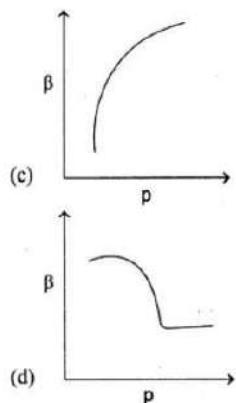
$$\therefore dT_2 = 42 \text{ K}$$

Hence (d) is correct.

Which of the following graph correctly represents the variation of

$$\hat{\alpha} = -\left(\frac{dV}{dp}\right)/V \quad \text{with } p \text{ for an ideal gas at constant temperature ?}$$





As temperature is constant,

$$pV = \text{constant}$$

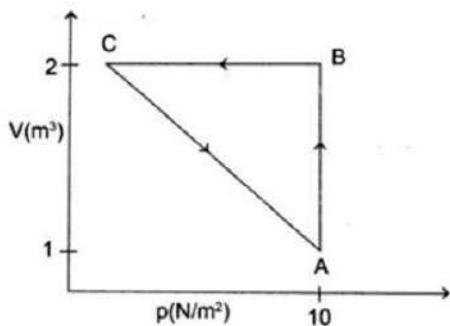
$$\Rightarrow pdV + Vdp = 0$$

$$\Rightarrow -\frac{(dV/dp)}{V} = \frac{1}{p}$$

$$\Rightarrow \beta = \frac{1}{p}$$

An ideal gas is taken through the cycle A \rightarrow B \rightarrow C \rightarrow A, as shown in the graph in the cycle is 5J, the work done by the gas in the process C \rightarrow A is (a) -5J (b) -10J

- (a) -15J (d) -20J



For the cyclic process $\Delta U = 0$

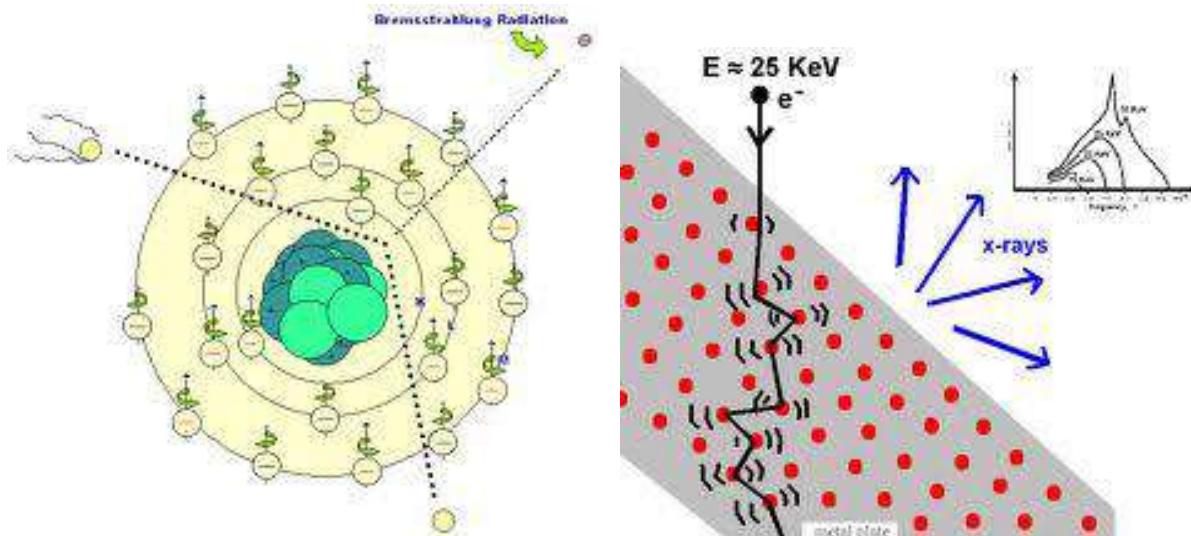
$$\begin{aligned}\Delta W &= W_{AB} + W_{BC} + W_{CA} \\ &= (10 + 0 + W_{CA}) \text{ J}\end{aligned}$$

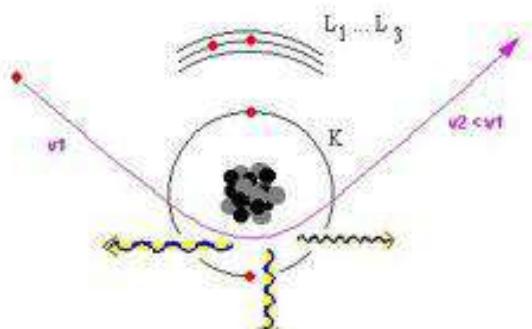
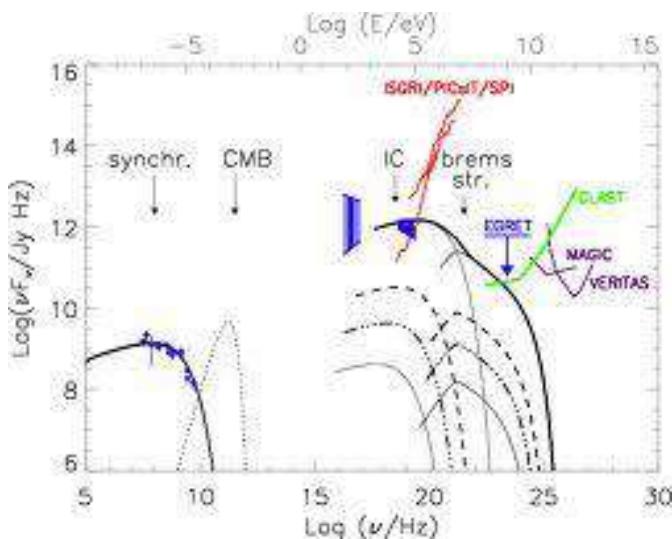
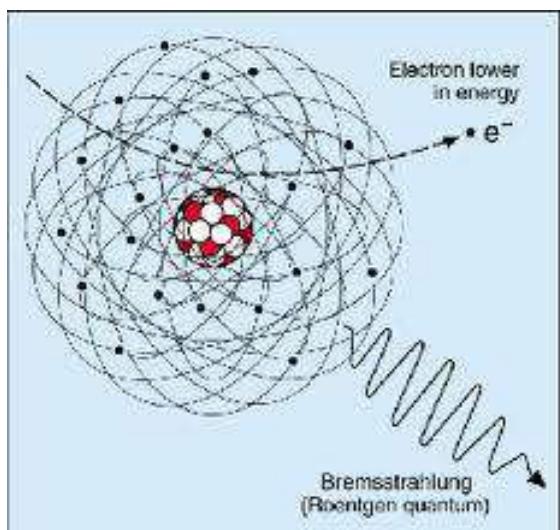
Given: $\Delta Q = 5 \text{ J}$

From first law of thermodynamics

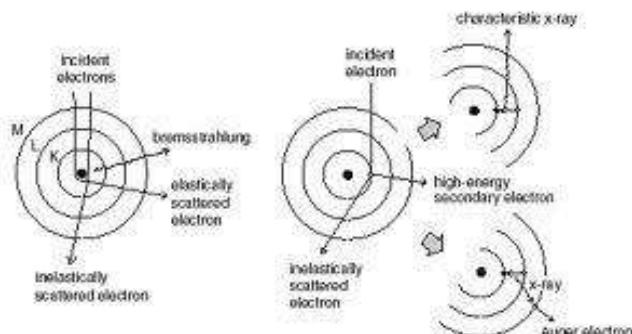
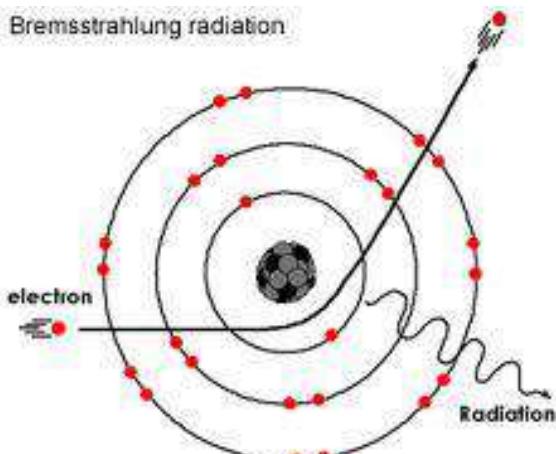
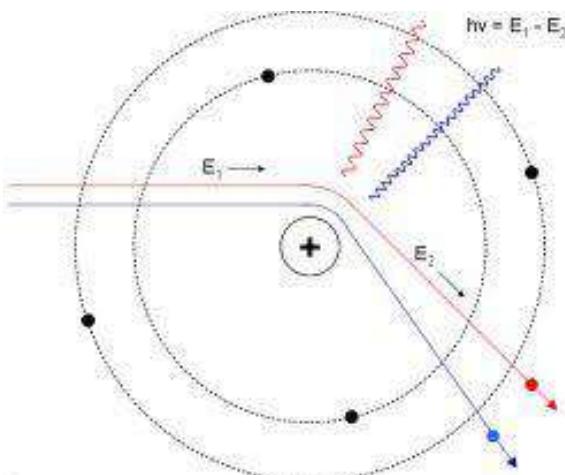
$$\begin{aligned}5 &= 10 + 0 + W_{CA} \\ \Rightarrow W_{CA} &= -5 \text{ J}\end{aligned}$$

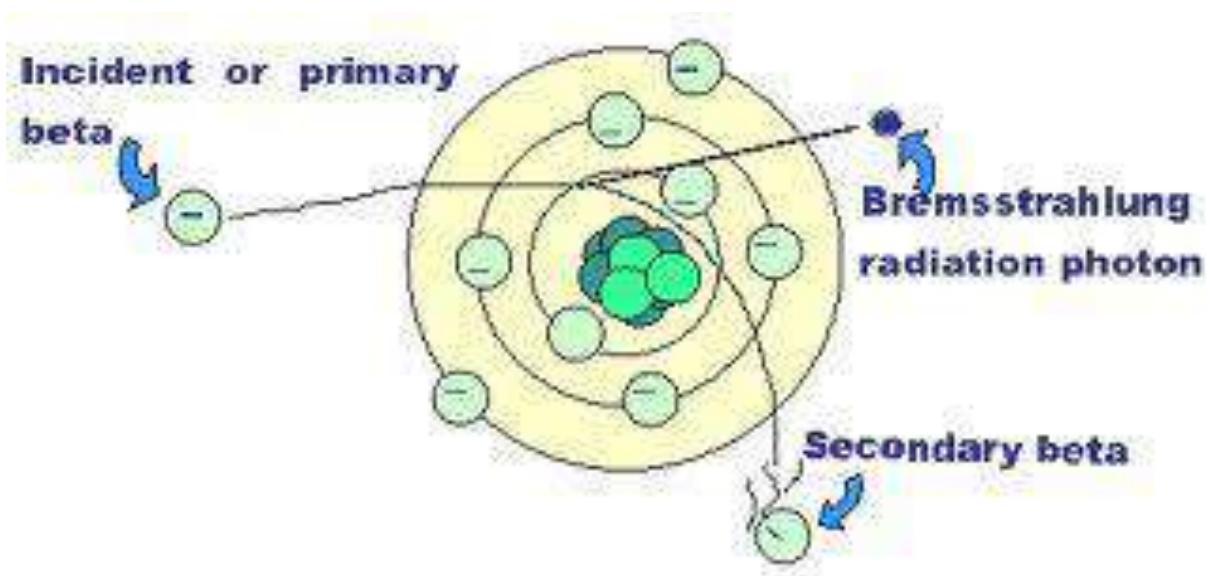
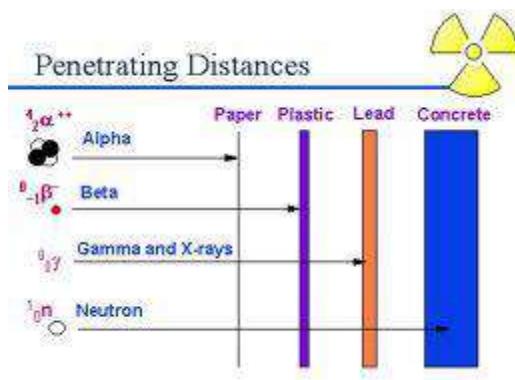
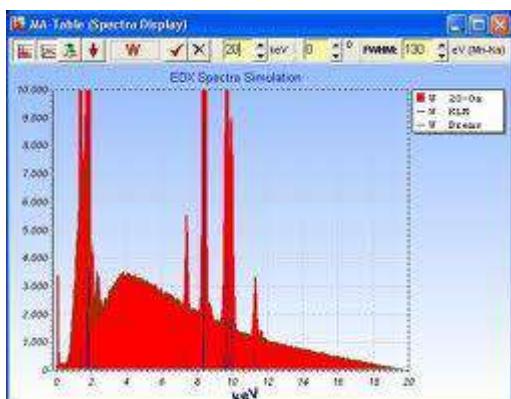
Bremsstrahlung Effect





Production of Bremsstrahlung

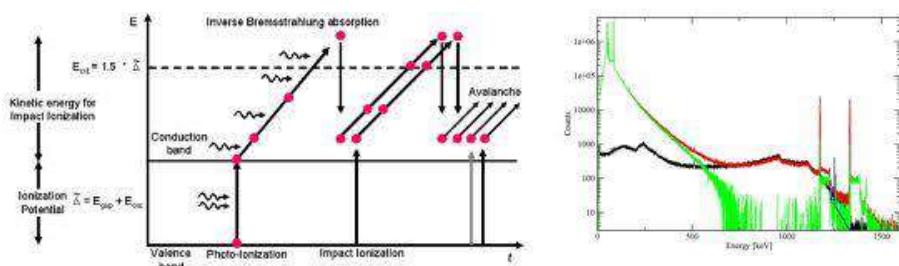




Bremsstrahlung (German word) from bremsen "to brake" and Strahlung "radiation", i.e. "braking radiation" or "deceleration radiation") is electromagnetic radiation produced by the deceleration of a charged particle when deflected by another charged particle, typically an electron by an atomic nucleus. The moving particle loses kinetic energy, which is converted into a photon because energy is conserved. The term is also used to refer to the process of producing the radiation. **Bremsstrahlung has a continuous spectrum**, which becomes more intense and shifts toward higher frequencies as the change of the energy of the accelerated particles increases.

Strictly speaking, bremsstrahlung is any radiation due to the acceleration of a charged particle, which includes **synchrotron radiation, cyclotron radiation, and the emission of electrons and positrons during beta decay**. However, the term is frequently used in the more narrow sense of radiation from electrons (from whatever source) stopping in matter.

Bremsstrahlung emitted from plasma is sometimes referred to as free-free radiation. This refers to the fact that the radiation in this case is created by charged particles that are free both before and after the deflection (acceleration) that causes the emission.



About Empirical Formulae

In chemistry, the empirical formula of a chemical compound is the simplest positive integer ratio of atoms present in a compound. A simple example of this concept is that the empirical formula of hydrogen peroxide, or H_2O_2 , would simply be HO. Glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), ribose ($\text{C}_5\text{H}_{10}\text{O}_5$), acetic acid ($\text{C}_2\text{H}_4\text{O}_2$), and formaldehyde (CH_2O) all have different molecular formulas but the same empirical formula: CH_2O . This is the actual molecular formula for formaldehyde, but acetic acid has double the number of atoms, ribose has five times the number of atoms, and glucose has six times the number of atoms.

In this article we are not discussing the above "Empirical formulas". There is another kind of "Empirical formulas" where the constants are determined by experiments, rather than derived. The dimensions on the left side or in the right sides may or may not match, case to case basis.

Slater's rule

In quantum chemistry, Slater's rules provide numerical values for the effective nuclear charge concept. In a many-electron atom, each electron is said to experience less than the actual nuclear charge owing to shielding or screening by the other electrons. For each electron in an atom, Slater's rules provide a value for the screening constant, denoted by s, S, or s_0 , which relates the effective and actual nuclear charges as

$$Z_{\text{effective}} = Z - \sigma \quad (\text{sigma})$$

The rules were devised semi-empirically by John C. Slater and published in 1930.

Revised values of screening constants based on computations of atomic structure by the Hartree-Fock method were obtained by Enrico Clementi et al in the 1960s

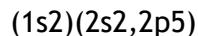
Steps to follow -

- 1.1) Write the electron configuration for the atom using the following design;
 $(1s)(2s,2p)(3s,3p) (3d) (4s,4p) (4d) (4f) (5s,5p)$
- 1.2) Any electrons to the right of the electron of interest contributes no shielding.
(Approximately correct statement.)
- 1.3) All other electrons in the same group as the electron of interest shield to an extent of 0.35 nuclear charge units
- 1.4) If the electron of interest is an s or p electron: All electrons with one less value of the principal quantum number shield to an extent of 0.85 units of nuclear charge. All electrons with two less values of the principal quantum number shield to an extent of 1.00 units.
- 1.5) If the electron of interest is an d or f electron: All electrons to the left shield to an extent of 1.00 units of nuclear charge.
- 1.6) Sum the shielding amounts from steps 2 through 5 and subtract from the nuclear charge value to obtain the effective nuclear charge.

—

Examples:

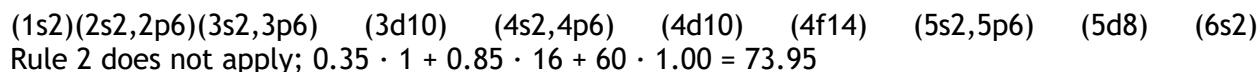
Calculate Z^* for a valence electron in fluorine.



$$\text{Rule 2 does not apply; } 0.35 \cdot 6 + 0.85 \cdot 2 = 3.8$$

$$Z^* = 9 - 3.8 = 5.2 \text{ for a valence electron.}$$

Calculate Z^* for a 6s electron in Platinum.



$$Z^* = 78 - 73.95 = 4.15 \text{ for a valence electron.}$$

Shielding

The first ionization energy for hydrogen is $1310 \text{ kJ}\cdot\text{mol}^{-1}$ while the first ionization energy for lithium is $520 \text{ kJ}\cdot\text{mol}^{-1}$. The IE for lithium is lower for two reasons—

1.7) The average distance from the nucleus for a 2s electron is greater than a 1s electron;

1.8) The 2s1 electron in lithium is repelled by the inner core electrons, so the valence electron is easily removed.

The inner core electrons shield the valence electron from the nucleus so the outer most electron only experiences an effective nuclear charge. In the case of the lithium the bulk of the 1s electron density lies between the nucleus and the 2s1 electron. So the valence electron ‘sees’ the sum of the charges or approximately +1. In reality the charge the valence electron experiences is greater than 1 because the radial distribution show there is some probability of finding the 2s electron close to the nucleus.

Effective nuclear charge Z^* increases very slowly down a group for the “valence” i.e. outermost orbital e.g.

H	1.0	Valence configuration same
Li	1.3	
Na	2.2	
K	2.2	
Rb	2.2	
Cs	2.2	

.....but increases rapidly along a period

Li	Be	B	C	N	O	F	Ne
1.3	1.95	2.6	3.3	3.9	4.6	5.2	5.9
2s ¹	2s ²	2p ¹	2p ²	2p ³	2p ⁴	2p ⁵	2p ⁶

Effective nuclear charges, Z_{eff}								
	H							He
Z	1							2
1s	1.00							1.69
	Li	Be	B	C	N	O	F	Ne
Z	3	4	5	6	7	8	9	10
1s	2.69	3.68	4.68	5.67	6.66	7.66	8.65	9.64
2s	1.28	1.91	2.58	3.22	3.85	4.49	5.13	5.76
2p			2.42	3.14	3.83	4.45	5.10	5.76
	Na	Mg	Al	Si	P	S	Cl	Ar
Z	11	12	13	14	15	16	17	18
1s	10.63	11.61	12.59	13.57	14.56	15.54	16.52	17.51
2s	6.57	7.39	8.21	9.02	9.82	10.63	11.43	12.23
2p	6.80	7.83	8.96	9.94	10.96	11.98	12.99	14.01
3s	2.51	3.31	4.12	4.90	5.64	6.37	7.07	7.76
3p			4.07	4.29	4.89	5.48	6.12	6.76

Moseley's Law

This law relates to the frequency of the spectral lines of the characteristic X–radiation of a chemical element to its atomic number. This law was experimentally established by H. Moseley in 1913. According to Moseley's law, the square root of the frequency ν of a spectral line of the characteristic radiation of an element is a linear function of its atomic number Z:

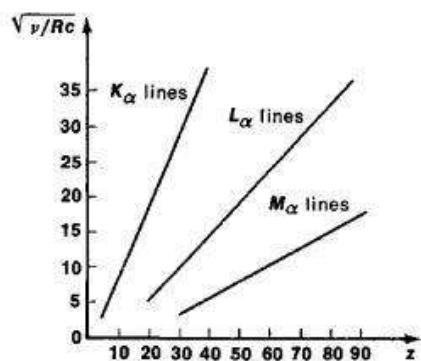
$$\sqrt{\frac{\nu}{R}} = \frac{Z - S_n}{n}$$

where R is the Rydberg constant, S_n is the screening constant, and n is the principal quantum number. On a Moseley plot (see Figure 1), the dependence of $\sqrt{\nu}$ on Z is a series of lines (such as the K_α lines, L_α lines, and M_α lines, which correspond to the values $n = 1, 2$, and 3).

Moseley's law was incontrovertible proof of the correctness of the arrangement of the elements in D. I. Mendeleev's periodic system of the elements and the law helped to clarify the physical significance of Z .

According to Moseley's law, the characteristic X-ray spectra do not display the periodic regularities that are inherent in optical spectra. This indicates that the inner electron shells of the atoms of all elements, which are manifested in the characteristic X-ray spectra, have an analogous structure.

Subsequent experiments revealed some deviations from a linear



Einstein–Debey equation (Dulong & Petit)

Dulong and Petit gave an Empirical Law for molar specific heat of Solids. The Dulong-Petit law, a thermodynamic rule proposed in 1819 by French physicists Pierre Louis Dulong and Alexis Thérèse Petit, states the classical expression for the molar specific heat capacity of a crystal. Experimentally the two scientists had found that the heat capacity per weight (the mass-specific heat capacity) for a number of substances became close to a constant value, after it had been multiplied by number-ratio representing the presumed relative atomic weight of the substance. These atomic weights had shortly before been suggested by Dalton.

In modern terms, Dulong and Petit found that the heat capacity of a mole of many solid substances is about $3R$, where R is the modern constant called the universal gas constant. Dulong and Petit were unaware of the relationship with R , since this constant had not yet been defined from the later kinetic theory of gases. The value of $3R$ is about 25 joules per kelvin (Close to 6 Calories per Kelvin), and Dulong and Petit essentially found that this was the heat capacity of crystals, per mole of atoms they contained.

The modern theory of the heat capacity of solids states that it is due to lattice vibrations in the solid, and was first derived in crude form from this assumption by Albert Einstein, in 1907. The Einstein solid model thus gave for the first time a reason why the Dulong-Petit law should be stated in terms of the classical heat capacities for gases.

Einstein's oscillator treatment of specific heat gave qualitative agreement with experiment and gave the correct high temperature limit (the Law of Dulong and Petit). The quantitative

fit to experiment was improved by Debye's recognition that there was a maximum number of modes of vibration in a solid. He pictured the vibrations as standing wave modes in the crystal, similar to the electromagnetic modes in a cavity which successfully explained blackbody radiation. The density of states for these modes, which are called "phonons", is of the same form as the photon density of states in a cavity.

In thermodynamics and solid state physics, the Debye model is a method developed by Peter Debye in 1912 for estimating the phonon contribution to the specific heat (heat capacity) in a solid. It treats the vibrations of the atomic lattice (heat) as phonons in a box, in contrast to the Einstein model, which treats the solid as many individual, non-interacting quantum harmonic oscillators. The Debye model correctly predicts the low temperature dependence of the heat capacity, which is proportional to T^3 (T Cube)

Reynolds number

In fluid mechanics, the Reynolds number (Re) is a dimensionless quantity that is used to help predict similar flow patterns in different fluid flow situations. The concept was introduced by George Gabriel Stokes in 1851, but the Reynolds number is named after Osborne Reynolds (1842-1912), who popularized its use in 1883

The Reynolds number is defined as the ratio of inertial forces to viscous forces and consequently quantifies the relative importance of these two types of forces for given flow conditions.

Reynolds numbers frequently arise when performing scaling of fluid dynamics problems, and as such can be used to determine dynamic similitude between two different cases of fluid flow. They are also used to characterize different flow regimes within a similar fluid, such as laminar or turbulent flow:

laminar flow occurs at low Reynolds numbers, where viscous forces are dominant, and is characterized by smooth, constant fluid motion;

turbulent flow occurs at high Reynolds numbers and is dominated by inertial forces, which tend to produce chaotic eddies, vortices and other flow instabilities.

In practice, matching the Reynolds number is not on its own sufficient to guarantee similitude. Fluid flow is generally chaotic, and very small changes to shape and surface roughness can result in very different flows. Nevertheless, Reynolds numbers are a very important guide and are widely used.

$$R = \text{Inertial Forces} / \text{Viscous Forces} = \rho v L \mu = \rho v L / \mu$$

$$\text{Inertial Force} = \rho (v^2) (L^2) = \rho v^2 L^2$$

$$\text{Viscous Force} = \mu v L = \mu v L$$

where

ρ = is the density of the fluid (kg/m^3).

ν = is the kinematic viscosity μ/ρ (m^2/s)

L = is a characteristic linear dimension, (travelled length of the fluid; hydraulic diameter when dealing with river systems) (m)

μ = is the dynamic viscosity of the fluid ($\text{Pa}\cdot\text{s}$ or $\text{N}\cdot\text{s}/\text{m}^2$ or $\text{kg}/(\text{m}\cdot\text{s})$)

—

Variation of viscosity with temperature

With an increase in temperature, there is typically an increase in the molecular interchange as molecules move faster in higher temperatures.

The gas viscosity will increase with temperature. According to the kinetic theory of gases, viscosity should be proportional to the square root of the absolute temperature, in practice, it increases more rapidly.

In a liquid there will be molecular interchange similar to those developed in a gas, but there are additional substantial attractive, cohesive forces between the molecules of a liquid (which are much closer together than those of a gas). Both cohesion and molecular interchange contribute to liquid viscosity.

The impact of increasing the temperature of a liquid is to reduce the cohesive forces while simultaneously increasing the rate of molecular interchange.

The former effect causes a decrease in the shear stress while the latter causes it to increase. The result is that liquids show a reduction in viscosity with increasing temperature. With high temperatures, viscosity increases in gases and decreases in liquids, the drag force will do the same.

The impact of increasing temperature will be to slow down the sphere in gases and to accelerate it in liquids. When you consider a liquid at room temperature, the molecules are tightly bound together by attractive inter-molecular forces (e.g. Van der Waal forces).

It is these attractive forces that are responsible for the viscosity since it is difficult for individual molecules to move because they are tightly bound to their neighbors.

The increase in temperature causes the kinetic or thermal energy to increase and the molecules become more mobile.

The attractive binding energy is reduced and therefore the viscosity is reduced. If you continue to heat the liquid the kinetic energy will exceed the binding energy and molecules will escape from the liquid and it can become a vapor.

So the temperature dependence of liquid viscosity is the phenomenon by which liquid viscosity tends to decrease (or, alternatively, its fluidity tends to increase) as its temperature

increases. This can be observed, for example, by watching how cooking oil appears to move more fluidly upon a frying pan after being heated by a stove.

Exponential model

An exponential model for the temperature-dependence of shear viscosity (μ) was first proposed by Reynolds in 1886.

$$\mu(T) = \mu_0 \exp(-bT)$$

where T is temperature and μ_0 and b are coefficients. See first-order fluid and second-order fluid. This is an empirical model that usually works for a limited range of temperatures.

Arrhenius model

The model is based on the assumption that the fluid flow obeys the Arrhenius equation for molecular kinetics:

$$\mu(T) = \mu_0 \exp\left(\frac{E}{RT}\right)$$

where T is temperature, μ_0 is a coefficient, E is the activation energy and R is the universal gas constant. A first-order fluid is another name for a power-law fluid with exponential dependence of viscosity on temperature.

Williams-Landel-Ferry model

The **Williams-Landel-Ferry** model, or **WLF** for short, is usually used for polymer melts or other fluids that have a glass transition temperature.

The model is:

$$\mu(T) = \mu_0 \exp\left(\frac{-C_1(T - T_g)}{C_2 + T - T_g}\right)$$

where T -temperature, C_1 , C_2 , T_g and μ_0 are empiric parameters (only three of them are independent from each other).

If one selects the parameter T_g based on the glass transition temperature, then the parameters C_1 , C_2 become very similar for the wide class of polymers. Typically, if T_g is set to match the glass transition temperature T_g , we get

$$C_1 \approx 17.44$$

and

$$C_2 \approx 51.6 \text{ K}$$

Van Krevelen recommends to choose

$$T_g = T_g + 43 \text{ K}, \text{ then}$$

$$C_1 \approx 8.86$$

and

$$C_2 \approx 101.6 \text{ K}$$

Using such *universal parameters* allows one to guess the temperature dependence of a polymer by knowing the viscosity at a single temperature.

In reality the *universal parameters* are not that universal, and it is much better to fit the **WLF** parameters from the experimental data.

Masuko and Magill model

The model is usually used for **polymer melts** or other fluids that have a **glass transition temperature** as well as the **WLF model**. Ordinarily, The WLF model is limited to the temperature interval between T_g and $T_g + 100 \text{ K}$. But this model can be applied to more wide temperature range.

The model is:

$$\log\left(\frac{\eta}{\eta_g}\right) = A \left[\exp\left\{\frac{B(T_g - T)}{T}\right\} - 1 \right]$$

The **A** and **B** are empirical parameters that does not depend on the materials. The average values are:

$$A = 14.25 \text{ to } 16.24,$$

and

$$B = 5.34 \text{ to } 7.60.$$

Viscosity of water

Viscosity of water equation accurate to within 2.5% from 0 °C to 370 °C:

$$\mu(T) = 2.414 \times 10^{-5} \times 10^{247.8/(T-140)}$$

where T has units of Kelvin, and μ has units of N·s/m².

Models for kinematic viscosity

The effect of temperature on the kinematic viscosity (ν) has also been described by a number of empirical equations.

Walther formula

The Walther formula is typically written in the form

$$\log_{10}[\log_{10}(\nu + \lambda)] = A - B \log_{10}(T)$$

where λ is a shift constant, and A, B are empirical parameters.

Wright model

The Wright model has the form

$$\log_{10}[\log_{10}[\nu + \lambda + f(\nu)]] = A - B \log_{10}(T)$$

where an addition function $f(\nu)$, often a polynomial fit to experimental data, has been added to the Walther formula.

Seeton model

The Seeton model is based on curve fitting the viscosity dependence of many liquids (refrigerants, hydrocarbons and lubricants) versus temperature and applies over a large temperature and viscosity range:

$$\ln \left(\ln \left(\nu + 0.7 + e^{-\nu} K_0 (\nu + 1.244067) \right) \right) = A - B * \ln (T)$$

where T is absolute temperature in kelvins, ν is the kinematic viscosity in centistokes, K_0 is the zero order modified Bessel function of the second kind, and A and B are liquid specific values. This form should not be applied to ammonia or water viscosity over a large temperature range.

For liquid metal viscosity as a function of temperature, Seeton proposed:

$$\ln \left(\ln \left(\nu + 0.7 + e^{-\nu} K_0 (\nu + 1.244067) \right) \right) = A - \frac{B}{T}$$

Variation of surface tension with temperature

Surface tension is dependent on temperature. For that reason, when a value is given for the surface tension of an interface, temperature must be explicitly stated. The general trend is that surface tension decreases with the increase of temperature, reaching a value of 0 at the critical temperature. For further details see the Eötvös rule below. There are only empirical equations to relate surface tension and temperature:

Eötvös:

$$\gamma V^{2/3} = k(T_C - T)$$

Here V is the molar volume of that substance, T_C is the critical temperature and k is a constant valid for almost all substances. A typical value is $k = 2.1 \times 10^{-7} [JK^{-1} mol^{2/3}]$. For water one can further use $V = 18 \text{ ml/mol}$ and $T_C = 374^\circ\text{C}$.

A variant on Eötvös is described by Ramay and Shields:

$$\gamma V^{2/3} = k(T_C - T - 6)$$

where the temperature offset of 6 kelvins provides the formula with a better fit to reality at lower temperatures.

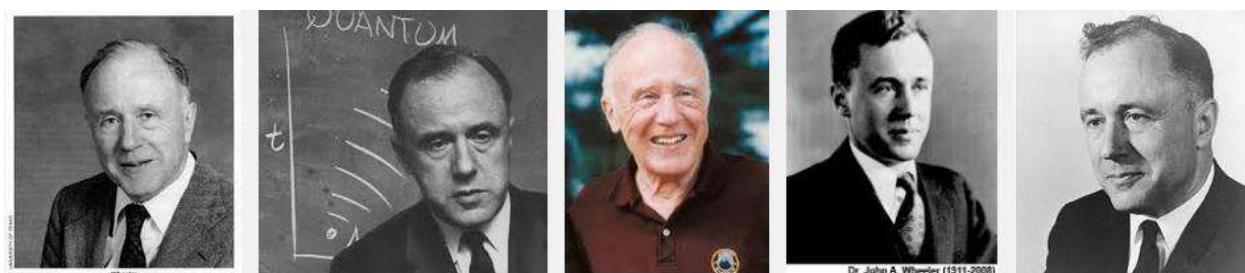
- Guggenheim-Katayama:

$$\gamma = \gamma^o \left(1 - \frac{T}{T_C}\right)^n$$

γ^o is a constant for each liquid and n is an empirical factor, whose value is 11/9 for organic liquids. This equation was also proposed by van der Waals, who further proposed that γ^0 could be given by the expression, $K_2 T_c^{1/3} P_c^{2/3}$, where K_2 is a universal constant for all liquids, and P_c is the critical pressure of the liquid (although later experiments found K_2 to vary to some degree from one liquid to another).

Both Guggenheim-Katayama and Eötvös take into account the fact that surface tension reaches 0 at the critical temperature, whereas Ramay and Shields fails to match reality at this endpoint.

Liquid drop model of Nucleus



In nuclear physics, description of atomic nuclei formulated (1936) by Niels Bohr and used (1939) by him and John A. Wheeler to explain nuclear fission. According to the model, the nucleons (neutrons and protons) behave like the molecules in a drop of liquid. If given sufficient extra energy (as by the absorption of a neutron), the spherical nucleus may be distorted into a dumbbell shape and then split at the neck into two nearly equal fragments, releasing energy. Although inadequate to explain all nuclear phenomena, the theory underlying the model provides excellent estimates of average properties of nuclei.

The semi-empirical mass formula (SEMF) (sometimes also called Weizsäcker's formula, or the Bethe–Weizsäcker formula, or the Bethe–Weizsäcker mass formula to distinguish it from the Bethe-Weizsäcker process) is used to approximate the mass and various other properties of an atomic nucleus from its number of protons and neutrons. As the name suggests, it is based partly on theory and partly on empirical measurements. The theory is based on the liquid drop model proposed by George Gamow, which can account for most of the terms in the formula and gives rough estimates for the values of the coefficients. It was first formulated in 1935 by German physicist Carl Friedrich von Weizsäcker, and although refinements have been made to the coefficients over the years, the structure of the formula remains the same today.

The SEMF gives a good approximation for atomic masses and several other effects, but does not explain the appearance of magic numbers of protons and neutrons, and the extra binding-energy and measure of stability that are associated with these numbers of nucleons.

Nuclear Shell Model



Maria Goeppert Mayer, who made important discoveries about nuclear structure, is one of only two women to have won the Nobel Prize in physics.

In August 1948, Goeppert Mayer published her first paper detailing the evidence for the nuclear shell model, which accounts for many properties of atomic nuclei.

During her time at Chicago and Argonne in the late 1940s, Goeppert Mayer developed a mathematical model for the structure of nuclear shells, which she published in 1950. Her model explained why certain numbers of nucleons in an atomic nucleus result in particularly stable configurations. These numbers are what Eugene Wigner called magic numbers: 2, 8, 20, 28, 50, 82, and 126. Enrico Fermi provided a critical insight by asking her: "Is there any indication of spin orbit coupling?" She realised that this was indeed the case, and postulated that the nucleus is a series of closed shells and pairs of neutrons and protons tend to couple together. She described the idea as follows:

Think of a room full of waltzers. Suppose they go round the room in circles, each circle enclosed within another. Then imagine that in each circle, you can fit twice as many dancers by having one pair go clockwise and another pair go counterclockwise. Then add one more variation; all the dancers are spinning twirling round and round like tops as they circle the room, each pair both twirling and circling. But only some of those that go counterclockwise are twirling counterclockwise. The others are twirling clockwise while circling counterclockwise. The same is true of those that are dancing around clockwise: some twirl clockwise, others twirl counterclockwise.

Three German scientists, Otto Haxel, J. Hans D. Jensen, and Hans Suess, were also working on solving the same problem, and arrived at the same conclusion independently. Their results were announced in the issue of the Physical Review before Goeppert Mayer's announcement in June 1949. Afterwards, she collaborated with them. Hans Jensen co-authored a book with Goeppert Mayer in 1950 titled *Elementary Theory of Nuclear Shell Structure*. In 1963, Goeppert Mayer, Jensen, and Wigner shared the Nobel Prize for Physics "for their discoveries concerning nuclear shell structure." She was the second and most recent female Nobel laureate in physics, after Marie Curie.

See <http://www.physicsoftheuniverse.com/intro.html>

The **shell model** of the nucleus presumes that a given nucleon moves in an effective attractive potential formed by all the other nucleons. If that is true, then the potential is probably roughly proportional to the **nuclear density** and therefore could be expressed in the form

$$V = \frac{-V_0}{1 + \exp\left(\frac{r - R}{a}\right)}$$

The parameters in this model of the potential have been evaluated to be approximately evaluated:

$$V_0 \approx 57 \text{ MeV} + \text{corrections}$$

$$R \approx 1.25 A^{1/3} \text{ fermi}$$

$$a \approx 0.65 \text{ fermi}$$

Note that the radius above is larger than that given by the **nuclear radius formula** since it is related to the nuclear force which extends beyond the radius. Two other corrections are typically applied to more nearly fit observations. The first is called the symmetry energy, arising when there is an unequal number of protons and neutrons. Empirically, it is evaluated as

$$\Delta V_s = \pm 27 \text{ MeV} \left[\frac{N - Z}{A} \right] \quad \begin{array}{l} - \text{neutrons} \\ + \text{protons} \end{array}$$

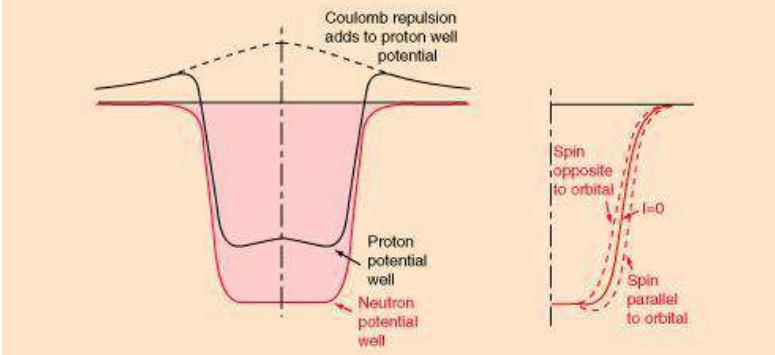
The other correction for protons is the electrostatic repulsion energy, which takes the form

$$V(r) = \frac{Zke^2}{R_c} \left(1 + \frac{1}{2} \left[1 - \left(\frac{r}{R_c} \right)^2 \right] \right) \quad r < R_c$$

$$V(r) = \frac{Zke^2}{r} \quad r > R_c$$

R_c = charge radius, distinct from R , the model radius for the nuclear potential.

The approximate potentials for neutrons and protons take the general form shown at left below.



Topic wise grouping of information kind of Dictionary of General Chemistry

Graphite and Diamond comparison

With respect to graphite and diamond, which of the following statement(s) given below is(are) correct?

- (a) Graphite is harder than diamond.
- (b) Graphite has higher electrical conductivity than diamond.
- (c) Graphite has higher thermal conductivity than diamond.
- (d) Graphite has higher C—C bond order than diamond.

Solution :

The given facts about graphite and diamond are as follows.

Graphite is less hard than diamond. Graphite has higher electrical and thermal conductivities than diamond. This is due to highly delocalized nature of π electrons. Graphite has higher C—C bond order (due to σ and π bonds) than that of diamond (which has only σ bonds)

Therefore, the **choices (b), (c) and (d)** are correct.

Stability of lyophobic colloidal particles

Choose the correct reason(s) for the stability of lyophobic colloidal particles.

- (a) Preferential adsorption of ions on their surface from the solution.
- (b) Preferential adsorption of solvent on their surface from the solution.
- (c) Attraction between different particles having opposite charges on their surface.
- (d) Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles.

Solution :

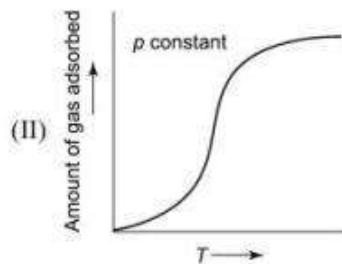
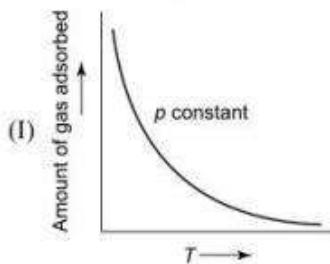
The stability of lyophobic colloidal particles is due to the preferential adsorption of common ion from the solution. Each colloidal particle has the same charge and are thus kept away from each other due to electronic repulsion (choice a).

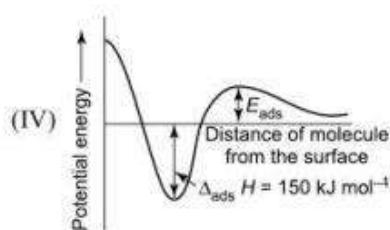
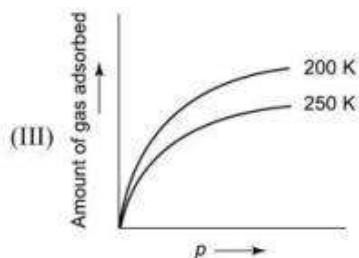
There exists potential difference between the fixed and diffused layer of opposite charge (choice d).

Therefore, the **choice (a) and (d)** are correct.

Physisorption and Chemisorption comparison

The given graph/data I, II, III and IV represent general trends observed for different physisorption and chemisorption processes under mild conditions of temperature and pressure. Which of the following choice(s) about I, II, III and IV is(are) correct.





- (a) I is physisorption and II is chemisorption
 (c) IV is chemisorption and II is chemisorption

(b) I is physisorption and III is chemisorption
 (d) IV is chemisorption and III is chemisorption

Solution:

We have the following facts.

- Adsorption decreases with increase in temperature at constant pressure in case of physisorption
 - Adsorption increases initially with increase in temperature at constant pressure in case of chemisorption as more molecules satisfy the energy of activation.
 - The enthalpy change during chemisorptions is high due to the bond formation between adsorbent and adsorbate.

With these guidelines, we will have

Graph I represents physisorption

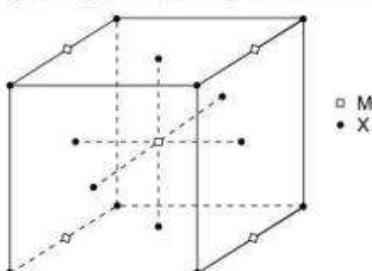
Graph III represents physisorption

Graph II represents chemisorption

Graph IV represents chemisorptions

Therefore, The **choices (a) and (c)** are correct.

A compound M_xX_y has cubic close packing (CCP) arrangement of X. Its unit cell structure is shown below.



The empirical formula of the compound is

Solution :

The atom at the corner of the cube is shared amongst 8 unit cells; the atom at the centre of a face is shared between 2 unit cells, the atom at the centre of edges is shared amongst 4 unit cells and that at the centre of the cube belongs wholly to the unit cell.

There are eight X atoms at the corners and six X atoms at the centre of faces. Thus, the number of X atoms per

unit cell is

$$8\left(\frac{1}{8}\right) + 6\left(\frac{1}{2}\right) = 1 + 3 = 4$$

There are four M atoms at the centre of edges and one M atom at the centre of the cube. Thus, the number of M atoms per unit cell is

$$4\left(\frac{1}{4}\right) + 1(1) = 1+1 = 2$$

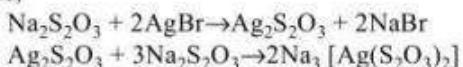
The formula of the compound will be M_2X_4 and the empirical formula will be MX_2 . Therefore, the choice (b) is correct.

HCl HBr and HI react with AgNO₃ to give a precipitate that dissolves in Na₂S₂O₃

Which of the following halides react(s) with $\text{AgNO}_3\text{(aq)}$ to give a precipitate that dissolves in $\text{Na}_2\text{S}_2\text{O}_3\text{(aq)}$?

Solution :

The precipitates of AgCl , AgBr and AgI are soluble in $\text{Na}_2\text{S}_2\text{O}_3$ (aq) forming the complex $\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$. For example,



AgF is soluble in water.

Therefore, the **choices (a), (c) and (d)** are correct.

Reversible expansion of an ideal gas

The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure.

Which of the following statement(s) is(are) correct?

- (a) $T_1 = T_2$
 (b) $T_2 > T_1$
 (c) $w_{\text{isothermal}} > w_{\text{adiabatic}}$
 (d) $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$

Solution :

We will have

$T_1 = T_2$ as the expansion is isothermal.

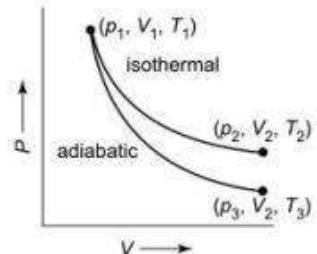
$T_3 < T_1$ as the adiabatic expansion involves cooling.

$W_{\text{isothermal}} > W_{\text{adiabatic}}$ as the area under the isothermal curve is greater than that under adiabatic curve.

$\Delta U_{\text{isothermal}} = 0$ as temperature remains constant while $\Delta U_{\text{adiabatic}} < 0$ as the expansion occurs at the expense of internal energy.

Therefore, the **choices (a) and (d)** are correct.

Note: The choice (c) is correct if the magnitude of the work is considered. Since expansion carries negative sign as per IUPAC recommendations, the choice (c) will not be correct if the negative sign is also considered.



Acid Ionization Constant	$K_a = \frac{[H^+][A^-]}{[HA]}$
Adiabatic change	$PV = k$
Base Ionization Constant	$K_b = \frac{[OH^-][HB^+]}{[B]}$
Bohr Radius	$a_0 = \frac{\hbar^2}{m_e k e^2}$
Boiling Point Elevation	$\Delta T_b = i K_b \times molality$
Buffer Design Equation	$pH \approx pK_a - \log \frac{[HA]_0}{[A^-]_0}$
Cell Voltage	$E_{cell} = E_{cell}^\circ - \frac{RT}{nF} \ln Q = E_{cell}^\circ - \frac{0.0592}{n} \log Q$
Charles' Law	$\frac{V}{t} = k$

Atomic Structure

DESCRIPTION	EQUATION
Bohr Radius	$a_0 = \frac{\hbar^2}{m_e k e^2}$
De Broglie Wavelength	$\lambda = \frac{\hbar}{mv}$
Linear Momentum	$p = mv$
Planck's Quantized (Quantum) Energy Equation	$\Delta E = h\nu$
Radii of stable orbits in the Bohr model	$r = n^2 \frac{\hbar^2}{m_e k Z e^2} = n^2 \frac{a_0}{Z}$
Relationship between Energy and Principal Quantum Number	$E_n = -R_H \left(\frac{1}{n^2} \right) = \frac{-2.178 \times 10^{-18}}{n^2} joule$

Rydberg Equation

$$\Delta E = R_H \left(\frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

Speed of Light to Wavelength and Frequency Relationship

$$c = \lambda\nu$$

Electrochemistry

DESCRIPTION	EQUATION
Cell Voltage	$E_{cell} = E_{cell}^\circ - \frac{RT}{nF} \ln Q = E_{cell}^\circ - \frac{0.0592}{n} \log Q$
Electric Current	$I = \frac{q}{t}$
Reaction Quotient	$Q = \frac{[C]^c [D]^d}{[A]^a [B]^b}$ where $aA + bB \rightarrow cC + dD$
Relationship between Equilibrium Constant and Cell Voltage	$\log K = \frac{nE^\circ}{0.0592}$

Equilibrium

DESCRIPTION	EQUATION
Acid Ionization Constant	$K_a = \frac{[H^+] [A^-]}{[HA]}$
Base Ionization Constant	$K_b = \frac{[OH^-] [HB^+]}{[B]}$
Buffer Design Equation	$pH \approx pK_a - \log \frac{[HA]_0}{[A^-]_0}$
Gas Pressure and Concentration Relationship	$K_p = K_c (RT)^{\Delta n}$
Ion Product Constant for Water	$K_w = [OH^-] [H^+] = K_a \times K_b = 1.0 \times 10^{-14} \text{ at } 25^\circ C$
pH and pOH Relationship	$14 = pH + pOH$
pH Defined	$pH = -\log [H^+]$
pK _a Definition	$pK_a = -\log K_a$

pK_b Definition

$$pK_b = -\log K_b$$

pOH and Base Ionization Equilibrium Constant Relationship

$$pOH = pK_b + \log \frac{[HB^+]}{[B]}$$

Gases, Liquids, and Solutions

DESCRIPTION	EQUATION
Adiabatic change	$PV = k$
Boiling Point Elevation	$\Delta T_b = iK_b \times \text{molality}$
Charles' Law	$\frac{V}{t} = k$
Combined Gas Law	$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$
Density of a Material	$D = \frac{m}{V}$
Freezing Point Depression	$\Delta T_f = iK_f \times \text{molality}$
Graham's Law of Effusion	$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$
Ideal gas equation	$PV = nRT$
Kinetic Energy per Mole	$\frac{KE}{mole} = \frac{3}{2}RTn$
Kinetic Energy per Mole	$\frac{KE}{mole} = \frac{3}{2}RTn$

Thermochemistry

DESCRIPTION	EQUATION
Acid Ionization Constant	$K_a = \frac{[H^+] [A^-]}{[HA]}$
Adiabatic change	$PV = k$
Base Ionization Constant	$K_b = \frac{[OH^-] [HB^+]}{[B]}$

Bohr Radius

$$a_0 = \frac{\hbar^2}{m_e k e^2}$$

Boiling Point Elevation

$$\Delta T_b = i K_b \times \text{molality}$$

Buffer Design Equation

$$pH \approx pK_a - \log \frac{[HA]_0}{[A^-]_0}$$

Cell Voltage

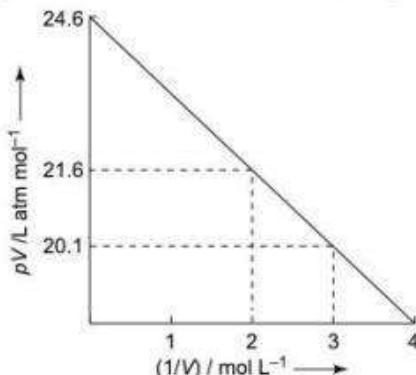
$$E_{cell} = E_{cell}^\circ - \frac{RT}{nF} \ln Q = E_{cell}^\circ - \frac{0.0592}{n} \log Q$$

Charles' Law

$$\frac{V}{t} = k$$

Vander waal's force

For one mole of a van der Waals gas when $b = 0$ and $T = 300 \text{ K}$, the plot of pV versus $1/V$ is shown below.



The value of the van der Waals constant a is

- (a) $1.0 \text{ L}^2 \text{ atm mol}^{-2}$ (b) $4.5 \text{ L}^2 \text{ atm mol}^{-2}$ (c) $1.5 \text{ L}^2 \text{ atm mol}^{-2}$ (d) $3.0 \text{ L}^2 \text{ atm mol}^{-2}$

Solution :

For one mole of a gas, the van der Waals equation is $\left(p + \frac{a}{V^2} \right)(V - b) = RT$

When $b = 0$, we have $\left(p + \frac{a}{V^2} \right)V = RT$ i.e. $pV = RT - \frac{a}{V}$

The plot of pV versus $1/V$ will be a straight line with slope equal to $-a$. Hence

Slope of the given straight line is $\frac{(20.1 - 21.6) \text{ L atm mol}^{-1}}{(3.0 - 2.0) \text{ mol L}^{-1}} = -1.5 \text{ L}^2 \text{ atm mol}^{-2}$

Equating this to $-a$, we get $a = 1.5 \text{ L}^2 \text{ atm mol}^{-2}$

Therefore, the **choice (c)** is correct.

dilute solution containing 2.5 gm of nonvolatile

For a dilute solution containing 2.5 g of a non-volatile non-electrolyte solute in 100 g of water, the elevation of boiling point at 1 atm pressure is 2 °C. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure of the solution (take $K_b = 0.76 \text{ K kg mol}^{-1}$) is

- (a) 724 mmHg (b) 740 mmHg (c) 736 mmHg (d) 718 mmHg

Solution :

From the expression $\Delta T_b = K_b m$, we find that the molality of solute (m) in the solution is

$$m = \frac{\Delta T_b}{K_b} = \frac{2 \text{ K}}{0.76 \text{ K kg mol}^{-1}} = \frac{2}{0.76} \text{ mol kg}^{-1}$$

Since $m = n_2/m_1$ (where n_2 is the amount of solute and m_1 is the mass of solvent expressed in kg), we get

$$n_2 = m m_1 = \left(\frac{2}{0.76} \text{ mol kg}^{-1} \right) (0.1 \text{ kg}) = \frac{2}{7.6} \text{ mol}$$

From the expression $-\Delta p = x_2 p_1^*$ of the relative lowering of vapour pressure of solvent (whose vapour pressure is 1 atm as the solute is non-volatile), we find that

$$x_2 = \frac{n_2}{n_1 + n_2} = \frac{n_2}{n_1} = \frac{n_2}{m_1 / M_1} = \frac{(2/7.6) \text{ mol}}{(100 \text{ g} / 18 \text{ g mol}^{-1})} = \frac{36}{76}$$

Hence $-\Delta p = \left(\frac{36}{760} \right) (760 \text{ mmHg}) = 36 \text{ mmHg}$

$$p = p_1^* + \Delta p = 760 \text{ mmHg} - 36 \text{ mmHg} = 724 \text{ mmHg}$$

Therefore, the choice (a) is correct.

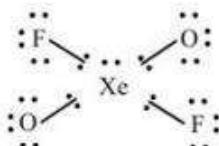
shape of XeO_2F_2 molecule is seesaw

The shape of XeO_2F_2 molecule is

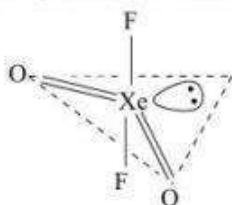
- (a) trigonal bipyramidal (b) square planar (c) tetrahedral (d) see-saw

Solution :

The number of valence electrons in XeO_2F_2 is $8 + 2 \times 6 + 2 \times 7 = 34$. These are distributed as shown in the following.



There are five pairs of electrons around Xe. To accommodate these, Xe undergoes dsp^3 hybridization leading to the trigonal bipyramidal arrangement of five pairs of electrons. The structure of XeO_2F_2 is



The shape of XeO_2F_2 is sea-saw.

Therefore, the choice (d) is correct.

Various increasing and Decreasing properties

Decreasing order of reactivity towards S_N2 displacement:

n-Butyl bromide, isobutyl bromide, *sec*-butyl bromide, *tert*-butyl bromide

Increasing order of reactivity towards S_N1 displacement:

1-bromopentane, 2-bromopentane, 2-bromo-2-methylbutane

Increasing reactivity sequence of S_N1 displacement of halogen: $CH_3X, 1^\circ X, 2^\circ X, 3^\circ X,$

Increasing reactivity sequence of S_N2 displacement of halogen: $CH_3X, 1^\circ X, 2^\circ X, 3^\circ X.$

Increasing reactivity of alcohols towards gaseous HBr:

2-butanol, 2-methyl-1-propanol, 2-methyl-2-propanol

Increasing order or reactivity towards E2 dehydrohalogenation of the bromides:

ethyl bromide, *n*-proyl bromide, isobutyl bromide, neopentyl bromide

Increasing stability of alkenes: $R_2C=CR_2, R_2C=CHR, R_2C=CH_2, RCH=CH_2, CH_2=CH_2$

Increasing dehydration of alcohol in the presence of H_2SO_4 :

ethyl alcohol, isopropyl alcohol, *tert*-butyl alcohol

Decreasing order of reactivity towards E2 dehydrohalogenation:

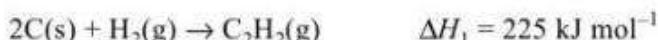
2-bromo-2-methylbutane, 1-bromopentane, 2-bromopentane, 3-bromopentane

Increasing order of dehydrohalogenation

1-bromo-3-methylbutane, 2-bromo-2-methylbutane, 3-bromo-2-methylbutane

calculate multiple bond energy of a C triple bond

Using the data provided, calculate the multiple bond energy of a $C\equiv C$ bond in C_2H_2 .

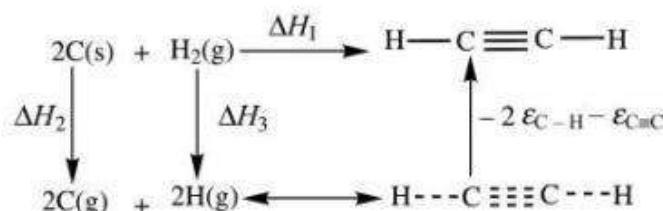


Take the bond energy of C—H bond equal to 350 kJ mol^{-1} .

- (a) 1165 kJ mol^{-1} (b) 837 kJ mol^{-1} (c) 865 kJ mol^{-1} (d) 815 kJ mol^{-1}

Solution:

Consider the following transformations.



According to Hess's law $\Delta H_1 = \Delta H_2 + \Delta H_3 - 2\epsilon_{C-H} - \epsilon_{C=C}$

This gives

$$\epsilon_{C=C} = \Delta H_2 + \Delta H_3 - \Delta H_1 - 2\epsilon_{C-H} = (1410 + 330 - 225 - 2 \times 350) \text{ kJ mol}^{-1} = 815 \text{ kJ mol}^{-1}$$

Therefore, the choice (d) is correct.

Some facts student must know

Largest Anion – At⁻

Metals having highest b.pt and m.pt. = mercury and tungsten

Most reactive solid element – Li

Most reactive liquid element – Cs

total no. of gaseous element in periodic table – 11 (H , He , N , O , F , Ne , Cl , Ar , Kr , Xe , Ra)

TOTAL NO. OF LIQUID elements – 6 (Ga , Br , Cs , Hg , Fr , EKa)

Liquid radioactive element – Francium

N.metal wid highest M.Pt – Carbon

Metal wid highest valency = Pluto

highest tensile strength — Boron

Most ionic compound = CsF

Strongest base = Cs (OH)

Strongest basic oxide = Cs_2O

Most conducting metal = Ag

T

Topic wise grouping of information kind of Dictionary of Organic Chemistry

Compounds of carbon with other elements in the periodic table:

Abscisic acid (ABA) – A PLANT HORMONE once thought to be responsible for the shedding (abscission) of flowers and fruit and for the onset of dormancy in buds (hence its early name, dormin). The compound is associated with the closing of pores (stoma) in the leaves of plants deprived of water.

Absolute configuration – A particular molecular configuration of a CHIRAL molecule, as denoted by comparison with a reference molecule or by some sequence rule. There are two systems for expressing absolute configuration in common use: the D-L convention and the R-S convention.

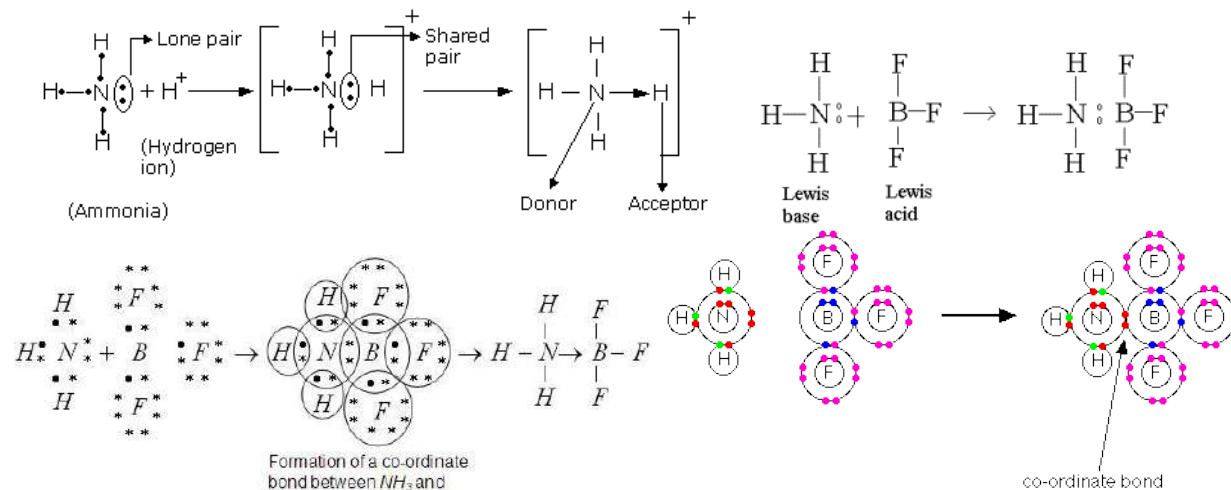
Absorption

1. A process in which a gas is taken up by a liquid or solid, or in which a liquid is taken up by a solid. In absorption, the substance absorbed goes into the bulk of the material. Solids that absorb gases or liquids often have a porous structure. The absorption of gases in solids is sometimes called sorption. There is a distinction between absorption (in which one substance is assimilated into the bulk of another) and ADSORPTION (which involves attachment to the surface). Sometimes it is not obvious which process is occurring. For example, a porous solid, such as activated CHARCOAL may be said to absorb a large volume of gas, but the process may actually be adsorption on the high surface area of internal pores in the material.

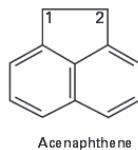
2. The process in which electromagnetic radiation, particles, or sound waves lose energy in passing through a medium. Absorption involves conversion of one form of energy into another.

Accelerator – A substance that increases the rate of a chemical reaction. In this sense the term is synonymous with CATALYST. It is common to refer to catalysts as ‘accelerators’ in certain industrial applications. For example, accelerators are used in the VULCANIZATION of rubber and in the polymerization of adhesives. Also, in the production of composite materials using polyester resins a distinction is sometimes made between the catalyst (which initiates the polymerization reaction) and the accelerator (which is an additional substance making the catalyst more effective). The terms promoter and activator are used in a similar way.

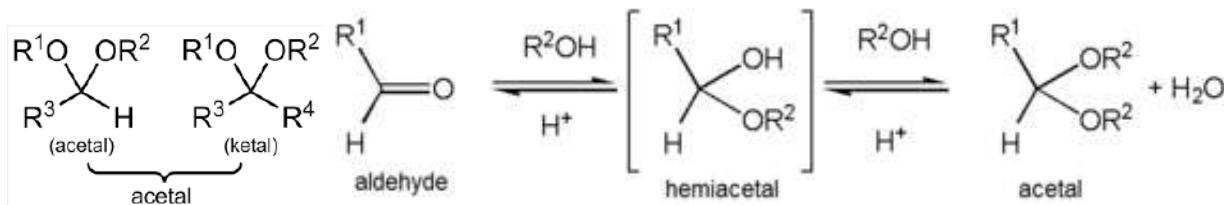
Acceptor – The atom or group to which a pair of electrons is donated in forming a COORDINATE BOND.



Acenaphthene – ($\text{C}_{12}\text{H}_{10}$) A colorless crystalline derivative of naphthalene, used in producing some dyes.



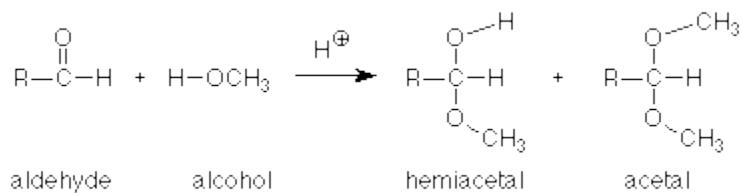
Acetal — A type of compound formed by reaction of an alcohol with either an aldehyde or a ketone. The first step in formation of an acetal is the formation of an intermediate, known as a hemiacetal. For example, ethanal (acetaldehyde; CH₃CHO) reacts with ethanol (C₂H₅OH) as follows: CH₃CHO + C₂H₅OH \rightleftharpoons CH(OH)(CH₃)(C₂H₅O). The **hemiacetal** has a central carbon atom (from the aldehyde) attached to a hydrogen, a hydroxyl group, a hydrocarbon group (methyl – CH₃), and an alkoxy group (C₂H₅O). If a ketone is used rather than an aldehyde, the resulting hemiacetal contains two hydrocarbon groups. For example, reaction of the ketone R₁COR₂ with the alcohol R₃OH is: R₁COR₂ + R₃OH \rightleftharpoons CR₁R₂(OH)(OR₃)



The formation of a hemiacetal is an example of NUCLEOPHILIC ADDITION to the carbonyl group of the aldehyde or ketone. The first step is attack of the lone pair on the O of the alcohol on the (positively charged) C of the carbonyl group. This is catalyzed by both acids and bases. Acid catalysis occurs by protonation of the O on the carbonyl, making the C more negative and more susceptible to nucleophilic attack. In base catalysis the OH⁻ ions from the base affect the -OH group of the alcohol, making it a more effective nucleophile.

In general, hemiacetals exist only in solution and cannot be isolated because they easily decompose back to the component alcohol and aldehyde or ketone. However, some cyclic hemiacetals are more stable. For example, cyclic forms of SUGAR molecules are hemiacetals.

Further reaction of hemiacetals with another molecule of alcohol leads to a full acetal. For example: CH(OH)(CH₃)(OC₂H₅) + C₂H₅OH \rightleftharpoons CH(CH₃)(OC₂H₅)₂

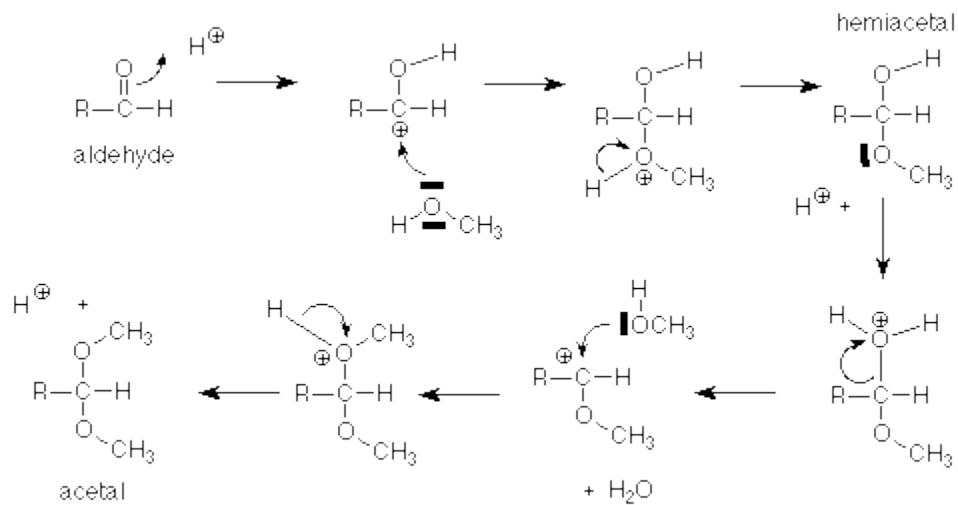


The overall reaction of an aldehyde or ketone with an alcohol to give an acetal can be written: R₁COR₂ + R₃OH \rightleftharpoons CR₁R₂(OR₃)₂

It is also possible to have ‘mixed’ acetals with the general formula CR₁R₂(OR₃)-(OR₄). Note that if the acetal is derived from an aldehyde, then R₁ and/or R₂

May be a hydrogen atom. The mechanism of formation of an acetal from a hemiacetal is acid catalyzed. It involves protonation of the -OH group of the hemiacetal followed by loss of water to form an oxonium ion, which is attacked by the alcohol molecule.

Formerly it was conventional to use the terms ‘hemiacetal’ and ‘acetal’ for compounds formed by reaction between aldehydes and alcohols. Similar reactions between ketones and alcohols gave rise to compounds called hemiketals and ketals. Current nomenclature uses ‘hemiacetal’ and ‘acetal’ for compounds derived from either an aldehyde or a ketone, but reserves ‘hemiketal’ and ‘ketal’ for those derived from ketones. In other words, the ketals are a subclass of the acetals and the hemiketals are a subclass of the hemiacetals.

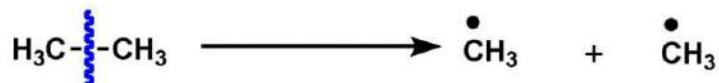


Achiral – Describing a molecule that does not have chiral properties; i.e. one that does not exhibit OPTICAL ACTIVITY.

Bond fission

A covalent bond is formed when electrons are shared between two atoms in the classical sense. A single bond (sigma bond) is thus made up of two electrons. Now a chemical reaction takes place when old bonds are broken and new ones are created. So how can one break a single bond—there are plainly two ways to go about breaking a bond as shown below.

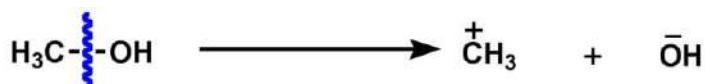
Homolytic fission



Homolysis

Homolytic fission is where each atom of the bond keeps an electron each resulting in species called free radicals. Radicals are important intermediates in organic chemistry and we will talk about them later. As the bond breaks to give two similar species each keeping an electron this form of bond breaking is called *Homolytic Fission*.

Heterolytic fission



Heterolysis

In this case we can see that one of the atoms carry a negative charge after bond cleavage indicating that it has both the electrons of the bond and the other has no electrons at all. Hence it is electron deficient thus positively charged. As the electrons are not divided equally after bond cleavage this is called *Heterolytic Fission*. In a case the C atom carries a positive charge it is called a carbocation and in the case it carries both the electrons of the broken bond and is negatively charged, it is called a Carbanion. Carbocation and Carbanions are the most important carbon intermediates in organic chemistry. Please note that both types of fissions are applicable to both homoatomic and heteroatomic bonds (bonds between two different atoms say C–N or C–O).

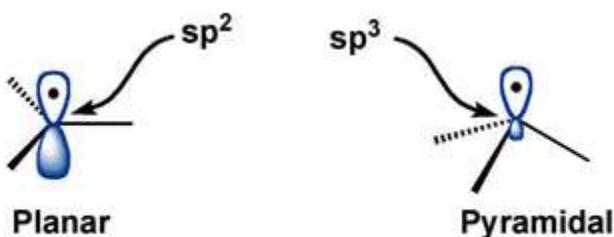
Free radicals

These are neutral intermediates, formed due to homolytic cleavage of a single bond. Some common bonds which cleave to give free radicals in organic chemistry are shown: C–O, C–Cl, C–Br, C–I, C–C, C–H. Carbon free radicals are mainly generated by:

- i. Photolysis (action of light) like acetone alpha cleavage
- ii. Other radical initiator like allylic bromination by N–Bromosuccinimide (NBS)

There has been a certain degree of debate as to what the shape and geometry of a free radical is like. Revisiting the theory of hybridization, there can be two basic shapes of these radicals.

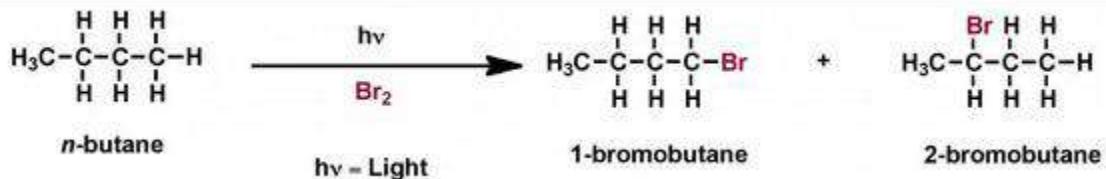
If the centre carbon atom of the radical is sp^3 hybridized (remember the one which was made of one s and three orbitals as in CH_4), the geometry will be tetrahedral.¹ But in the case of a radical there are only three groups attached to the sp^3 hybridized carbon atom so they we will have a shape of what resembles a pyramid—it's a tetrahedron with its head cut off. So sp^3 hybridized radicals are pyramidal in shape. The single electron of the radical would then be housed in a sp^3 orbital. The other option is sp^2 hybridization. In that case the C atom is sp^2 hybridized, so as discussed previously the shape would be planar with the single electron in the unhybridized p-orbital with the three substituents having sp^2 hybridized bonds.



Two different geometries of free radicals. The single electrons are shown as black dots.

So to summarize free radicals:

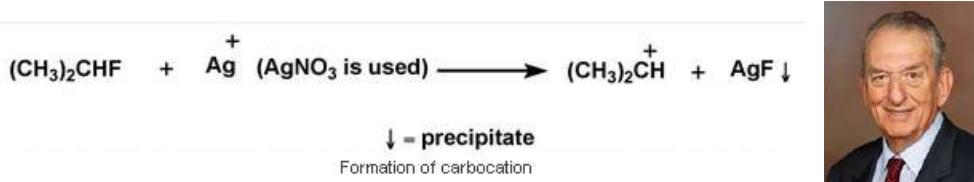
- Formed under activation by light or use of additional compounds called Radical Initiators.
- They are very reactive, because they have an unpaired electron which wants to get paired up.
- They are either pyramidal or planar with the lone electron in their sp^3 or p orbitals respectively.
- Because of their high reactivity, they tend to be less selective. In simple terms it means that it sometimes difficult to predict what products are formed in reactions which involve free radicals and we actually get several products from a single reaction.



This reaction shows the formation of two products with the Br atom attached to different carbons.

Carbocations

Carbocations are formed from the heterolytic cleavage of a carbon–heteroatom (meaning a non carbon atom in general) bond where the other atom is more electronegative than carbon like a C–O, C–N, C–X (X can be Cl, Br, I, etc) bond. This is quite logical as after the cleavage if a carbocation is to be formed the two electrons of the bond must go to the other atom. And this is favoured if that other atom is electronegative. Carbocations can be made in difficult conditions by using so-called superacids, developed by George Olah (Nobel Prize, 1994), which helps stabilize these intermediates substantially to be analyzed. Formation of carbocations can be assisted by using cations like Ag^+ , with alkyl halides as substrates.



The precipitating out of the silver salt forces the equilibrium to shift towards the forwards reaction.

A Similar reaction is [Finkelstein reaction](#) is particularly useful for preparing iodoalkanes. The iodoalkanes are obtained by heating chloro or bromoalkanes with a concentrated solution of sodium iodide in dry acetone.

In Acetone after Reflux (Heating in enclosed container) for a long time [Refluxing is a process of heating a liquid in a flask provided with a condenser. The vapours of the liquid which rise up get condensed back into the flask.]



Sodium chloride and sodium bromide being less soluble in acetone get precipitated from the solution and can be removed by filtration. This also prevents the backward reaction to occur according to Le Chatelier's principle. The reaction gives the best results with primary halides.

With iodide, the solvate $\text{NaI} \cdot 3(\text{CH}_3)_2\text{CO}$ can be formed, in which each Na^+ is coordinated by 6 acetone ligands via oxygen lone pairs, and the I^- ions fill in the gaps between these octahedral units, being surrounded by the methyl groups of the acetones. I^- has a larger ionic radius compared to Cl^- and Br^- and thus fills the gap completely, thereby minimizing empty space in the lattice and its distance to Na^+ , which is, however, still larger than in solvent–free sodium iodide. This larger distance between the ions decreases the lattice energy, which in turn makes the compound readily soluble in acetone. Cl^- and Br^- are too small to fit in these gaps, and as the cation–anion distance becomes too large, the only way to minimize the lattice energy is the formation of a solvent–free structure NaX ($\text{X} = \text{Cl}^-, \text{Br}^-$). When the lattice energy is larger than the energy released by solvation of the ions, namely that of Na^+ by complexation with acetone, the compound becomes insoluble and precipitates from the solution.

The positively charged carbon atom in carbocations is sp^2 hybridized, which means it's planar as we know by now. The three substituents of the carbocation lie in a plane leaving the unhybridized empty p orbital perpendicular to them.

These intermediates react with species which are electron rich (quite obvious) and being charged are stabilized in polar solvents. (Just as Na^+ is soluble and stable in polar water). Carbocations are important intermediates in most mechanisms along with carbanions as we shall see later.

To summarize carbocations:

- Formed due to heterolysis of a C–X bond (where X is more electronegative) and thus has a positive charge.
- Planar in shape (sp^2 hybridized carbon), with empty p orbital perpendicular to the plane of the molecule.
- Reactive towards electron rich species.

Carbanions

These are intermediates also formed as a result of heterolysis, but here the electron pair from the bond is kept by the carbon atom. From what we saw earlier the more electronegative atom keeps the electrons, so in this case carbon must be the more electronegative of the two atoms making up the bond. Now there are only a few atoms (non-metals; metals are not usually part of organic chemistry) which are less electronegative, so the most common bond cleavage which yields carbanions is the C–H bond. The ease of breaking this bond and creating a carbanion is also a measure of the compound's acidity, because a H^+ is also generated with the carbanion, which makes the molecule an acid in the Bronsted sense.

Carbanions have three groups attached to each other and a lone pair of electrons which gives it its negative charge (similar to the ammonia molecule where the central N has 3 Hs and a lone pair of electrons). So its geometry is pyramidal (tetrahedral but since there is no fourth group again it's like a tetrahedral with head cut off) and the carbon atom is sp^3 hybridized.

Carbanions are also stable in polar solution (electrostatic stabilization).

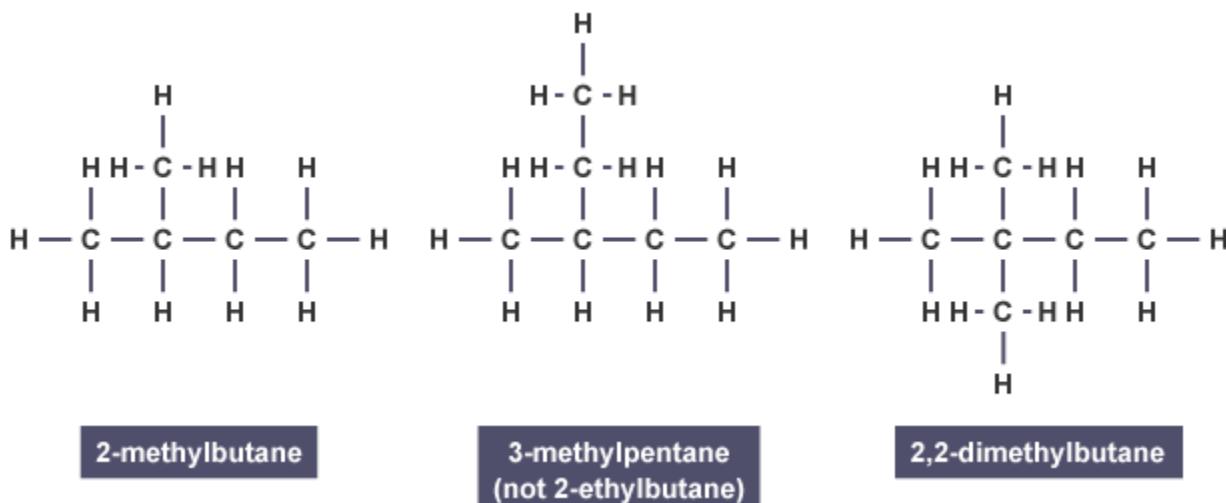
To summarize carbanions:

- Formed due to heterolysis of a C–X bond (where X is less electronegative) and thus has a negative charge.
- Pyramidal in shape (sp^3 hybridized) with the excess electrons placed in one sp^3 hybrid orbital.
- Reactive towards positively charged (electron deficient species).

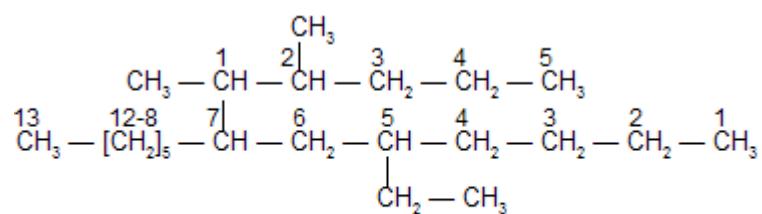
Stability of intermediates

Most organic reactions take place via formation of intermediates. So the study of different intermediates would help us predict the course of the reaction and the main aspect to look at would be their stability. No organic mechanism has been conclusively 'PROVEN', all the mechanism we see are the most plausible ones derived from many experiments, a major component of which is isolating and studying the intermediates. It is difficult to say that a certain mechanism is absolutely correct, but it is quite simple to point out an incorrect mechanism. One of the ways a chemist would confirm an incorrect mechanism is if it involves a very unstable intermediate. The good thing about this is that with a few empirical rules and principles in mind, it is quite simple to assign relative stability of intermediates like radicals, carbocations and carbanions. And what is even better is that we have already discussed these principles.

For carbocations and free radicals (both electron poor species), any group which donates electron density to the carbon centre would stabilize it and inversely electron withdrawing groups would increase electron deficiency on the carbon centre leading to destabilization. (Remember charge is not desirable, the most stable species are usually neutral). So following the same logic the effect should just be opposite in the case of carbanions as they are electron rich (negatively charged) instead of being electron deficient like the above two. So groups which pull away electrons from the charged carbon atom would have a stabilizing effect whereas electron donation would destabilize the intermediate as it loads more negative charge on an already negatively charged atom.

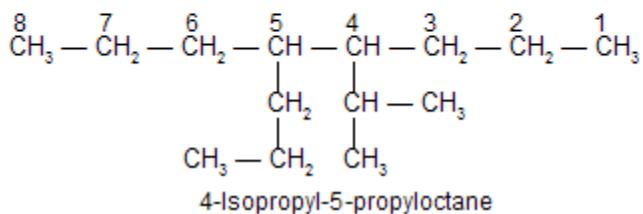
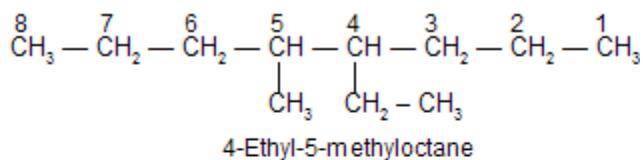


The name of a complex radical is considered to start with the first letter of its complete name.

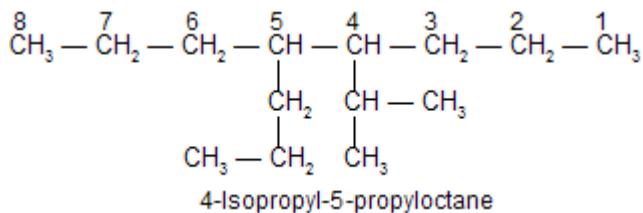
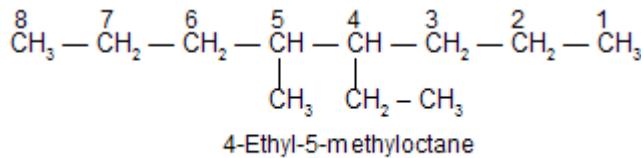


dimethylpentyl (as a complete single substituent) is alphabetized under "d", thus 7-(1,2-Dimethylpentyl)-5-ethyltridecane

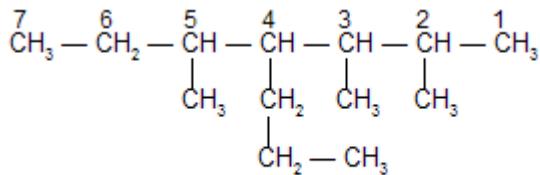
In cases where names of complex radicals are composed of identical words, preference for citation is given to that radical which contains the lowest locant at the first cited point of difference in the radical.



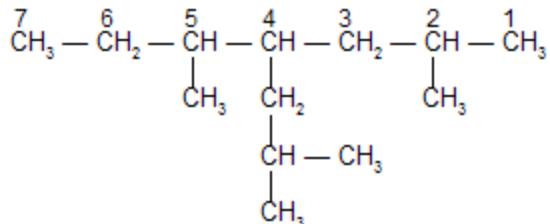
If two or more side chains are in equivalent positions the one to be assigned the lower number is that cited first in the name.



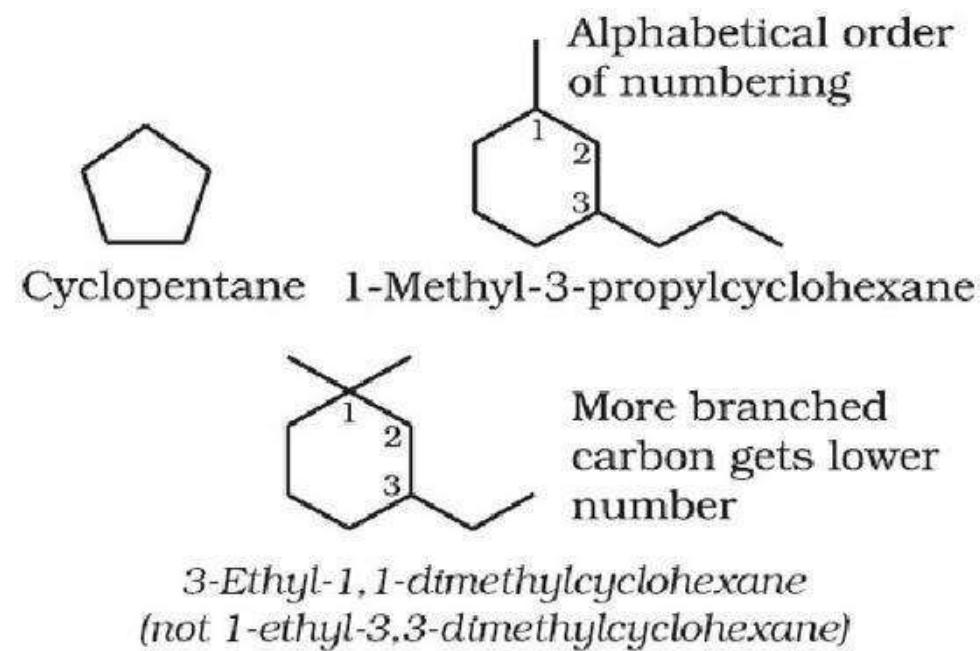
The lowestsum rule.



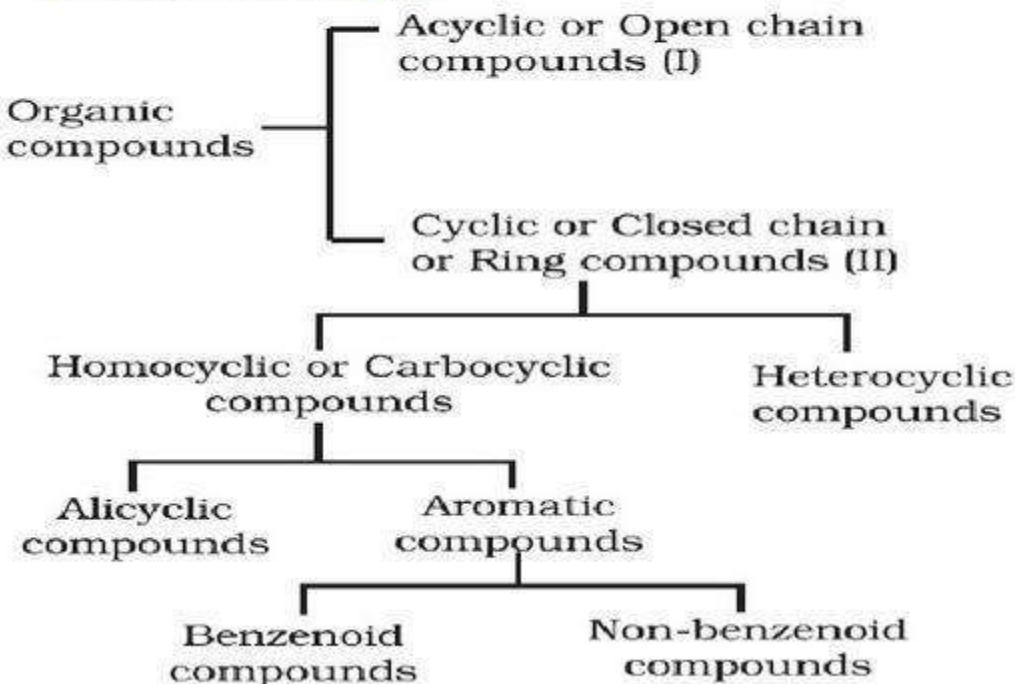
2,3,5-Trimethyl-4-propylheptane (not 3,5,6-Trimethyl-4-propylheptane)



4-Isobutyl-2,5-dimethylheptane (not 4-Isobutyl-2,6-dimethylheptane)



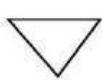
CLASSIFICATION OF ORGANIC COMPOUNDS



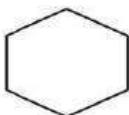
Alicyclic or closed chain or ring compounds

Alicyclic (aliphatic cyclic) compounds contain carbon atoms joined in the form of a ring (homocyclic). Sometimes atoms other than carbon are also present in the ring (heterocyclic).

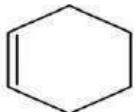
Some examples are



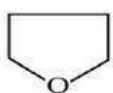
Cyclopropane



Cyclohexane



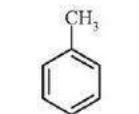
Cyclohexene



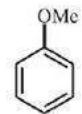
Tetrahydrofuran

Nomenclature of Substituted Benzene Compounds

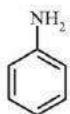
For IUPAC nomenclature of substituted benzene compounds, the substituent is placed as prefix to the word *benzene* as shown in the following examples.



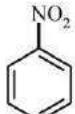
Methylbenzene (Toluene)



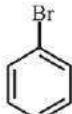
Methoxybenzene (Anisole)



Aminobenzene
(Aniline)



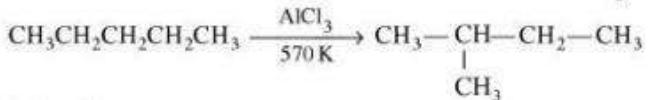
Nitrobenzene



Bromobenzene

How Isomers are made ?

- (a) *Normal to branched chain in alkane* n -Alkane is heated with AlCl_3 at 570 K to give branched chain

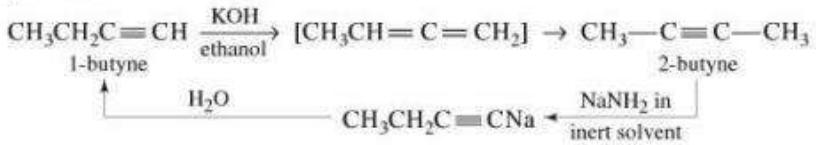


- (b) *Shift of double bond*

In the presence of catalyst like $\text{Al}_2(\text{SO}_4)_3$, alkene undergo isomerization at high temperature (770 – 970 K).



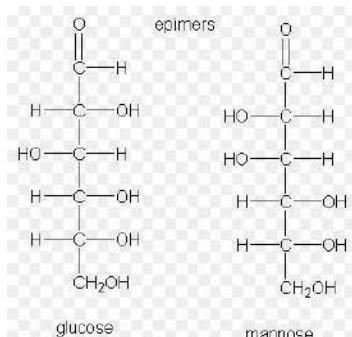
- (c) *Shift of triple bond*



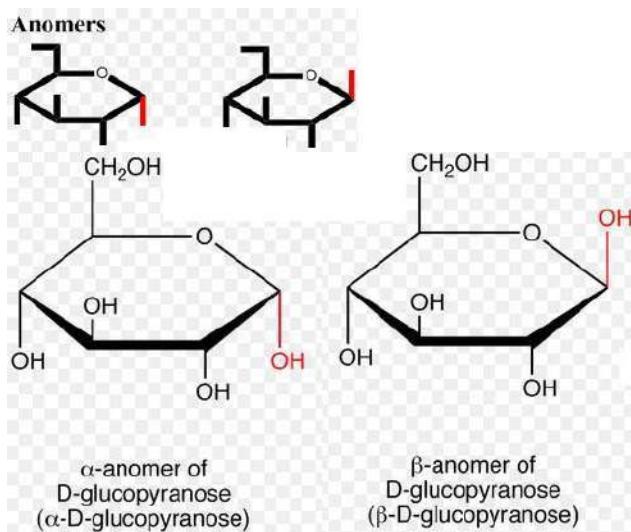
Heating with ethanolic potassium hydroxide shifts the triple bond towards the centre of the chain whereas heating with sodamide in an inert solvent shifts the bond towards the end of chain.

The choice of principal functional group is made on the basis of order of preference. **The order of decreasing priority for some functional groups is:** -COOH, -SO₃H, -COOR (R=alkyl group), COCl, -CONH₂, -CN, -HC=O, >C=O, -OH, -NH₂, >C=C<, -C≡C- .

Epimers



Anomers

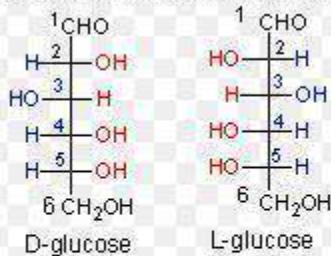


Epimer Anomer comparison

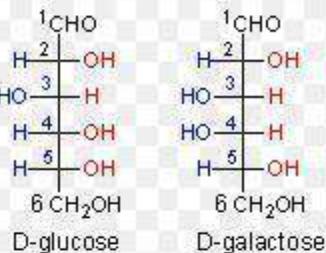
CONFIGURATIONAL ISOMERS

enantiomers

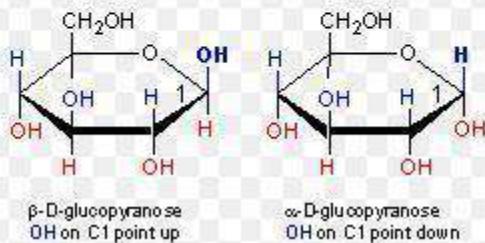
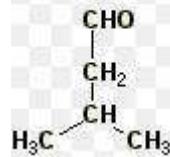
stereoisomers that are mirror images


diastereomers

stereoisomers that are not mirror images


anomers

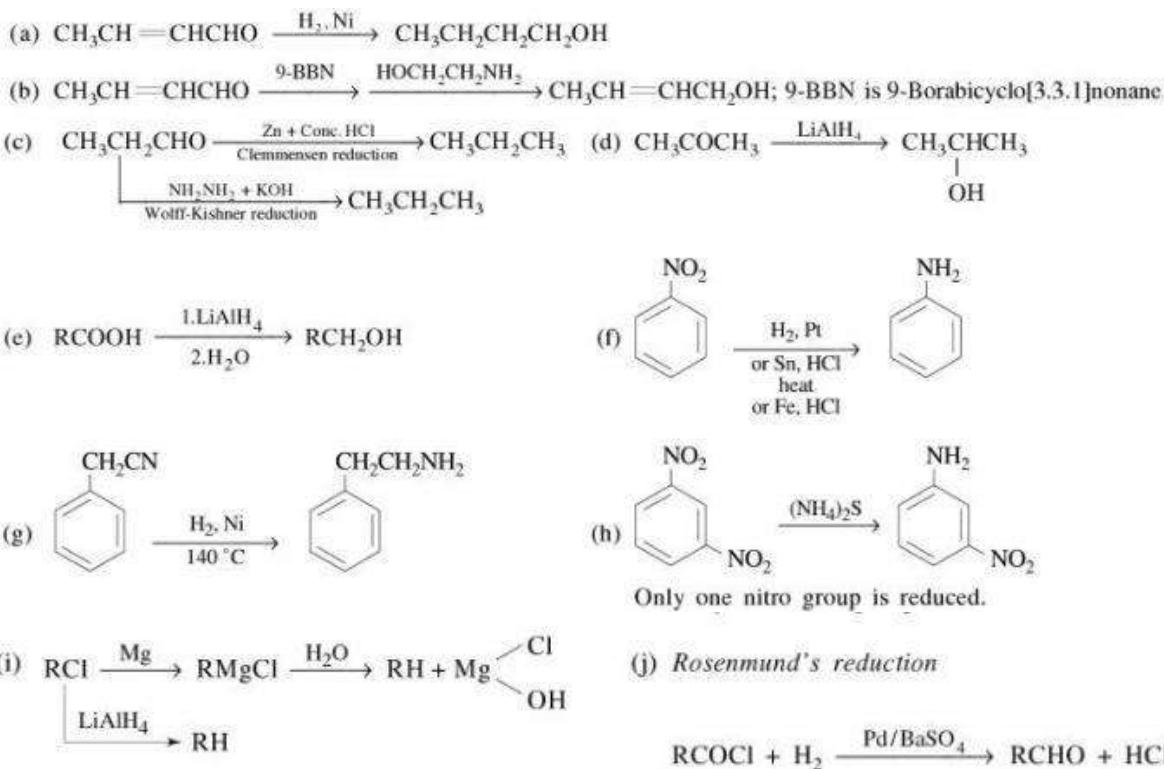
stereoisomers and diastereomers that differ in config. around anomeric C


3-Methylbutanal


Epimers are monosaccharides that differ in chirality at only one carbon. In the straight-chain format, epimers will have H and OH-substituents switched at one backbone carbon, but not at any others.

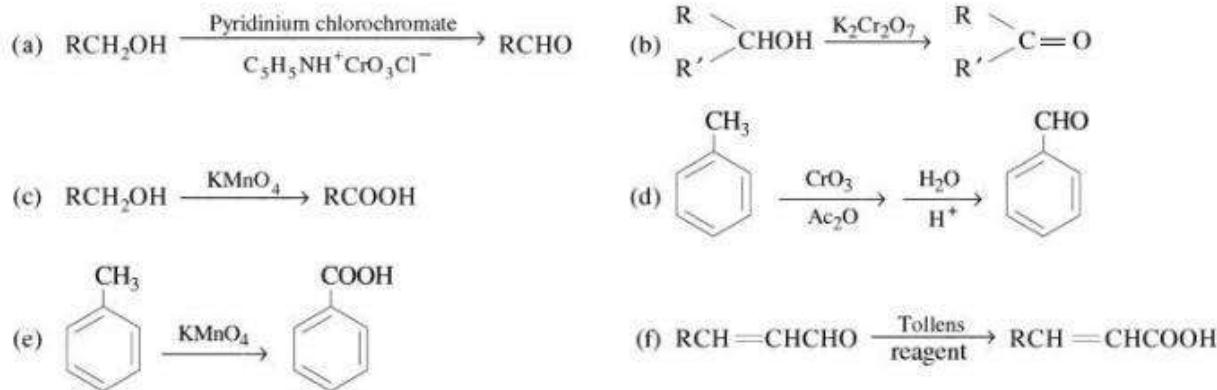
Anomers are special epimers; in cyclic forms of one single monosaccharide, anomers differ in chirality at the anomeric (hemiacetal) carbon only. In the straight-chain format, anomers will have the same configuration.

Various Methods of Reduction used in Organic Chemistry



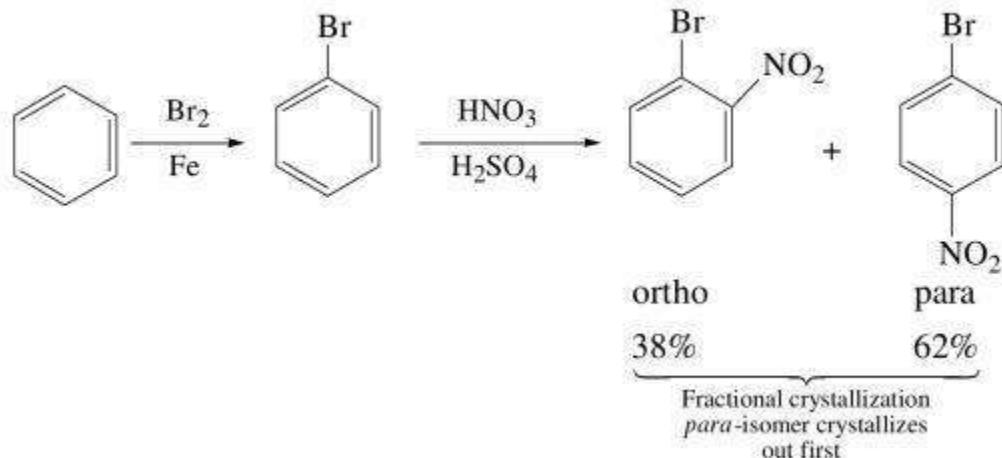
Various methods of Oxidation

Oxidation

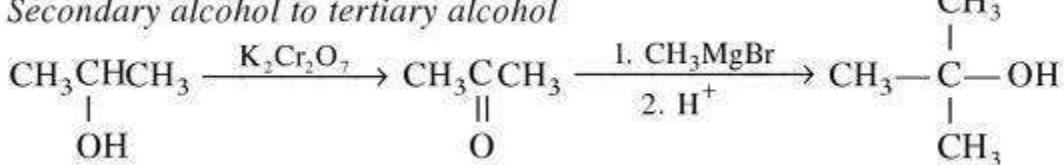


Synthesis of p-bromonitrobenzene in 2 steps

a synthesis of *p*-bromonitrobenzene from benzene in two steps.

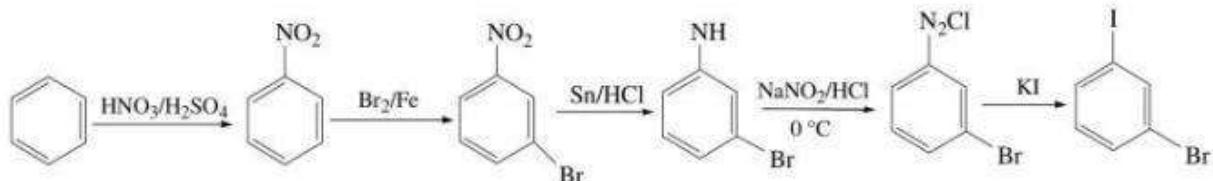


Secondary alcohol to tertiary alcohol

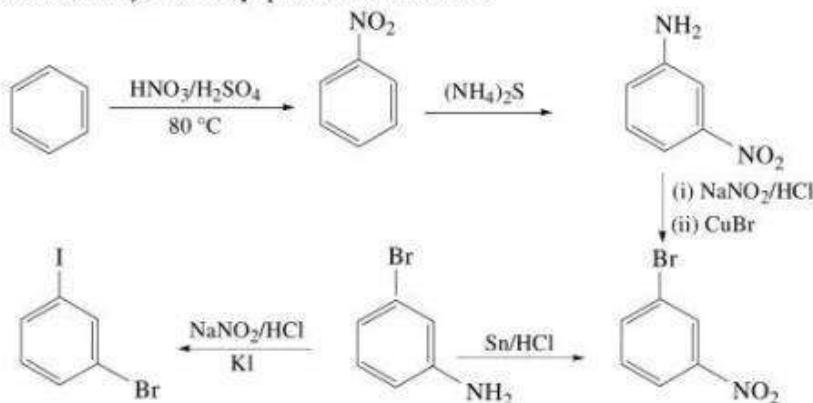


Prepare m-bromoiodobenzene from benzene

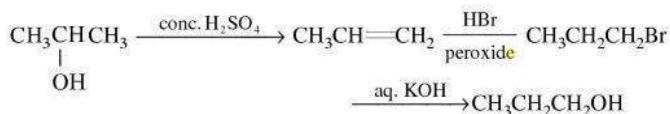
prepare *m*-bromoiodobenzene from benzene (in not more than 5-7 steps)?



Alternatively, we may proceed as follows:



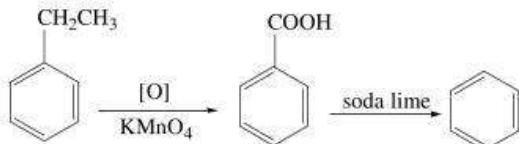
Secondary alcohol to Primary alcohol



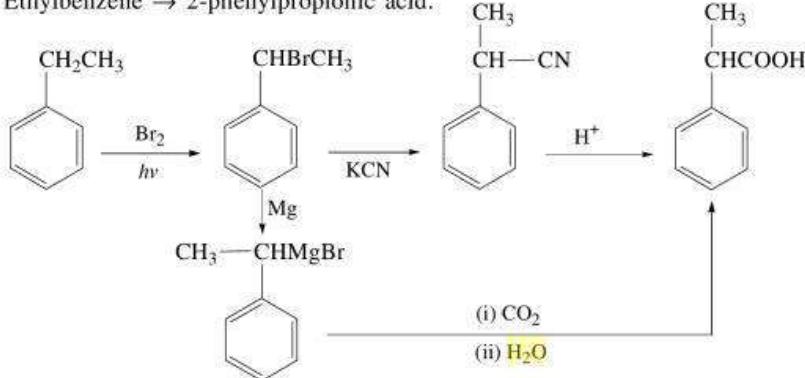
To convert Ethylebenzene to Benzene and Ethylebenzene to phenylpropionic acid

Show the steps to carry out the following transformations.

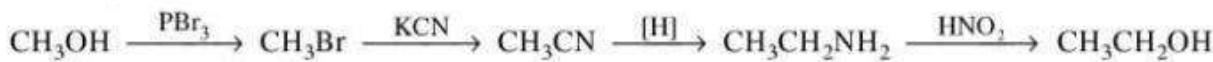
(i) Ethylbenzene \rightarrow benzene



(ii) Ethylbenzene \rightarrow 2-phenylpropionic acid.

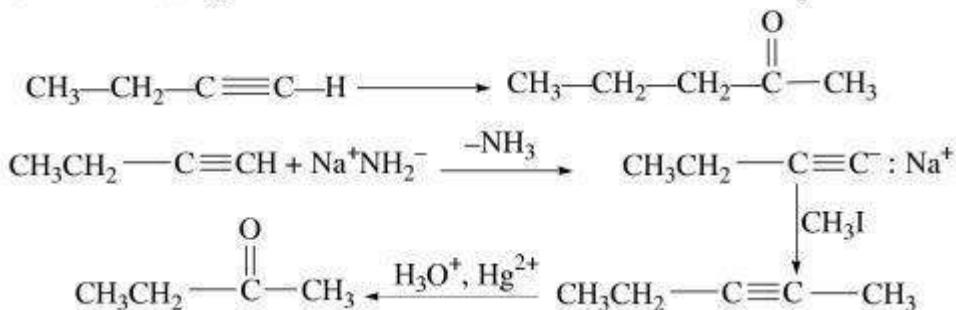


Alcohol to alcohol with one carbon more

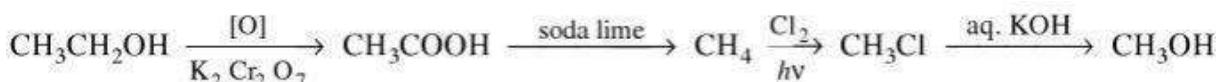


Carryout the transformations 1-Butyne to ketone

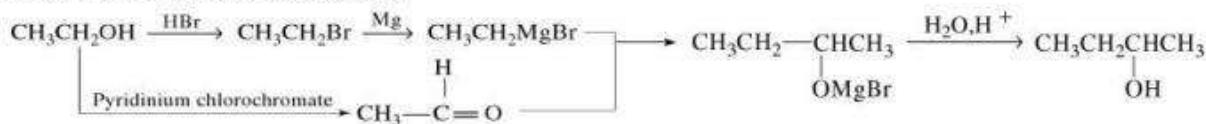
Carry out the following transformation in not more than three steps.



Alcohol to alcohol with one carbon less



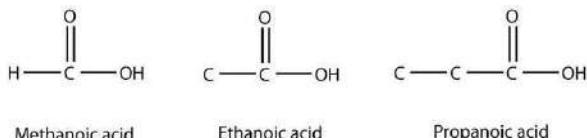
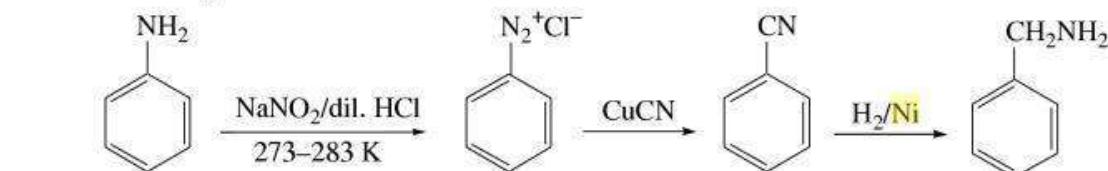
Simple alcohol to complicated alcohol



Conversion of Aniline to Benzylamine

How would you bring about the following conversion (in 3 steps)?

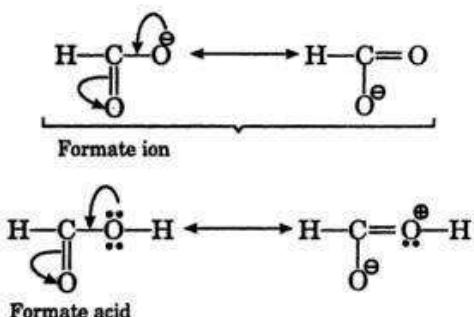
Aniline \rightarrow Benzylamine



(i) Carbon-oxygen bond lengths in formic acid are different but are the same in sodium formate. Justify.

(ii) Phenate ion has more number of contributing structures than benzoate ion: but still benzoic acid is a stronger acid. Explain.

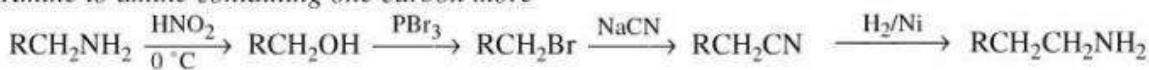
Solution. (i) In sodium formate, the contributing structures for the anion are equivalent while these are not the same in formic acid.



Thus, carbon-oxygen bond length in formate ion is the same for both the bonds while these are different in formic acid.

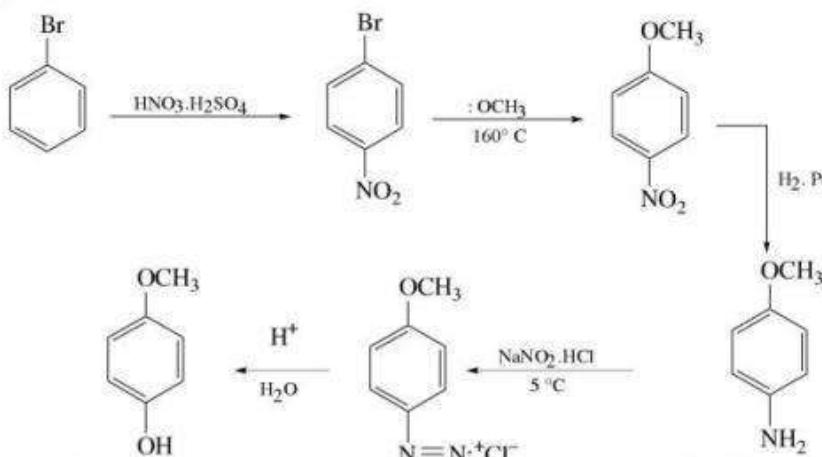
(ii) In phenoxide ion, the negative charge is dispersed only one electronegative oxygen atoms while there are two available oxygen atoms in benzoate ion to disperse the negative charge.

Amine to amine containing one carbon more

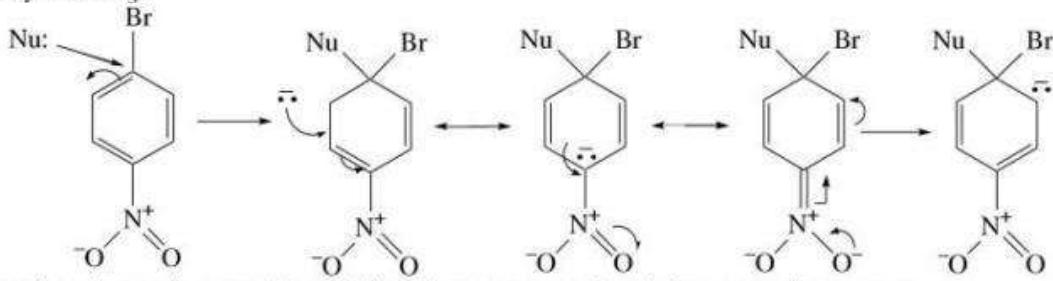


Synthesis of 4-methoxyphenol from bromobenzene

How would you synthesise 4-methoxyphenol from bromobenzene in NOT more than five steps? State clearly the reagents used in each step and show the structure of the intermediate compounds in your synthetic scheme.



The introduction of $-\text{NO}_2$ group at *para* position in bromobenzene facilitates the nucleophilic replacement of $-\text{Br}$ by $-\text{OCH}_3$.



The negative charge is strongly stabilised by resonance involving *para*-nitro group.

Write chemical tests to distinguish between:

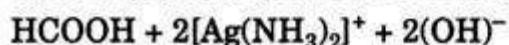
Solution. Formic acid $\left(\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C}-\text{OH} \end{array} \right)$ contains

both an aldehyde $\left(\begin{array}{c} \text{H} \\ | \\ -\text{C}=\text{O} \end{array} \right)$ as well as carboxyl

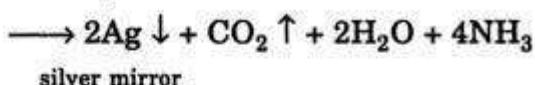
group $\left(\begin{array}{c} -C-OH \\ || \\ O \end{array} \right)$ but acetic acid contain only a

carboxyl group. Formic acid behaves as reducing agent whereas acetic acid does not.

(a) Formic acid reduces Tollen's reagent to metallic silver but acetic acid does not.

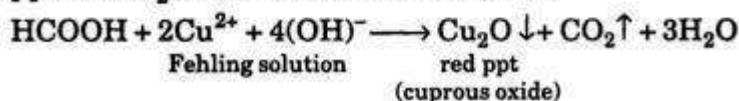


Tollen's reagent



No silver mirror is formed with acetic acid.

(b) Formic acid reduced Fehling solution to red ppt. of Cu_2O but acetic acid does not.



Amine to amine containing one carbon less

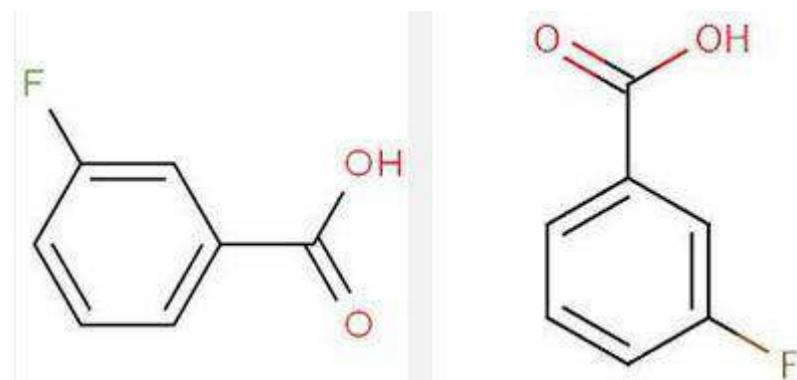


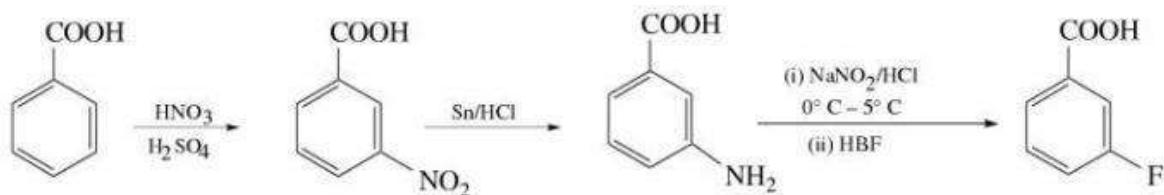
Convert Benzoic acid to meta fluorobenzoic acid (2-fluorobenzoic acid)

Convert

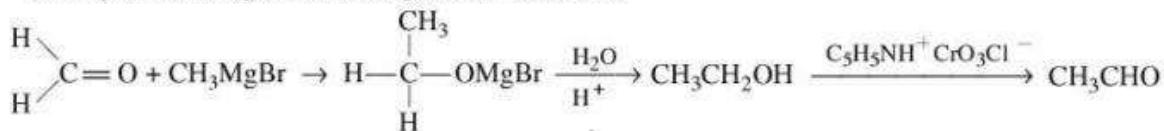


metafluoro benzoicacid

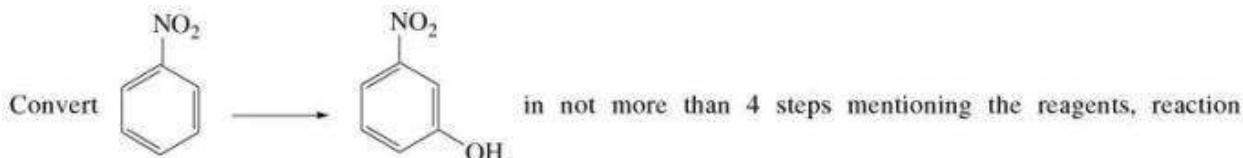




Aldehyde to aldehyde containing one carbon more

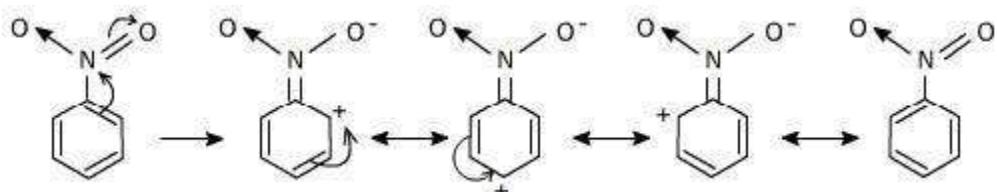


Convert Nitrobenzene to meta hydroxynitrobenzene (or 4-nitrophenol)

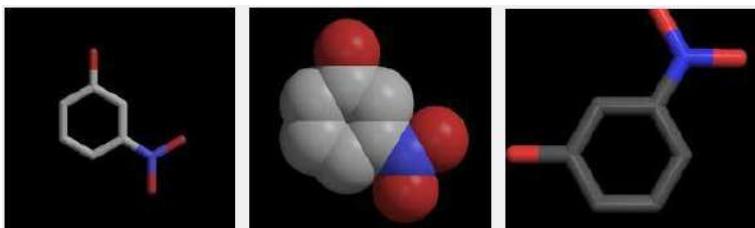


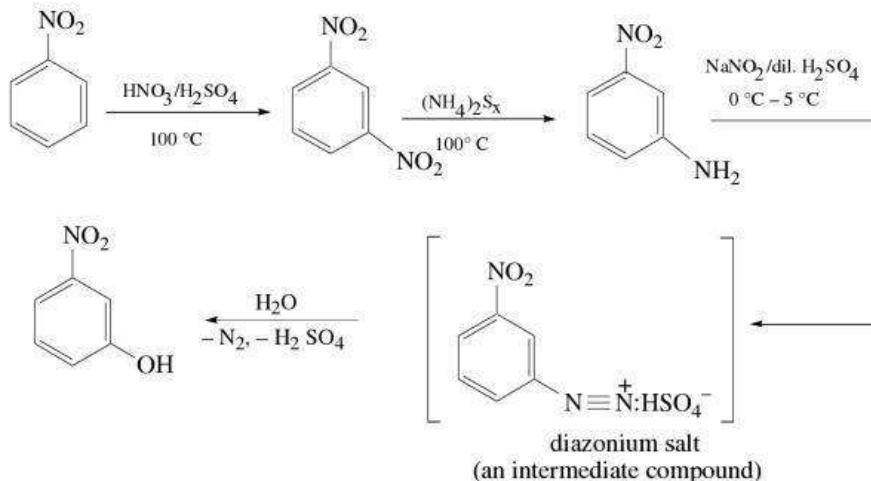
The given conversion can be carried out as follows.

Nitrobenzene resonance structure



4 nitrophenol or metahydroxynitrobenzene





Many conversions or preparations

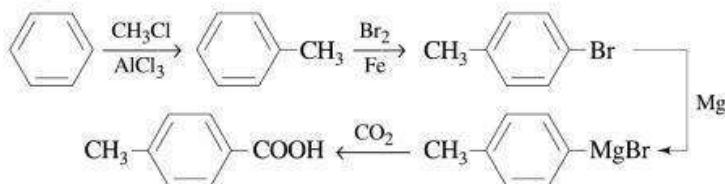
Write down the reactions involved in the preparation of the following using the reagents indicated against each in parenthesis

- (i) Ethylbenzene from benzene [$\text{C}_2\text{H}_5\text{OH}$, PCl_5 , anhydrous AlCl_3]
- (ii) Propanoic anhydride from propanol [$\text{AgNO}_3/\text{NH}_4\text{OH}$, P_2O_5]
- (iii) Acetoxime from acetaldehyde [$\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$, $\text{Ca}(\text{OH})_2$ and $\text{NH}_2\text{OH.HCl}$]
- (i) $\text{C}_2\text{H}_5\text{OH} + \text{PCl}_5 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{POCl}_3 + \text{HCl}$
- $$\text{C}_6\text{H}_6 + \text{C}_2\text{H}_5\text{Cl} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{HCl}$$
- (ii) $\text{C}_3\text{H}_7\text{OH} \xrightarrow{\text{AgNO}_3/\text{NH}_4\text{OH}} \text{C}_2\text{H}_5\text{COOH}; \quad 2\text{C}_2\text{H}_5\text{COOH} \xrightarrow[\Delta]{\text{P}_2\text{O}_5} (\text{C}_2\text{H}_5\text{CO})_2\text{O}$
- (iii) $\text{CH}_3\text{CHO} \xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+} \text{CH}_3\text{COOH}; \quad \text{CH}_3\text{COOH} \xrightarrow{\text{Ca}(\text{OH})_2} (\text{CH}_3\text{COO})_2\text{Ca}$

$$(\text{CH}_3\text{COO})_2\text{Ca} \xrightarrow{\text{heat}} \text{CH}_3\text{COCH}_3 + \text{CaCO}_3; \quad \text{CH}_3\text{COCH} \xrightarrow{\text{NH}_2\text{OH}} \begin{array}{c} \text{CH}_3 \\ | \\ \text{C}=\text{N}-\text{OH} \\ | \\ \text{CH}_3 \end{array}$$

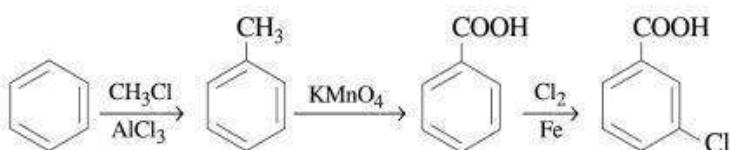
Benzene to p-toluidine

Benzene to *p*-toluic acid



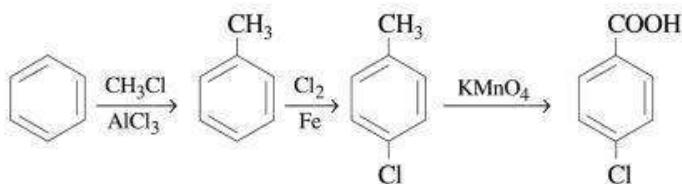
Benzene to m-chlorobenzoic acid

Benzene to *m*-chlorobenzoic acid



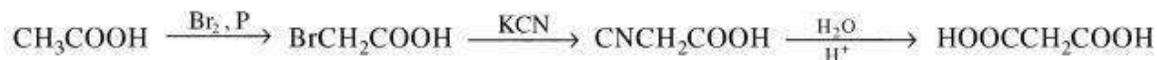
Benzene to p-chlorobenzoic acid

Benzene to *p*-chlorobenzoic acid



Acetic acid to Malonic acid

Acetic acid to malonic acid



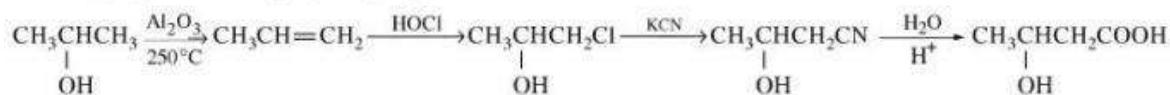
Ethyne to propanoic acid

Ethyne to propanoic acid



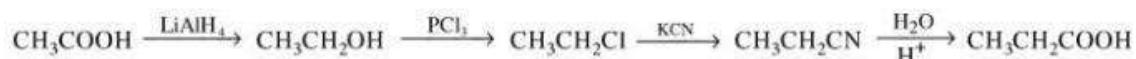
Isopropyl alcohol to β -hydroxybutyric acid

Isopropyl alcohol to β -hydroxybutyric acid



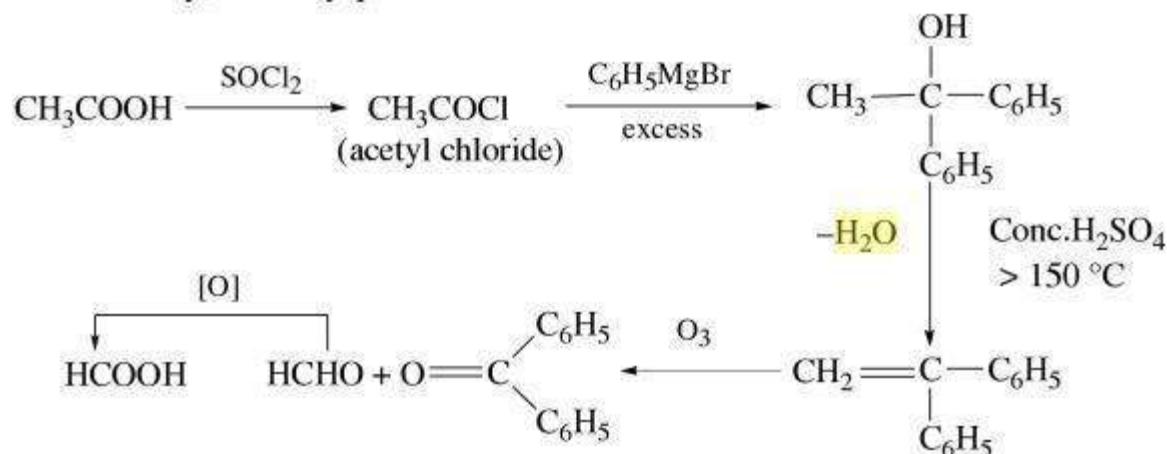
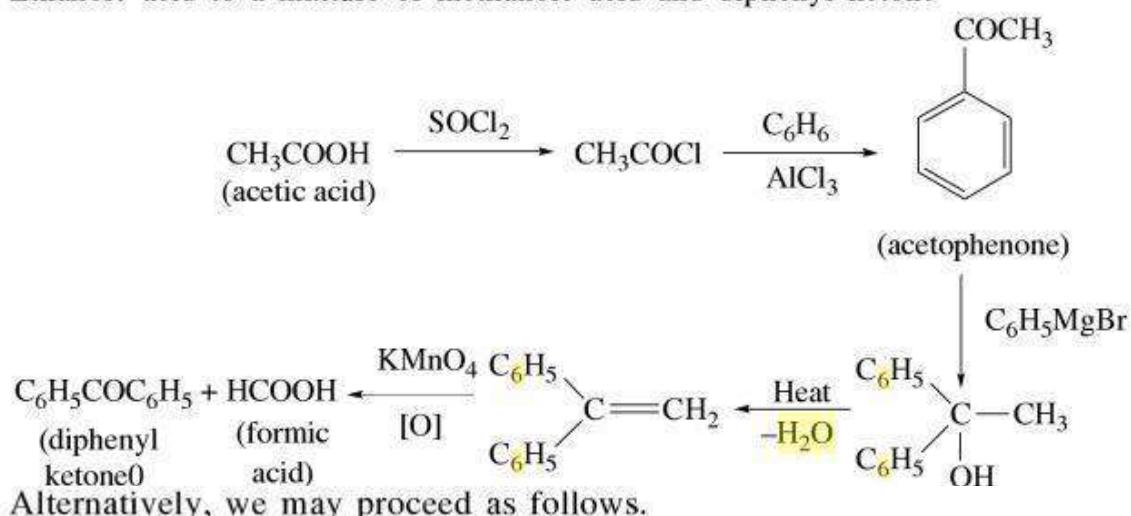
Acetic acid to Propanoic acid

Acetic acid to propanoic acid



Ethanoic acid to a mixture of methanoic acid and diphenyl ketone

Ethanoic acid to a mixture of methanoic acid and diphenyl ketone

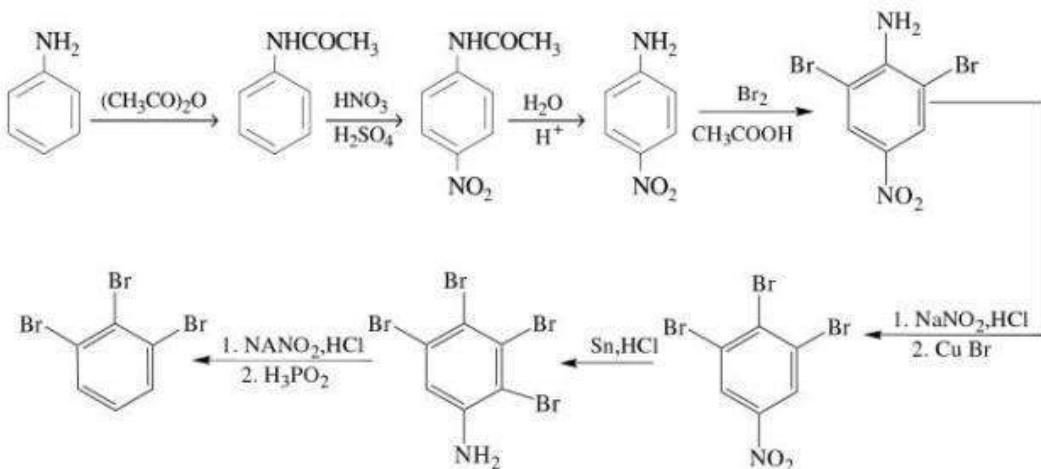


Propanoic acid to acetic acid

Propanoic acid to acetic acid

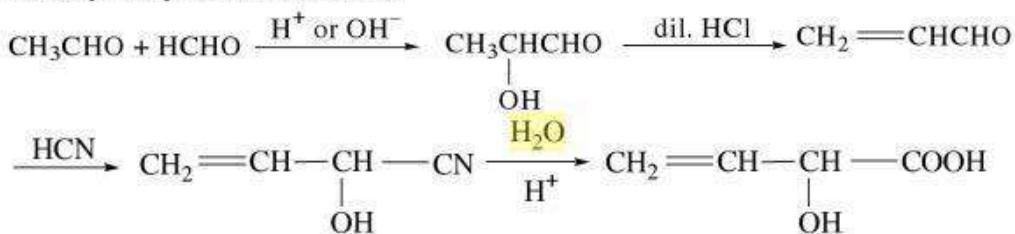


Aniline to 1, 2, 3-tribromobenzene



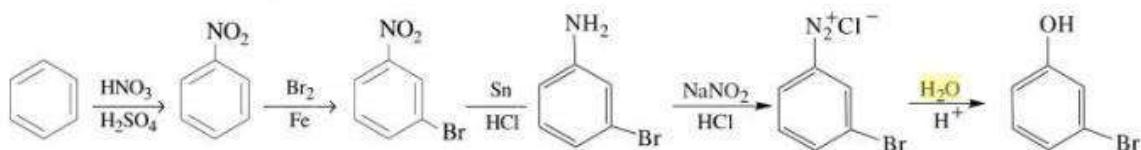
Ethanal to 2-hydroxy-3-butenoic acid

Ethanal to 2-hydroxy-3-butenoic acid



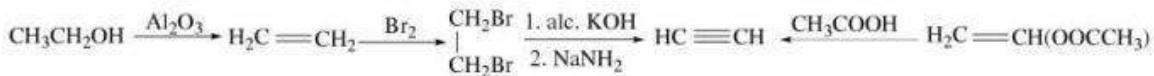
Benzene to m-bromophenol

Benzene to *m*-bromophenol



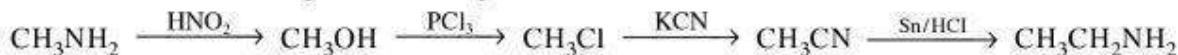
Ethyl alcohol to Vinyl alcohol

Ethyl alcohol to vinyl acetate

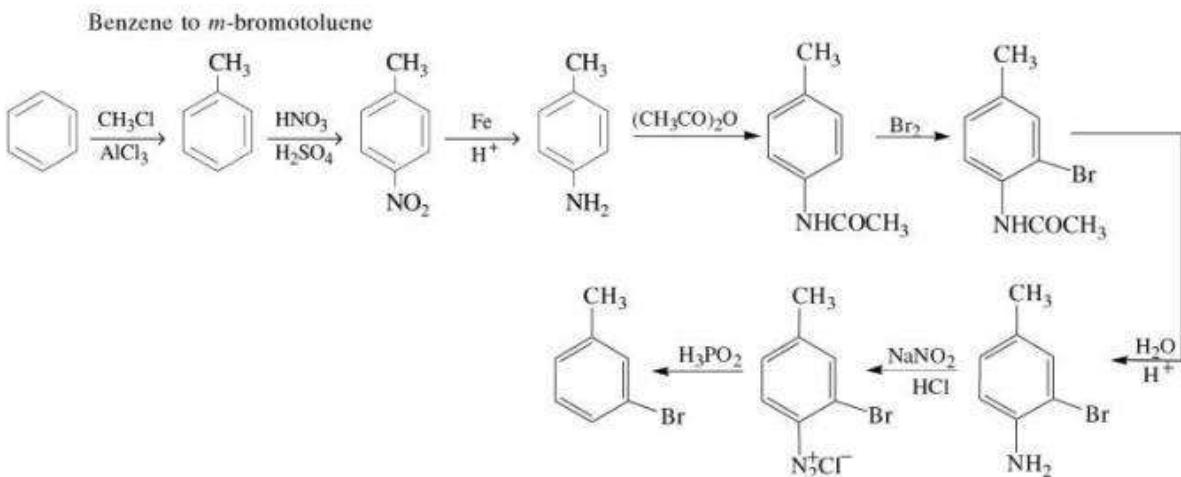


Methylamine to ethylamine

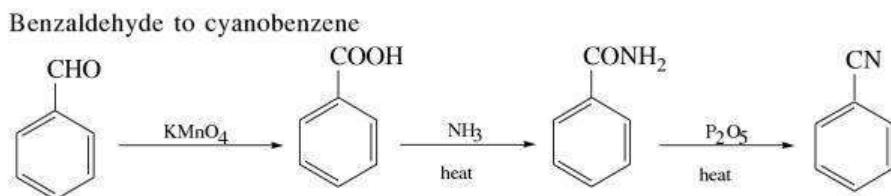
Methylamine to ethylamine



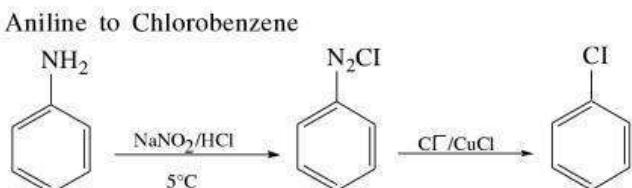
Benzene to m–bromotoluene



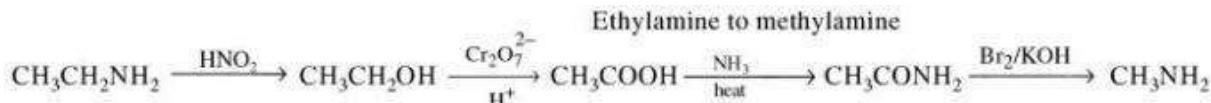
Benzaldehyde to cyanobenzene



Aniline to Chlorobenzene

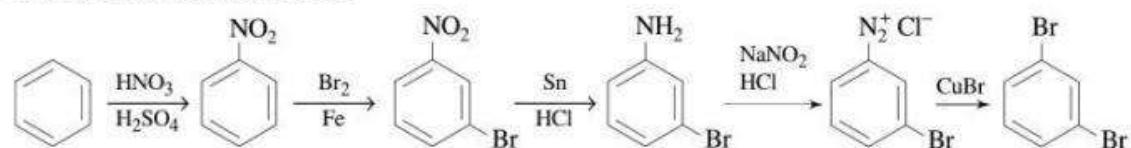


Ethylamine to Methylamine



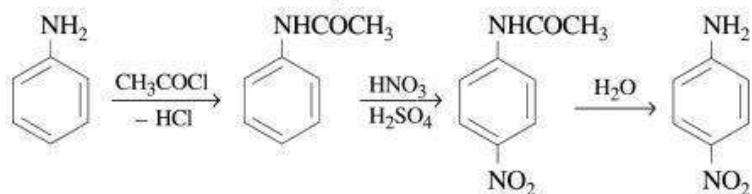
Benzene to m–dibromobenzene

Benzene to *m*-dibromobenzene

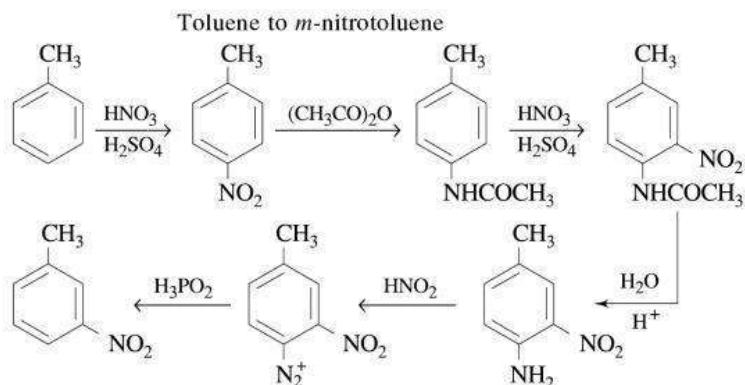


Aniline to p–nitroaniline

Aniline to *p*-nitroaniline

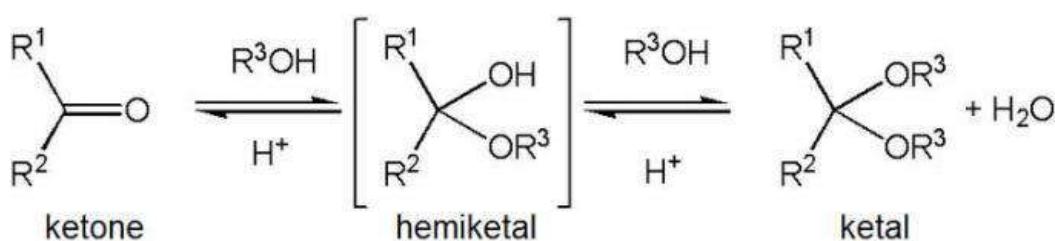
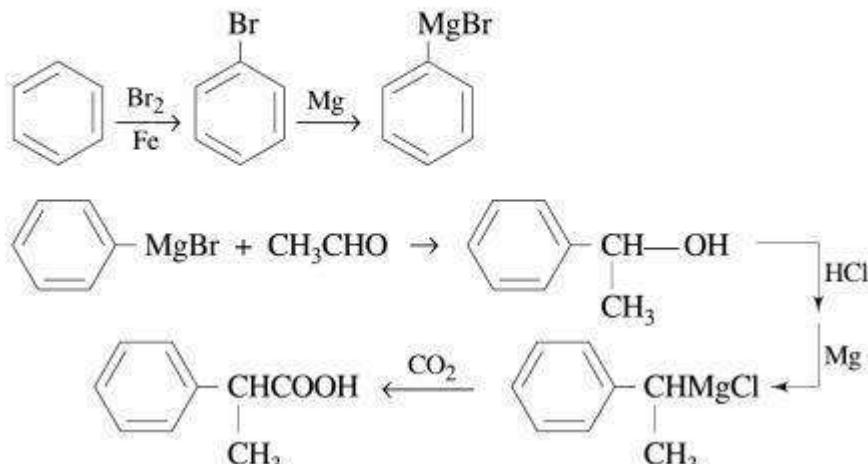


Toluene to m–nitrotoluene



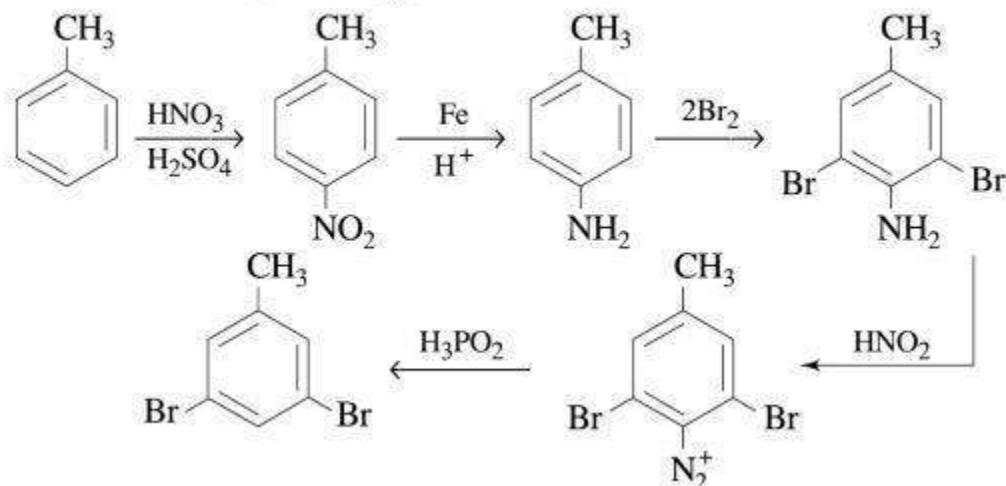
Convert Benzene + Alcohol to α -methylphenylacetic acid

Benzene + alcohol to α -methylphenylacetic acid



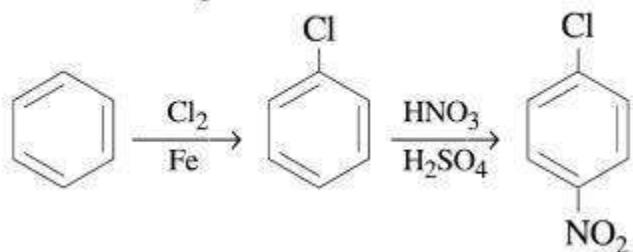
Toluene to 3,5 dibromotoluene

Toluene to 3, 5-dibromotoluene



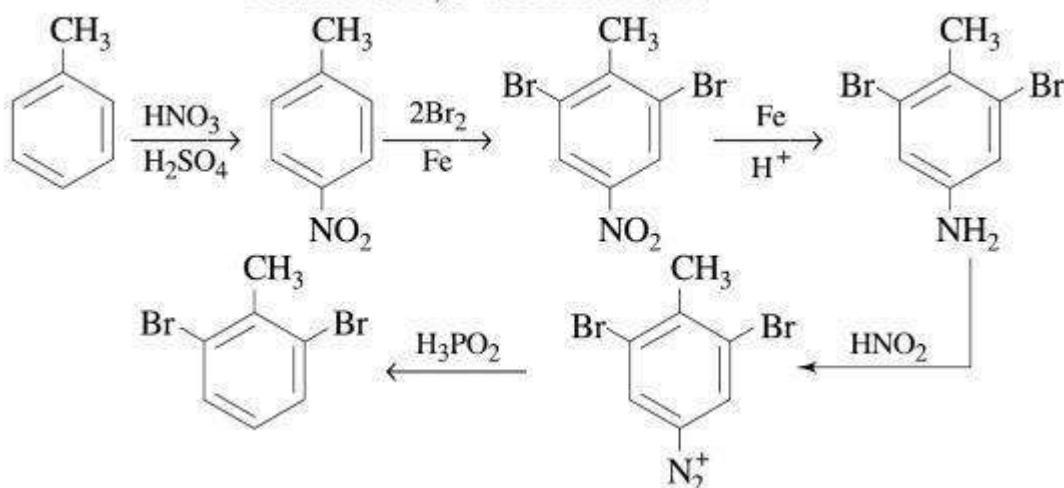
Benzene to p-chloronitrobenzene

Benzene to *p*-chloronitrobenzene



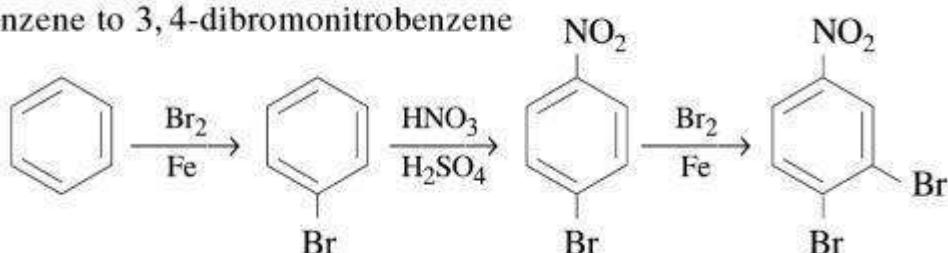
Toluene to 2,6 dibromotoluene

Toluene to 2,6-dibromotoluene



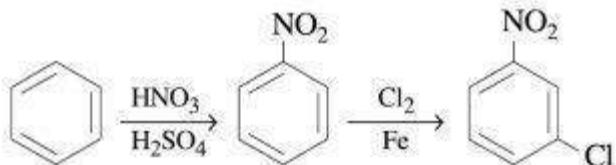
Benzene to 3,4-dibromonitrobenzene

Benzene to 3,4-dibromonitrobenzene



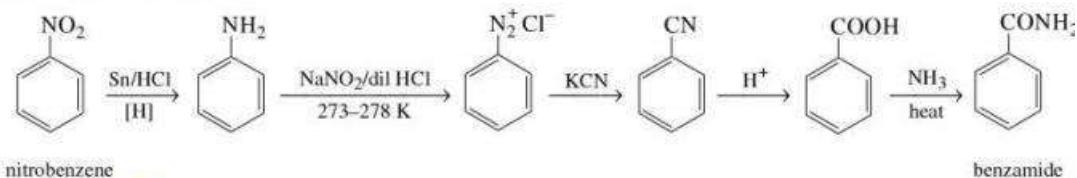
Benzene to *m*–chloronitrobenzene

Benzene to *m*-chloronitrobenzene



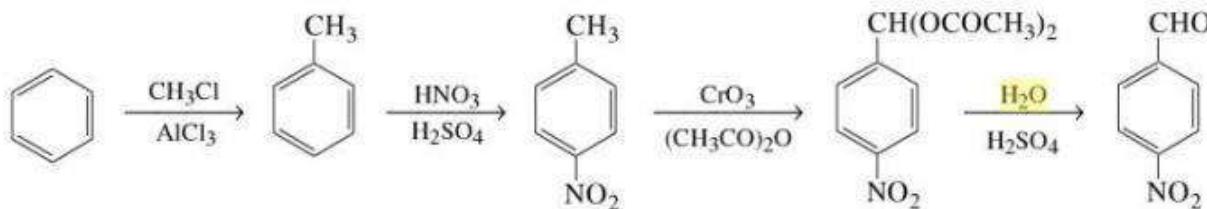
Nitrobenzene to benzamide

Nitrobenzene to benzamide



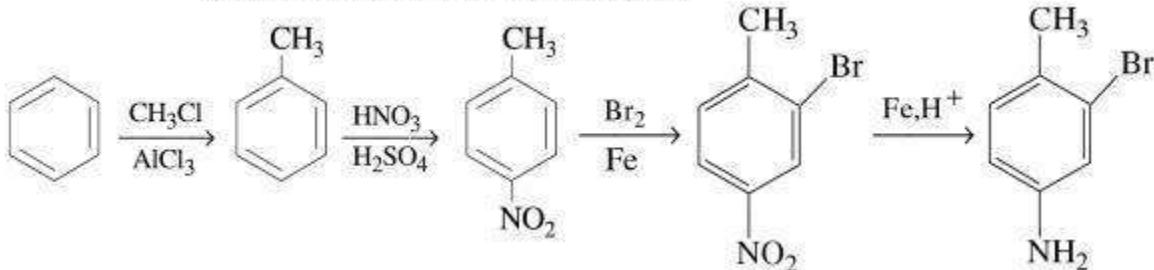
Benzene to 4–nitrobenzaldehyde

Benzene to 4-nitrobenzaldehyde



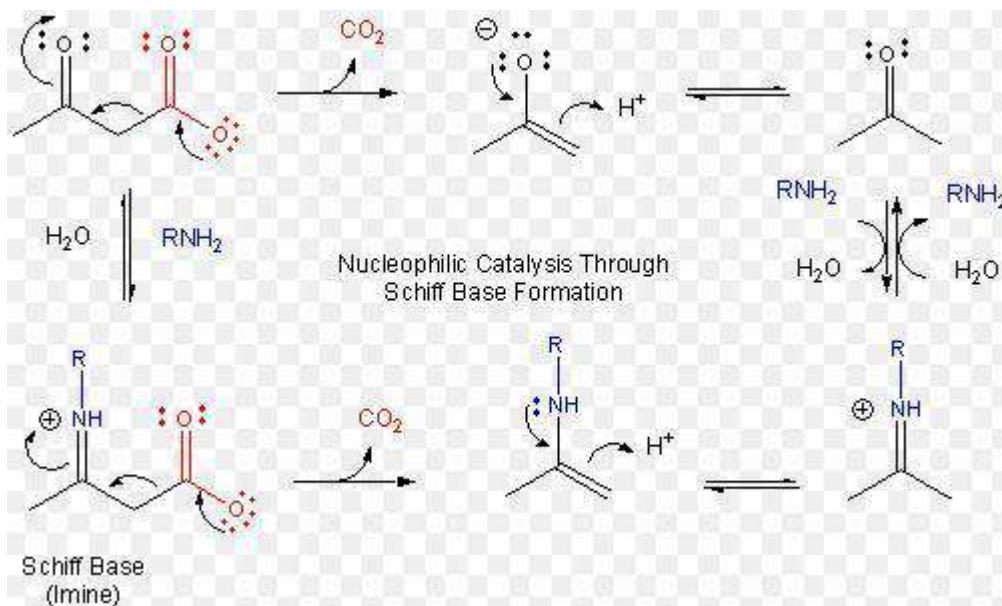
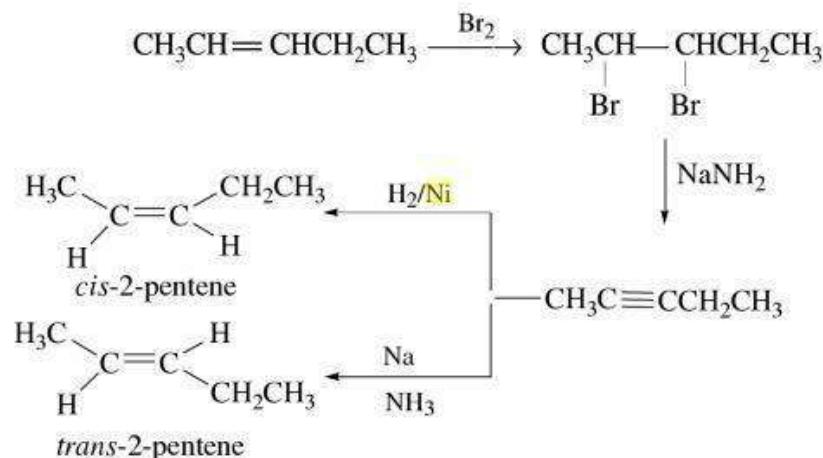
Benzene to 4–amino–2–bromotoluene

Benzene to 4-amino-2-bromotoluene



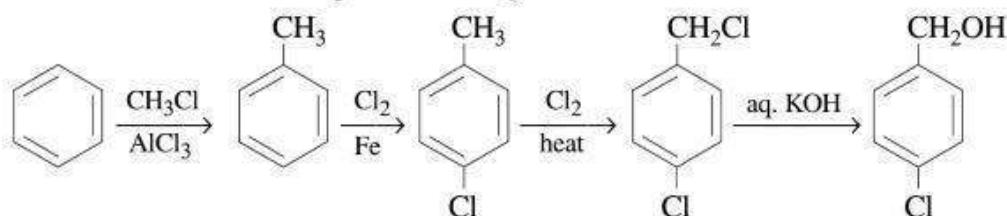
Convert a mixture of cis-2-pentene and trans-2-pentene into cis-2-pentene or trans-2-pentene

A mixture of *cis*-2-pentene and *trans*-2-pentene into *cis*-2-pentene or *trans*-2-pentene



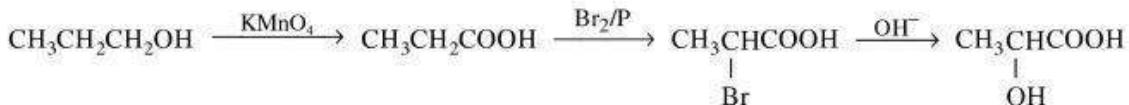
Benzene to p-chlorobenzylalcohol

Benzene to *p*-chlorobenzylalcohol

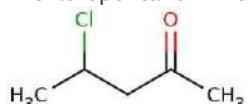


Convert Propanol to α -hydroxypropanoic acid

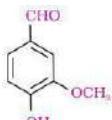
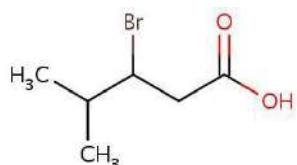
Propanol to α -hydroxypropionic acid



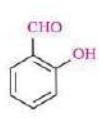
4-chloropentane-2-one



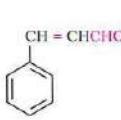
3-Bromo-4-methylpentanoic acid



Vanillin

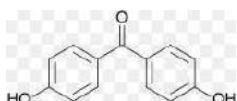


Salicylaldehyde

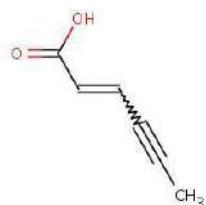


Cinnamaldehyde

p,p' – dihydroxybenzophenone



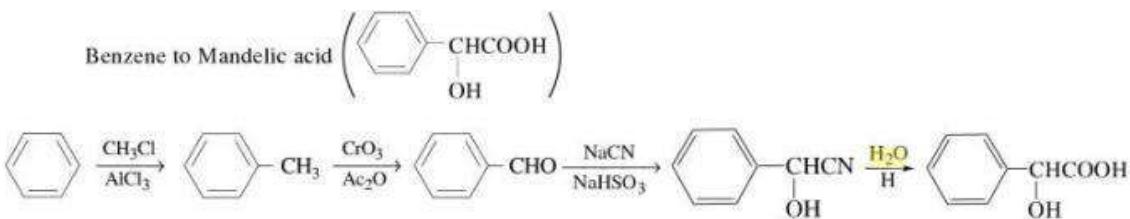
Hex-2-ene-4-yneicacid



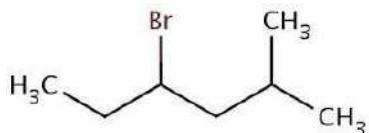
Heptan-2-one



Benzene to Mandelic Acid



4–Bromo–2–methylhexane

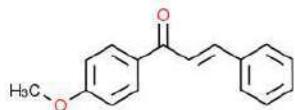


Heptanal

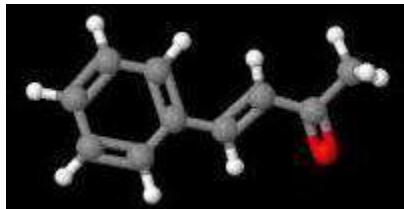
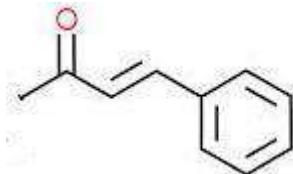


1–(4–Methoxyphenyl)–3–phenylprop–2–en–1–one

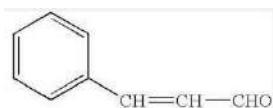
1-(4-Methoxyphenyl)-3-phenylprop-2-en-1-one



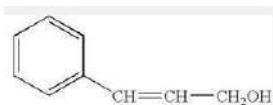
4–phenylprop–3–ene–2–one



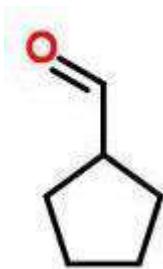
3–phenylprop–2–ene–1–al



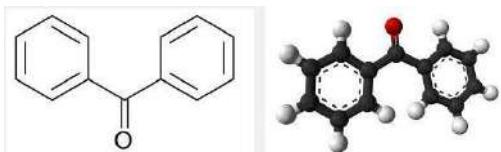
3–phenyl–prop–2–ene–1–ol



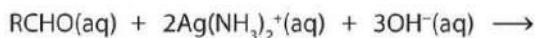
cyclopentancarbaldehyde



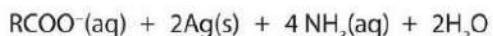
Benzophenone also diphenylmethanone



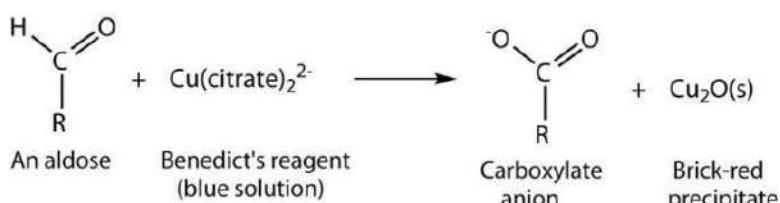
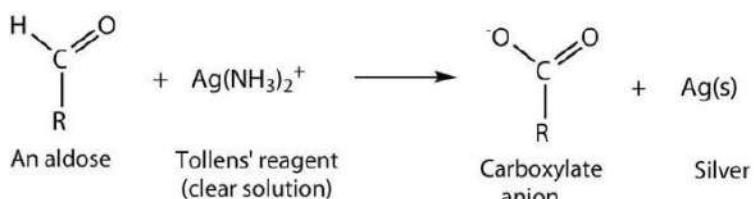
Tollen's Reagent



An aldehyde

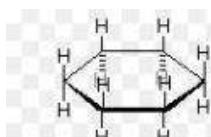
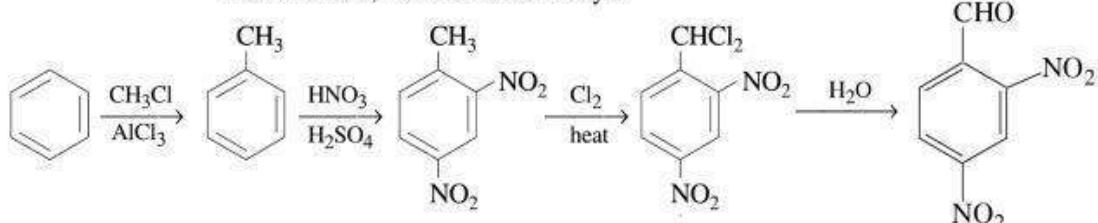


Free silver

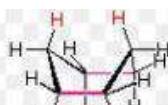


Benzene to 2,4-dinitrobenzaldehyde

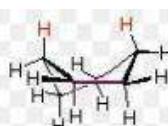
Benzene to 2,4-dinitrobenzaldehyde



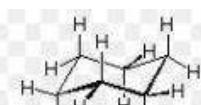
Planar Structure
severe angle strain (120°)
severe eclipsing strain (all bonds)
small steric strain



Boat Conformation
slight angle strain
eclipsing strain at **two bonds**
steric crowding of **two hydrogens**



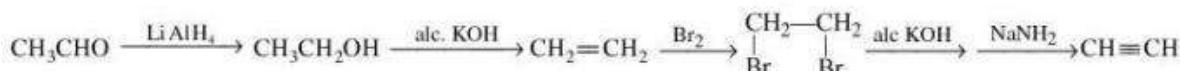
Twist Boat Conformation
slight angle strain
small eclipsing strain
small steric strain

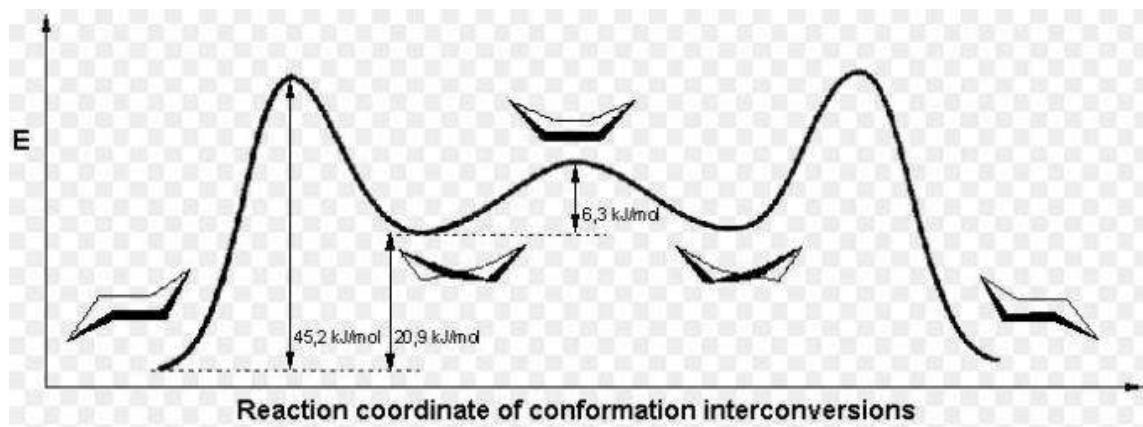


Chair Conformation
no angle strain
no eclipsing strain
small steric strain

Acetaldehyde to Acetylene

Acetaldehyde to acetylene



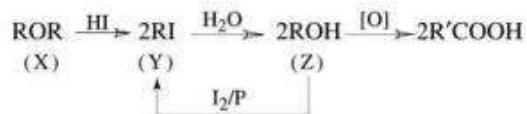


Identify the compounds

compound contains C, H and O unreactive towards Na (Sodium)

A compound (X) containing only C, H and O is unreactive towards sodium. It does not add bromine. It also does not react with Schiff's reagent. On refluxing with an excess of hydroiodic acid, X yields only one organic product Y. On hydrolysis Y yields a new compound Z which can be converted to Y by reaction with red phosphorus and iodine. The compound Z on oxidation with potassium permanganate gives a carboxylic acid. The equivalent weight of this acid is 60. What are the compounds X, Y and Z? Write chemical equations leading to the conversion of X to Y. (1981)

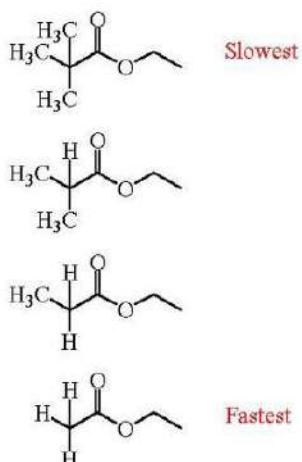
Solution Since the compound is unreactive towards sodium, it is neither alcohol (including phenol) nor carboxylic acid. It is also not an aldehyde. It may be a symmetrical ether because on refluxing with excess of HI, it gives only one product. Thus, we have



Now the equivalent weight of $R'COOH$ is 60. From this, it follows that R' is $-\text{CH}_3$ group and hence R is $-\text{CH}_2\text{CH}_3$ group. Thus, the compounds X, Y and Z are



Steric Effects and the Relative Reactivity of Carboxylic Acid Derivatives

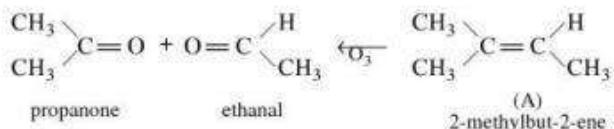


Identify the compound

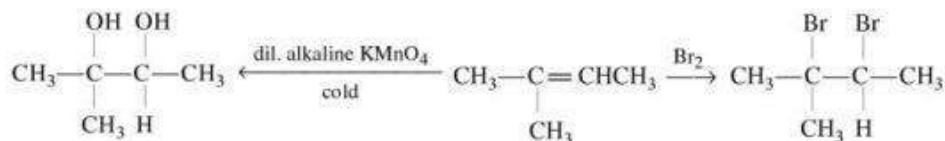
A hydrocarbon reacts with Bromine to give dibromo compound

One mole of a hydrocarbon A reacts with one mole of bromine giving a dibromo compound $C_5H_{10}Br_2$. Substance A on treatment with cold, dilute alkaline potassium permanganate solution forms a compound $C_5H_{12}O_2$. On ozonolysis, A gives equimolar quantities of propanone and ethanal. Deduce the structural formula of A.

Solution From the products of ozonolysis, we conclude that



The compound A contains a double bond. This is also confirmed from the fact that the compound A reacts with one mole of bromine. Thus, the given reactions are

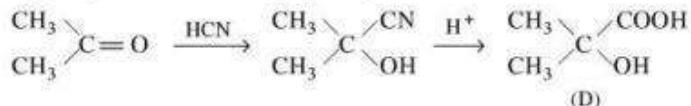


Identify the compound

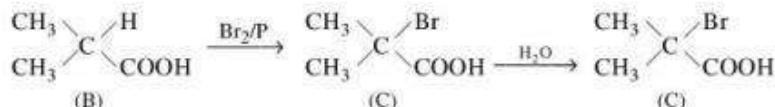
An alkene A on ozonolysis yields acetone and an aldehyde

An alkene A on ozonolysis yields acetone and an aldehyde. The aldehyde is easily oxidized to an acid B. When B is treated with bromine in presence of phosphorus, it yields a compound C which on hydrolysis gives a hydroxy acid D. This acid can also be obtained from acetone by the reaction with hydrogen cyanide followed by hydrolysis. Identify the compounds A, B, C and D.

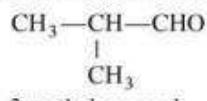
Solution The structure of compound D is easily deduced from the fact that it is obtained by the combination of acetone with hydrogen cyanide followed by hydrolysis.



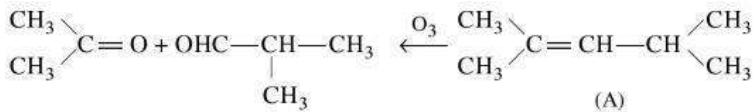
The conversion B to C and then C to D indicates that the reaction B to C is Hell-Volhard-Zelinsky reaction. Thus, we have



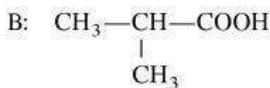
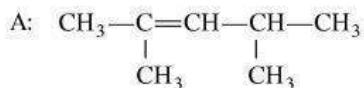
Hence, we conclude that the aldehyde from which compound B is obtained by oxidation has the structure



Now, the ozonolysis of the compound A gives acetone and 2-methyl-propanal, i.e.

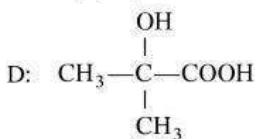
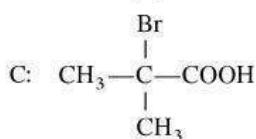


Hence, the compound A, B, C and D are



2, 4-dimethylpent-2-ene

2-methylpropanoic acid



2-bromo-2-methylpropanoic acid

2-hydroxy-2-methylpropanoic acid

Identify the compound

An aromatic comound contains 69.4% carbon, 5.8% hydrogen

An aromatic compound contains 69.4% carbon and 5.8% hydrogen. A sample of 0.303 g of this compound was analysed for nitrogen by Kjeldahl's method. The ammonia evolved was absorbed in 50 mL of 0.05 M sulphuric acid. The excess acid required 25 mL of 0.1 M sodium hydroxide for neutralization. Determine the molecular formula of the compound if its molar mass is 121 g mol^{-1} . Draw two possible structures for this compound.

Solution The reactions involved are



$$\text{Amount of sodium hydroxide to neutralize excess of sulphuric acid} = (25 \text{ mL}) \left(\frac{0.1 \text{ mol}}{1000 \text{ mL}} \right) = \frac{1}{400} \text{ mol}$$

$$\text{Amount of sulphuric acid neutralized with sodium hydroxide} = \frac{1}{2} \left(\frac{1}{400} \text{ mol} \right) = \frac{1}{800} \text{ mol}$$

$$\text{Amount of sulphuric acid taken to start with} = (50 \text{ mL}) \left(\frac{0.05 \text{ mol}}{1000 \text{ mL}} \right) = \frac{1}{200} \text{ mol}$$

$$\text{Amount of sulphuric acid neutralized by ammonia} = \left(\frac{1}{400} - \frac{1}{800} \right) \text{ mol} = \frac{1}{800} \text{ mol}$$

$$\text{Amount of ammonia evolved} = 2 \left(\frac{1}{800} \text{ mol} \right) = \frac{1}{400} \text{ mol}$$

$$\text{Mass of nitrogen in the evolved ammonia} = \left(\frac{1}{400} \text{ mol} \right) (14 \text{ g mol}^{-1}) = \frac{7}{200} \text{ g}$$

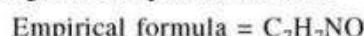
$$\text{Per cent of nitrogen in the given aromatic compound} = \frac{(7/200) \text{ g}}{0.303 \text{ g}} \times 100 = 11.6$$

$$\text{Per cent of oxygen in the given aromatic compound} = 100 - (69.4 + 5.8 + 11.6) = 13.2$$

The ratios of atoms present in the given compound are

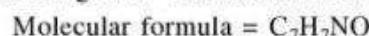
$$\text{C : H : N : O} :: \frac{69.4}{12} : \frac{5.8}{1} : \frac{11.6}{14} : \frac{13.2}{16} :: 5.8 : 5.8 : 0.83 : 0.83 :: 7 : 7 : 1 : 1$$

Hence, for the given compound, we have

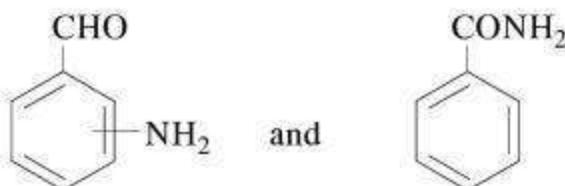


$$\text{Empirical molar mass} = 121 \text{ g mol}^{-1}$$

It is given that 121 g mol⁻¹ is also the molar mass. Hence,



Since, the given compound is aromatic, the two possible structures are



Identify the compound

An Organic compound $\text{C}_x\text{H}_y\text{O}_z$ was burnt with twice the amount of Oxygen

An organic compound $\text{C}_x\text{H}_y\text{O}_z$ was burnt with twice the amount of oxygen needed for complete combustion to CO_2 and H_2O . The hot gases, when cooled to 0°C and 1 atm pressure, measured 2.24 L. The water collected during cooling weighed 0.9 g. The vapour pressure of pure water at 20°C is 17.5 mmHg and is lowered by 0.104 mmHg when 50 g of the organic compound is dissolved in 1000 g of water. Give the molecular formula of the organic compound.

Solution The combustion reaction is $\text{C}_x\text{H}_y\text{O}_z + x \text{ O}_2 \rightarrow x \text{ CO}_2 + y \text{ H}_2\text{O}$

To start with, the amount of O_2 taken is $2x$. Hence, after the combustion reaction, we will be left with the following amounts.

Amount of oxygen left unreacted = x ; Amount of carbon dioxide = x ; Amount of water = y

When this mixture is cooled to 0°C and 1 atm, we will be left with oxygen and carbon dioxide. Hence, the amount $2x$ occupies the given volume of 2.24 L at STP. Hence,

$$\text{Amount } x = \frac{(2.24/2) \text{ L}}{22.4 \text{ L mol}^{-1}} = 0.05 \text{ mol}$$

$$\text{Now, Mass of water collected} = 0.9 \text{ g} \quad \text{Amount of water collected, } y = \frac{0.9 \text{ g}}{18 \text{ g mol}^{-1}} = 0.05 \text{ mol}$$

Thus, the empirical formula of the compound is $\text{C}_{0.05}\text{H}_{2 \times 0.05}\text{O}_{0.05}$, i.e. CH_2O . Now, according to Raoult's law

$$-\frac{\Delta p}{p^*} = x_2 \text{ i.e. } \frac{0.104 \text{ mmHg}}{17.5 \text{ mmHg}} = \frac{(50 \text{ g/M})}{(50 \text{ g/M}) + (1000 \text{ g}/18 \text{ g mol}^{-1})}$$

Solving for M , we get $M = 150.5 \text{ g mol}^{-1}$

$$\text{Number of repeating units of } \text{CH}_2\text{O in the molecular formula} = \frac{150.5}{12 + 2 + 16} \approx 5$$

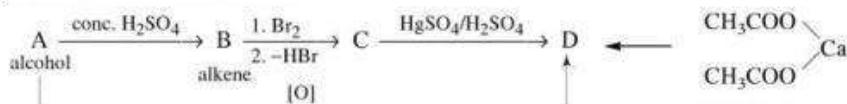
Hence, Molecular formula of the compound is $\text{C}_5\text{H}_{10}\text{O}_5$.

Identify the Compound

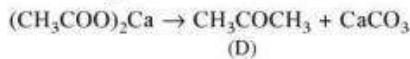
Alcohol when heated with concentrated H_2SO_4

An alcohol A, when heated with concentrated H_2SO_4 gives an alkene B. When B is bubbled through bromine water and the product obtained is dehydrohalogenated with excess of sodamide, a new compound C is obtained. The compound C gives D when treated with warm dilute H_2SO_4 in presence of HgSO_4 . D can also be obtained either by oxidizing A with KMnO_4 or from acetic acid through its calcium salt. Identify A, B, C and D.

Solution The given reactions are as follows.

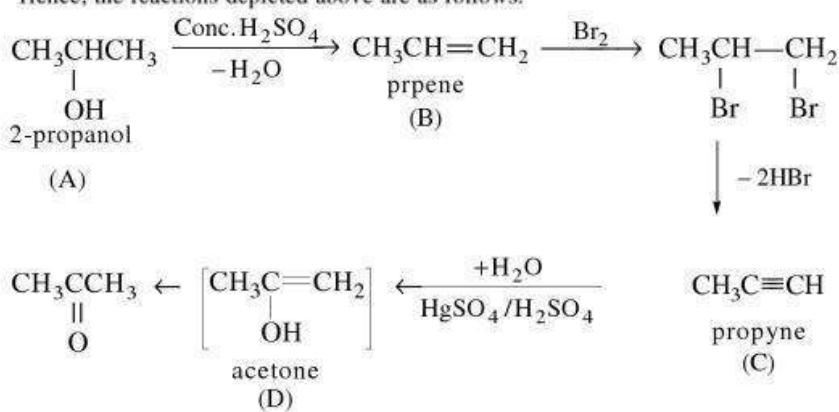


The reaction of obtaining D from calcium acetate is



Hence, D is acetone. Since the latter is also obtained from the oxidation of alcohol A, compound A will be $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$.

Hence, the reactions depicted above are as follows.



Identify the compound

Certain hydrocarbon was found to contain 85.7% carbon

A certain hydrocarbon A was found to contain 85.7 per cent carbon and 14.3 per cent hydrogen. This compound consumes 1 molar equivalent of hydrogen to give a saturated hydrocarbon B. 1.0 g of hydrocarbon A just decolorized 38.05 g of a 5 per cent solution (by mass) of Br_2 in CCl_4 . Compound A, on oxidation with concentrated KMnO_4 , gave compound C (molecular formula $\text{C}_4\text{H}_8\text{O}$) and compound D could easily be prepared by the action of acidic aqueous mercuric sulphate on 2-butyne. Determine the molecular formula of A and deduce the structures A, B and C.

Solution The ratio of atoms in the compound A is $\text{C} : \text{H} : \frac{85.7}{12} : \frac{14.3}{1} :: 7.14 : 14.3 :: 1 : 2$

Thus, Empirical formula of A is CH_2 .

Since the compound A consumes 1 mol of hydrogen, the molecule of A contains only one carbon-carbon double bond. From the data on the absorption of bromine, we can calculate the molar mass of A as shown in the following.

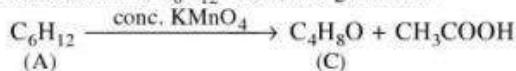
$$\text{Mass of bromine absorbed by } 1.0 \text{ g of hydrocarbon} = \frac{5}{100} \times 38.05 \text{ g}$$

$$\text{Mass of hydrocarbon absorbing } 160 \text{ g } (= 1 \text{ mol}) \text{ of } \text{Br}_2 = \frac{1.0}{(5 \times 38.05/100)} \times 160 \text{ g} = 84.1 \text{ g.}$$

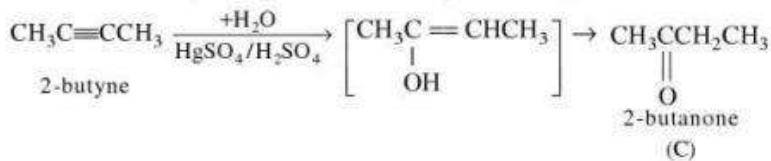
Hence, Molar mass of A is 84.1 g mol^{-1} .

The number of repeating CH_2 group in one molecule of A will be 6 ($= 84.1/14$). Hence,

Molecular formula of A is C_6H_{12} . Now, it is given that



The compound C is obtained by the hydration of 2-butyne. Hence, its structure obtained from the reaction is

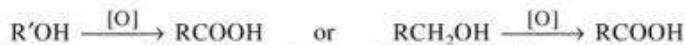


Identify the compound

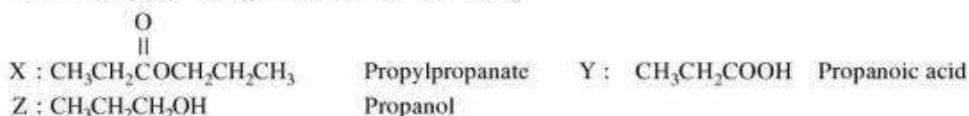
A liquid X having a molecular formula $\text{C}_6\text{H}_{12}\text{O}_2$ is hydrolyzed with water

A liquid X, having a molecular formula $\text{C}_6\text{H}_{12}\text{O}_2$ is hydrolysed with water in the presence of an acid to give a carboxylic acid, Y, and an alcohol Z. Oxidation of Z with chromic acid gives Y. What are the structures of X, Y and Z?

Solution Since the hydrolysis of X gives a carboxylic acid (Y) and an alcohol (Z), the compound X must be an ester. Let it be RCOO' . The compounds Y and Z will be RCOOH and $\text{R}'\text{OH}$, respectively. Since the oxidation of Z gives Y, we will have



Hence, the given compound X may be written as RCOOCH_2R . From this it follows that



Identify the compound

An unknown compound of carbon, hydrogen, and oxygen contains 69.77% carbon and 11.63% hydrogen and has a molar mass of 86 g mol^{-1} . It does not reduce Fehling's solution, but forms a bisulphite addition compound and gives a positive iodoform test. What are the possible structures?

Solution The given compound is a ketone as it does not reduce Fehling's solution, but forms a bisulphite addition compound. It will also contain CH_3CO group as it shows positive iodoform test.

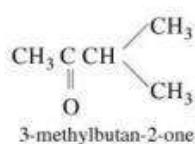
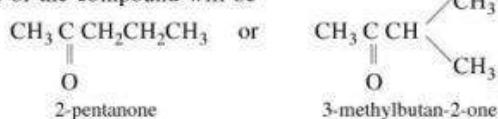
The ratios of atoms in the compound are

$$\text{C : O : H} :: \frac{69.77}{12} : \frac{18.60}{16} : \frac{11.63}{1} :: 5.81 : 1.16 : 11.63 :: 5 : 1 : 10$$

Hence Empirical formula is $\text{C}_5\text{H}_{10}\text{O}$.

Thus, Molecular formula is $\text{C}_5\text{H}_{10}\text{O}$.

The structure of the compound will be

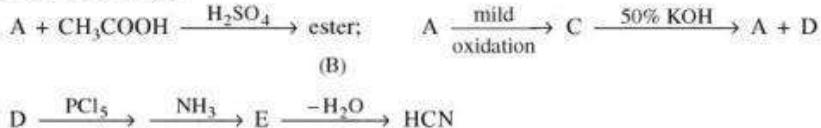


Identify the compound

An organic compound A on treatment with acetic acid in the presence of Sulphuric acid

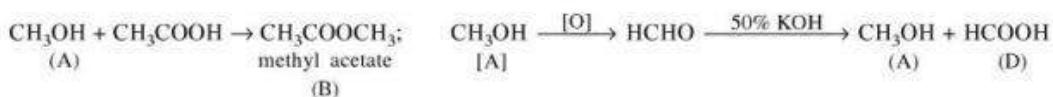
An organic compound A on treatment with acetic acid in the presence of sulphuric acid produces an ester B. The compound A on mild oxidation gives C. The compound C with 50% potassium hydroxide followed by acidification with dilute hydrochloric acid generates A and D. The compound D with phosphorus pentachloride followed by reaction with ammonia gives E. The compound E on dehydration produces hydrocyanic acid. Identify the compounds A, B, C, D and E.

Solution The given reactions are

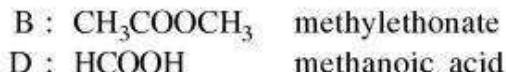
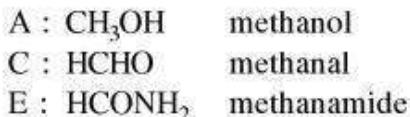
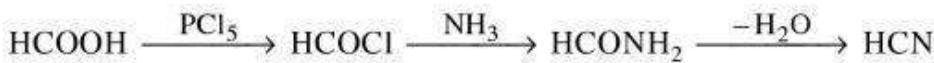


The reaction $\text{C} \xrightarrow{50\% \text{ KOH}} \text{A} + \text{D}$ is a Cannizzaro reaction and thus the compound C is an aldehyde with no α -hydrogen, C must be HCHO . From this it follows that A must be CH_3OH as its mild oxidation gives HCHO .

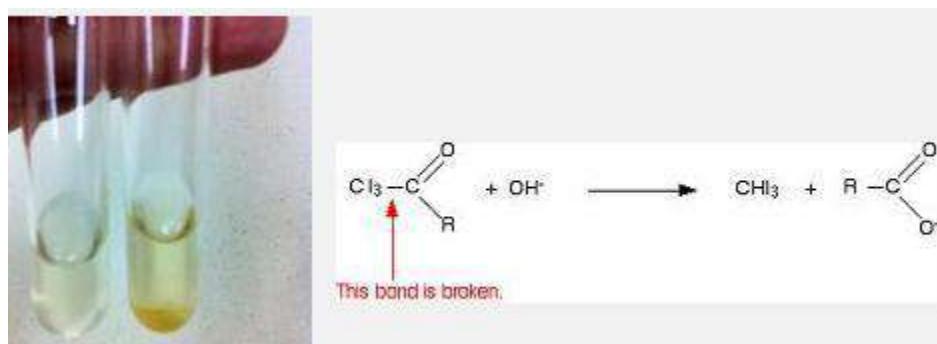
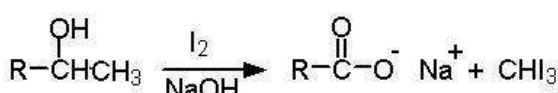
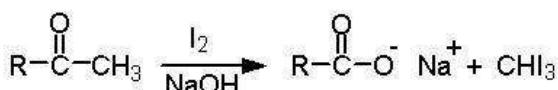
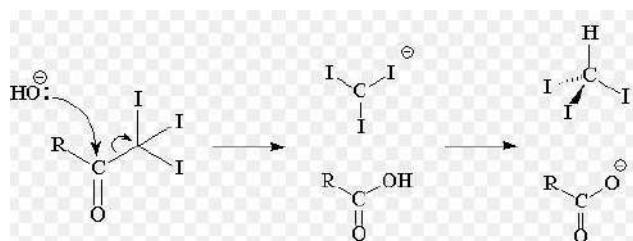
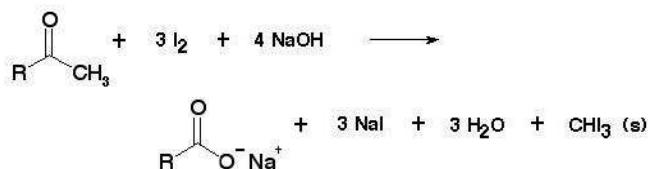
With this fact, we can write the given reactions as shown below.



Hence



Iodoform Test



Identify the compound

An organic compound X, on analysis gives 24.24 per cent carbon and 4.04 per cent hydrogen. Further, sodium extract of 1.0 g of X gives 2.90 g of silver chloride with acidified silver nitrate solution. The compound X may be represented by two isomeric structures, Y and Z. The compound Y on treatment with aqueous potassium hydroxide solution gives a dihydroxy compound, while Z on similar treatment gives ethanal. Find out the molecular formula of X and give the structures of Y and Z.

Solution Mass per cent of chlorine in the organic compound X

$$= \frac{M_{\text{Cl}}}{M_{\text{AgCl}}} \times \frac{m_{\text{AgCl}}}{m_{\text{compound}}} \times 100 = \frac{35.5}{143.5} \times \frac{2.90}{1.0} \times 100 = 71.21$$

The ratios of atoms in the molecule of X are

$$\text{C:H:Cl:} : \frac{24.24}{12} : \frac{4.04}{1} : \frac{71.72}{35.5} :: 2 : 4 : 2 :: 1 : 2 : 1$$

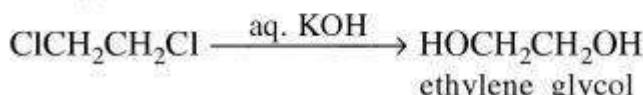
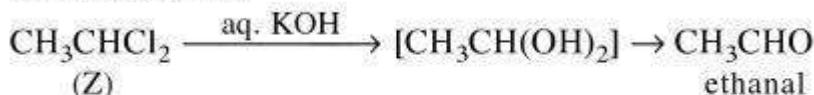
Empirical formula of X is CH_2Cl

Since the isomer Y of the compound gives a dihydroxy compound on treating with aqueous KOH, it follows that the compound must contain two Cl atoms. Hence,

Molecular formula of X is $\text{C}_2\text{H}_4\text{Cl}_2$.

Its two isomers are CH_3CHCl_2 and $\text{ClCH}_2\text{CH}_2\text{Cl}$.
(Z) (Y)

The reaction are



Match the entries given on the left with those given on the right.

- | | |
|---|--------------------------------|
| (a) Cyclopropane, chlorine and light | (p) Electrophilic substitution |
| (b) Propanone and sodium bisulphite | (q) Homologous pair |
| (c) Ethanal and Methanal | (r) Homolytic addition |
| (d) Benzene, nitric acid and sulphuric acid | (s) Free radical substitution |
| (e) Propene, hydrogen bromide and a peroxide catalyst | (t) nucleophilic addition |

Ans :

- (a) – (s); (b) – (t); (c) – (q); (d) – (p); (e) – (r)

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Match the entries given on the left with those given on the right.

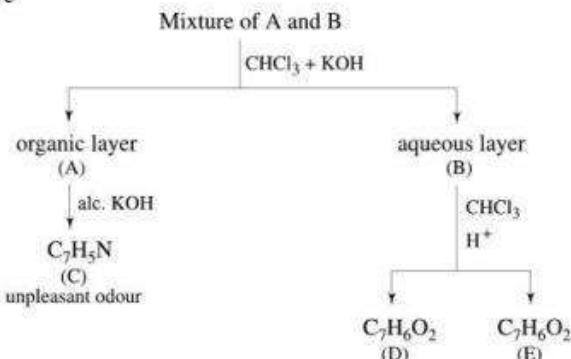
- | | |
|--|-----------------------------|
| (a) Pyrolysis of alkanes | (p) Elimination reaction |
| (b) Benzene + Chloroethane
(+ anhydrous AlCl ₃) | (q) Saponification |
| (c) CH ₃ COOC ₂ H ₅ + NaOH | (r) Wurtz reaction |
| (d) Preparation of alkanes | (s) Friedel-craft reaction |
| (e) Phenol + CHCl ₃ (NaOH) | (t) Reimer-Tiemann reaction |
| (f) C ₂ H ₅ Br + alcKOH | (u) Cracking |

Ans :

Identify the compound

A mixture of two aromatic compounds A and B was separated by dissolving in chloroform followed by extraction with aqueous KOH solution. The organic layer containing compound A, when heated with alcoholic solution of KOH produced a compound C (C_7H_5N) associated with an unpleasant odour. The alkaline aqueous layer on the other hand, when heated with chloroform and then acidified gave a mixture of two isomeric compounds D and E of molecular formula $C_7H_6O_2$. Identify the compounds A, B, C, D, and E and write their structures.

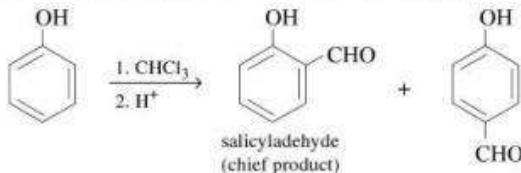
Solution We have



The compound C is an isocyanide which is produced from a primary amine. Hence, the structures of C and A are



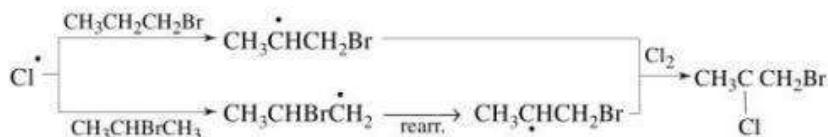
The compound B exhibits Reimer-Tiemann reaction. Thus, the compound B must be phenol. The reaction is



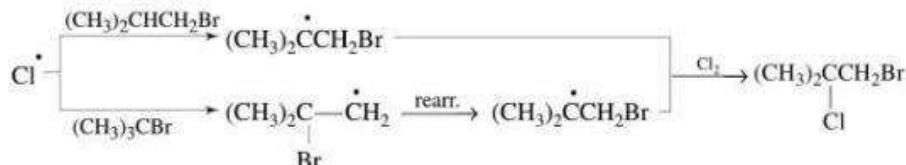
Rearrangement by migration of Bromine

Rearrangement, by migration of Br, of initially formed 1° radical into more stable 2° or 3° radical.

Chlorination of either *n*-propyl or isopropyl bromide gives 1-bromo-2-chloropropane.



Chlorination of either isobutyl or *tert*-butyl bromide gives 1-bromo-2-chloro-2-methylpropane.



Identify the Compound

An organic compound containing C, H and O exists in two isomeric forms A and B. A mass of 0.108 g of one of the isomers gives on combustion 0.308 g of CO₂ and 0.072 g of H₂O. A is insoluble in NaOH and NaHCO₃ while B is soluble in NaOH. A reacts with concentrated HI to give compounds C and D. C can be separated from D by the ethanolic AgNO₃ solution and D is soluble in NaOH. B reacts readily with bromine to give compound E of molecular formula, C₇H₅OBr₃. Identify A, B, C, D and E with justification and give their structures.

Solution We have

$$\text{Per cent of carbon in the compound} = \frac{M_C}{M_{\text{CO}_2}} \times 100 = \left(\frac{12}{44} \right) \left(\frac{0.308}{0.108} \right) (100) = 77.78$$

$$\text{Per cent of hydrogen in the compound} = \frac{2 M_H}{M_{\text{H}_2\text{O}}} \times 100 = \left(\frac{2}{18} \right) \left(\frac{0.072}{0.108} \right) (100) = 7.41$$

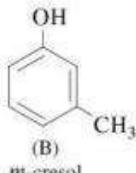
$$\text{Per cent of oxygen in the compound} = 100 - (77.78 + 7.41) = 14.81.$$

The ratios of atoms in the compound are

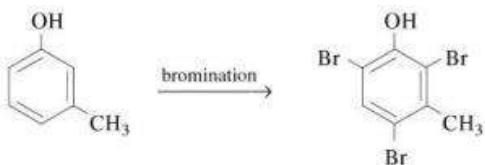
$$C : H : O :: \frac{77.78}{12} : \frac{7.41}{1} : \frac{14.81}{16} :: 6.48 : 7.41 : 0.926 :: 7 : 8 : 1$$

Hence, Empirical formula of the compound is C₇H₈O.

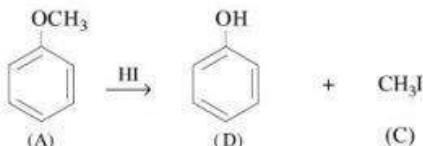
Since the isomer B on reacting with bromine water gives compound E (C₇H₅OBr₃), the molecular formula of A and B will be the same as the empirical formula derived above, since both contain the same number of carbon atoms. As E is obtained from B by the substitution of hydrogen with bromine and since there is high carbon content in B, the compounds A and B must be aromatic. Now, since compound A is insoluble in NaOH and NaHCO₃ and compound B is soluble in NaOH, it may be concluded that B is a phenolic compound and A is an ether. Hence, the structures of A and B are



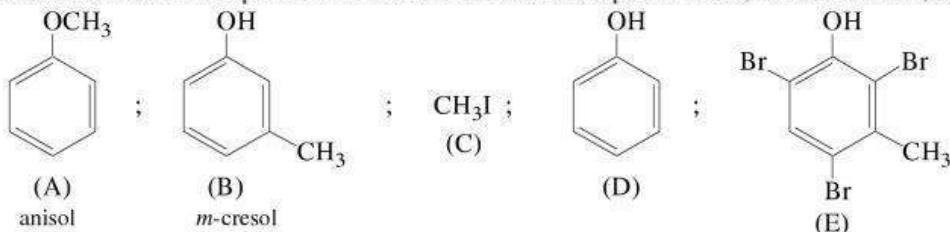
The bromination of B gives



The reaction of compound A with HI is



The compound C can be separated from D by use of ethanolic AgNO_3 solution as it is soluble in it whereas D will remain insoluble. The compound D will be soluble in NaOH as it is phenol. Hence, the structures of A, B, C, D and E are



Match the entries given on the left with those given on the right.

- | | |
|----------------------------|-------------------------|
| (a) Decarboxylation | (p) Addition reaction |
| (b) Ozonolysis | (q) Sodalime |
| (c) Williamson's synthesis | (r) Structure of alkene |
| (d) Dichloroethylene | (s) Ether |

Ans :

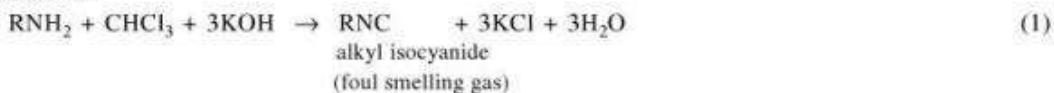
$$(a) - (q); \quad (b) - (r); \quad (c) - (s); \quad (d) - (p)$$

Identify the compound

Basic volatile Nitrogen compound

A basic volatile nitrogen compound gave a foul smelling gas when treated with chloroform and alcoholic potash. A 0.295 g sample of the substance, dissolved in aqueous HCl, and treated with NaNO_2 solution at 0 °C liberated a colourless, odourless gas whose volume corresponded to 112 mL at STP. After the evolution of the gas was complete, the aqueous solution was distilled to give an organic liquid which did not contain nitrogen and which on warming with alkali and iodine gave a yellow precipitate. Identify the original substance. Assume that it contains one N atom per molecule.

Solution Since the compound gives a foul smelling gas on treating with CHCl_3 and alcoholic KOH, the compound must be a primary amine.



Since the compound on treating with NaNO_2/HCl at 0 °C produces a colourless gas, the compound must be an aliphatic primary amine.



Thus, the gas produced is nitrogen.

$$\text{Amount of gas liberated} = \frac{112 \text{ mL}}{22400 \text{ mL mol}^{-1}} = \frac{1}{200} \text{ mol}$$

From the above equation, it is obvious that

$$\text{Amount of compound } \text{RNH}_2 = \frac{1}{200} \text{ mol}$$

If M is the molar mass of RNH_2 , then

$$\frac{2.295 \text{ g}}{M} = \frac{1}{200} \text{ mol} \quad \text{or} \quad M = 0.295 \times 200 \text{ g mol}^{-1} = 59 \text{ g mol}^{-1}.$$

Thus, the molar mass of alkyl group R is $(59 - 16)$ g mol⁻¹, i.e. 43 g mol⁻¹. Hence, R must be C₃H₇.

From Eq. (2), it is obvious that the liquid obtained after distillation is ROH. Since this gives yellow precipitate with

alkali and iodine (iodoform test), it must contain $\text{CH}_3-\overset{\text{I}}{\underset{\text{OH}}{\text{C}}}-$ group. Hence, it is concluded that ROH is

$$\text{CH}_3-\underset{\text{OH}}{\overset{|}{\text{CH}}}-\text{CH}_3 \text{. Thus, the original compound is } \text{CH}_3-\underset{\text{NH}_2}{\overset{|}{\text{CH}}}-\text{CH}_3$$

isopropylamine

Match the entries given on the left with those given on the right.

- | | |
|-----------------------------|----------------------|
| (a) Lucas test | (p) Phenol |
| (b) Neutral FeCl_3 | (q) Glucose |
| (c) Dye test | (r) Tertiary alcohol |
| (d) Tollens test | (s) Aniline |

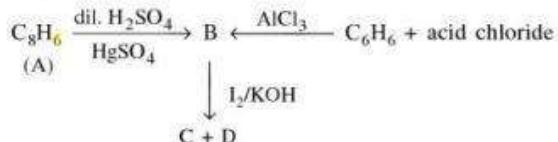
Ans :

(a) – (r); (b) – (p); (c) – (s); (d) – (q)

Identify the compound

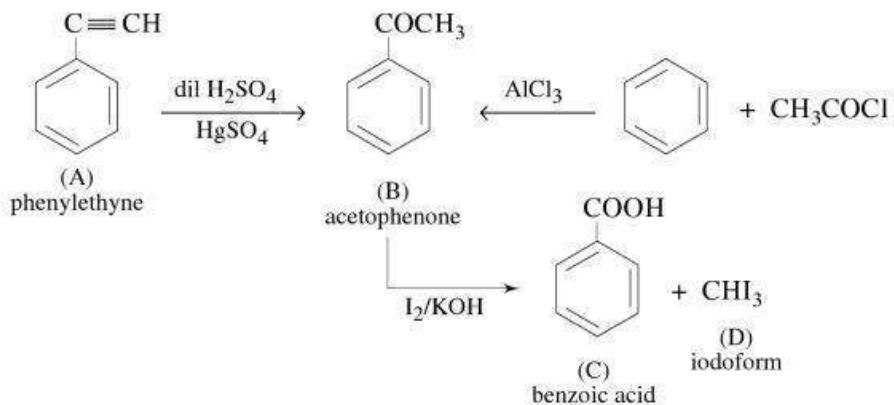
An organic compound A, C_8H_6 , on treatment with dilute sulphuric acid containing mercuric sulphate gives a compound B, which can also be obtained from a reaction of benzene with an acid chloride in the presence of anhydrous aluminium chloride. The compound B, when treated with iodine in aqueous KOH, yields C and a yellow compound D. Identify A, B, C and D with justification. Show how B is formed from A.

Solution The given reactions are



The reaction of B with I_2 in KOH is iodoform reaction. The compound D is iodoform, CHI_3 . The compound B must contain $-COCH_3$ group so as to exhibit iodoform reaction. Since D is obtained from benzene by Friedel-Crafts reaction, it is an aromatic ketone ($C_6H_5COCH_3$). The compound C must be an acid.

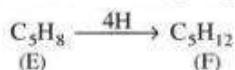
The compound A may be represented as $C_6H_5C_2H$. Since it gives $C_6H_5COCH_3$ on treating with dilute H_2SO_4 and $HgSO_4$, it must contain a triple bond ($-C\equiv CH$) in the side chain. Hence, the given reactions may be represented as



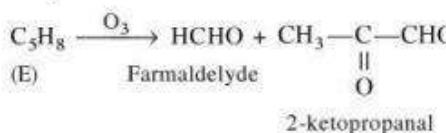
Identify the compound

An organic compound E (C_5H_8) on hydrogenation gives compound F (C_5H_{12}). Compound E on ozonolysis gives formaldehyde and 2-keto-propanal. Deduce the structure of compound E.

Solution Since there are four hydrogen atoms added in the reaction



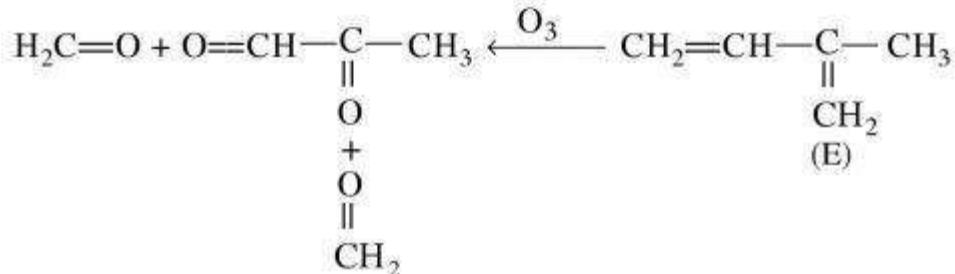
the compound E may contain two double bonds. The ozonolysis reaction is



Since there is no loss of carbon atoms in an ozonolysis reaction, probably 2 molecules of formaldehyde are formed. In 2-ketopropanal, —C— and —CHO groups must have resulted due to the cleavage of double bonds. Hence, the net

In 2-ketopropanal, $\text{---C=}\begin{matrix} \parallel \\ \text{O} \end{matrix}$ and ---CHO groups must have resulted due to the cleavage of double bonds. Hence, the net

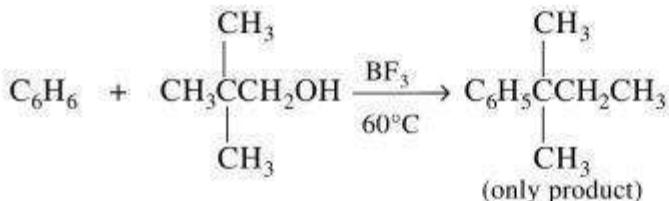
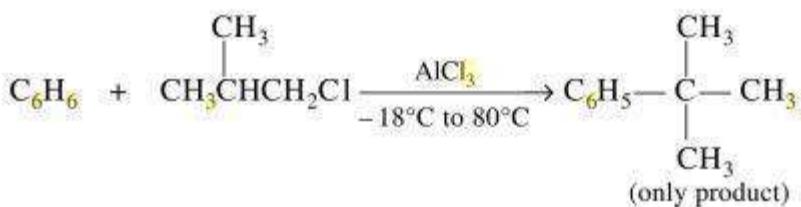
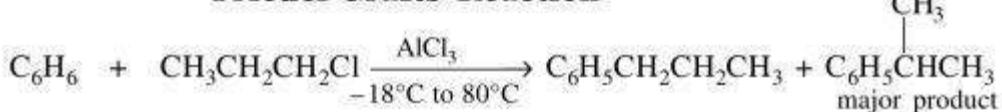
reaction can be explained as follows.



Hence, the compound E is 2-methyl-1, 3-butadiene.

Friedel Crafts Reaction

Friedel-Crafts Reaction



Identify the compound

An Organic compound A has 76.6% C and 6.38% H (Aspirin)

An organic compound A has 76.6% C and 6.38% H. Its vapour density is 47. It gives characteristic colour with FeCl_3 solution. The compound A when treated with CO_2 and NaOH at 140°C under pressure gives B which on being acidified gives C. The compound C reacts with acetyl chloride to give D which is a well known pain killer. Identify A, B, C and D and explain the reactions involved.

Solution The ratios of atoms present in one molecule of A are

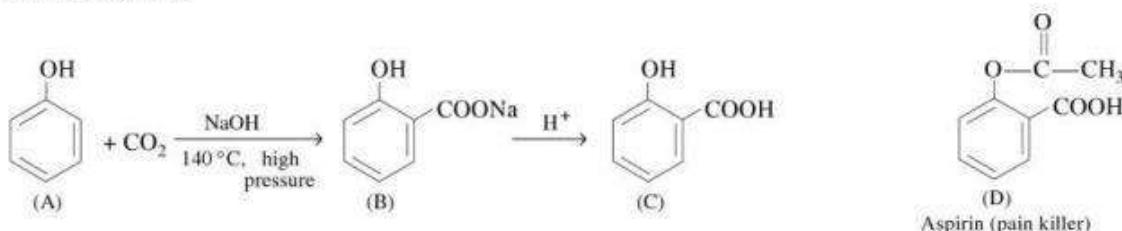
$$\text{C : H : O} \quad :: \frac{76.6}{12} : \frac{6.38}{1} : \frac{17.02}{16} \quad :: 6.38 : 6.38 : 1.064 :: 6 : 6 : 1$$

Hence, Empirical formula of A is C_6H_6O . Molar empirical formula mass of A = 94 g mol⁻¹

This tallies with the given molar mass ($= 2 \times 47 \text{ g mol}^{-1}$). Thus Molecular formula of A is $\text{C}_2\text{H}_6\text{O}$.

Since, the compound A gives characteristic colour with FeCl_3 , it must be a phenol.

The given reactions are



Match the entries given on the left with those given on the right.

Friedel-Crafts	oil	alkenes
Fermentation	Lewis acid	soap
Dehydrohalogenation	cuprous chloride	anhydrous AlCl_3
Sandmeyer	yeast	chlorobenzene
Saponification	alcoholic alkali	ethanol

Ans :

Friedel-Crafts;	Lewis acid;	anhydrous AlCl_3
Fermentation;	yeast;	ethanol
Dehydrohalogenation;	alcoholic alkali;	alkenes
Sandmeyer;	cuprous chloride;	chlorobenzene
Saponification;	oil;	soap

Identify the compound

An organic compound A of molar mass 140.5 gm per mole has 68.32% Hydrogen

An organic compound A of molar mass 140.5 g mol^{-1} has 68.32% C, 6.4% H and 25.26% Cl. Hydrolysis of A with dilute acid gives compound B, $\text{C}_8\text{H}_{10}\text{O}$. Compound B can be oxidized under mild conditions to compound C, $\text{C}_8\text{H}_8\text{O}$. Compound C forms a phenylhydrazone D with PhNNH_2 and gives a positive iodoform test. Deduce the structures of compounds A to D with proper reasoning.

Solution The ratios of atoms in a molecule of A are

$$\text{C : H : Cl} :: \frac{68.32}{12} : \frac{6.4}{1} : \frac{25.26}{35.5} :: 5.69 : 6.4 : 0.71 :: 8 : 9 : 1$$

Hence, Empirical formula of A is $\text{C}_8\text{H}_9\text{Cl}$. Molar empirical formula mass of A = 140.5 g mol^{-1}

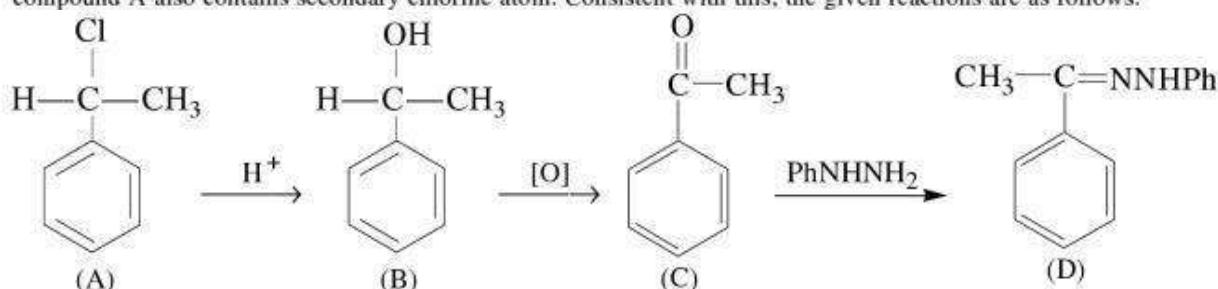
This tallies with the given molar mass. Thus Molecular formula of A is $\text{C}_8\text{H}_9\text{Cl}$.

The high content of carbon indicates the presence of aromatic (or benzene) ring in the molecule.

Since Cl atom in the compound A is easily replaced during hydrolysis of A with dilute acid, the Cl atom must be attached to the aliphatic portion of the molecule.

Since the compound C gives a positive iodoform test, it must contain— COCH_3 group.

Since the compound C is obtained by mild oxidation of B, the latter must be a secondary alcohol. Hence, the compound A also contains secondary chlorine atom. Consistent with this, the given reactions are as follows.



Question

Bleaching powder and bleach solution are produced on a large scale and used in several household products. The effectiveness of bleach solution is often measured by iodometry.

25 mL of household bleach solution was mixed with 30 mL of 0.50 M KI and 10 mL of 4 N acetic acid. In the titration of the liberated iodine, 48 mL of 0.25 N $\text{Na}_2\text{S}_2\text{O}_3$ was used to reach the end point. The molarity of the household bleach solution is

- (a) 0.48 M (b) 0.96 M (c) 0.24 M (d) 0.024 M

Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is

- (a) Cl_2O (b) Cl_2O_7 (c) ClO_2 (d) Cl_2O_6

Solutions :

For Q.11, we may write



$$\text{Amount of Na}_2\text{S}_2\text{O}_3 \text{ used} = VM = (48 \times 10^{-3} \text{ L}) (0.25 \text{ mol L}^{-1}) = 12 \times 10^{-3} \text{ mol}$$

$$\text{Amount of I}_2 \text{ generated} = \frac{1}{2} (12 \times 10^{-3} \text{ mol}) = 6 \times 10^{-3} \text{ mol}$$

Assuming 1 mol of household bleach produces 1 mol I_2 , we will have

Amount of household bleach in 25 mL solution = 6×10^{-3} mol

$$\text{Molarity of household bleach} = \frac{n}{V} = \frac{6 \times 10^{-3} \text{ mol}}{25 \times 10^{-3} \text{ L}} = 0.24 \text{ M}$$

For Q 12, we have

Bleaching powder contains $\text{Ca}(\text{OCl})\text{Cl}$

The oxoacid of this salt is HOCl. The formation of this acid through its anhydride is $\text{Cl}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{HOCl}$

Hence we have

The choice (c) is correct.

The choice (a) is correct

Match the compounds/ions in Column I with their properties/reactions in Column II.

Column I

- (a) $\text{C}_6\text{H}_5\text{CHO}$
 (b) $\text{CH}_3\text{C}\equiv\text{CH}$
 (c) CN^-
 (d) I^-

Column II

- (p) gives precipitate with 2,4-dinitrophenylhydrazine
 - (q) gives precipitate with AgNO_3
 - (r) is a nucleophile
 - (s) is involved in cyanohydrin formation

Ans :

(a) - (p), (q), (s); (b) - (q); (c) - (q), (r), (s); (d) - (q)

In decreasing order of Oxidation state of Nitrogen

Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen ?

- (a) HNO_3 , NO, NH_4Cl , N_2
 (c) HNO_3 , NH_4Cl , NO, N_2

- (b) HNO_3 , NO, N_2 , NH_4Cl
 (d) NO, HNO_3 , NH_4Cl , N_2

Solution :

The oxidation states of nitrogen in the given compounds are as follows.

$$\begin{array}{ll} \text{HNO}_3 : +1 + x + 3(-2) = 0 & \Rightarrow x = +5 \\ \text{NH}_4\text{Cl} : x + 4(+1) + (-1) = 0 & \Rightarrow x = -3 \end{array} \quad \begin{array}{ll} \text{NO} : x + (-2) = 0 & \Rightarrow x = +2 \\ \text{N}_2 : 2(x) = 0 & \Rightarrow x = 0 \end{array}$$

Thus, the decreasing oxidation numbers of nitrogen is HNO_3 , NO, N_2 and NH_4Cl .

Therefore, the **choice (b)** is correct.

Gyan Question

The Kinetic energy of an electron in the second Bohr orbit

The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom (a_0 is Bohr radius) is

- (a) $h^2/(4\pi^2 m a_0^2)$ (b) $h^2/(16\pi^2 m a_0^2)$ (c) $h^2/(32\pi^2 m a_0^2)$ (d) $h^2/(64\pi^2 m a_0^2)$

Solution :

Bohr model of an atom satisfies the following two requirements.

- Equality of centripetal and centrifugal forces, i.e.
- Quantization of angular momentum, i.e.

$$\frac{(Ze)(e)}{(4\pi\epsilon_0)r^2} = \frac{mv^2}{r} \quad mv r = n \left(\frac{h}{2\pi} \right)$$

Eliminating v in these two expressions, we get

$$r = n^2 \left[\frac{h^2}{4\pi^2 m (Ze^2 / 4\pi\epsilon_0)} \right] = \frac{n^2}{Z} a_0$$

where a_0 is the Bohr radius. The kinetic energy of the electron in Bohr orbit of an atom is

$$\text{KE} = \frac{1}{2}mv^2 = \frac{1}{2}m \left[\frac{n}{mr} \left(\frac{h}{2\pi} \right) \right]^2 = \frac{1}{2}m \left[\frac{n}{m(n^2 a_0 / Z)} \left(\frac{h}{2\pi} \right) \right]^2 = \frac{Z^2}{n^2} \left(\frac{h^2}{8\pi^2 m a_0^2} \right)$$

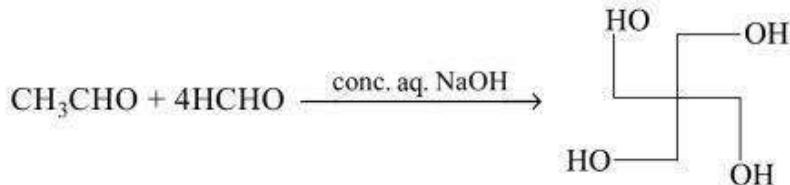
For the second Bohr orbit of hydrogen atom, $Z = 1$, and $n = 2$. Hence

$$\text{KE} = \frac{1}{32} \left(\frac{h^2}{\pi^2 m a_0^2} \right)$$

Therefore, the **choice (c)** is correct.

Question on Aldol reaction

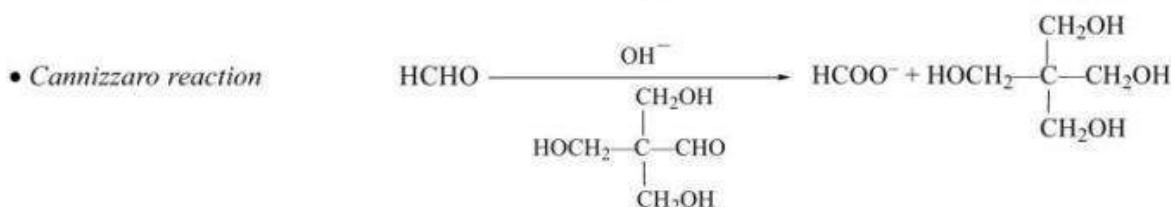
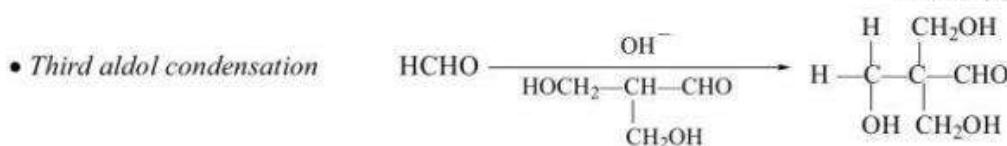
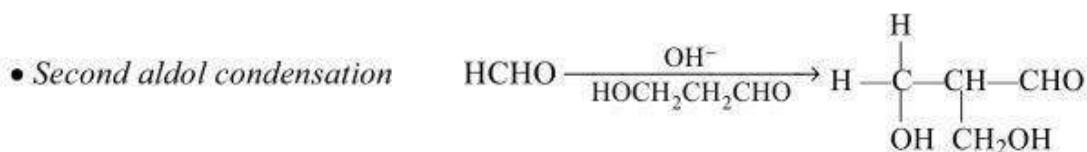
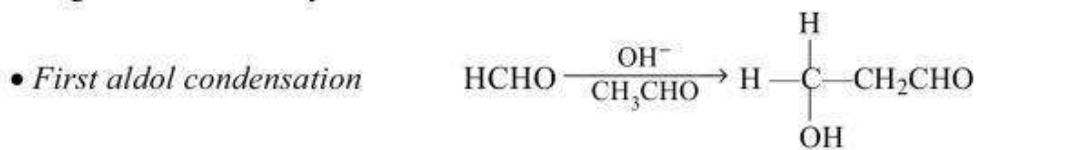
The number of aldol reaction(s) that occurs in the given transformation



is

Solution :

The given reaction may be formulated as follows.



There are three aldol condensations and one Cannizzaro reaction.

An organic compound undergoes first order decomposition

An organic compound undergoes first-order decomposition. The time taken for its decomposition to 1/8 and 1/10 of its initial concentration are $t_{1/8}$ and $t_{1/10}$, respectively. What is the value of $(t_{1/8}/t_{1/10}) \times 10^3$? ($\log 2 = 0.3$)

Solution :

$$\text{Hence } \ln(1/8) = -k t_{1/8} \quad \text{and} \quad \ln(1/10) = -k t_{1/10}$$

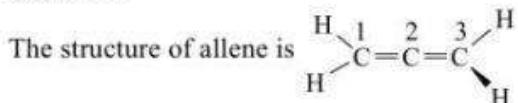
$$\text{Thus } \frac{\ln(1/8)}{\ln(1/10)} = \frac{t_{1/8}}{t_{1/10}} \quad \text{or} \quad \frac{\log 8}{\log 10} = \frac{t_{1/8}}{t_{1/10}}$$

Allene has sp hybridization

In allene (C_3H_4), the type(s) of hybridization of the carbon atom is (are)

- (a) sp and sp^3 (b) sp and sp^2 (c) sp^3 only (d) sp^2 and sp^3

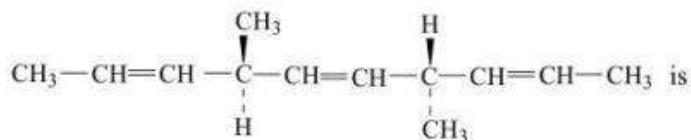
Solution :



In this molecule, carbon atoms 1 and 3 are sp^2 hybridized while the carbon atom 2 is sp hybridized. Therefore, the **choice (b)** is correct.

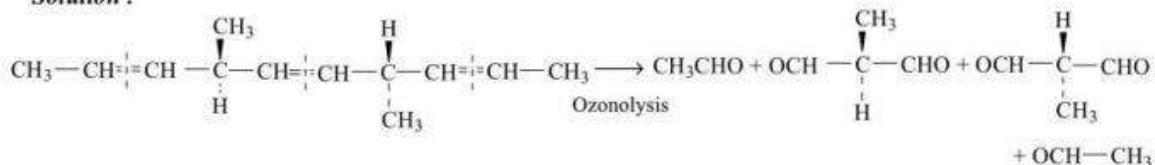
Number of chiral carbon and optically active products

The number of optically active products obtained from the complete ozonolysis of the given compound



- (a) 0 (b) 1 (c) 2 (d) 4

Solution :



None of the products will be optically active.

Therefore, the **choice (a)** is correct.

Carboxylic functional group is present in aspirin

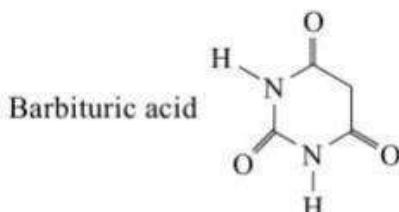
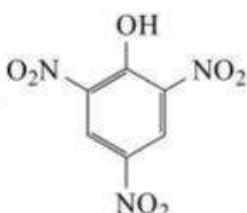
The carboxylic functional group (—COOH) is present in

- (a) picric acid (b) barbituric acid (c) ascorbic acid (d) aspirin

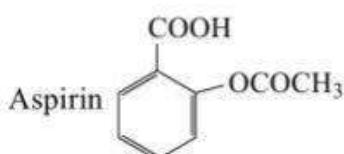
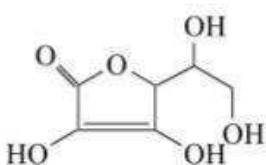
Solution :

The structures of the given compounds are as follows.

Picric acid



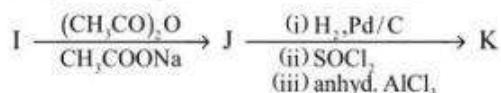
Ascorbic acid



Therefore, the **choice (d)** is correct.

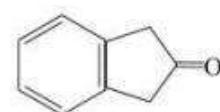
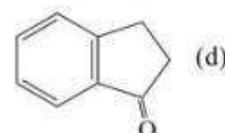
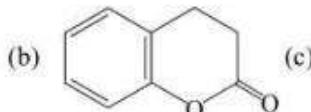
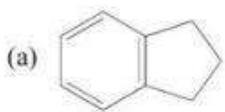
Identify the compound

In the following reaction sequence, the compound J is an intermediate

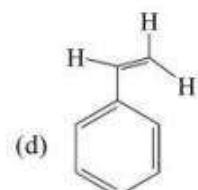
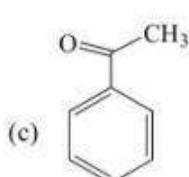
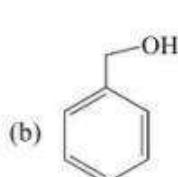
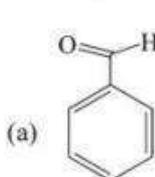


J($\text{C}_9\text{H}_8\text{O}_2$) gives effervescence on treatment with NaHCO_3 and positive Baeyer's test.

Q - The compound K is



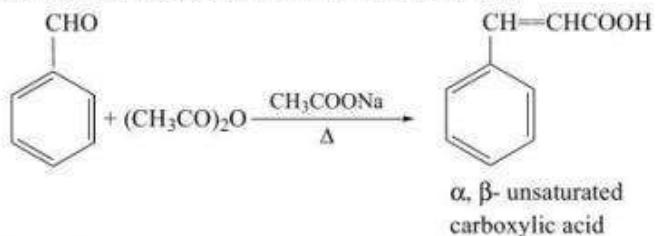
Q - The compound I is



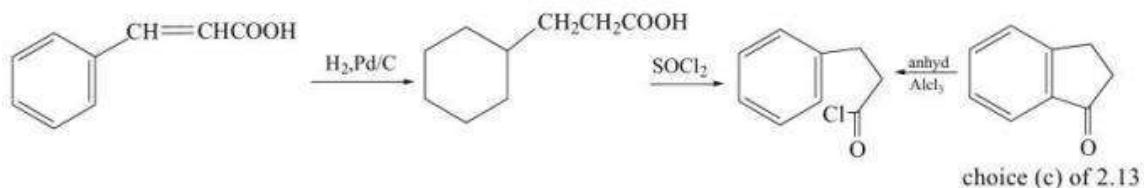
Perkin Condensation

Solutions :

The compound J must contain a —COOH group as it gives effervescence with NaHCO_3 . Also, it is an unsaturated compound as it gives positive Baeyer's test (decolourization of pink colour of alkaline KMnO_4). Since the compound J is obtained by treating the compound I with $(\text{CH}_3\text{CO})_2\text{O}$ and CH_3COONa , and more over the compound J seems to be aromatic (high carbon content), the compound I amongst the choices given in Q.14 seems to be benzaldehyde as it shows Perkin condensation shown in the following



The conversion J to K is as follows.



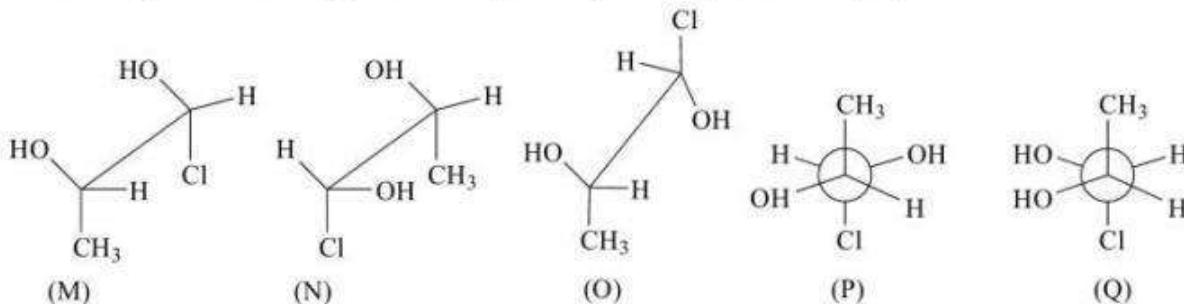
Hence, we have

The choice (c) is correct.

The choice (a) is correct.

Question on isomers

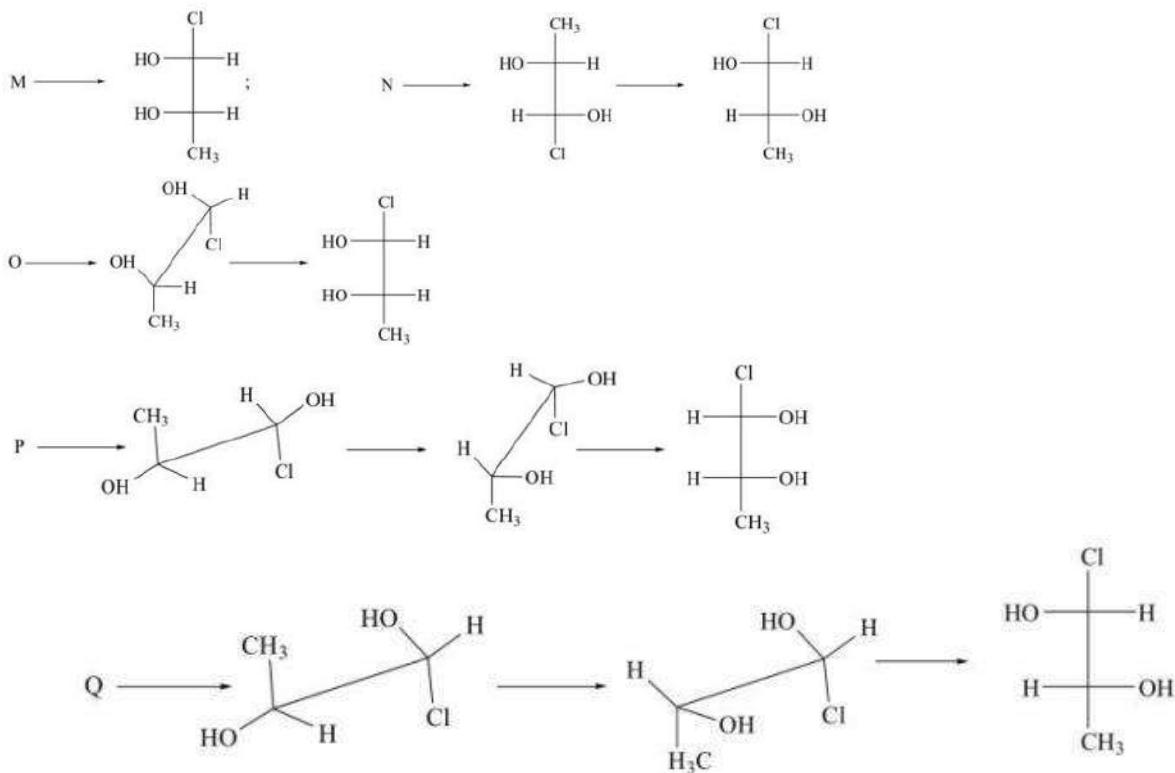
Which of the given statement(s) about N, O, P and Q with respect to M is(are) correct?



- (a) M and N are non-mirror image stereoisomers. (b) M and O are identical
 (c) M and P are enantiomers (d) M and Q are identical

Solution :

First of all, we may draw Fischer projections of the given compounds



From the Fischer projections, it follows that

M and N are non-mirror images.

M and P are enantiomers.

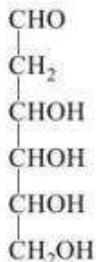
M and O are identical.

M and Q are not identical.

Therefore the choices (a), (b) and (c) are correct.

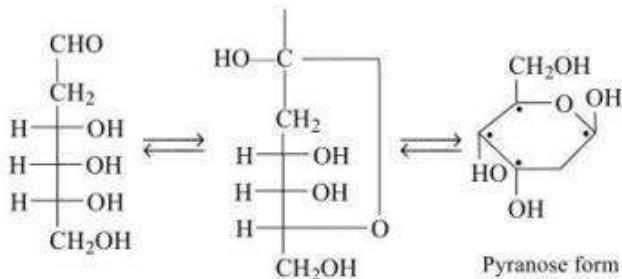
Aldohexose exists in D configuration

When the following aldohexose exists in D-configuration, the total number of stereoisomers in its pyranose form is



Solution:

In D-configuration, the hydroxyl group at the asymmetric carbon placed at the bottom of Fischer projection lies to the right of the straight skeleton. Thus, we will have

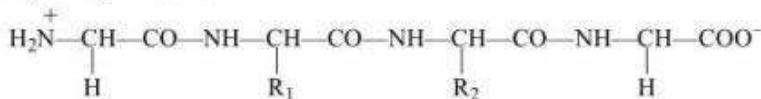


There are four chiral carbon atoms in the pyranose form of the given aldohexose. Thus, there will be $16 (= 2^4)$ stereoisomers, out of which 8 are of D-configurations (CH_2OH group above the ring) and 8 are of L-configurations (CH_2OH group below the ring).

Therefore, the correct answer is **8**.

Peptides

The substituents R_1 and R_2 for nine peptides are listed in the table given below. How many of these peptides are positively charged at $\text{pH} = 7.0$?



Peptide	R_1	R_2
I	H	H
II	H	CH_3
III	CH_2COOH	H
IV	CH_2CONH_2	$(\text{CH}_2)_4\text{NH}_2$
V	CH_2CONH_2	CH_2CONH_2
VI	$(\text{CH}_2)_4\text{NH}_2$	$(\text{CH}_2)_4\text{NH}_2$
VII	CH_2COOH	CH_2CONH_2
VIII	CH_2OH	$(\text{CH}_2)_4\text{NH}_2$
IX	$(\text{CH}_2)_4\text{NH}_2$	CH_3

Solution

In general, the pH of the solution at which amino acids exist as zwitterion follows the order :

Acidic side chain < neutral chain < basic side chain

($\text{pH} = 3$) ($\text{pH} = 5.5 - 6.0$) ($\text{pH} = 9 - 10$)

This pH is known as isoelectric point.

At $\text{pH} = 7$, the acidic side chain (for which isoelectric point < 7) exists as a negatively-charged species (e.g. $-\text{COO}^-$) and the basic side chain (for which isoelectric point > 7) exists as a positively charged species (e.g. $-\text{NH}_3^+$). Since peptides IV, VI, VIII and IX contain $-\text{NH}_2$ group in R_1 or/and R_2 group(s), these are expected to exist as positively-charged species.

Therefore, the correct answer is **4**.

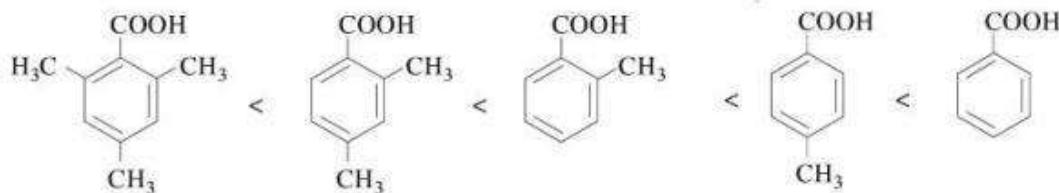
Try to figure out what sequence is depicted

neopentane < isopentane < *n*-pentane. A branched chain isomer has a lower boiling point than a straight chain isomer. The more numerous the branches, the lower the boiling point. The branching lowers the boiling point for all families of organic compounds. Branching causes the shape of molecule to approach towards a sphere and thus surface area decreases, with the result that the intermolecular forces become weaker and are overcome at a lower temperature.

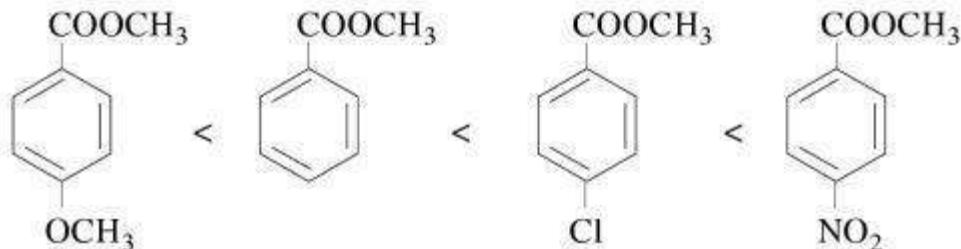
n-butyl alcohol < isobutyl alcohol < *sec*-butyl alcohol < *tert*-butyl alcohol. Polarity of O—H bond increases in the same order.



The presence of bulky groups near the site of reaction, whether in the alcohol or in the acid, slows down esterification as well as de-esterification (hydrolysis).



Try to figure out the sequences



adipic acid < succinic acid < malonic acid < oxalic acid

Acidity decreases with increase in the intervening CH_2 groups.

isobutane < *n-butane* < *n-butyl chloride* < *n-butanol*

chlorobenzene < benzene < toluene < methoxybenzene

Decreasing order of reactivity towards alcoholic silver nitrate:

2-bromo-1-phenylethene, α -phenylethyl bromide, β -phenylethyl bromide

Increasing order of reactivity towards aqueous NaOH:

chlorobenzene, *m*-chloronitrobenzene, *o*-chloronitrobenzene, 2,4-dinitrochlorobenzene,
2,4,6-trinitrochlorobenzene

Increasing reactivity towards HCN: CH_3CHO , CH_3COCH_3 , HCHO , $\text{C}_2\text{H}_5\text{COCH}_3$

Increasing basicity: *p*-toluidine, *N,N*-dimethyl-*p*-toluidine, *p*-nitroaniline, aniline.

Increasing ease of hydrolysis: $\text{CH}_3\text{COOC}_2\text{H}_5$, CH_3COCl , $(\text{CH}_3\text{CO})_2\text{O}$, CH_3CONH_2

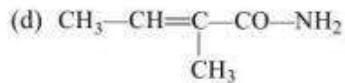
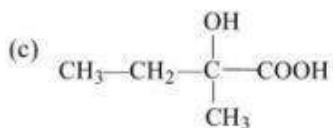
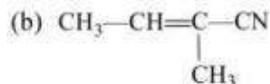
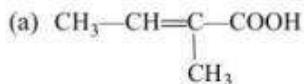
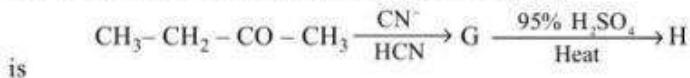
Increasing order of acid strength:

ClCH_2COOH , $\text{CH}_3\text{CH}_2\text{COOH}$, $\text{ClCH}_2\text{CH}_2\text{COOH}$, $(\text{CH}_3)_2\text{CHCOOH}$, CH_3COOH

Increasing reactivity in nucleophilic substitution reactions: CH_3F , CH_3I , CH_3Br , CH_3Cl

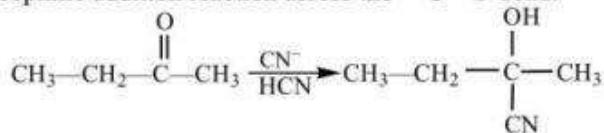
major product H in the given reaction sequence

The major product H in the given reaction sequence

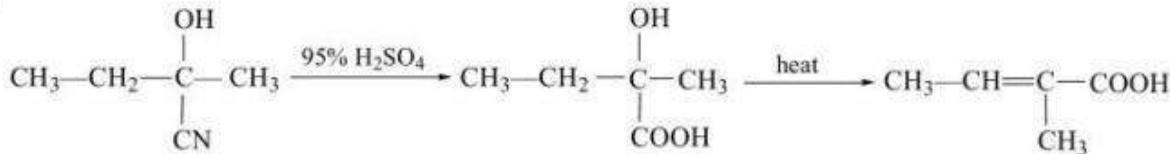


Solution :

The first reaction is nucleophilic addition reaction across the $-\text{C}=\text{O}$ bond.



In the second reaction, $-\text{CN}$ is hydrolysed to $-\text{COOH}$. The resultant molecule undergoes dehydration on heating.



Therefore, the **choice (a)** is correct.

Decreasing order of acidity of substituted benzoic acids:

p-chlorobenzoic acid, 2, 4-dichlorobenzoic acid, 2,4,6-trichlorobenzoic acid.

Decreasing order of acidity of carboxylic acids:

α -chlorophenylacetic acid, *p*-chlorophenylacetic acid, phenylacetic acid, α -phenylpropionic acid

Decreasing order of acidity of carboxylic acids:

p-nitrobenzoic acid, *p*-nitrophenylacetic acid, β -(*p*-nitrophenyl) propionic acid

Increasing order of basicity : ammonia, aniline, cyclohexylamine

Decreasing order of basicity: ethylamine, 2-aminoethanol, 3-amino-1-propanol

Decreasing order of basicity : aniline, *p*-methoxyaniline, *p*-nitroaniline

Increasing order of acidity: benzene sulphonic acid, benzoic acid, benzyl alcohol, phenol

Decreasing order of acidity: *m*-bromophenol, *m*-cresol, *m*-nitrophenol, phenol

Decreasing order of acidity of substituted phenol:

p-chlorophenol, 2, 4-dichlorophenol, 2, 4, 6-trichlorophenol

Decreasing order of reactivity towards KCN: benzyl chloride, chlorobenzene, ethyl chloride

Increasing order of nitration: benzene, chlorobenzene, nitrobenzene, toluene

Increasing order of reactivity towards alcoholic silver nitrate:

1-bromo-1-butene, 3-bromo-1-butene, 4-bromo-1-butene

Explain these by solving in right order -

Increasing reactivity towards S_N1 solvolysis:

benzyl chloride, *p*-chlorobenzyl chloride, *p*-methoxybenzyl chloride, *p*-methylbenzyl chloride,
p-nitrobenzyl chloride

Increasing order of reactivity towards elimination by alcoholic KOH:

1-phenyl-2-bromopropane, 1-phenyl-3-bromopropane

Decreasing order of reactivity towards aqueous HBr: Isomeric pentyl alcohols

Increasing order of reactivity towards aqueous HBr:

1-phenyl-1-propanol, 3-phenyl-1-propanol, 1-phenyl-2-propanol

Decreasing order of reactivity towards aqueous HBr:

benzyl alcohol, *p*-cyanobenzyl alcohol, *p*-hydroxybenzyl alcohol

Increasing order of reactivity towards aqueous HBr:

benzyl alcohol, diphenylmethanol, methanol and triphenylmethanol

Decreasing order of reactivity towards bromination:

anisole, benzene, toluene, chlorobenzene, nitrobenzene, phenol

Increasing order of reactivity towards bromination:

hydroquinone, *p*-methoxyphenol, *p*-methylphenol, *p*-chlorophenol, *p*-nitrophenol, *sym*-trihydroxybenzene

Decreasing order of acidity of carboxylic acids:

butanoic acid, 2-bromobutanoic acid, 3-bromobutanoic acid, 4-bromobutanoic acid

Decreasing reactivity towards S_N1 substitution: 1-chloropropene 3-chloropropene, *n*-propylchloride

Decreasing acidity: H_2O , $HC\equiv CH$, NH_3 , RH, ROH

Decreasing basicity: R^- , $HC\equiv C^-$, NH_2^- , OH^- , OR^-

Decreasing order of reactivity towards the addition of HCl:

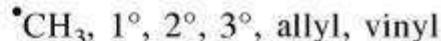
styrene, *p*-chlorostyrene, *p*-methylstyrene, *p*-nitrostyrene

Decreasing order of reactivity towards dehydration:

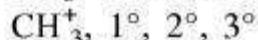
α -phenyl ethyl alcohol, α -(*p*-nitrophenyl) ethyl alcohol, α -(*p*-aminophenyl) ethyl alcohol

Various Increasing Properties

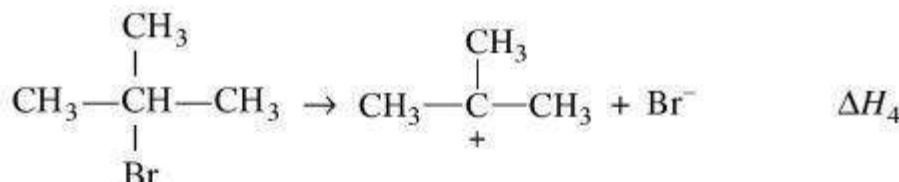
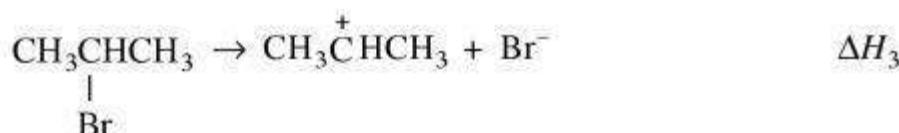
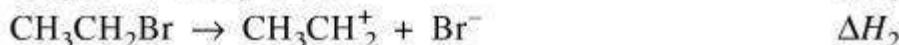
Increasing stability of free radicals:



Increasing stability of carbocation:



Increasing enthalpy of reaction:

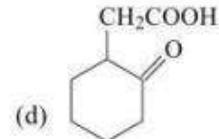
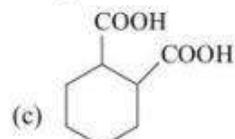
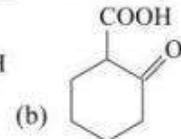
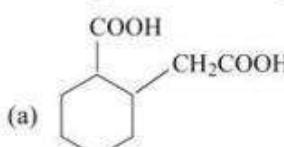


Increasing order of reactivity towards S_N2 displacement:

1-bromopentane, 2-bromopentane, 2-bromo-2-methylbutane

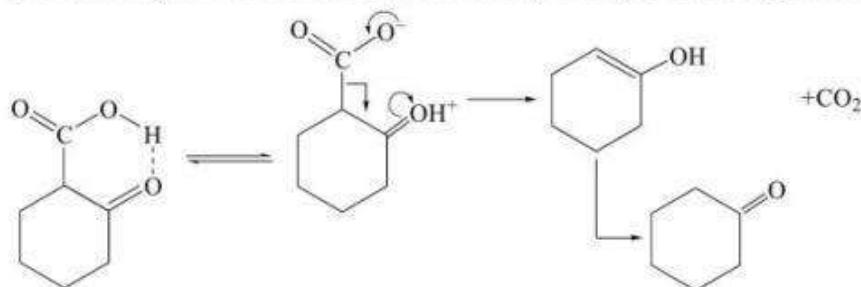
compound undergoes decarboxylation most readily

The compound that undergoes decarboxylation most readily under mild condition is



Solution :

β -Ketocarboxylic acid is unstable acid. It readily undergoes decarboxylation through a cyclic transition state.



Therefore, the choice (b) is correct.

A compound contains 88.89% C and 11.1% H. It gives white precipitate with ammoniacal silver nitrate. The compound is

- (a) $\text{C}_5\text{H}_7\text{C}=\text{CH}$ (b) $\text{C}_8\text{H}_9\text{C}=\text{CH}$ (c) $\text{C}_6\text{H}_{11}\text{C}=\text{CH}$ (d) $\text{C}_4\text{H}_7\text{C}=\text{CH}$

Ans :

Empirical formula contains $C : H :: \frac{88.89}{12} : \frac{11.1}{1} :: 7.4 : 11.11 :: 2 : 3$

Only the compound $C_6H_{11}C=CH$ has composition 4 times the composition of empirical formula.

More the number of electron withdrawing group stronger is the acid

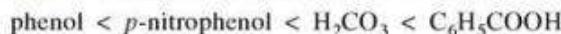
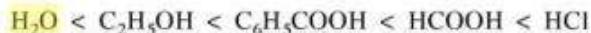
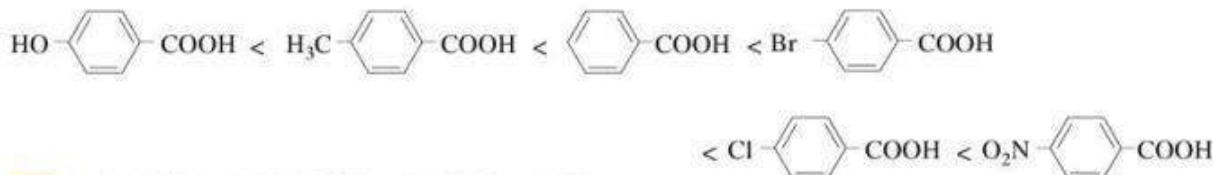
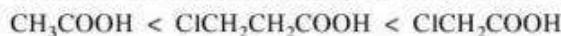


The more the number of electron-withdrawing group, the stronger the acid.

Try to figure out what sequence is depicted



The more the electronegativity of halogen, the stronger the acid.



$(CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$. $(CH_3)_3N$ is the weakest because of steric factors.

1-butanol < 2-butanol < 2-methyl-2-propanol. A tertiary alcohol reacts immediately, a secondary alcohol reacts within five minutes and a primary alcohol does not.

2-methyl-2-propanol < 2-butanol < 1-butanol. Reactivity of ROH is $CH_3OH > 1^\circ > 2^\circ > 3^\circ$.

An organic compound A contains 49.32% C, 9.59% H and 19.18% N and rest oxygen. The compound A on boiling with NaOH gives nitrogen free carboxylic acid whose silver salt contains 59.67% Ag. The compound A is

- (a) CH_3CONH_2 (b) $C_2H_5CONH_2$ (c) $C_3H_7CONH_2$ (d) $C_3H_5CONH_2$

Ans :

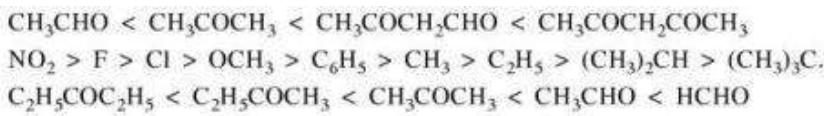
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Hence $\frac{108}{M_R + 44 + 108} = 0.5967$. This gives $M = 29$ i.e. $R \equiv C_2H_5$.

Hence, the compound is $C_2H_5CONH_2$.

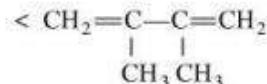
Try to figure out what sequence is depicted



The smaller the alkyl group, the more reactive the carbonyl group.



The more stable the intermediate carbocation, the greater the reactivity.



Conjugated dienes form the more stable allyl carbocations and are thus more reactive than alkenes. Alkyl groups on the unsaturated carbon atoms increase reactivity.



tert-butanol < *sec*-butanol < *n*-butanol < CH₃OH. Alkyl group makes an alcohol less acidic. Bigger the alkyl group, the less acidic the alcohol. Methanol is the strongest and tertiary alcohols are the weakest.



An aromatic compound contains 69.4% C and 5.8% H.

An aromatic compound contains 69.4%C and 5.8%H. A sample of 0.3 g of this compound give ammonia which neutralizes 25 mL of 0.05 M H₂SO₄. The empirical formula of the compound is

- (a) $C_5H_8N_2O$ (b) C_7H_7NO (c) $C_6H_5NO_2$ (d) C_6H_5NO

Ans :

Amount of H_2SO_4 neutralized $\equiv (25 \times 10^{-3} \text{ L})(0.05 \text{ M}) \equiv 1.25 \times 10^{-3} \text{ mol}$



Amount of NH_3 evolved = $2 \times 1.25 \times 10^{-3}$ mol = 2.5×10^{-3} mol

$$\text{Mass of N in the compound} = (2.5 \times 10^{-3} \text{ mol}) (14.8 \text{ g mol}^{-1}) = 0.035 \text{ g}$$

$$\text{Per cent of N in the compound} = \frac{0.035}{0.2} \times 100 = 11.67$$

Per cent. of O in the compound = $100 - (69.4 + 5.8 + 11.67) = 13.13$

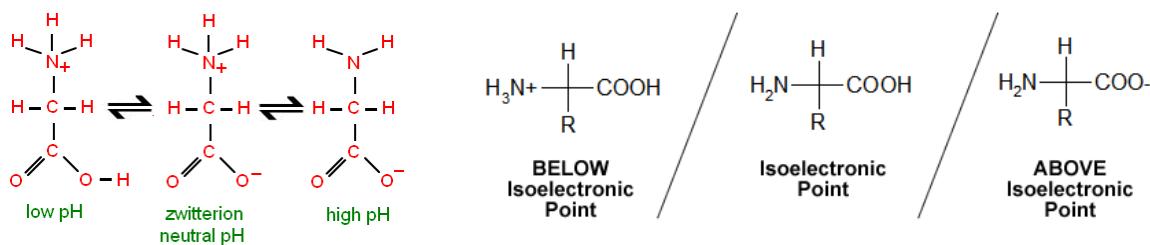
Per cent of O in the compound =
Ratio of atoms in the compound to

$$\text{C : H : N : O} :: \frac{69.4}{12} : \frac{5.8}{1} : \frac{11.67}{14} : \frac{13.13}{16} :: 5.78 : 5.8 : 0.83 : 0.82 :: 7 : 7 : 1 : 1$$

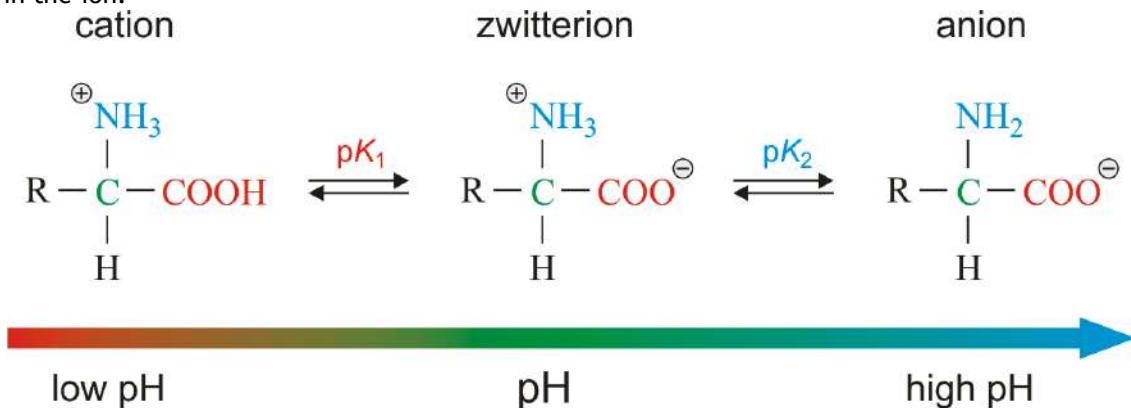
Hence, empirical formula: C_6H_8NO

Alternatively, calculate per cent of C in the given choices which comes out to be (a) 0.55, (b) 0.69, (c) 0.58 and (d) 0.65 only for choice (b), the answer tallies.

Zwitter ions – The Hydrogen atom (rather ion) moves to different positions depending on the PH (So can have a positive charge at some position, or a negative charge at some other position, depending on the pH)

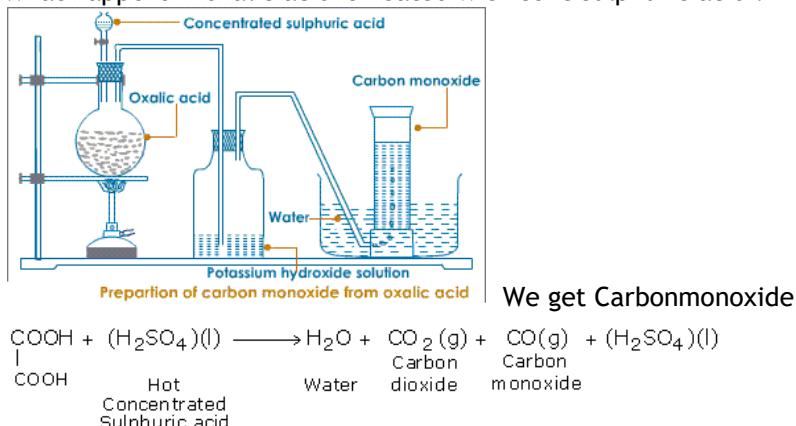


Electrophoresis – is a method to confirm if a positive charge is present or a negative charge is present in the ion.



Iso-Electric point – the pH at which the ion (molecule) does not migrate to any electrodes.

What happens if oxalic acid is heated with conc sulphuric acid ?

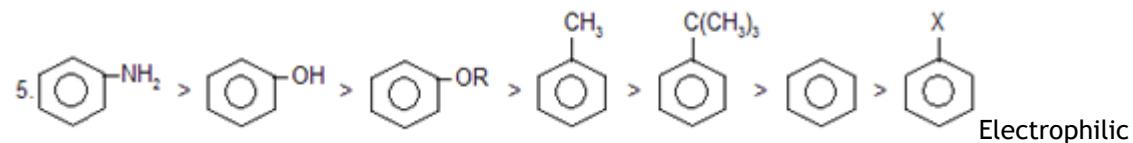


IMPORTANT ORDER AND FACTS OF ORGANIC CHEMISTRY

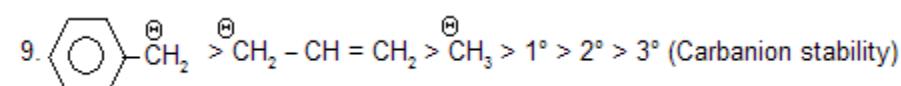
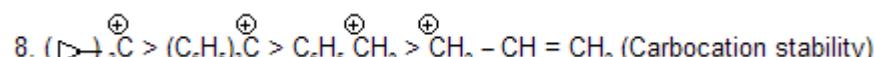
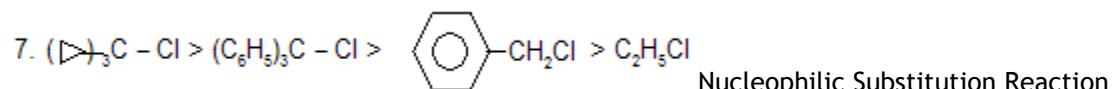
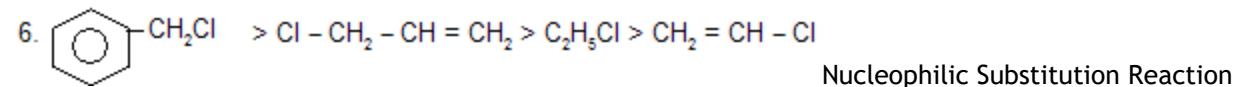
- RCOCl > RCOOCOR > RCOOR > RCONH₂ Nucleophilic substitution reaction.
- HI > HBr > HCl > RCOOH > C₆H₅OH > H₂O > CH ≡ CH > NH₃ (Acidic nature).

3. $\text{CCl}_3\text{CHO} > \text{HCHO} > \text{CH}_3\text{CHO} > \text{CH}_3\text{COCH}_3$ Nucleophilic addition reaction.

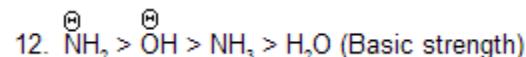
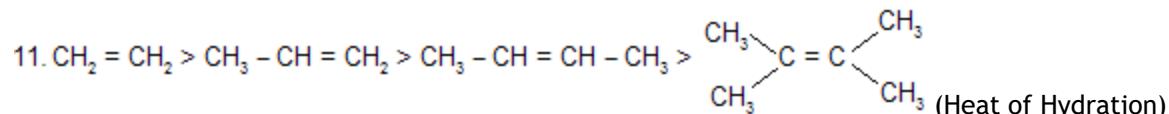
4. $\text{CH}_2 = \text{CH}_2 > \text{CH} \equiv \text{CH} > \text{C}_6\text{H}_6$ Electrophilic addition reaction.



Substitution Reaction



10. $(\text{CH}_3)_2\text{C} = \text{C}(\text{CH}_3)_2 > \text{CH}_3 - \text{CH} = \text{C} - (\text{CH}_3)_2 > \text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3 > \text{CH}_3 - \text{CH} = \text{CH}_2$ (Stability)



13. $\text{NI}_3 > \text{NBr}_3 > \text{NCl}_3 > \text{NF}_3$ (Basic strength)

14. $\text{Br}_2 > \text{Cl}_2 > \text{I}_2$ (Selectivity for halogenation)

15. Halogenation of alkenes by cyclic halonium state, so anti attack takes place.

16. Hydroboration followed by oxidation is always anti markownikoff's addition due to steric effect.

17. Oximercuration – demercuration is markownikoff's addition of water because some carbocation character in cyclic mercurium state.

18. CHCl_3 in the presence of strong bases forms biradical : CCl_2 which undergo addition with double or triple bonds.

19. When conjugated diene reacts with alkene or alkyne it is known as diel's elder synthesis.

20. Ozonolysis of cyclo alkene forms one mole dialdehyde while ozonolysis of cyclo alkadiene forms two moles of dialdehyde.

21. Ozonolysis with $(\text{CH}_3)_2\text{S}$ is known as reductive ozonolysis.

22. Hydration of alkyne occur's in HgSO_4 and dil H_2SO_4 .

23. 1-alkynes forms ppt with $\text{Ag}(\text{NH}_3)_2^+$ and $\text{Cu}(\text{NH}_3)_4^+$.

24. Cis-2-butene reacts with Br_2 to form dl(±) pair of enantiomers of 2,3-dibromobutane while in case of trans-2-butene forms meso-2,3-dibromo butane due to anti addition always.

25. Haloform test given by species with $\text{CH}_3\text{CO}-$ group but not in case of A.A.E. and tert. Butyl alcohol.

26. Chloral reacts with chloro benzene in con. H_2SO_4 to form insecticide DDT.

27. NBS is used for free radical allylation.

28. Rate for S_N^1 reaction is $3^\circ > 2^\circ > 1^\circ$ in protic polar solvent.

29. Rate for S_N^2 reaction is $1^\circ > 2^\circ > 3^\circ$ in polar aprotic solvent like DMSO, DMF, HMPT.

30. Chemical reactions like Hoffmann carbylamine and Reimer Tiemann's reaction active species is biradical CCl_2 .

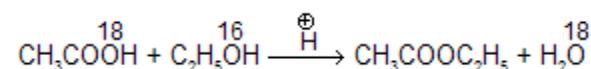
31. If cyclo 1,3-penta diene reacts with CHCl_3 and potassium tert. butoxide to form chlorobenzene.

32. Alkyl halides reacts with AgCN to form isocyanides due to ambident nature of nucleophile, other ambident nucleophiles are NO_2^- and SO_3^{2-} .

33. In dehydration of alcohols active species is carbocation so rearrangement occurs like hydride shift or alkyl shift.

34. Dehydration of cyclobutyl methyl alcohol ring expansion takes place, formation of cyclo pentene occurs.

35. In esterification where acid reacts with alcohol to form ester, $- \text{OH}$ given by acid while $- \text{H}$ by alcohol



36. Ether's reacts with HI to form alcohol and halide where fission of lower ether by S_N^2 mechanism while higher ethers like ter. butyl methyl ether or alkyl methyl ether by S_N^1 mechanism.

37. Quantitative estimation of ethers is done by ziesal's method.

38. If unsym. cyclic ether undergo fission it depends upon medium weather it is acid or basic like in acidic medium some character of carbocation so nucleophile goes to carbon where more alkyl groups are there while reverse in basic medium due to steric factor.

39. Aldehydes are reducing agent while ketones are not.

40. Aldehydes and ketones are separated by tollen's reagent.

41. Carbonyl and noncarbonyl are separated by sodium bi sulphite and bradye's reagent.

42. As the size of alkyl group increases steric hindrance comes into play, reactivity towards nucleophilic addition decreases.

43. Aldehydes with α -hydrogen atom in the presence of dil base undergo enolization and form α -

carbonian to give aldol product.

44. If there is two—CHO group with α -hydrogen atom to form cyclic intra aldol product.

45. Aldehydes without —hydrogen atom in the presence of con. alkali to form each molecule of acid and alcohol by hydride active species.

46. Glyoxal reacts with con. KOH to form glycolate ion by Intra Cannizaro's.

47. Pinacol pinacolone type reactions involve protonation, deprotonation and alkyl shift.

48. Aldol, Perkin, reformatsky and knovengel's reactions are classified as carbanion active reaction.

49. In Beckmann's rearrangement migration of group which is anti to—OH group takes place.

50. Beckmann's rearrangtent is a reaction of oximes in the presence of H_2SO_4 or PCl_5 to produce N—alkyl amide derivatives.

51. Migratory attitude of alkyl group in Pinacol—pinacolone, beckmann's and bayer villegar oxidation is
 $-C_6H_5 > (CH_3)_3C - > (CH_3)_2CH - > C_2H_5 - > CH_3 -$

52. Cyclo hexanoneoxime on beckmann's reaction gives caprolectum which on reaction with H^+ to give polymer nylon-6

53. 2—methyl propanal even contains α -hydrogen atom but does not give aldol reaction.

54. Diphenyl glyoxal reacts with con. KOH to form salt of benzillic acid.

55. Propanone in the presence of dry HCl gas by enolic intermediate to form diacetone alcohol undergo heating form mesityl oxide. If this again reacts with propanone to form phoron.

56. Benzaldehyde reacts with alc. KCN to form Benzoin which on oxidation form benzil.

57. By wittig reaction carbonyl compounds are converted into E—Z form of alkene.

58. Benzaldehyde do not respond to benedict's and fehling's solution due to less redusing power of aromatic aldehyde.

59. $HCOOH$ respond to oxidising agent due to presence of — CHO group.

60. $HI > H_2SO_4 > HNO_3 > RCOOH > H_2CO_3 > C_6H_5OH > H_2O > CH \equiv CH > NH_3 > CH_3 - C \equiv CH > CH_2 = CH_2 > H_2$ this is decreasing acidic nature.

61. Acids with α -hydrogen atom when reacts with halogen in the presence of P to form α -haloacid (HVZ).

62. Carboxylic acid on reaction with PCl_5 , CH_2N_2 and H_2O to form higher acid or next homologue.

63. For reactivity of acid derivatives use funda weaker the base better the leaving group.

64. Acid amide on reaction with PCl_5 to form alkane nitrile.

65. Anhydride on reaction with carbonyl compound in the presence of base (carbanion) forms α, β —unsaturated carboxylic acid (perkin reaction)

66. Amide on reaction with Br_2 and alkali to form primary amine of lower homologue. Intermediate species is nitrene which undergo intra rearrangement to form RNH_2 .

67. Ester's with α -hydrogen atom in the presence of strong base to form carbanion undergo nucleophilic substitution reaction forms β -keto ester for example ethyl acetate in the presence of pot. ter. Butoxide form aceto acetic ester (AAE). reaction is known as clesen's ester condensation of four types

- (a) Simple clesen's ester condensation.
- (b) CROSS clesen's ester condensation.
- (c) Intra CEC (Dieckmann's condensation).
- (d) mixed clesen ester condensation.

68. For a compound to be aromatic it must be cyclic, planar and obey $(4n + 2)\pi$ electron rule.

69. Cyclooctatetraene is non aromatic compound while pyrrole, pyredene, furan, cyclopentadienylanion all are aromatic.

70. In aromatic electrophilic substitution reaction there is no hydrogen isotopic effect except sulphonation and iodination.

71. m- directing groups like nitrobenzene and benzaldehyde cannot undergo fridal craft reaction.

72. Phenol is less acidic than general carboxylic acid, cannot react with NaHCO_3 .

73. Anilene is more reactive than phenol towards electrophilic substitution reaction because less energy difference between nitrogen and carbon.

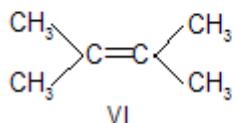
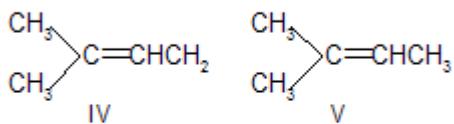
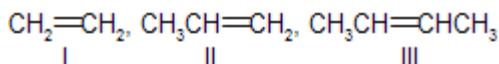
74. Benzene diazonium chloride reacts with phenol or anilene to form azo compounds.

75. $\text{C}_6\text{H}_5\text{NH}_2 > \text{C}_6\text{H}_5\text{OH} > \text{C}_6\text{H}_5\text{OR} > \text{C}_6\text{H}_5\text{Br} > \text{C}_6\text{H}_5\text{NO}_2$ (Reactivity towards electrophilic substitution reaction)

General Series – Chemistry Fact Sheet – 3

General series	Order	Why ?
1.	B.P. of $\text{CH}_3\text{CH}_2\text{OH}$, CH_3OCH_3 , CH_3CH_3 I II III	I > II > III There is intermolecular H–bonding I, III has weak force of attraction and is most volatile.
2.	B.P. of o, m, p–nitro phenol	o < m < p Intramolecular H–bonding in o–isomer makes it more volatile.

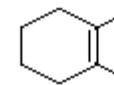
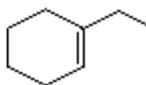
	Reactivity of ... with Tollen's reagent		
3.	HCHO, CH ₃ CHO, CH ₃ COCH ₃ , C ₆ H ₅ CHO I II III IV	I > II > IV > III	-CHO group is easily oxidised compared to keto group due to reducing hydrogen.
4.	Reactivity of ... with Fehling's solution I II III IV (above)	I > II > IV > III	-do-
5.	Extent of hydration of 	I < II < III < IV	Aldehydes are more hydrated than ketones. Halide makes C of carbonyl group more electropositive.
6.	Electrophilic nature of for nucleophilic attack 	I > II > III	CH ₃ group decreases +ve charge on C hence nucleophilic attack.
7.	Reactivity of isomeric 1°, 2°, 3° butyl halide towards elimination (E1 or E2)	3° < 2° < 1°	due to stability of intermediate carbocation
8.	Dehydration of 	IV < I < II < III	Alcohol leading to increase in conjugation due to dehydration is more easily dehydrated. IV is vinylic, hence least.
9.	Stability of		



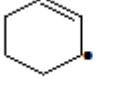
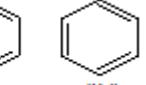
Substituted alkenes are more stable. More the alkyl groups are attached to the doubly bonded carbon atom more is the stability.

$\text{I} < \text{II} < \text{III} < \text{IV} < \text{V} < \text{VI}$

10. **Stability of**

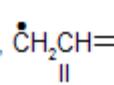
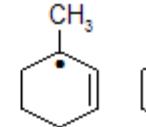
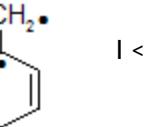


- $\text{I} < \text{III} < \text{II}$ II is more substituted than III (More hyperconjugation more stability)

11. **Stability of**

- $\text{III} > \text{II} > \text{I} > \text{IV}$ IV is vinylic while in conjugative, II allylic.

12. **Stability of**




- $\text{I} < \text{IV} < \text{II} < \text{III}$ III is 3° allylic and II is 1° allylic

13. **Dehydration of**
 $1^\circ, 2^\circ, 3^\circ$ isomeric butyl alcohol

More the stability of intermediate, greater the reactivity of chemical reaction.

I, II have H-bonding but electronegativity of O > N hence H-bonding in II > I

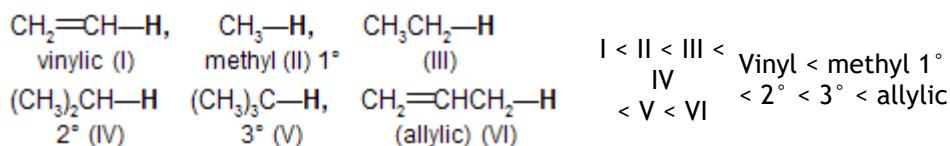
$3^\circ < 2^\circ < 1^\circ$
 $\text{II} > \text{I} > \text{III}$ greater the stability, easier the formation of particular species.

14. **Boiling points of**
n-butyl amine, *n*-butyl alcohol, *n*-pentane
 I II III

15. **Formation of**

 I II III IV

16. **Reactivity of C-H bond (abstraction of H)**



Leaving nature (tendency) of ... in S_N reaction.

17. $\text{H}^-, \text{R}^-, \text{MeO}^-, \text{OH}^-, \text{CN}^-, \text{CH}_3\text{COO}^-$,
 I II III IV V VI
 ROSO_2^- , ArSO_3^-
 VII VIII

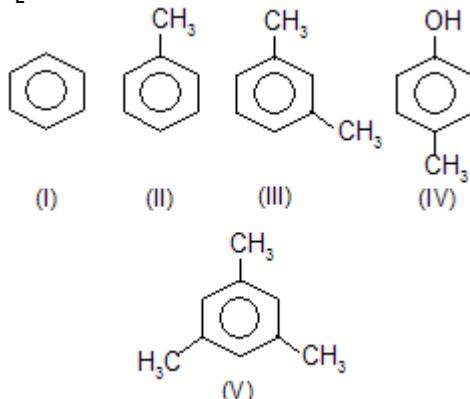
I < II < III ~ If acid is strong,
 IV its conjugate
 < V < VI < VII base is weak and
 < VIII greater the
 leaving tendency.

Rate of esterification of the following acids with MeOH

18. MeCH_2COOH , Me_2CHCOOH , MeCCOOH ,
 I II III
 Et_3CCOOH (*i*-Pr)₂ CHCOOH
 IV V

I > II > III >
 IV > V
 As the size of the substituents on the α -C increases, the tetrahedrally bonded intermediate becomes more crowded and these slower the rate.

Relative reactivity of ... with electrophile in S_E reaction



I > II > IV > III > V
 $-\text{CH}_3$ is *o*-, *p*-directing and responsible for activation.

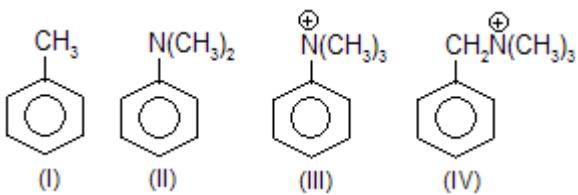
Relative reactivity of these compounds with electrophile in S_E reaction

- 20.

II > I > III > IV
 $-\text{CH}_3$ is *o*-, *p*-directing due to activation while $-\text{COOH}$ is *m*-directing and deactivating group.

21. Relative reactivity of ... with electrophile in S_E reaction.

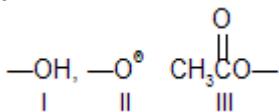
II > I > IV > I
 As the number of sp^3 hybridised C



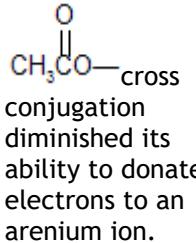
atoms separating the ring from the positively charged substituent increases, deactivating effect decreases due to less electronegativity.

 is best able to donate electrons there by giving a very stable uncharged intermediate. In

22.



|| > | > |||



Intermediates are benzylic cations. So CH_3O (electron repelling) gives greater stability through delocalisation while NO_2 (electron attracting) decreases stability.

Relative reactivity of ... towards S_N1 reaction
benzyl chloride, *p* - methoxy benzyl chloride

23.

and *p* - nitro benzyl chloride
III

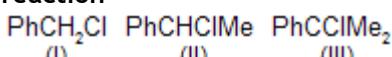
|| > | > |||

S_N1 : $1^\circ < 2^\circ < 3^\circ$
alkyl halide

$$\begin{array}{c} \text{S}_{\text{N}}2 \\ \text{alkyl halide} \end{array}$$

24.

Relative reactivity of ... towards S_N1 and S_N2 reaction



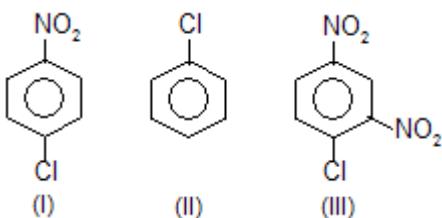
(Ph stands for phenyl, C_6H_5-)

25.

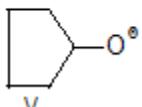
Relative reactivity of ... with E^+ (electrophile) in S_E reaction.

11 of 11

$-NO_2$ deactivates benzene ring for S_E



26. Order of S_N2 reactivity of alkoxide nucleophiles



S_N2 reactivity is susceptible to steric hindrance by the nucleophile as well as by the size of alkyl group.

$I < IV < V < III < II$

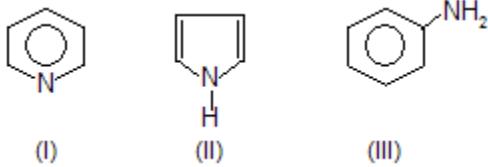
Basic power – Chemistry Fact Sheet – 2

Basic power

Order

Why ?

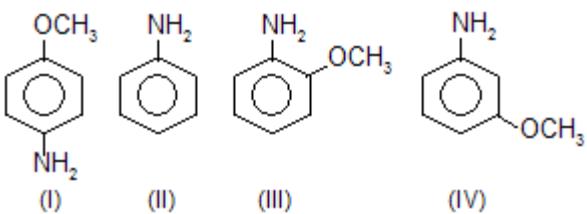
1.



$I > III > II$

lone pair on N is not used in resonance of π -electrons in I. In II lone pair of the ring is itself used in delocalisation while that of outside ring in III.

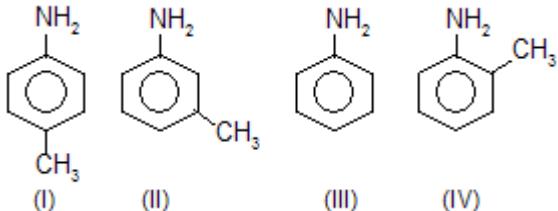
2.



$I > II > III > IV$

$-OCH_3$ is strong electron donating group. This is due to ortho effect, all the aniline are less basic than *p*-substituted aniline due to steric hindrance.

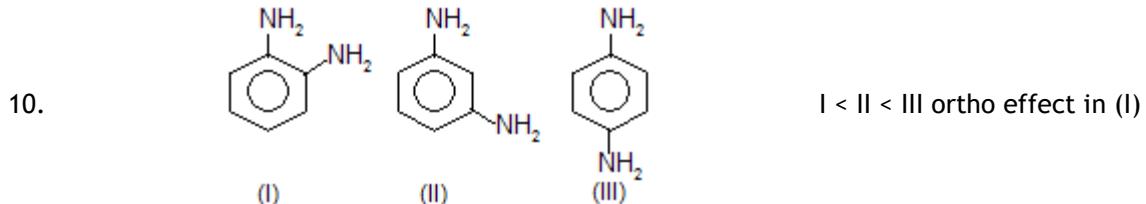
3.



$I > II > III > IV$

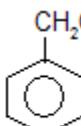
I (hyper conjugation and induction) II (induction) IV (ortho effect), ortho effect normally decreases basic nature.

- 4.
-
- (I) Cc1ccccc1N (II) C1CCCCC1N (III) Cc1ccccc1Nc2ccccc2[N+](=O)[O-]
- In II there is sp^3 hybridised C, In I, sp^2 . NO_2 is electron withdrawing.
 $\text{II} > \text{I} > \text{III}$
- 5.
-
- (I) Nc1ccccc1 (II) Cc1ccccc1Nc2ccccc2 (III) C1CCCCC1N
- lone pair on N is used in delocalisation of π electrons in aromatic amines while cyclohexyl is electron repelling (III); in II, lone pair on N is used by two benzene ring.
 $\text{III} > \text{I} > \text{II}$
- 6.
-
- (I) Nc1ccccc1 (II) Nc1ccccc1Nc2ccccc2[N+](=O)[O-] (III) Nc1ccccc1Nc2cccc2[N+](=O)[O-] (IV) Nc1ccccc1Nc2ccccc2[N+](=O)[O-]
- NO_2 is electron-withdrawing, thus nitro-anilines are less basic than aniline.
 $\text{I} > \text{II} > \text{III} > \text{IV}$ IV is less basic than III because $-\text{NO}_2$ is closer and exerts a stronger inductive effect.
- 7.
-
- (I) Nc1ccccc1Cc2ccccc2 (II) Nc1ccccc1C(=O)C2CCCC2 (III) Nc1ccccc1
- phenyl and $-\text{COCH}_3$ are electronwithdra-wing and $-\text{C}_6\text{H}_5 < \text{COCH}_3$
 $\text{III} > \text{I} > \text{II}$
- 8.
-
- (I) Nc1ccccc1 (II) Nc1ccccc1Cc2ccccc2 (III) Nc1ccccc1Cc2ccccc2Cc3ccccc3
- Electron donating nature of $\text{C}_2\text{H}_5 > \text{CH}_3$ So more basic strength.
 $\text{I} < \text{II} < \text{III}$
- 9.
-
- (I) Nc1ccccc1Cl (II) Nc1ccccc1Cl (III) Nc1ccccc1Cl
- $\text{I} < \text{II} < \text{III}$ ortho effect in I.



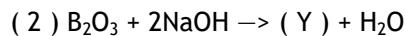
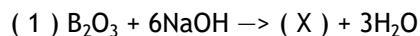
Acidic Powers & Their Orders – Chemistry Fact Sheet

Acidic power	Order	Why ?
1. I II III	1-, 2-, 3- chlorobutanoic acid	Farther the (-I) group (Cl), lesser the acidic strength III < II < I
2. I II III	1-, 2-, 3- methyl pentanoic acid	Farther the (+I) group, greater the acidic power I < II < III
3. I II III		–CH ₃ is electron donating and –NO ₂ is electron attracting II < I < III
4. I II III		–CH ₃ is electron repelling; decreases acidic strength of phenol II < I < III
5. I II III		–OCH ₃ group contains +M effect and decreases acidic power. III < I < II
6. I II III		–NO ₂ is electron attracting; III is more resonance stabilised than I and also than II. In I, only inductive effect is operative. I < II < III

				sp ² hybridised carbon of I, II are more el-ectronegative hence acid strength is inc-reased.
7.	 (I)	$\text{CH}_2=\text{CHCH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{COOH}$	I > II > III
8.	oxalic acid, succinic acid, malonic acid, adipic acid I II III	adipic acid IV	(all dibasic)	I > II > III > IV
9.	o- I	m- II	p- III	nitrobenzoic acid
10.	o- I	m- II	p- III	hydroxy benzoic acid
11.	o- I	m- II	p- III	methoxy benzoic acid
12.	o- I	m- II	p- III	amino benzoic acid

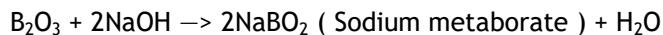
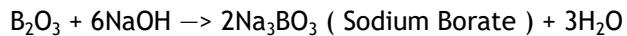
Topic wise grouping of information kind of Dictionary of Inorganic Chemistry

Given two Equations



What are (X) and (Y) ?

Ans : X is Sodium Borate and Y is Sodium meta borate



Silica is soluble in which of the following acids ?

- (1) HF (2) HCl (3) HBr (4) HI

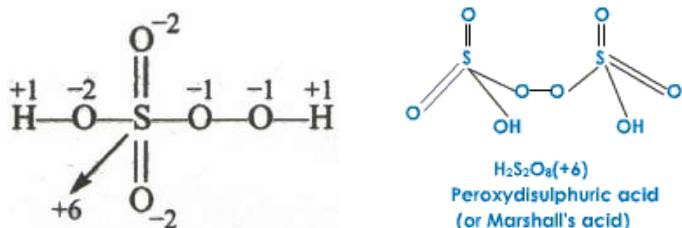
Solution : $\text{SiO}_2 + 4\text{HF} \rightarrow \text{SiF}_4 + 2\text{H}_2\text{O}$ and again $\text{SiF}_4 + 2\text{HF} \rightarrow \text{H}_2\text{SiF}_6$ (Hydrofluorosilicic acid)

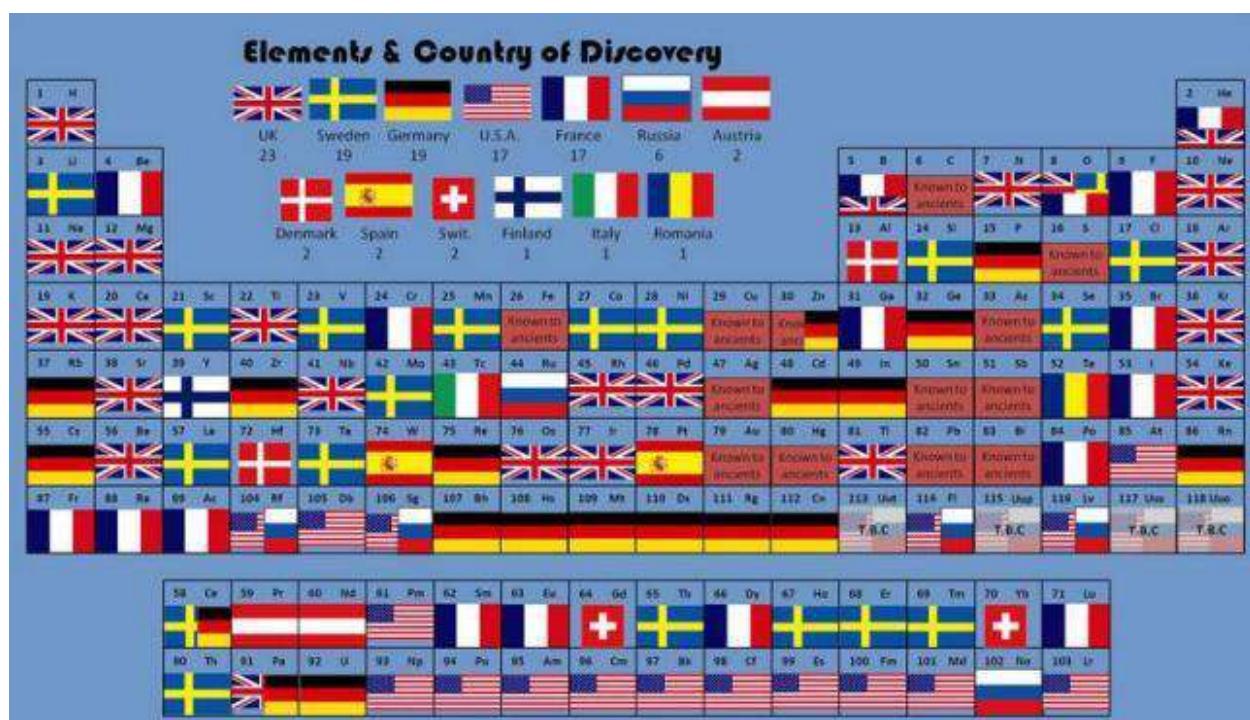
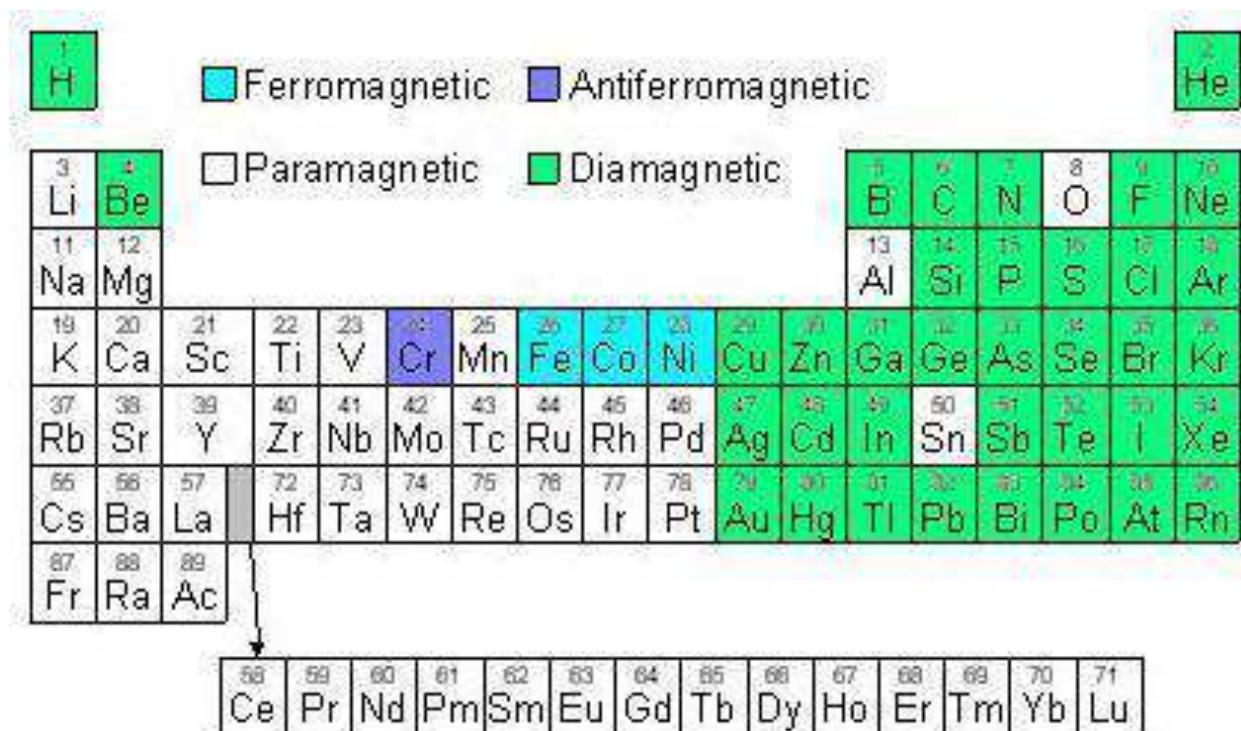
$K_3Co(NO_3)_6$ is Fischer's Salt

The brown ring test for NO_3^- is due to formation of the complex $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$

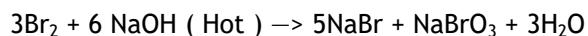
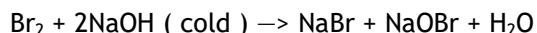
Merck's perhydrol is 30.4% H₂O₂

H_2SO_5 , $\text{H}_2\text{S}_2\text{O}_8$ have peroxide linkages



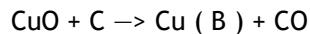
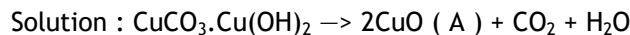


Bromine reacting with NaOH in cold and hot give different mix of products. Specify



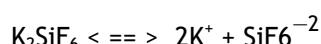
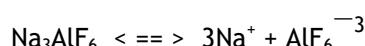
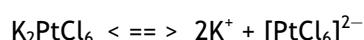
Malachite decomposes to give A + CO₂ + H₂O and compound A on reduction with Carbon gives CO + B

Identify A and B



—

Some examples of Complex Anions



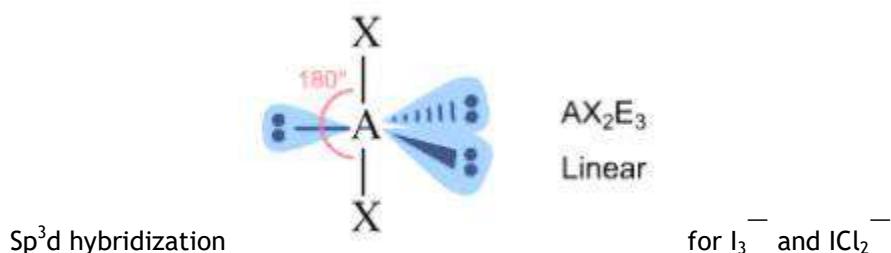
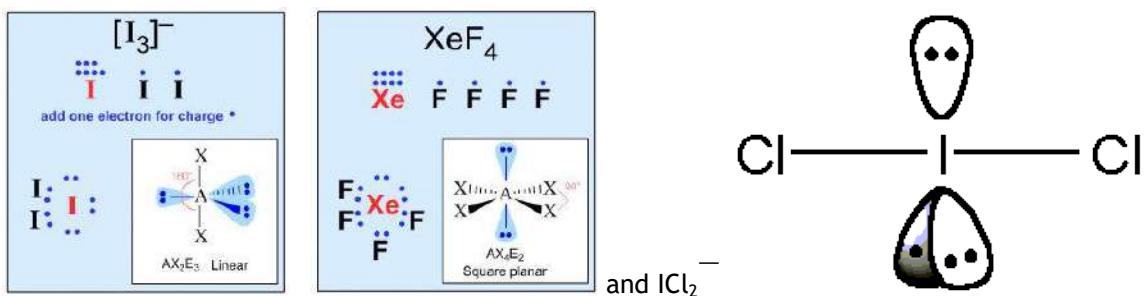
1 H																2 He	
3 Li	4 Be																
11 Na	12 Mg																
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 -71 Hf	72 Ta	73 W	74 Re	75 Os	76 Ir	77 Pt	78 Au	79 Hg	80 Tl	81 Pb	82 Bi	83 Po	84 At	85 Rn	
87 Fr	88 Ra	89 -103 Rf	104 Db	105 Sg	106 Bh	107 Hs	108 Mt	109 Ds	110 Rg	111 Cn	112 Uut	113 Fl	114 Uup	115 Lv	116 Uus	117 118 Uuo	
57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu			
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr			

Known in antiquity
akw Seaborg published his periodic table (1945)

also known when (akw) Levoisier published his list of elements (1789)
also known (ak) up to 2000

akw Mendeleev published his periodic table (1869)
ak to 2012

akw Deming published his periodic table (1923)



The ionization potential of Pb is higher than Sn due to poor shielding by 14f electrons present in Pb

Selenous acid H_2SeO_3 (Oxidation Number of Se is +4)

Telluric acid H_6TeO_6 (Oxidation Number of Te is +6)

Electronegativity Values (in Pauling Scale)

H 2.1																He —	
Li 1.0	Be 1.5																
Na 0.9	Mg 1.2																
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr —
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe —
Cs 0.7	Ba 0.9	La-Lu 1.1-1.2	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Oa 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2	Rn —

Microcosmic Salt is $Na(NH_4)HPO_4$ Sodium ammonium hydrogen phosphate

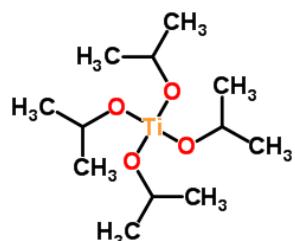
Which of the following electrolyte will be most effective in coagulation of gold sol ?

- (1) NaNO_3 (2) $\text{K}_4\text{Fe}(\text{CN})_6$ (3) Na_3PO_4 (4) MgCl_2

Gold sol is a negatively charged coagulation which is carried out by positively charged ion furnished by electrolyte

Coagulating power depends on the valency of cation of electrolyte. (Schulze Hardy Law) Mg^{2+} ion has highest valency so MgCl_2 is most effective.

Organometallic compounds are Metal atoms directly linked with Carbon. So $\text{Ti}(\text{OC}_3\text{H}_7)_4$ is not an organometallic compound.



Periodic table of electronegativity using the Pauling scale																		
→ Atomic radius decreases → Ionization energy increases → Electronegativity increases →																		
Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓ Period																		
1	H 2.20																	He
2	Li 0.98	Be 1.57																Ne
3	Na 0.93	Mg 1.31																Ar
4	K 0.82	Ca 1.00	Sc 1.36	Ti 1.54	V 1.63	Cr 1.66	Mn 1.55	Fe 1.83	Co 1.88	Ni 1.91	Cu 1.90	Zn 1.65	Ga 1.81	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr 3.00
5	Rb 0.82	Sr 0.95	Y 1.22	Zr 1.33	Nb 1.6	Mo 2.16	Tc 1.9	Ru 2.2	Rh 2.28	Pd 2.20	Ag 1.93	Cd 1.69	In 1.78	Sn 1.96	Sb 2.05	Te 2.1	I 2.66	Xe 2.60
6	Cs 0.79	Ba 0.89	*	Hf 1.3	Ta 1.5	W 2.36	Re 1.9	Os 2.2	Ir 2.20	Pt 2.28	Au 2.54	Hg 2.00	Tl 1.62	Pb 1.87	Bi 2.02	Po 2.0	At 2.2	Rn 2.2
7	Fr 0.7	Ra 0.9	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo
* Lanthanoids																		
La 1.1																		
Ce 1.12																		
Pr 1.13																		
Nd 1.14																		
Pm 1.13																		
Sm 1.17																		
Eu 1.2																		
Gd 1.2																		
Tb 1.1																		
Dy 1.22																		
Ho 1.23																		
Er 1.24																		
Tm 1.25																		
Yb 1.1																		
Lu 1.27																		
* Actinoids																		
Ac 1.1																		
Th 1.3																		
Pa 1.5																		
U 1.38																		
Np 1.36																		
Pu 1.28																		
Am 1.13																		
Cm 1.28																		
Bk 1.3																		
Cf 1.3																		
Es 1.3																		
Fm 1.3																		
Md 1.3																		
No 1.3																		
Lr 1.3																		

IUPAC name of Diamminetetraqua cobalt III chloride

As per IUPAC nomenclature, the name of the complex $[\text{Co}(\text{H}_2\text{O})_4(\text{NH}_3)_2]\text{Cl}_3$ is

- (a) Tetraquadiaminocobalt(III) chloride
(c) Diaminetetraaquacobalt(III) chloride

(b) Tetraquadiaminocobalt(III) chloride
(d) Diamminetetraaquacobalt(III) chloride

Solution :

While naming a complex, the ligands are quoted in alphabetical order, regardless of their charges (followed by the metal). The oxidation state of the central metal is shown by a Roman numeral in brackets immediately following the metal name without any intervening blank. NH_3 is named as ammine and not as amine. Hence, the IUPAC name of the given compound is Diamminetetraqua**cobalt(III)** chloride.

Therefore, the choice (d) is correct.

Color of light absorbed by aqueous solution of CuSO₄

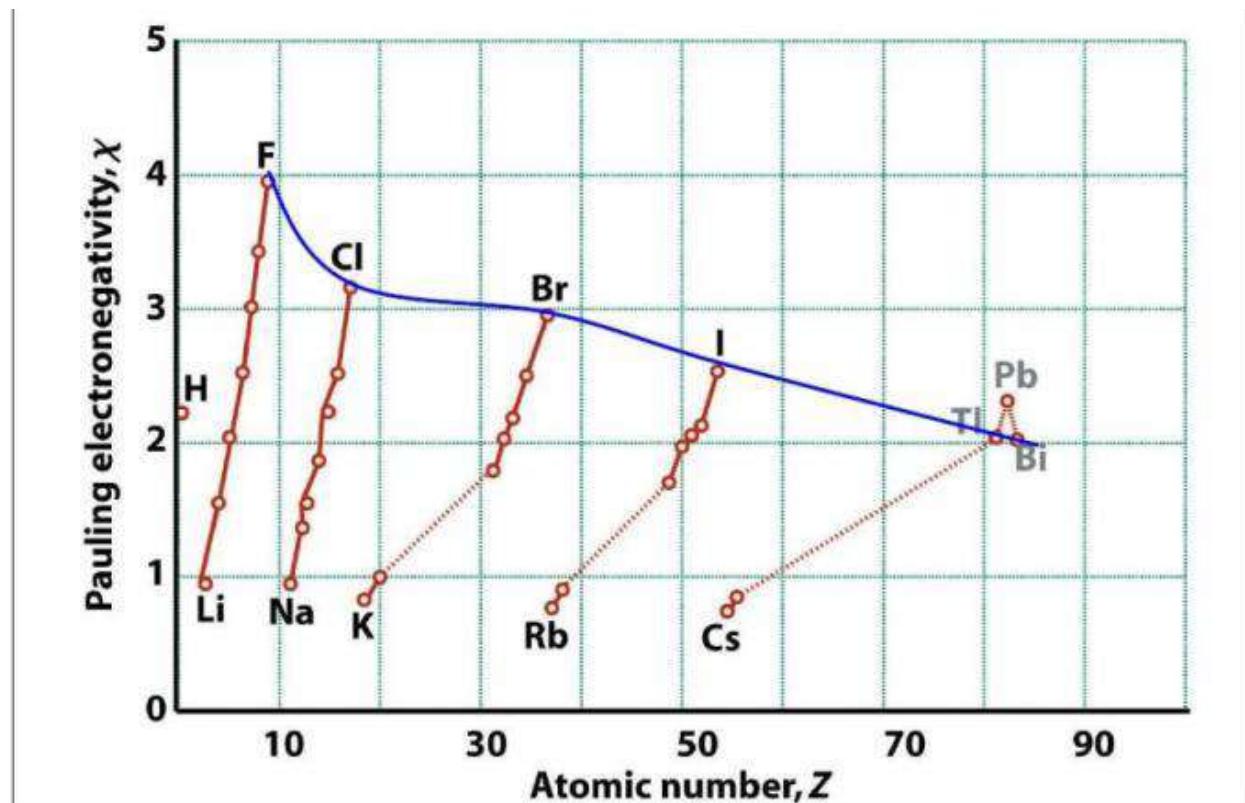
The colour of light absorbed by an aqueous solution of CuSO_4 is

- (a) orange-red (b) blue-green (c) yellow (d) violet

Solution :

An aqueous solution of CuSO_4 is blue. The colour of light absorbed by this solution is that of complementary colour which is orange-red.

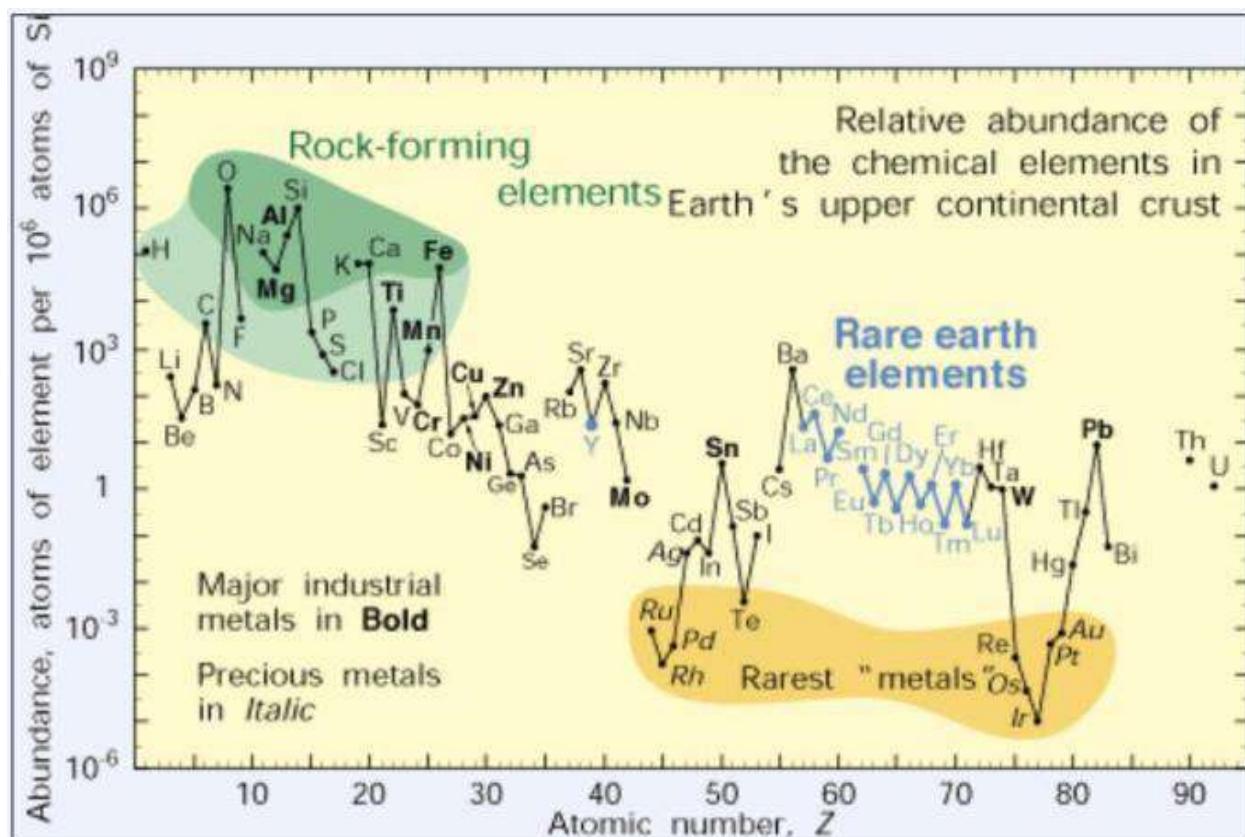
Therefore, the choice (a) is correct



Periodic Table of the Elements
Abundance of Elements
in Seawater near the Surface

all values are in mg/L.

1A	2A															8A																																																																																																						
1 H 10000 Hydrogen	2 Be 1.9×10^4 Boron															2 He 1×10^4 Helium																																																																																																						
3 Li 1.5×10^3 Lithium	4 Be 1.9×10^4 Boron	5 B 6×10^4 Boron	6 C 2.5×10^3 Carbon	7 N 2×10^4 Nitrogen	8 O 6.7×10^3 Oxygen	9 F 1.3×10^4 Fluorine	10 Ne 1.2×10^4 Neon	11 Na 10000 Sodium	12 Mg 1.2×10^4 Magnesium	13 Al 4.8×10^3 Aluminum	14 Si 3×10^3 Silicon	15 P 4×10^3 Phosphorus	16 S 3×10^3 Sulfur	17 Cl 1.6×10^4 Chlorine	18 Ar 4×10^3 Argon	19 K 7.0×10^3 Potassium	20 Ca 6.1×10^3 Calcium	21 Sc 6×10^3 Scandium	22 Ti 7.3×10^3 Titanium	23 V 2×10^4 Vanadium	24 Cr 2×10^4 Chromium	25 Mn 1×10^4 Manganese	26 Fe 3×10^4 Iron	27 Co 2×10^4 Cobalt	28 Ni 5.5×10^3 Nickel	29 Cu 4.8×10^3 Copper	30 Zn 2.5×10^3 Zinc	31 Ga 4.8×10^3 Gallium	32 Ge 2×10^3 Germanium	33 As 9.5×10^3 Arsenic	34 Se 2×10^3 Selenium	35 Br 2×10^3 Bromine	36 Kr 2×10^3 Krypton	37 Rb 1.0×10^4 Rubidium	38 Sr 1.8×10^4 Strontium	39 Y 1.8×10^4 Yttrium	40 Zr 7.3×10^3 Zirconium	41 Nb 1×10^4 Niobium	42 Mo 1×10^4 Molybdenum	43 Tc 1×10^4 Technetium	44 Ru 1×10^4 Ruthenium	45 Rh 1×10^4 Rhodium	46 Pd 1×10^4 Palladium	47 Ag 1×10^4 Silver	48 Cd 1×10^4 Cadmium	49 In 1×10^4 Indium	50 Sn 1×10^4 Tin	51 Sb 2.4×10^3 Antimony	52 Te 1.9×10^3 Tellurium	53 I 1.9×10^3 Iodine	54 Xe 1.1×10^3 Xenon	55 Cs 3.7×10^3 Cesium	56 Ba 3.7×10^3 Barium	57-71 Lanthanides	72 Hf 7.3×10^3 Hafnium	73 Ta 2×10^4 Tantalum	74 W 1×10^4 Tungsten	75 Re 1×10^4 Rhenium	76 Os 1×10^4 Osmium	77 Ir 1×10^4 Iridium	78 Pt 1×10^4 Platinum	79 Au 1×10^4 Gold	80 Hg 1×10^4 Mercury	81 Tl 1.9×10^3 Thallium	82 Pb 2.3×10^3 Lead	83 Bi 2.3×10^3 Bismuth	84 Po 2.3×10^3 Polonium	85 At 1.1×10^3 Astatine	86 Rn 1.1×10^3 Radon	87 Fr 1.0×10^3 Francium	88-103 Actinides	104 Rf 1×10^4 Rutherfordium	105 Db 1×10^4 Dubnium	106 Sg 1×10^4 Seaborgium	107 Bh 1×10^4 Bohrium	108 Hs 1×10^4 Hassium	109 Mt 1×10^4 Meitnerium	110 Ds 1×10^4 Darmstadtium	111 Rg 1×10^4 Rutherfordium	112 Cn 1×10^4 Copernicium	113 Uut 1×10^4 Ununtrium	114 Fl 1×10^4 Florium	115 Uup 1×10^4 Ununpentium	116 Lv 1×10^4 Livermorium	117 Uus 1×10^4 Ununseptium	118 Uuo 1×10^4 Ununoctium	Lanthanides	57 La 3.4×10^4 Lanthanum	58 Ce 1.2×10^4 Cerium	59 Pr 4.4×10^3 Praseodymium	60 Nd 2.5×10^4 Neodymium	61 Pm 4.5×10^3 Promethium	62 Sm 2.5×10^4 Samarium	63 Eu 1.2×10^4 Europium	64 Gd 2.1×10^4 Gadolinium	65 Tb 1.4×10^4 Terbium	66 Dy 3.1×10^3 Dysprosium	67 Ho 2.1×10^3 Holmium	68 Er 2.1×10^3 Erbium	69 Tm 1.7×10^3 Thulium	70 Yb 9.2×10^3 Ytterbium	71 Lu 1.5×10^4 Lutetium	Actinides	89 Ac 1×10^4 Actinium	90 Th 1×10^4 Thorium	91 Pa 5×10^3 Protactinium	92 U 3.2×10^4 Uranium	93 Np 1×10^4 Neptunium	94 Pu 1×10^4 Plutonium	95 Am 1×10^4 Americium	96 Cm 1×10^4 Curium	97 Bk 1×10^4 Berkelium	98 Cf 1×10^4 Californium	99 Es 1×10^4 Einsteinium	100 Fm 1×10^4 Fermium	101 Md 1×10^4 Mendelevium	102 No 1×10^4 Nobelium	103 Lr 1×10^4 Lawrencium
$< 10^{-12}$ $10^{-12} - 10^{-9}$ $10^{-9} - 10^{-6}$ $10^{-6} - 10^{-3}$ $10^{-3} - 1$ $1 - 10^3$ $> 10^3$																																																																																																																						



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H 1.00794				Alkali Metals	Alkaline Earth Metals	Lanthanoids		Actinoids		Transition Metals						He 4.002602	
2	Li 6.941	Be 9.012182			Post-transition Metals	Metalloids	Other Non-metals		Halogens	Noble gases		B 10.811	C 12.0107	N 14.0067	O 15.9994	F 16.994032	Ne 20.1797	
3	Na 22.989762	Mg 24.305			Solid	Liquid	Gas	Unknown			Al 26.9815398	Si 28.0855	P 30.973762	S 32.065	Cl 35.453	Ar 39.948		
4	K 39.0983	Ca 40.078	Sc 44.9159	Ti 47.867	V 50.9415	Cr 51.9961	Mn 54.938045	Fe 55.845	Co 58.933195	Ni 58.6934	Cu 63.546	Zn 65.38	Ga 69.723	Ge 72.63	As 74.9216	Se 78.96	Br 79.904	Kr 83.798
5	Rb 85.4678	Sr 87.62	Y 88.90585	Zr 91.234	Nb 92.90638	Mo 95.936	Tc 98	Ru 101.07	Rh 102.9055	Pd 106.42	Ag 107.8682	Cd 112.411	In 114.818	Sn 118.71	Sb 121.76	Te 127.6	I 126.90447	Xe 131.293
6	Cs 132.95451	Ba 137.327	Hf 178.49	Ta 180.94788	W 183.84	Re 186.207	Os 190.23	Ir 192.17	Pt 195.084	Au 196.965569	Hg 200.59	Tl 204.3833	Pb 207.2	Bi 208.9804	Po 209	At 210	Rn 222	
7	Fr 223	Ra 226	Rf 267	Db 268	Sg 271	Bh 272	Hs 270	Mt 276	Ds 281	Rg 280	Cn 285	Uut 284	Fl 289	Uup 288	Lv 293	Uus 294	Uuo 294	
	La 138.90547	Ce 140.116	Pr 140.90765	Nd 144.242	Pm 145	Sm 150.36	Eu 151.964	Gd 157.25	Tb 158.92353	Dy 162.5	Ho 164.93032	Tm 167.259	Er 168.93421	Yb 173.054	Lu 174.3668			
	Ac 227	Th 238.03806	Pa 231.93588	U 238.02891	Np 237	Pu 244	Am 243	Cm 247	Bk 247	Cf 251	Es 253	Fm 257	Md 258	No 259	Lr 262			

Periodic Table of the Radioactive Elements

Half-life of Most Stable Isotope																	
1A		Stable														8A	
H		Atomic Number						$h_{1/2} > 10^8$ years								He	
Li	Be	Symbol						10^8 yrs < $h_{1/2}$ < 10^6 yrs									
Na	Mg	# of Isotopes				$1 \text{ yr} < h_{1/2} < 10^3$ yrs				$1 \text{ day} < h_{1/2} < 10^3$ yrs				$h_{1/2} < 1 \text{ day}$			
		UNKNOWN															
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	57-71	Hf	Ta	W	75	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	89-103	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo
Actinides		Actinides															
Lanthanides		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
		34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
		58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
Actinides		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	
		99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114

Temperature dependent Magnetic behaviour

$\text{NiCl}_2(\text{P}(\text{C}_2\text{H}_5)_2(\text{C}_6\text{H}_5))_2$ exhibits temperature dependent magnetic behaviour (paramagnetic/diamagnetic). The coordination geometries of Ni^{2+} in the paramagnetic and diamagnetic states are respectively

Solution :

In the paramagnetic state, the complex will have unpaired 3d electrons in Ni^{2+} ion, whereas no such electrons (i.e. all the 3d electrons will be paired) are present in the diamagnetic state.

The electronic configuration of ${}_{28}^{54}\text{Ni}^{2+}$ is $\begin{array}{c} \text{3d} \\ \uparrow\downarrow\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow\uparrow\end{array}$ $\boxed{\quad}$ $\begin{array}{c} \text{4s} \\ \boxed{\quad} \end{array}$ $\begin{array}{c} \text{4p} \\ \boxed{\quad}\end{array}$

If the two unpaired electrons remain present in the ion, it will undergo sp^3 hybridization to accommodate ligands and the geometry of the complex ion will be tetrahedral.

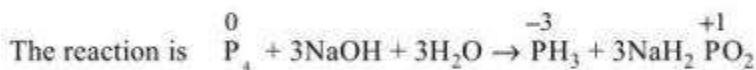
If the two unpaired electrons are coupled, the ion will be diamagnetic and it can undergo dsp^2 hybridization to accommodate ligands leading to the square planar geometry to the complex ion.

Therefore, the choice (c) is correct.

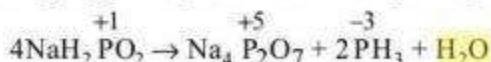
Reaction of white phosphorus with aqueous NaOH

The reaction of white phosphorus with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type, the oxidation states of phosphorus in phosphine and the other product, respectively, are

Solution :

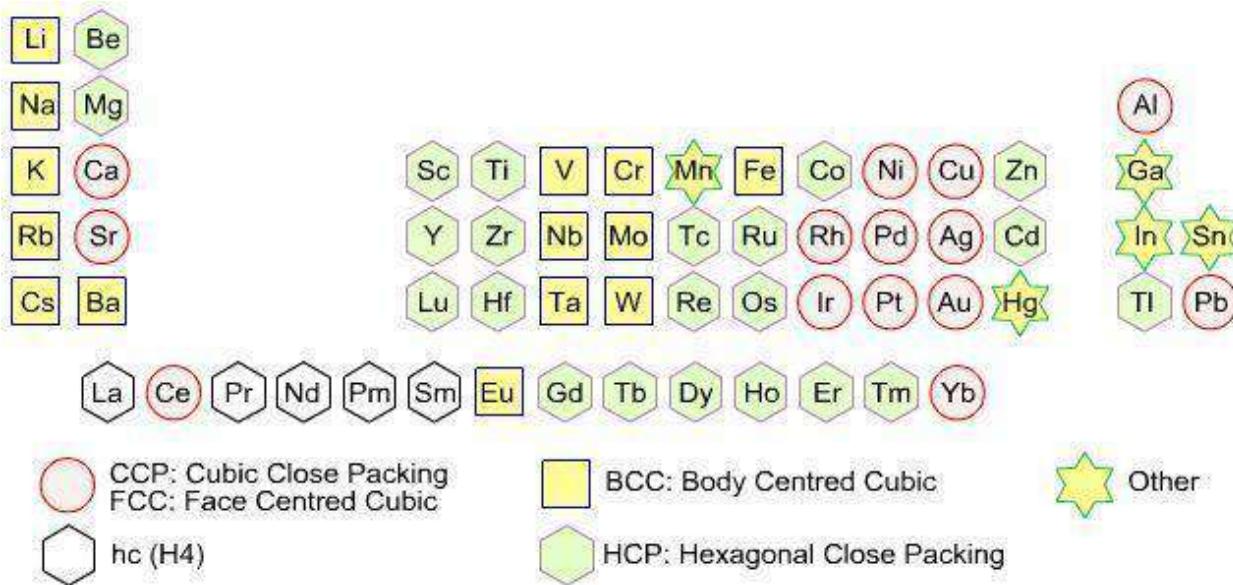


The salt NaH_2PO_4 undergoes the following changes on heating:



The reaction is disproportionation reaction and the oxidation states of phosphorus are -3 (in phosphine) and +5 in the second product.

Therefore, the **choice (c)** is correct.

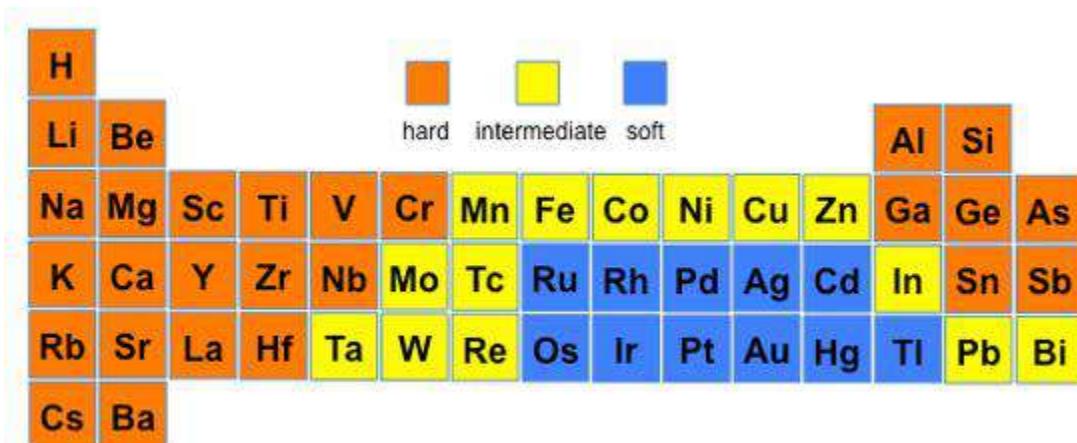


Generally the stabilities of complexes decreases with increasing atomic number for the electropositive metals e.g. group IIA or hard Lewis acids, and increase with increasing atomic number for the noble metals (soft acids), following the general trend of ionization energy.

(a) For electropositive metals (hard acids) the order of stabilities of the Halide complexes $\text{F}^- > \text{Cl}^- > \text{Br}^- > \text{I}^-$ but for highly polarizing soft acid metal ions such as Hg^{+2} , we see the reverse order.

(b) The most electropositive metals (hardest acids) show a greater tendency of forming complexes, with hard ligands such as F^- or Oxygen containing ligands.

Class A



Class A

Class C(Yellow)

Class B

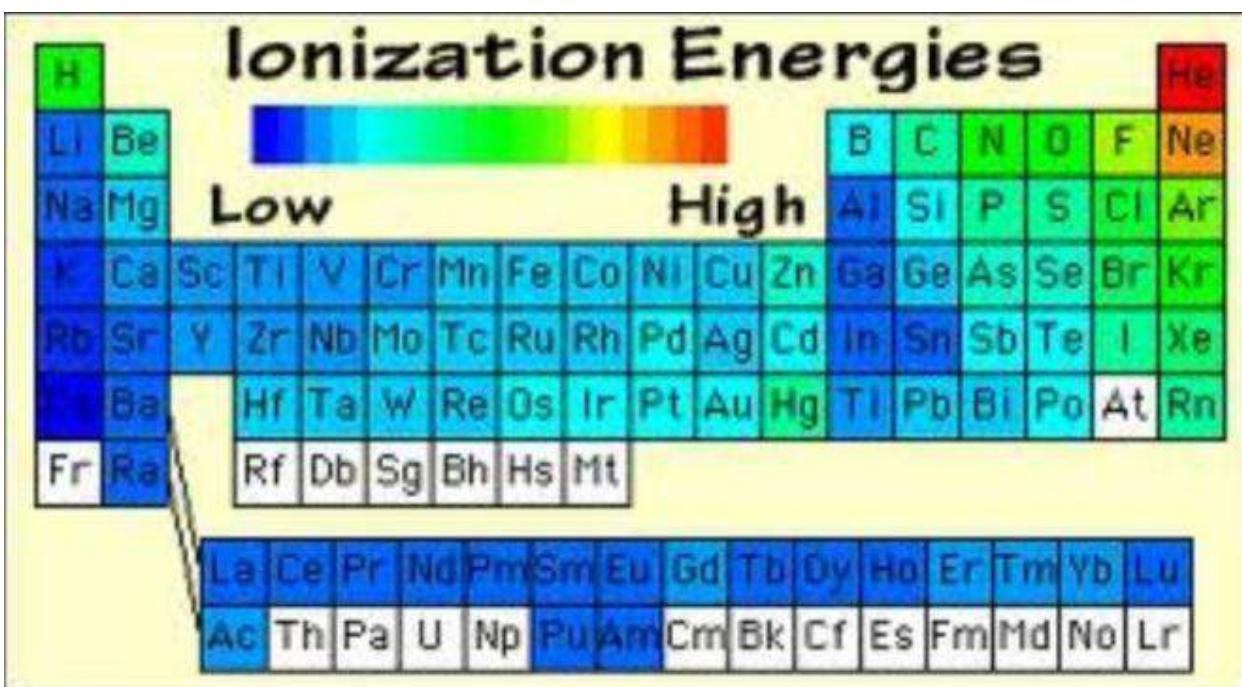
Class C (Yellow)

Metals are classified according to their acceptor properties.

Class A – Hard Acids. Show affinities to ligands whose basicity is proportional to protons.

Class B – Soft acids form stable olefin complexes.

Class C – Borderline metals



The figure shows a portion of the periodic table focusing on groups 13 and 14. The elements in group 13 (Boron, Carbon, Nitrogen, Phosphorus, Sulfur, and Selenium) are highlighted in blue boxes. The elements in group 14 (Silicon, Germanium, Arsenic, and Bromine) are also highlighted in blue boxes. The element Boron (B) is highlighted in orange, indicating it is amphoteric. The element Carbon (C) is highlighted in green, indicating it is basic. The element Silicon (Si) is highlighted in orange, indicating it is amphoteric. The element Germanium (Ge) is highlighted in green, indicating it is basic. The element Arsenic (As) is highlighted in blue, indicating it is acidic. The element Bromine (Br) is highlighted in blue, indicating it is acidic. The element Phosphorus (P) is highlighted in blue, indicating it is acidic. The element Sulfur (S) is highlighted in blue, indicating it is acidic. The element Nitrogen (N) is highlighted in blue, indicating it is acidic. The element Selenium (Se) is highlighted in blue, indicating it is acidic. The element Tin (Sn) is highlighted in orange, indicating it is amphoteric. The element Lead (Pb) is highlighted in orange, indicating it is amphoteric. The element Bismuth (Bi) is highlighted in blue, indicating it is acidic. The element Polonium (Po) is highlighted in blue, indicating it is acidic. The element Astatine (At) is highlighted in blue, indicating it is acidic.

Results of the Flame Test for Various Cations

Electron affinities in the periodic table																		
Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
↓ Period																		
1	H 73																He •	
2	Li 80	Be •											B 27	C 122	N •	O 141	F 328	Ne •
3	Na 53	Mg •											Al 42	Si 134	P 72	S 200	Cl 349	Ar •
4	K 48	Ca 2	Sc 18	Ti 8	V 51	Cr 65	Mn •	Fe 15	Co 64	Ni 112	Cu 119	Zn •	Ga 41	Ge 119	As 79	Se 195	Br 324	Kr •
5	Rb 47	Sr 5	Y 30	Zr 41	Nb 86	Mo 72	Tc •	Ru 101	Rh 110	Pd 54	Ag 126	Cd •	In 39	Sn 107	Sb 101	Te 190	I 295	Xe •
6	Cs 46	Ba 14	•	Hf 31	Ta 79	W •	Re •	Os 104	Ir 150	Pt 205	Au 223	Hg •	Tl 36	Pb 35	Bi 91	Po •	At •	Rn •
7	Fr ...	Ra ...	•	Rf ...	Db ...	Sg ...	Bh ...	Hs ...	Mt ...	Ds ...	Rg ...	Cn ...	Uut ...	Fl ...	Uup ...	Lv ...	Uus ...	Uuo ...
* Lanthanides																		
** Actinides																		
Legend																		
The number mentioned is Electron affinity in kJ/mol (rounded)																		
• Denotes elements that are expected to have electron affinities close to zero on quantum mechanical grounds																		

Period	First Ionization Energies of Some Elements (kJ/mol)																	
Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H 1310	Be 900											B 800	C 1090	N 1400	O 1310	F 1680	Ne 2080
2	Li 520												Al 580	Si 780	P 1060	S 1000	Cl 1250	Ar 1520
3	Na 490	Mg 730	Sc 630	Ti 660	V 650	Cr 660	Mn 710	Fe 760	Co 760	Ni 730	Cu 740	Zn 910	Ga 580	Ge 780	As 960	Se 950	Br 1140	Kr 1350
4	K 420	Ca 590											Ru 710	Rh 720	Pd 800	Ag 730	Cd 870	In 560
5	Rb 400	Sr 550	Y 620	Zr 660	Nb 670	Mo 680	Tc 700	Ru 710	Rh 720	Pd 800	Ag 730	Cd 870	In 560	Sn 700	Sb 830	Te 870	I 1010	Xe 1170
6	Cs 380	Ba 500	La 540	Hf 700	Ta 760	W 770	Re 760	Os 840	Ir 890	Pt 870	Au 890	Hg 1000	Tl 590	Pb 710	Bi 800	Po 810	At ...	Rn 1030
7	Fr ...	Ra 510																

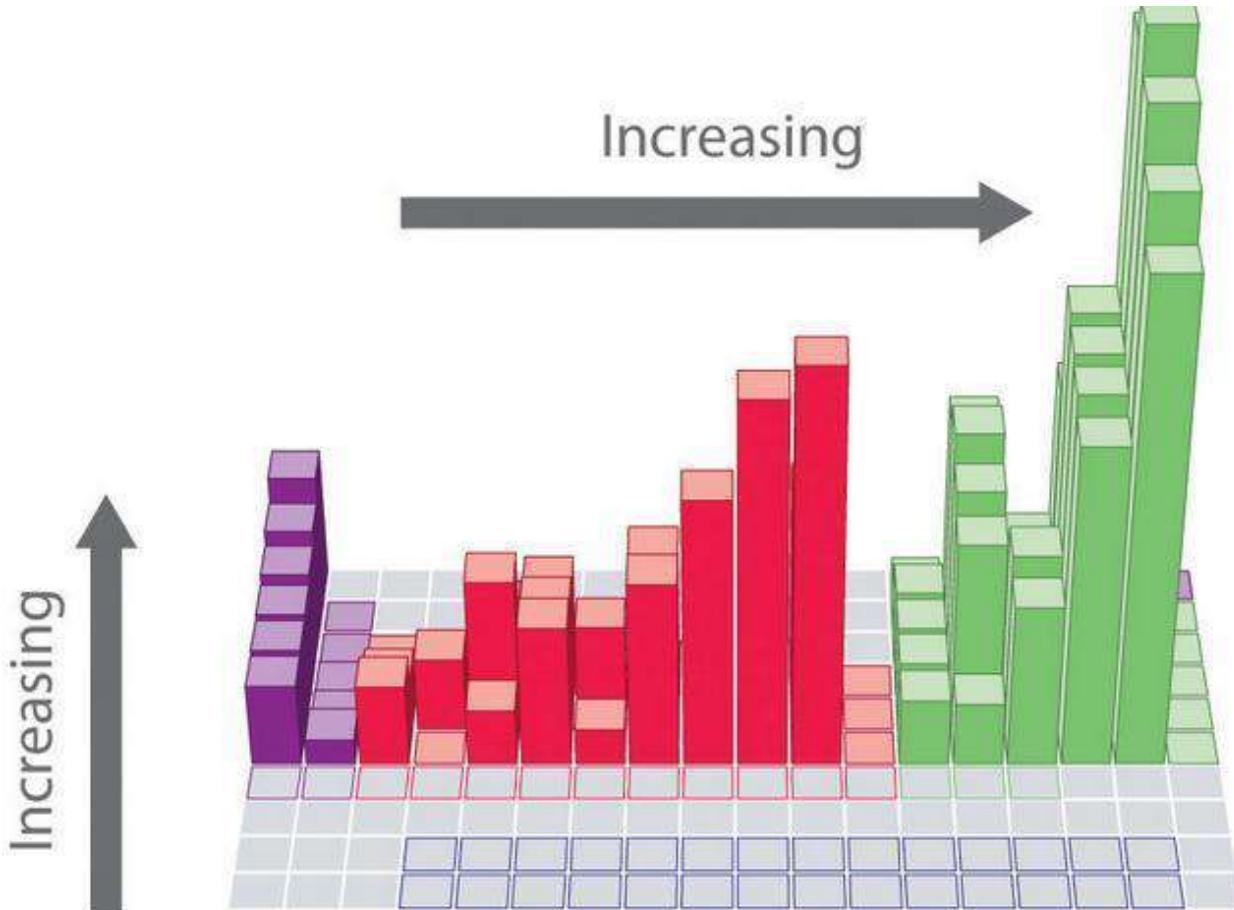
cyanide extraction process of silver from argentite ore

- In the cyanide extraction process of silver from argentite ore, the oxidizing and reducing agents used are
- (a) O₂ and CO, respectively
 - (b) O₂ and Zn dust, respectively
 - (c) HNO₃ and Zn, respectively
 - (d) HNO₃ and CO, respectively

Solution :

The argentite ore contains Ag₂S. After crushing and concentration by froth flotation process, the ore is leached with 0.4 – 7% solution of sodium cyanide kept agitated with a current of air.

Silver passes into the solution as argentocyanide. $\text{Ag}_2\text{S} + 4\text{NaCN} \rightleftharpoons 2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{S}$
The air blown removes Na_2S as $\text{Na}_2\text{S}_2\text{O}_3$ and Na_2SO_4 causing the above reaction to proceed to completion. Silver is recovered by adding zinc into argentocyanide. $2\text{Ag}(\text{CN})_2^- + \text{Zn} \rightarrow [\text{Zn}(\text{CN})_4]^{2-} + 2\text{Ag}$
Thus, oxidizing agent is O_2 (from air) and the reducing agent is Zn.
Therefore, the **choice (b)** is correct.



Magnitude of electron affinity (kJ/mol), s-, p-, and d-block elements

■ s block ■ p block ■ d block ■ f block

Common Name	Chemical Name
acetone	dimethyl ketone; 2-propanone (usually known as acetone)
acid potassium sulfate	potassium bisulfate
acid of sugar	oxalic acid
ackey	nitric acid
alcali volatil	ammonium hydroxide
alcohol, grain	ethyl alcohol
alcohol sulfuris	carbon disulfide
alcohol, wood	methyl alcohol
alum	aluminum potassium sulfate
alumina	aluminum oxide
antichlor	sodium thiosulfate
antimony black	antimony trisulfide
antimony bloom	antimony trioxide
antimony glance	antimony trisulfide
antimony red (vermillion)	antimony oxysulfide
aqua ammonia	aqueous solution of ammonium hydroxide
aqua fortis	nitric acid
aqua regia	nitrohydrochloric acid
aromatic spirit of ammonia	ammonia in alcohol
arsenic glass	arsenic trioxide
azurite	mineral form of basic copper carbonate
asbestos	magnesium silicate
aspirin	acetylsalicylic acid
baking soda	sodium bicarbonate
banana oil (artificial)	isoamyl acetate
barium white	barium sulfate
benzol	benzene
bicarbonate of soda	sodium hydrogen carbonate or sodium bicarbonate
bichloride of mercury	mercuric chloride
bichrome	potassium dichromate
bitter salt	magnesium sulfate
black ash	crude form of sodium carbonate

black copper oxide	cupric oxide
black lead	graphite (carbon)
blanc–fixe	barium sulfate
bleaching powder	chlorinated lime; calcium hypochlorite
blue copperas	copper sulfate (crystals)
blue lead	lead sulfate
blue salts	nickel sulfate
blue stone	copper sulfate (crystals)
blue vitriol	copper sulfate
bluestone	copper sulfate
bone ash	crude calcium phosphate
bone black	crude animal charcoal
boracic acid	boric acid
borax	sodium borate; sodium tetraborate
bremen blue	basic copper carbonate
brimstone	sulfur
burnt alum	anhydrous potassium aluminum sulfate
burnt lime	calcium oxide
burnt ochre	ferric oxide
burnt ore	ferric oxide
brine	aqueous sodium chloride solution
butter of antimony	antimony trichloride
butter of tin	anhydrous stannic chloride
butter of zinc	zinc chloride
calomel	mercury chloride; mercurous chloride
carbolic acid	phenol
carbonic acid gas	carbon dioxide
caustic lime	calcium hydroxide
caustic potash	potassium hydroxide
caustic soda	sodium hydroxide
chalk	calcium carbonate
Chile saltpeter	sodium nitrate
Chile nitre	sodium nitrate

Chinese red	basic lead chromate
Chinese white	zinc oxide
chloride of soda	sodium hypochlorite
chloride of lime	calcium hypochlorite
chrome alum	chromic potassium sulfate
chrome green	chromium oxide
chrome yellow	lead (VI) chromate
chromic acid	chromium trioxide
copperas	ferrous sulfate
corrosive sublimate	mercury (II) chloride
corundum (ruby, sapphire)	chiefly aluminum oxide
cream of tartar	potassium bitartrate
crocus powder	ferric oxide
crystal carbonate	sodium carbonate
dechlor	sodium thiophosphate
diamond	carbon crystal
emery powder	impure aluminum oxide
epsom salts	magnesium sulfate
ethanol	ethyl alcohol
farina	starch
ferro prussiate	potassium ferricyanide
ferrum	iron
flores martis	anhydride iron (III) chloride
fluorspar	natural calcium fluoride
fixed white	barium sulfate
flowers of sulfur	sulfur
'flowers of' any metal	oxide of the metal
formalin	aqueous formaldehyde solution
French chalk	natural magnesium silicate
French vergidris	basic copper acetate
galena	natural lead sulfide
Glauber's salt	sodium sulfate
green verditer	basic copper carbonate

green vitriol	ferrous sulfate crystals
gypsum	natural calcium sulfate
hard oil	boiled linseed oil
heavy spar	barium sulfate
hydrocyanic acid	hydrogen cyanide
hypo (photography)	sodium thiosulfate solution
Indian red	ferric oxide
Isinglass	agar–agar gelatin
jeweler's rouge	ferric oxide
killed spirits	zinc chloride
lampblack	crude form of carbon; charcoal
laughing gas	nitrous oxide
lead peroxide	lead dioxide
lead protoxide	lead oxide
lime	calcium oxide
lime, slaked	calcium hydroxide
limewater	aqueous solution of calcium hydroxide
liquor ammonia	ammonium hydroxide solution
litharge	lead monoxide
lunar caustic	silver nitrate
liver of sulfur	sulfurated potash
lye or soda lye	sodium hydroxide
magnesia	magnesium oxide
manganese black	manganese dioxide
marble	mainly calcium carbonate
mercury oxide, black	mercurous oxide
methanol	methyl alcohol
methylated spirits	methyl alcohol
milk of lime	calcium hydroxide
milk of magnesium	magnesium hydroxide
milk of sulfur	precipitated sulfur
"muriate" of a metal	chloride of the metal
muriatic acid	hydrochloric acid

natron	sodium carbonate
nitre	potassium nitrate
nordhausen acid	fuming sulfuric acid
oil of mars	deliquescent anhydrous iron (III) chloride
oil of vitriol	sulfuric acid
oil of wintergreen (artificial)	methyl salicylate
orthophosphoric acid	phosphoric acid
Paris blue	ferric ferrocyanide
Paris green	copper acetoarsenite
Paris white	powdered calcium carbonate
pear oil (artificial)	isoamyl acetate
pearl ash	potassium carbonate
permanent white	barium sulfate
plaster of Paris	calcium sulfate
plumbago	graphite
potash	potassium carbonate
potassa	potassium hydroxide
precipitated chalk	calcium carbonate
Prussic acid	hydrogen cyanide
pyro	tetrasodium pyrophosphate
quicklime	calcium oxide
quicksilver	mercury
red lead	lead tetraoxide
red liquor	aluminum acetate solution
red prussiate of potash	potassium ferrocyanide
red prussiate of soda	sodium ferrocyanide
Rochelle salt	potassium sodium tartrate
rock salt	sodium chloride
rouge, jeweler's	ferric oxide
rubbing alcohol	isopropyl alcohol
sal ammoniac	ammonium chloride
sal soda	sodium carbonate
salt, table	sodium chloride

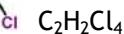
salt of lemon	potassium binoxalate
salt of tartar	potassium carbonate
saltpeter	potassium nitrate
silica	silicon dioxide
slaked lime	calcium hydroxide
soda ash	sodium carbonate
soda nitre	sodium nitrate
soda lye	sodium hydroxide
soluble glass	sodium silicate
sour water	dilute sulfuric acid
spirit of hartshorn	ammonium hydroxide solution
spirit of salt	hydrochloric acid
spirit of wine	ethyl alcohol
spirits of nitrous ether	ethyl nitrate
sugar, table	sucrose
sugar of lead	lead acetate
sulfuric ether	ethyl ether
talc or talcum	magnesium silicate
tin crystals	stannous chloride
trona	natural sodium carbonate
unslaked lime	calcium oxide
Venetian red	ferric oxide
verdigris	basic copper acetate
Vienna lime	calcium carbonate
vinegar	impure dilute acetic acid
vitamin C	ascorbic acid
vitriol	sulfuric acid
washing soda	sodium carbonate
water glass	sodium silicate
white caustic	sodium hydroxide
white lead	basic lead carbonate
white vitriol	zinc sulfate crystals
yellow prussiate of potash	potassium ferrocyanide

yellow prussiate of soda sodium ferrocyanide

zinc vitriol zinc sulfate

zinc white zinc oxide

Westron – A refrigerant.

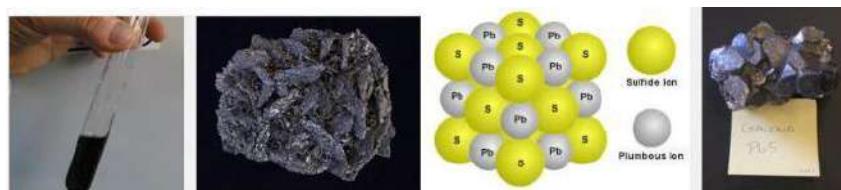


Colours of Compounds

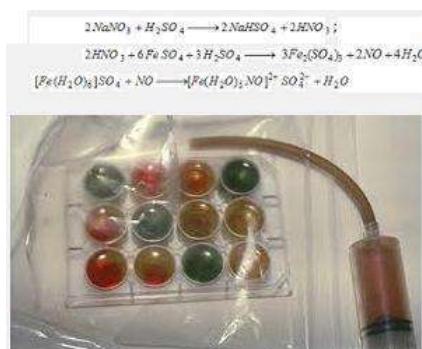
$\text{Cr}_2(\text{SO}_4)_3$ - green



PbS - Black



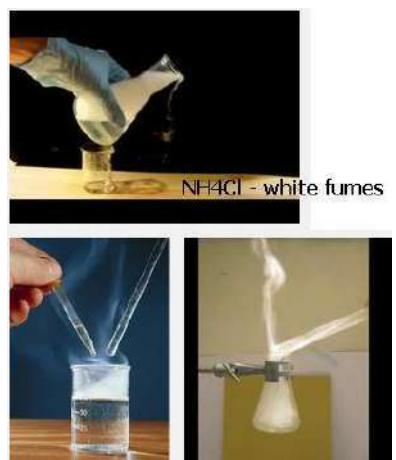
$[\text{Fe}(\text{H}_2\text{O})_5\text{NO}] \text{SO}_4$ - brown



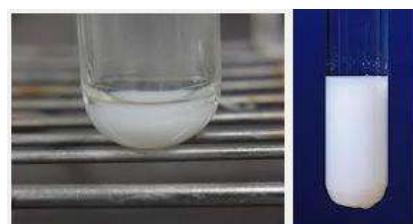
$(\text{CH}_3\text{COO})_3\text{Fe}$ - blood red



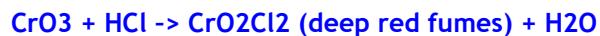
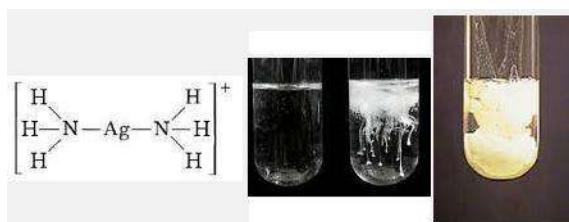
NH₄Cl - white fumes



AgCl - curdy white precipitate



AgCl - curdy white precipitate

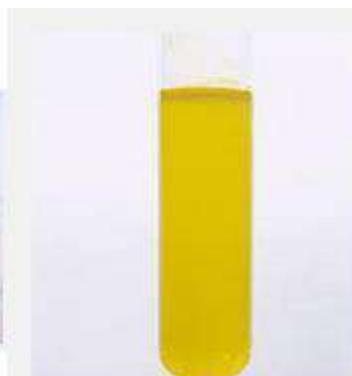




CrO_2Cl_2 (deep red fumes)



Na_2CrO_4 (yellow)



Sodium Chromate

Sodium chromate is used in the industry to manufacture chromium compounds. Sodium chromate (Na_2CrO_4) is a yellow solid chemical compound. It is used in many industries like petroleum industry, textile industry. Sodium chromate is used in the industry as an important source for manufacture of chromium compounds. Sodium Chromate makes a protective film on metal surfaces and is used in corrosion control applications such as coolants containing alcohols and water cooling systems.

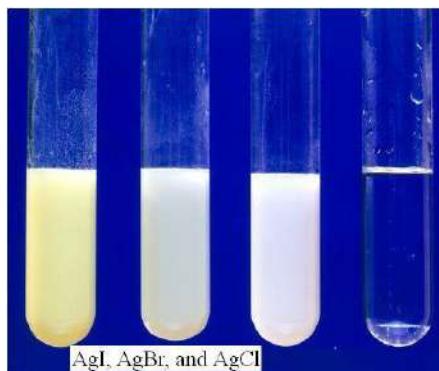


PbCrO_4 (yellow)





AgI, AgBr, AgCl



Ammonia test for silver halides. Test tubes and the results of using concentrated ammonia to test for the presence of three silver halides. Each one of the silver halides is next to a fuller test tube that shows the result of adding concentrated ammonia. Halides are compounds containing halogens such as here, from left to right silver chloride, silver bromide and silver iodide. Adding dilute ammonia dissolves the chloride, while concentrated ammonia is needed to dissolve the bromide, but it fails to dissolve the iodide. The silver halides are themselves the results of standard tests using silver nitrate to test for the halide ions.



BrCl - pale yellow







In the presence of Arsenic, we get yellow precipitate of $(\text{NH}_4)_3\text{AsO}_4 \cdot 12\text{MoO}_3$ (ammonium arsenomolybdate)

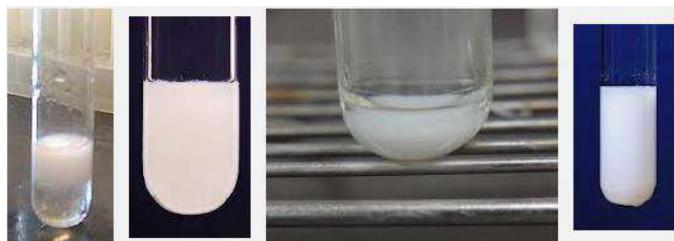


$\text{Mo}_3\text{O}_8 \cdot x\text{H}_2\text{O}$ - molybdenum blue



$\text{SiF}_4 + \text{H}_2\text{O} \rightarrow \text{H}_4\text{SiO}_4$ (silicic acid - white) + H_2SiO_4





AgCl White

PbCl₂ is white



Hg₂Cl₂ is white

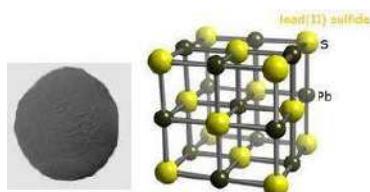


H₂S, PbS, Bi₂S₃, CuS - black

H₂S is Black



PbS is Black



PbS Lead Sulfide is
Black

Bi₂S₃ is Black



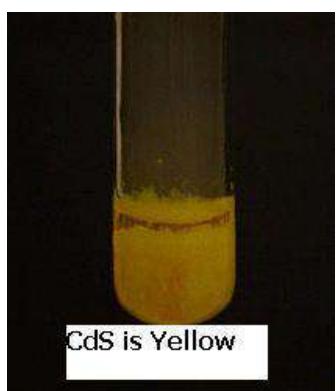
CuS - black



Copper Sulfide
Powder

CdS, As₂S₃, SnS₂ - Yellow

CdS is Yellow



As₂S₃ is Yellow



SnS₂ is Yellow



Tin Sulfide SnS₂



Sb₂S₃ is orange



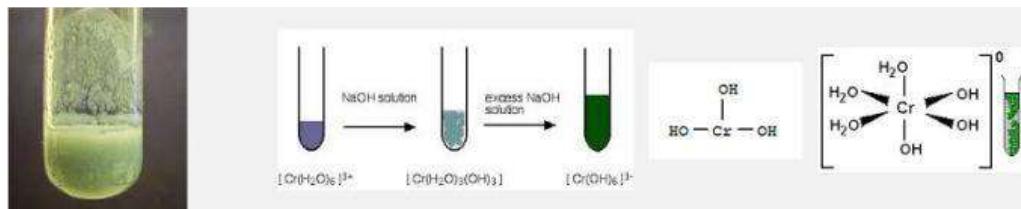
Sb₂S₃ is Orange

SnS is Brown



SnS is Brown is your
teacher says so. SnS
is Yellow if your
teacher says so :-(

Cr(OH)3 is green



Chromium (III) Oxide is Green

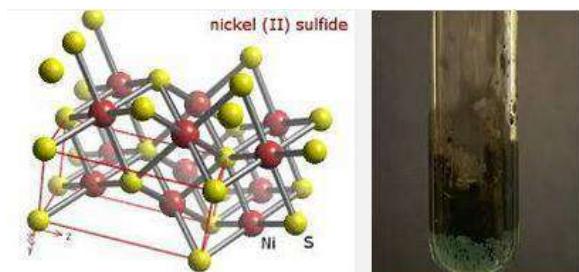


CoS, NiS - black

CoS is black



NiS is Black Mineral Millerite



Cobalt Oxide is Black



Cobalt Sulphate is deep red brown



Cobalt Nitrate is deep red brown



Cobalt Chloride is deep Brown red



Cobalt Acetate is deep Brown



Azulene – **Deep Blue**

Iodoform – CHI_3 **Yellow**

Iron Phenol complex – **Violet** – $[\text{Fe}(\text{OC}_6\text{H}_5)_6]^{-3}$

$6 \text{C}_6\text{H}_5\text{OH} + \text{FeCl}_3 \rightarrow [\text{Fe}(\text{OC}_6\text{H}_5)_6]^{-3} + 3 \text{H}^+ + \text{Cl}^-$

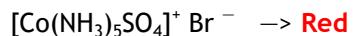
Ammonium Phosphomolybdate – **Yellow** – $(\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3$ (**Yellow**)

Prussian Blue – $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3 \cdot x\text{H}_2\text{O}$

$[\text{Fe}(\text{CN})_3 \text{NOS}]^{-4}$ – **Violet**

$[\text{Fe}(\text{SCN})]^{2+}$ **Blood Red**

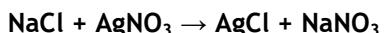
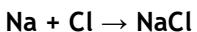
$[\text{Co}(\text{NH}_3)_5 \text{Br}]^{+2} \text{SO}_4^{-2}$ – **Violet** – Pentaaminebromocobalt(III)sulphate



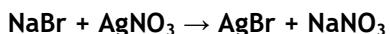
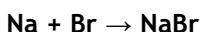
Test for Halogen:

Halogens present in an organic compound forms sodium halide on fusion with sodium metal. Sodium halide extracted with water can be easily identified by adding silver nitrate solution after acidifying with dil. HNO_3 .

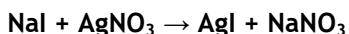
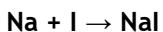
If chlorine is present, a white curdy precipitate soluble in ammonium hydroxide solution is formed.



If bromine is present, an yellowish white precipitate sparingly soluble in ammonium hydroxide solution is formed.



If iodine is present, an yellow precipitate insoluble in ammonium hydroxide solution is formed.

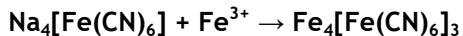


Test for Nitrogen:

The carbon and nitrogen present in the organic compound on fusion with sodium metal gives sodium cyanide (NaCN) soluble in water. This is converted in to sodium ferrocyanide by the addition of sufficient quantity of ferrous sulphate. Ferric ions generated during the process react with ferrocyanide to form prussian blue precipitate of ferric ferrocyanide.



Sodium ferrocyanide

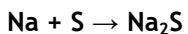


Ferric ferrocyanide



Test for Sulphur:

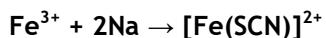
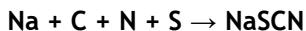
If sulphur is present in the organic compound, sodium fusion will convert it into sodium sulphide. Sulphide ions are readily identified using sodium nitroprusside.



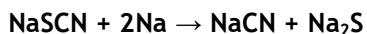
Sodium nitroprusside violet colour

Test for both Nitrogen and Sulphur:

If both nitrogen and sulphur are present in an organic compound, sodium fusion will convert it into sodium thiocyanate which then react with Fe^{3+} to form blood colour complex $[\text{Fe}(\text{SCN})]^{2+}$



Note: If the Lassaigne's extract containing excess of sodium metal, sodium cyanide and sulphides are formed instead of sodium thiocyanate.



Here in this type of cases, both sulphur and nitrogen are to be identified in separate tests.

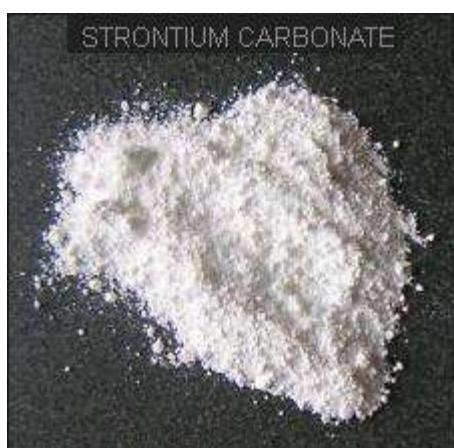
BaCO₃, SrCO₃, CaCO₃, Mg(NH₄)PO₄ - white

BaCO₃ is white



BaCO₃ powder

SrCO₃ is white

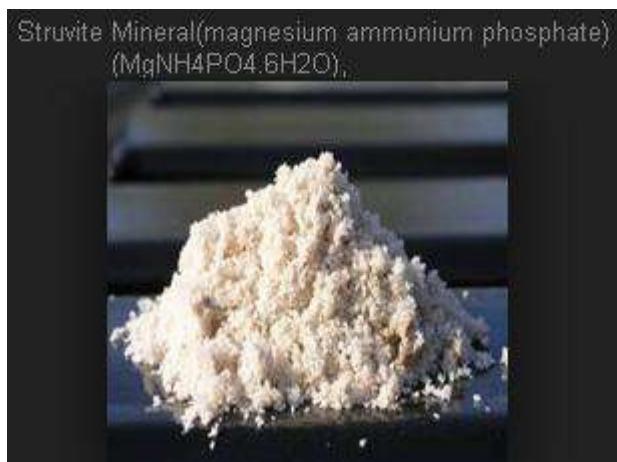


CaCO₃ powder is white



CaCO₃ Calcium Carbonate Powder

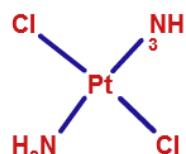
Mg(NH₄)PO₄ is white



Pentaamminechlorocobalt(III)Bromide

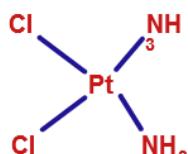


Dark Yellow

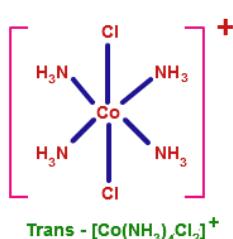


trans- Pt(NH₃)₂Cl₂

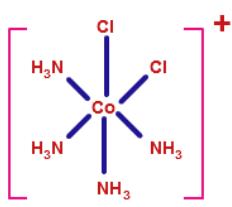
Pale Yellow



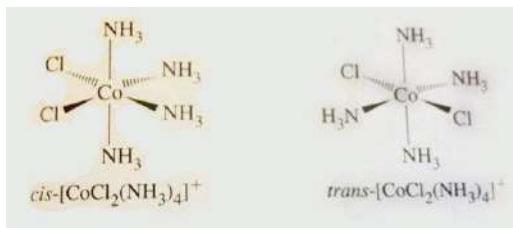
cis- Pt(NH₃)₂Cl₂



Trans - [Co(NH₃)₄Cl₂]⁺

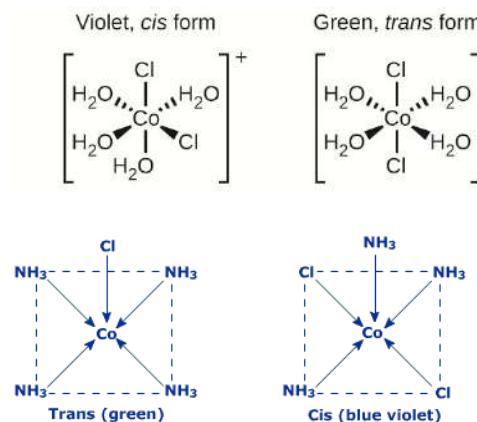


Cis - [Co(NH₃)₄Cl₂]⁺



Cis is Blue Violet

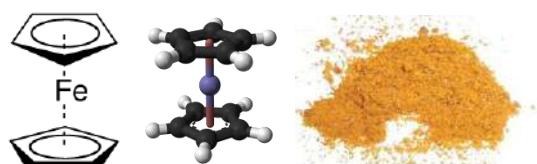
trans is green



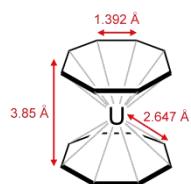
Eta bonds – Also known as Hapticity – Hapticity is the coordination of a ligand to a metal center via an uninterrupted and contiguous series of atoms.

The hapticity of a ligand is described with the Greek letter η ('eta'). For example, η^2 describes a ligand that coordinates through 2 contiguous atoms. In general the η –notation only applies when multiple atoms are coordinated (otherwise the κ –notation is used). In addition, if the ligand coordinates through multiple atoms that are not contiguous then this is considered denticity (not hapticity), and the κ –notation is used once again. Lastly, bridging ligands are described with the μ ('mu') notation.

Ferrocene – bis(η^5 –cyclopentadienyl)iron



Uranocene – bis(η^8 –1,3,5,7–cyclooctatetraene)uranium



$\text{W}(\text{CO})_3(\text{PPri}_3)_2(\eta^2-\text{H}_2)$ – the first compound to be synthesized with a dihydrogen ligand (also known as Dihydrogen Complexes)

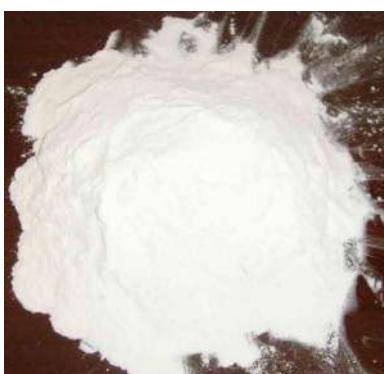
$\text{IrCl}(\text{CO})[\text{P}(\text{C}_6\text{H}_5)_3]_2(\eta^2-\text{O}_2)$ – the dioxygen derivative which forms reversibly upon oxygenation of Vaska's complex.

—

Chromium (III) chloride is purple



black ppt



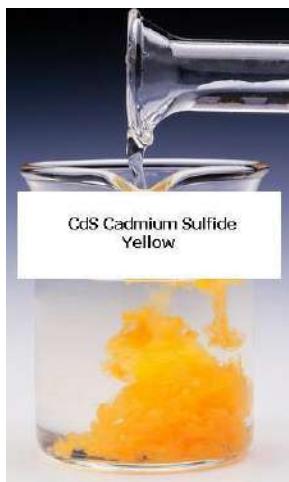
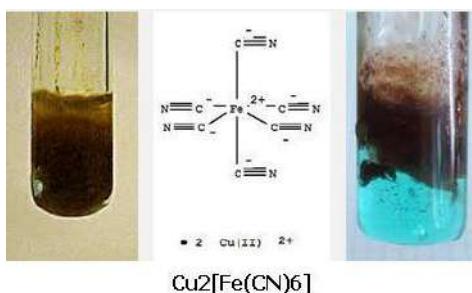
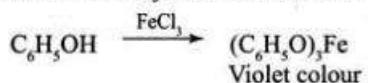
$\text{Bi}(\text{OH})_3$ Bismuth Hydroxide is white



Oxidation of Phenol

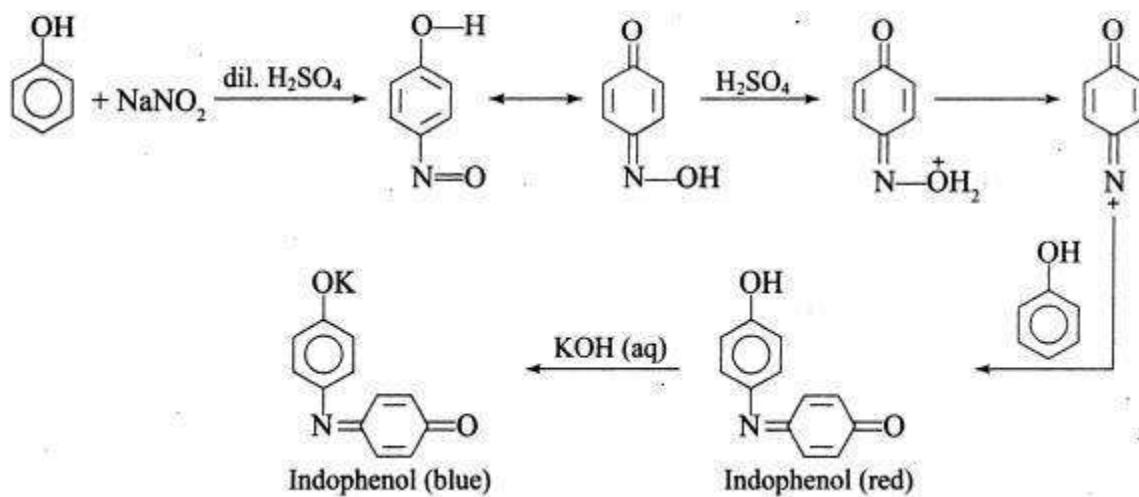
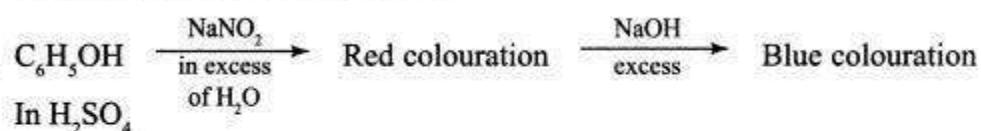
Test of Phenol

With Neutral FeCl₃, Phenol on reaction with neutral ferric chloride gives violet colour of ferric phenoxide

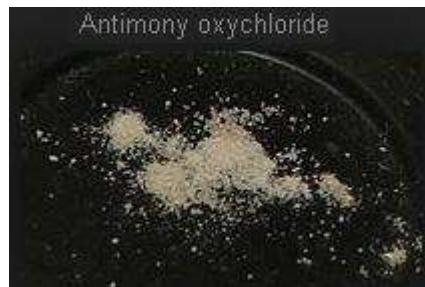




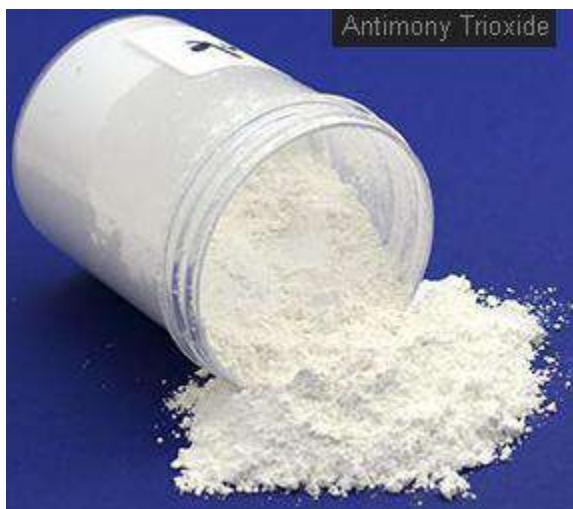
Liebermann's Nitroso Reaction



SbOCl Antimony oxychloride



Antimony Trioxide is white



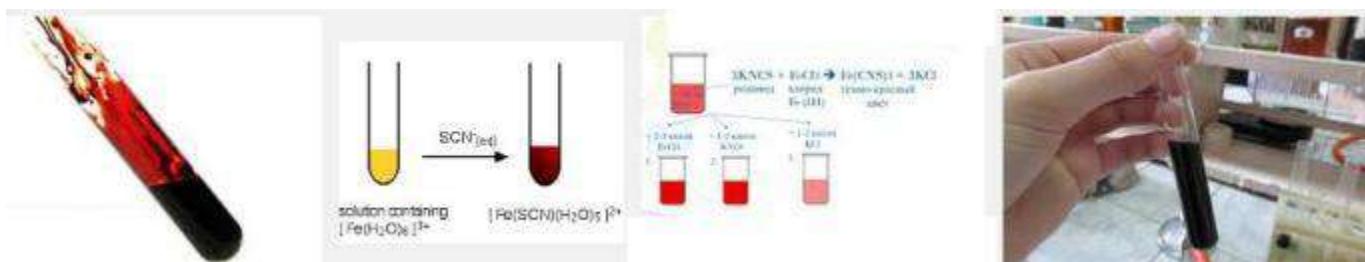
Antimony Pentoxide is gray



Antimony Trichloride is white

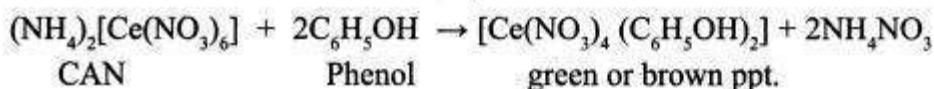


Potassium antimonate white

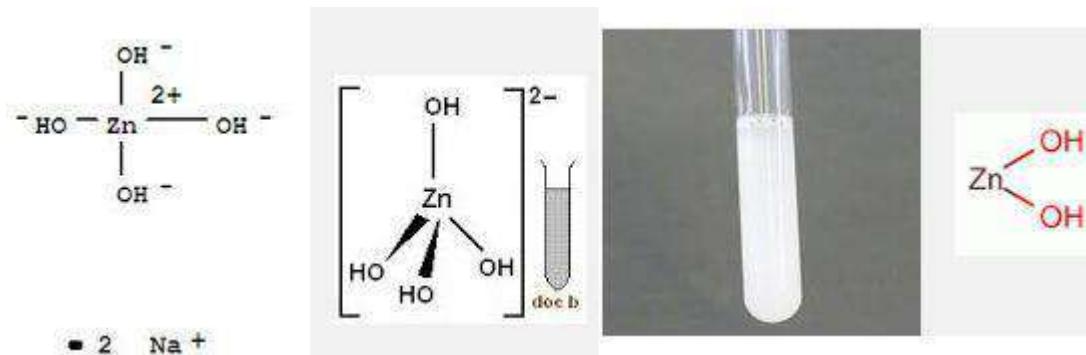


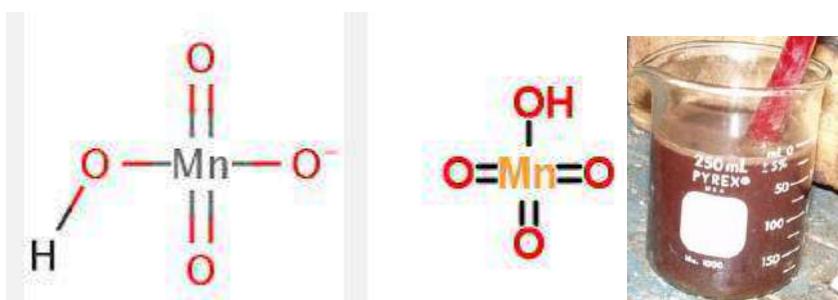
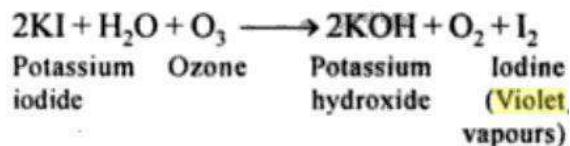
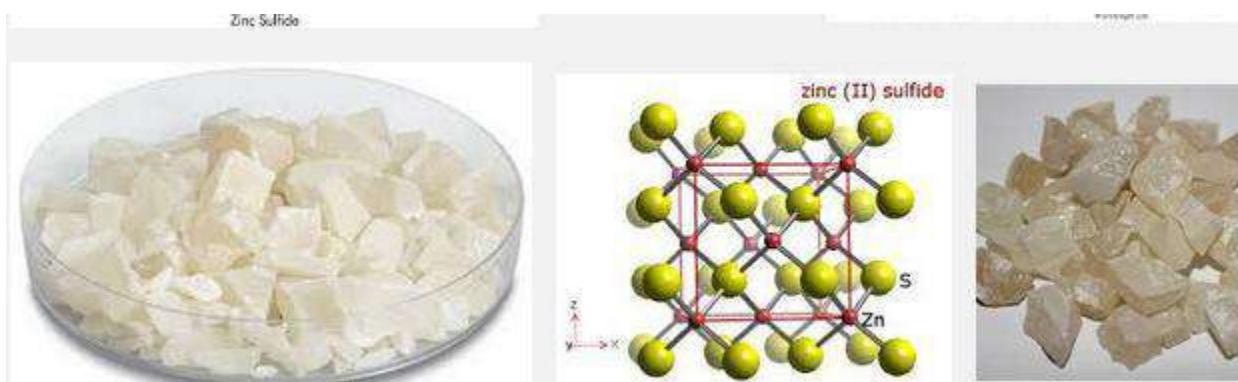
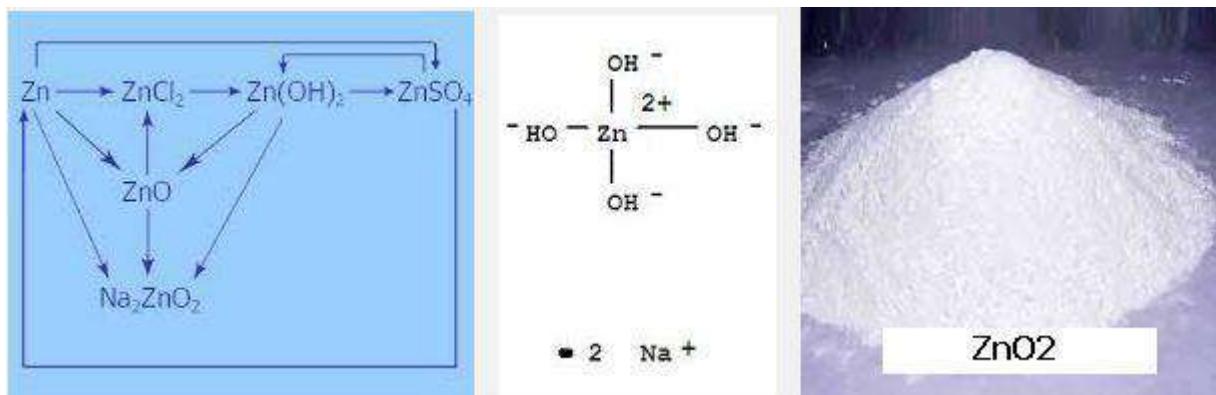
Can Test

Treat a few drops of ceric ammonium nitrate with 3-4 ml of hot aqueous solution of the organic compound. A green or brown precipitate is formed.



Phenol gives blue colour with ammonia and sodium hypo chlorite.









magnesium ammonium phosphate





Chromium oxide powder is green



Chromium Oxide
Powder

Bismuth oxide is Yellow



Bismuth Oxide
Powder

KI Potassium Iodide is white



Tin reacts with conc. HNO_3 forming metastannic acid (H_2SnO_3).

Tin is not attacked by organic acids and hence is used for tinning of utensils to resist corrosion. Tin foils are used for wrapping cigarettes, confectionary items and for making tooth-paste tubes.

SnO_2 is an amphoteric oxide.

Stannous chloride (SnCl_2) acts as a good reducing agent. It reduces HgCl_2 to first Hg_2Cl_2 and then to Hg. It also reduces FeCl_3 to FeCl_2 .

Stannic chloride (SnCl_4) is a liquid and fumes in air due to hydrolysis. It acts as a Lewis acid and dissolves in concentrated HCl forming H_2SnCl_6 .

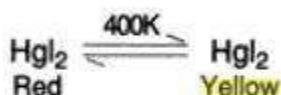
$\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ is called butter of tin.

SnS dissolves in yellow ammonium sulphide.

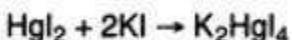
Aluminum Oxide is white



Mercuric Iodide HgI_2 : It is a yellow solid below 400K but changes to red solid above 400K.

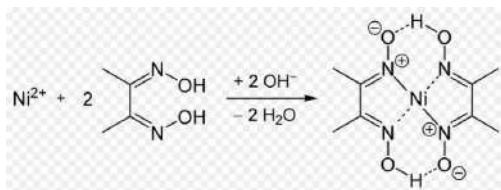


It dissolves in excess of KI forming K_2HgI_4 ;



Alkaline solution of K_2HgI_4 is called Nessler's reagent.

Add NH₄OH excess and dimethylglyoxime to NiCl₂ then a rosy red ppt of nickel appears



A sample of Ni(dmgH)₂

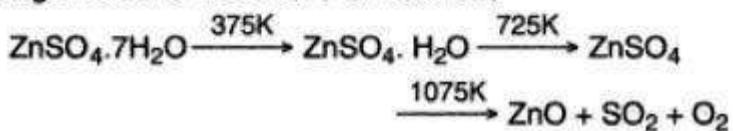
CuO + B₂O₃ (Glassy bead) → Cu(B₂O₃)₂ (Copper metabolite - blue)



Compounds of zinc

Zinc oxide ZnO : Zincite (ZnO) is also called Philosopher's wool. It is a white powder, becomes yellow on heating and again white on cooling. It is amphoteric in nature. It is used as a white pigment under the name Zinc white or Chinese white.

Zinc Sulphate (white vitriol), ZnSO₄. 7H₂O : It is a colourless transparent crystal highly soluble in water. It is used as an eye-lotion and for preparing double salts. On heating it loses its molecules of water as,



Verdigris - basic copper acetate



This pigment was used to the Middle Ages in paints. Until the nineteenth century this was the most vibrant shade of green available and it was used by artists widely. The color comes from copper acetate and you should know that it is highly toxic to humans.

Compounds of Mercury

(1) Mercuric oxide, HgO : It is obtained as a red solid by heating mercury in air or oxygen for a long time at 673 K



$2Hg + O_2 \rightarrow 2 HgO$ (red) or by heating mercuric nitrate alone or in the presence of Hg

Heat



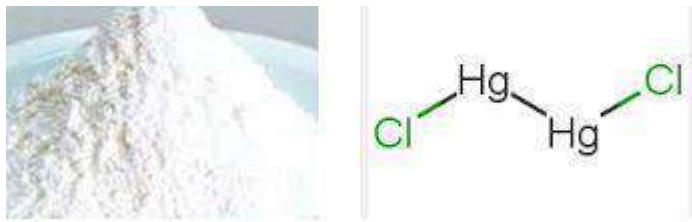
red



When NaOH is added to a solution of HgCl_2 , yellow precipitate of HgO are obtained.



(yellow)



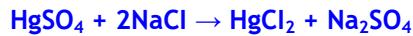
Red and yellow forms of HgO differ only in their particle size. On heating to 673 K, yellow form changes to red form.



It is used in oil paints or as a mild antiseptic in ointments.

(2) Mercuric chloride, HgCl_2 : It is obtained by treating Hg with Cl_2 or by heating a mixture of NaCl and HgSO_4 in presence of small amount of MnO_2 (which oxidizes any Hg(I) salts formed during the reaction).

Heat



MnO_2

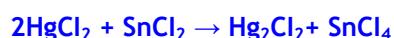




HgCl₂ is a white crystalline solid and is commonly known as corrosive sublimate. It is a covalent compound since it dissolves in organic solvents like ethanol and ether.

It is extremely poisonous and causes death. Its best antidote is white of an egg.

When treated with stannous chloride, it is first reduced to white ppt. of mercurous chloride and then to mercury (black).



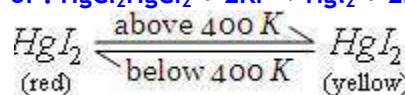
white ppt.



grey

With ammonia it gives a white ppt. known as infusible white ppt.

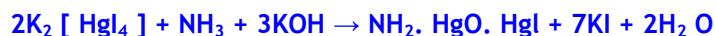
$\text{HgCl}_2 + 2\text{NH}_3 \rightarrow \text{Hg}(\text{NH}_2)_2 + \text{NH}_4\text{Cl}$ A dilute solution of HgCl₂ is used as an antiseptic. (3) Mercuric iodide, HgI₂: It is obtained when a required amount of KI solution is added to a solution of . $\text{HgCl}_2 + 2\text{KI} \rightarrow \text{HgI}_2 + 2\text{KCl}$ Below 400 K, HgI₂ is red but above 400 K, it turns yellow



HgI₂ readily dissolves in excess of KI solution to form the (HgI₄)²⁻ complex ion. $\text{HgI}_2 + 2\text{KI} \rightarrow \text{K}_2\text{HgI}_4$ Red ppt. soluble colourless solution

An alkaline solution of K₂[HgI₄] is called Nessler's reagent and is used to test NH₄⁺ ions.

It gives a brown ppt. of NH₂-Hg-O-Hg-I (iodide of Millon's base) with NH₄⁺ ions.



It is used in ointments for treating skin infections.

(4) Mercurous chloride, Hg₂Cl₂: It is obtained as under :



white ppt.

Heat in an iron retort

(b) $HgCl_2 + Hg \rightarrow Hg_2 Cl_2$ (condenses on cooling)

It is purified by sublimation.

Mercurous chloride is also called calomel. It is a white powder insoluble in H_2O . On heating, it decomposes to give $HgCl_2$ and Hg .



It dissolves in chlorine water forming mercuric chloride.



With ammonia, it turns black due to the formation of a mixture of finely divided black Hg and mercuric amino chloride.



(black)

It is used to prepare standard calomel electrode and as a purgative in medicine.

(5) Mercuric sulphide, HgS : The solubility product of HgS is lower than that of ZnS and hence it gets precipitated as black solid when H_2S is passed through an acidic solution of any mercury (II) salt.



It is insoluble in water and HCl but dissolves in aqua regia (1 part conc. HNO_3 + 3 parts conc. HCl)



Aqua regia Nitrosyl chloride

Nacent chlorine



(Soluble)

On sublimation, its colour changes to red and hence it is used as a red pigment.

(6) Mercuric sulphate, $HgSO_4$: It is obtained when HgS is treated with conc. H_2SO_4 .



It is a white solid which decomposes on heating to give mercurous sulphate.



It is used as a catalyst in the hydration of alkynes to give aldehydes or ketones. It is also used as a cosmetic under the name Vermillon and in ayurvedic medicine as makardhwaj.

(7) Amalgams : Mercury forms alloys commonly known as amalgams, with all metals except iron and platinum. Hence it is transported in iron containers.

(8) Alloy of transition metal : See in table discuss earlier in metallurgy.

xxxxxxxxxxxxxxxxxxxxxx

The common Anions are divided into 3 groups for the purpose of identification:

Those which evolve gases with dilute hydrochloric acid :

Carbonate (CO_3^{2-})

bicarbonate(HCO_3^-)

Nitrite(NO_2^-)

Sulphide (S^{2-})

Sulphite(SO_3^{2-})

Thiosulphate($\text{S}_2\text{O}_3^{2-}$)

Those which do not react with dilute HCl, but which do evolve gases or volatile liquids with concentrated sulphuric acid:

Chloride (Cl^-)

Bromide (Br^-)

Iodide (I^-)

Nitrate (NO_3^-)

Those which do not react with either dilute hydrochloric acid or concentrated sulphuric acid:

Phosphate (PO_4^{3-})

Borate ($\text{B}_4\text{O}_7^{2-}$)

Sulphate (SO_4^{2-})

A Radical is an atom, or group of atoms that behaves like a single atom. Examples : H, K, Na, Cu, Pb, simple radicals ; NH₄, SO₂, NO₂, compound

radicals.

A Basic Radical is a metal, or any radical behaving like a metal. Examples : Ag, Cu, Ca, Na, and NH₄ the last

so classified because it behaves like such simple radicals as Na, K, and Li.

An Acid Radical is a nonmetal, or any radical behaving like a nonmetal. Examples : Cl, Br, I, SO₂, NO₂

An Acid is a substance containing H that may be replaced by a basic radical. When a nonmetal is combined with H only, as in HCl, HBr, H₂S, the compound is said to be a binary (i.e. composed of two elements) acid, or an hydracid. When the nonmetal is combined with H and O, the compound is called a ternary (i.e. composed of three or more elements) acid, or an oxyacid ; and the characteristic name of the acid is formed by adding the termination -ic to the name of the nonmetal to denote more oxygen, or the termination -ous to denote less. Examples : H₂SO₄ sulphuric, and H₂SO₃ sulphurous acid.

These are classified in six different groups in accordance with certain properties which permit a group precipitation by a single reagent. A reagent used for precipitation of a whole group is called a general reagent.

A reagent used as a test for a single substance is known as a special reagent.

Experiments showing Method of Classification

Use the following solutions : AgNO₃, Cu(NO₃)₂, AsCl₃, Fe₂Cl₆, Co(NO₃)₂, Ba(NO₃)₂, NaCl.

Take about 2 c.c. of each solution, and add HCl.*

Points to be Observed Whether a precipitate is formed.

Whether the precipitate is soluble in an excess of the reagent.

* Always use dilute acids unless otherwise directed.

GROUPING THE BASES

The color of each precipitate.

Whether there is change in color of the precipitate.

Change in color of solutions.

Chemical equations.

Tabulate all results carefully in your notebook, according to the following scheme :

HCl was added to the seven solutions with the following results :

Typical of Gr. I $\text{AgNO}_3 + \text{HCl} = \text{AgCl}$ w. pp. + $\text{HIN} () 8$.

Typical of Gr. II A $\text{Cu}(\text{NO}_3)_2 + \text{HCl} = \text{No change.}$

Typical of Gr. II B $\text{AsCl}_3 + \text{HCl} = \text{No change.}$

Typical of Gr. III $\text{Fe}_2\text{Cl}_6 + \text{HCl} = \text{No change.}$

Typical of Gr. IV $\text{Co}(\text{NO}_3)_2 + \text{HCl} = \text{No change.}$

Typical of Gr. V $\text{Ba}(\text{NO}_3)_2 + \text{HCl} = \text{No change.}$

Typical of Gr. VI $\text{NaCl} + \text{HCl} = \text{No change.}$

1) Anions which react with dilute hydrochloric acid

	Carbonates (CO_3^{2-})	Bicarbonates (HCO_3^-)	Nitrites (NO_2^-)
	All carbonates except those of alkali metals, and ammonium are very slightly or difficulty soluble in water. Accordingly reactions in solution are only carried out in case of the soluble salts.	All bicarbonates are water soluble.	Most nitrites are water soluble except that of silver.
Solid salt + dil. HCl	Effervescence and a colourless odourless gas is evolved, Carbon dioxide(CO_2). $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$	Effervescence and a colourless odourless gas is evolved, Carbon dioxide(CO_2). $\text{NaHCO}_3 + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$	Pungent brown fumes are evolved consisting mainly of nitrogen dioxide (NO_2), which is produced by the combination of nitric oxide (NO) with the oxygen of the air. $\text{NaNO}_2 + \text{HCl} \rightarrow \text{NaCl} + \text{HNO}_2$ $3\text{HNO}_2 \rightarrow \text{HNO}_3 + \text{H}_2\text{O} + 2\text{NO}$ $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$

	Carbonate To differentiate between CO_3^{2-} and HCO_3^- :	Bicarbonate	Nitrites Confirmatory tests of nitrites:
1) Salt solution + magnesium sulphate solution	White precipitate of magnesium carbonate $\text{Na}_2\text{CO}_3 + \text{MgSO}_4 \rightarrow \text{MgCO}_3 \downarrow + \text{Na}_2\text{SO}_4$	No ppt. in the cold, as magnesium bicarbonate is soluble, but on heating, a white ppt. of magnesium carbonate is obtained: $\begin{array}{l} 2\text{NaHCO}_3 + \text{MgSO}_4 \rightarrow \\ \text{Na}_2\text{SO}_4 + \text{Mg}(\text{HCO}_3)_2 \\ \text{soluble in water} \\ \text{Mg}(\text{HCO}_3)_2 \xrightarrow{\Delta} \text{MgCO}_3 \downarrow + \text{CO}_2 \\ \text{ppt} + \text{H}_2\text{O} \end{array}$	1) The brown ring test: To a dilute solution of the nitrite, add two drops of freshly prepared ferrous sulphate solution (FeSO_4), and then add dil. H_2SO_4 very carefully drop by drop down the inside of the test tube: a brown ring forms due to the formation of $(\text{FeNO})\text{SO}_4$. Note: If the addition of dil. H_2SO_4 is not down the inside of the test tube, the solution becomes brown color (we can not notes the ring).
2) Salt solution + mercuric chloride solution	Reddish brown precipitate of mercuric carbonate $\text{Na}_2\text{CO}_3 + \text{HgCl}_2 \rightarrow \text{HgCO}_3 \downarrow + 2\text{NaCl}$	No ppt. in the cold, but on heating a reddish-brown ppt. of mercuric carbonate is obtained: $\begin{array}{l} 2\text{NaHCO}_3 + \text{HgCl}_2 \rightarrow \\ 2\text{NaCl} + \text{Hg}(\text{HCO}_3)_2 \\ \text{soluble in water} \\ \text{Hg}(\text{HCO}_3)_2 \xrightarrow{\Delta} \text{HgCO}_3 \downarrow + \text{CO}_2 \\ \text{ppt} + \text{H}_2\text{O} \end{array}$	2) solution of nitrite + potassium iodide solution (KI) + dilute sulfuric acid : a pale brown colour appears, due to the libration of iodine. (The nitrite solution is an oxidizing agent.) $2\text{KNO}_2 + 2\text{KI} + 2\text{H}_2\text{SO}_4 \rightarrow 2\text{K}_2\text{SO}_4 + 2\text{H}_2\text{O} + \text{I}_2 + 2\text{NO}$ Iodide Iodine



	Sulphites (SO_3^{2-})	Thiosulphates ($\text{S}_2\text{O}_3^{2-}$)	Sulphides (S^{2-})				
	All sulphites are slightly soluble in water except the alkali metal sulphites and the ammonium salt.	Sodium thiosulphate is readily soluble in water, other thiosulphates are slightly soluble.	All sulphides, except those of alkali, alkali earth metals and the ammonium ion are slightly soluble in water.				
Solid salt + dilute HCl	<p>Sulphur dioxide gas (SO_2), is evolved , which is recognizable by its pungent smell:</p> $\text{Na}_2\text{SO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{SO}_2$ <p><u>Test for sulphur dioxide:</u> Dip a small piece of paper into an acidic solution of potassium dichromate, and hold it over the mouth of the test tube. The paper will turn green, because the sulphur dioxide reduces the dichromate to a chromic sulphate:</p> $3\text{SO}_2 + \text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$ <table style="margin-left: 100px;"> <tr> <td>Orange colour</td> <td>Green colour</td> </tr> </table>	Orange colour	Green colour	<p>Colourless gas with pungent odour , which turns an acidified potassium dichromate paper green , is evolved (SO_2), and a yellow precipitate of sulphur (S) appears:</p> $\text{Na}_2\text{S}_2\text{O}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{SO}_2 + \text{S} \downarrow$ $3\text{SO}_2 + \text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$ <table style="margin-left: 100px;"> <tr> <td>Orange colour</td> <td>Green colour</td> </tr> </table>	Orange colour	Green colour	<p>Colourless gas, hydrogen sulphide (H_2S), is evolved which is recognizable by its bad smell.</p> $\text{Na}_2\text{S} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{S}$ <p><u>Test for hydrogen sulphide:</u> Dip a piece of paper in a solution of lead acetate, and hold it over the mouth of the test tube in which the H_2S is being generated. The paper will turn black due to the formation of lead sulphide.</p> $\text{H}_2\text{S} + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbS} + 2\text{CH}_3\text{COOH}$ <p>Black</p>
Orange colour	Green colour						
Orange colour	Green colour						

K_2SO_4 is white



$\text{Cr}_2(\text{SO}_4)_3$ is green



	Sulphites	Thiosulphates	Sulphides
Confirmatory tests: 1) Salt solution + silver nitrate solution (AgNO_3)	A white precipitate forms (silver sulphite Ag_2SO_3), which dissolves in excess of sulphite due to the formation of soluble complex. $\text{Na}_2\text{SO}_3 + 2 \text{AgNO}_3 \rightarrow \text{Ag}_2\text{SO}_3 \downarrow + 2 \text{NaNO}_3 \text{ ppt}$ $\text{Ag}_2\text{SO}_3 + \text{Na}_2\text{SO}_3 \rightarrow 2 \text{Na}[\text{AgSO}_3]$ Soluble complex	A white precipitate forms (silver thiosulphate $\text{Ag}_2\text{S}_2\text{O}_3$), which is soluble in excess of the thiosulphate due to the formation of complex, which is unstable(it changes to yellow, brown and finally to black Ag_2S). $\text{Na}_2\text{S}_2\text{O}_3 + 2 \text{AgNO}_3 \rightarrow \text{Ag}_2\text{S}_2\text{O}_3 \downarrow + 2 \text{NaNO}_3$ White ppt	A black precipitate of silver sulphide (Ag_2S) is formed. $\text{Na}_2\text{S} + 2\text{AgNO}_3 \rightarrow \text{Ag}_2\text{S} \downarrow + 2\text{NaNO}_3$ ppt
2) Salt solution + lead acetate solution $\text{Pb}(\text{CH}_3\text{COO})_2$	A white ppt. of lead sulphite (PbSO_3) is formed. $\text{Na}_2\text{SO}_3 + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbSO}_3 \downarrow + 2 \text{CH}_3\text{COONa}$ ppt	A white ppt. of lead thiosulphate (PbS_2O_3) is formed, the ppt. turns black (PbS) on boiling. $\text{Na}_2\text{S}_2\text{O}_3 + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbS}_2\text{O}_3 \downarrow + 2 \text{CH}_3\text{COONa}$ White ppt $\text{PbS}_2\text{O}_3 + \text{H}_2\text{O} \rightarrow \text{PbS} \downarrow + \text{H}_2\text{SO}_4$ Black ppt	A black ppt. of lead sulphide (PbS) is formed. $\text{Na}_2\text{S} + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbS} \downarrow + 2 \text{CH}_3\text{COONa}$ Black ppt
	* Salt solution + drops of acidified solution of KMnO_4 : The purple colour of the permanganate will disappear. The sulphite reduces the permanganate ion to (Mn^{2+}) which is almost colourless. $5\text{Na}_2\text{SO}_3 + 2\text{KMnO}_4 + 3\text{H}_2\text{SO}_4 \rightarrow 5\text{Na}_2\text{SO}_4 + \text{K}_2\text{SO}_4 + 2\text{MnSO}_4 + 3\text{H}_2\text{O}$		* Salt solution + Sodium nitroprusside solution: A violet colour is formed.

	Sulphites	Thiosulphates
<u>Salt solution + 2 drops of dil. H_2SO_4 + Iodine solution (I_2)</u>		
	The brown colour of the iodine solution disappears. $\text{Na}_2\text{SO}_3 + \text{I}_2 + \text{H}_2\text{O} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{HI}$	The brown colour of the iodine solution disappears, because the iodine is reduced to the iodide ion, which is colourless. At the same time, the thiosulphate is oxidized to tetrathionate: $2\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2 \rightarrow \text{Na}_2\text{S}_4\text{O}_6 + 2\text{NaI}$

2) Anions which react with concentrated sulphuric acid

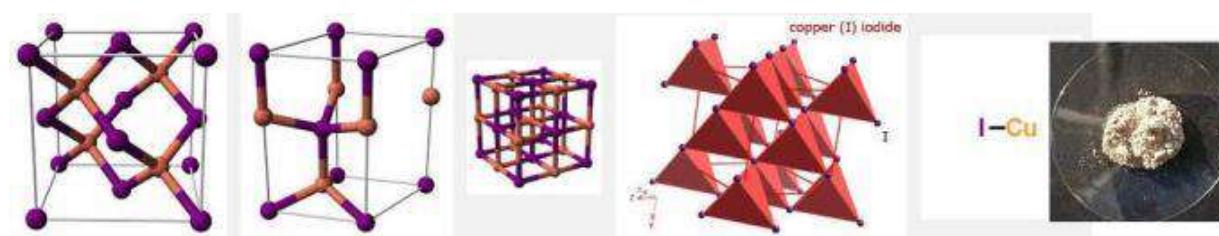
Note: Do these tests in fuming ~~copper~~ because the gases which are given off in these tests are extremely irritating, and can cause damage to the sensitive mucous membranes of nose and throat.

	Chlorides (Cl ⁻)	Bromides (Br ⁻)	Iodides (I ⁻)	Nitrates (NO ₃ ⁻)
	All chlorides are water soluble except the chlorides of silver, mercurous and cuprous.	Bromides resemble chlorides in their solubility.	Iodides resemble chlorides and bromides in their solubility. However, bismuth iodide is insoluble.	All nitrates are soluble in water except some basic nitrates.
Solid salt + conc. H ₂ SO ₄ :	<p>Effervescence with evolution of colourless gas, Hydrogen chloride (HCl).</p> $2\text{NaCl} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{HCl}$ <p><u>Test for HCl gas:</u> Dip a clean glass rod into a bottle of conc. ammonia solution, and hold it close to the mouth of the test tube in which the HCl is being produced. Dense white fumes of ammonium chloride will be formed: $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl}$</p>	<p>Raddish fumes evolve and the solution turns orange due to liberation of bromine (Br₂)</p> $2\text{NaBr} + \text{H}_2\text{SO}_4 \rightarrow 2\text{HBr} + \text{Na}_2\text{SO}_4$ $2\text{HBr} + \text{H}_2\text{SO}_4 \rightarrow 2\text{H}_2\text{O} + \text{SO}_2 + \text{Br}_2$	<p>Violet fumes are evolved, (Iodine gas I₂) and a brown or black precipitate is formed in the test tube.</p> $2\text{KI} + 2\text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O} + \text{SO}_2 + \text{I}_2$	<p>-ve If a small piece of copper metal and drops of water are added, dense brown fumes of nitrogen dioxide (NO₂) will be given off. If no results, heat carefully.</p> $2\text{KNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{HNO}_3$ $4\text{HNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{H}_2\text{O} + 2\text{NO}_2$

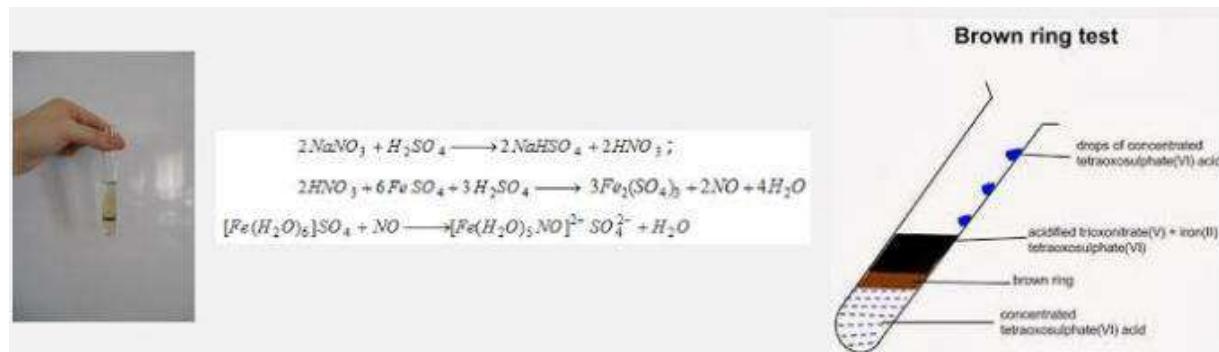
	Chlorides	Bromides	Iodides	Nitrates
Confirmatory test: 1) Salt solution + silver nitrate (AgNO ₃)	A dense white ppt. of silver chloride (AgCl) slowly turns a violet colour when exposed to bright sunlight. $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} \downarrow + \text{NaNO}_3$ Ppt	A yellowish white precipitate of silver bromide(AgBr) is formed. $\text{NaBr} + \text{AgNO}_3 \rightarrow \text{AgBr} \downarrow + \text{NaNO}_3$ Ppt	A yellow precipitate of silver iodide (AgI) is formed. $\text{KI} + \text{AgNO}_3 \rightarrow \text{AgI} \downarrow + \text{KNO}_3$ Ppt	-ve
2) Salt solution + lead acetate Pb(CH ₃ COO) ₂	A white precipitate of lead chloride (PbCl ₂) is formed which is soluble in hot water, and reprecipitates on cooling. $2\text{NaCl} + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbCl}_2 \downarrow + 2\text{CH}_3\text{COONa}$	A white precipitate of lead bromide (PbBr ₂) appears which is soluble in boiling water and reprecipitates on cooling. $2\text{NaBr} + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbBr}_2 \downarrow + 2\text{CH}_3\text{COOK}$	A yellow precipitate of lead iodide (PbI ₂) is formed which dissolves in boiling water and recrystallises on cooling.	---
			<p>* Salt solution + Mercuric chloride (HgCl₂) A reddish precipitate of mercuric iodide is formed which dissolves in excess of KI.</p> $\text{HgCl}_2 + 2\text{KI} \rightarrow \text{HgI}_2 \downarrow + 2\text{KCl}$ Ppt $\text{HgI}_2 + 2\text{KI} \rightarrow \text{K}_2[\text{HgI}_4]$ soluble	<p>* Brown ring test: The nitrate solution is mixed with freshly prepared FeSO₄ solution, then conc. H₂SO₄ is added and allowed to flow causiously on the side of the test tube. A brown ring (Fe³⁺NO₃)₄ is formed at the interface of the two layers. The brown ring disappears on shaking the solution.</p>



CuI Cuprous Iodide

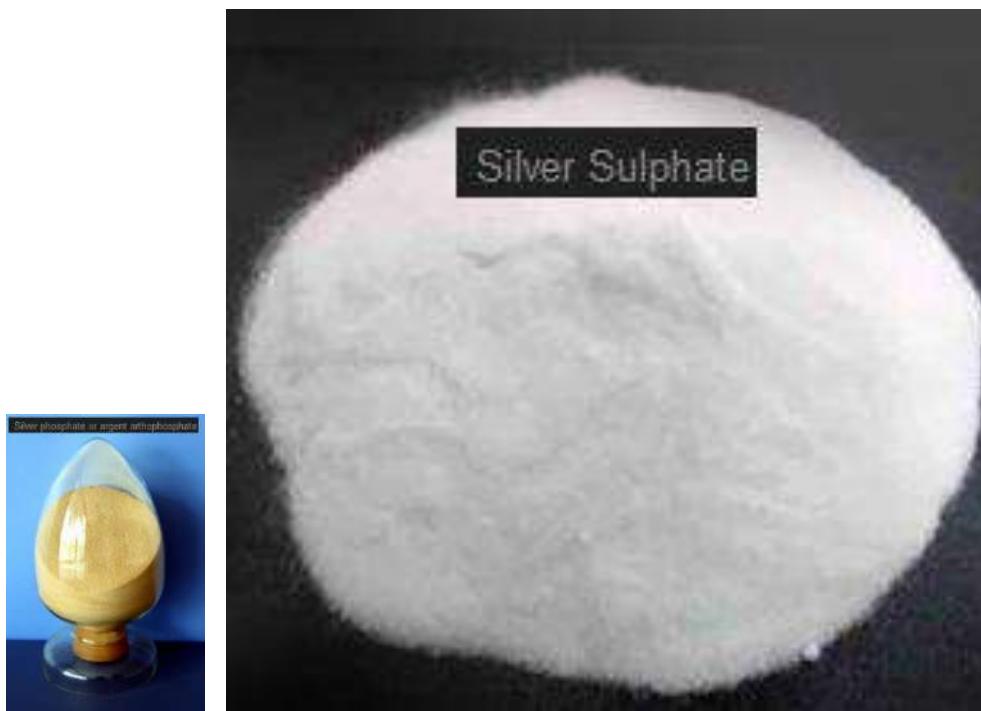


Brown Ring Test



3) Anions which do not react with acids:

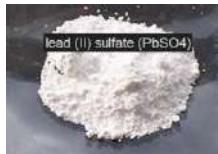
	Phosphates ($H_2PO_4^-$, HPO_4^{2-}, PO_4^{3-})	Borates (BO_2^-, BO_3^{3-}, $B_4O_7^{4-}$)	Sulphates (SO_4^{2-})
	Most phosphates are insoluble in water except those of ammonium and alkali metals.	Ammonium and alkali metal borates are water soluble while other borates are slightly soluble in water.	All sulphates are soluble in water except those of some divalent metals e.g. calcium, strontium, barium and lead.
Salt solution + Barium chloride solution ($BaCl_2$)	A white precipitate of barium phosphate ($BaHPO_4$) is produced, soluble in dilute acids e.g. HNO_3 or HCl and insoluble in excess of barium chloride. $Na_2HPO_4 + BaCl_2 \rightarrow BaHPO_4 \downarrow + 2NaCl$	A white ppt. of barium borate from concentrated solutions $Ba(BO_2)_2$ is produced, soluble in dilute acids and in excess of barium chloride. $Na_2B_4O_7 + 3H_2O + BaCl_2 \rightarrow Ba(BO_2)_2 + 2H_3BO_3 + 2NaCl$	A white precipitate of barium sulphate ($BaSO_4$) is formed which is insoluble in dilute acids and in excess of barium chloride. $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 \downarrow + 2NaCl$
Confirmatory tests: 1) Salt solution + silver nitrate ($AgNO_3$)	A yellow precipitate of silver phosphate (Ag_3PO_4) is formed, which is readily soluble in dil. HNO_3 and ammonia.	A white ppt. of silver borate ($AgBO_2$) is formed, from concentrated solution, which give brown ppt. after boiling. (also a brown ppt. is formed with diluted solution) $Na_2B_4O_7 + 3H_2O + 2AgNO_3 \rightarrow 2AgBO_2 + 2H_3BO_3 + 2NaNO_3$ $2AgBO_2 + 3H_2O \rightarrow Ag_2O + 2H_3BO_3$	A white ppt. of silver sulphate (Ag_2SO_4) is formed with concentrated solution. $Na_2SO_4 + 2AgNO_3 \rightarrow Ag_2SO_4 \downarrow + 2NaNO_3$



BaSO₄ is white



<p>For phosphates:</p> <p>0.5 ml of salt solution + 4 ml of ammonium molybdate solution + 0.5 ml of conc.HNO_3:</p> <p>Form a canary yellow precipitate of ammonium phosphomolybdate $(\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3 \cdot \text{H}_2\text{O}$ in the cold or by gentle warming. (notes the volume needed in this test).</p>		<p>For sulphates:</p> <p>Salt solution + lead acetate:</p> <p>A white precipitate of lead sulphate is formed, which is readily soluble in hot concentrated ammonium acetate or conc.H_2SO_4</p> $\text{K}_2\text{SO}_4 + \text{Pb}(\text{CH}_3\text{COO})_2 \rightarrow \text{PbSO}_4 \downarrow + 2\text{CH}_3\text{COOK}$ $\text{PbSO}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{Pb}(\text{HSO}_4)_2$
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Scheme for the identification of acid radicals

1) Solid salt + dil. HCl:

Observation	Effervescence and a colourless odourless gas is evolved.	Pungent brown fumes are evolved.	Colourless gas with pungent odour, which turns an acidified dichromate paper green, is evolved.	Colourless gas with pungent odour, which turns an acidified potassium dichromate paper green, is evolved, and a yellow precipitate of sulphur appears.	Colourless gas is evolved which is characterized by its bad odour and turning a lead acetate paper black	-ve The salt does not react with dil. HCl.
Results	The gas is CO_2 . The anion is carbonate or bicarbonate.	The gas is NO_2 . The anion is Nitrite	The gas is SO_2 and the green colour is $\text{Cr}_2(\text{SO}_4)_3$. The anion is sulphite	The gas is SO_2 , the ppt. is S and the green colour is $\text{Cr}_2(\text{SO}_4)_3$. The anion is thiosulphate.	The gas is H_2S , and the black colour is PbS . The anion is sulphide	The anion is not from group 1. <u>(Go to step 2)</u> .

To differentiate between carbonate and bicarbonate:

1) Salt solution + magnesium sulphate solution:

For carbonate: White precipitate of magnesium carbonate (MgCO_3).

For bicarbonate: No ppt. in the cold, as magnesium bicarbonate is soluble, but on heating, a white ppt of magnesium carbonate is obtained.

2) Salt solution + mercuric chloride solution:

For carbonate: Reddish brown precipitate of mercuric carbonate (HgCO_3).

For bicarbonate: No ppt. in the cold, but on heating a reddish-brown ppt. of mercuric carbonate is obtained.

2) Solid salt + conc. H_2SO_4 :

Observation	Effervescence with the evolution of a colourless gas which forms white fumes with NH_4OH .	Raddish fumes evolve and the solution turns orange.	Violet fumes are evolved, and a brown or black precipitate is formed in the test tube.	-ve If a small piece of copper metal and drops of water are added, dense brown fumes will be given off. If no results, heat carefully.	-ve The salt does not react with conc. H_2SO_4
Results	The gas is HCl and the white fumes are NH_4Cl . The anion is chloride.	The gas is Br_2 . The anion is Bromide.	The gas is I_2 . The anion is iodide.	The gas is NO_2 . The anion is Nitrate.	The anion is not from group 2. <u>(Go to step 3)</u> .

3) Salt solution + BaCl_2 :

Observation	A white precipitate is produced, soluble in dilute acids e.g. HNO_3 or HCl and insoluble in excess of barium chloride.	A white ppt. from concentrated solutions is produced, soluble in dilute acids and in excess of barium chloride	A white precipitate is formed which is insoluble in dilute acids and in excess of barium chloride.
Results	The white precipitate is barium phosphate (BaHPO_4). The anion is phosphate.	The white ppt. is barium borate $\text{Ba}(\text{BO}_3)_2$. The anion is Borate.	A white precipitate is barium sulphate (BaSO_4). The anion is sulphate.

To differentiate between phosphate, borate and sulphate:

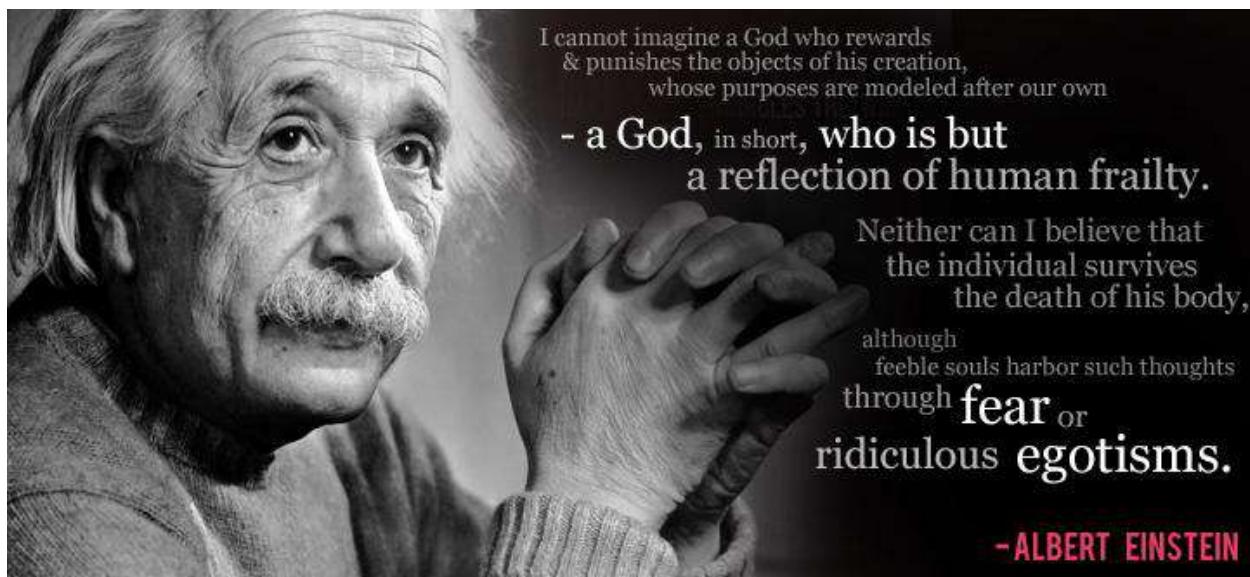
Salt solution + AgNO_3 (silver nitrate):

	phosphate	borate	Sulphate
Observation	A yellow precipitate is formed, which is readily soluble in dil. HNO_3 and ammonia.	A white ppt. is formed from concentrated solution, which give brown ppt. after boiling. (also, a brown ppt. is formed with diluted solution.)	A white ppt. is formed, with concentrated solution
Results	The yellow ppt. is silver phosphate (Ag_3PO_4). The anion is phosphate.	The white ppt. is silver borate (AgBO_2). The anion is borate.	The white ppt. is silver sulphate (Ag_2SO_4). The anion is sulphate.

Oxidation States and Colors

Metal	+1	+2	+3	+4	+5	+6	+7
Sc			Colorless				
Ti			Violet	Colorless			
V		Violet	Green	blue	Yellow		
Cr		Blue	Green			Yellow (CrO_4^{2-}) orange ($\text{Cr}_2\text{O}_7^{2-}$)	
Mn		Pale pink		Brown		Dark green (MnO_4^{2-})	Intense purple (MnO_4^-)
Fe		Pale green	Yellow or brown				
Co		Pink	Orange/yellow				
Ni		Green					
Cu		Blue					
Zn		colorless					





(Apart from Millions of smart people) **Several Nobel Laureates were Atheists.**

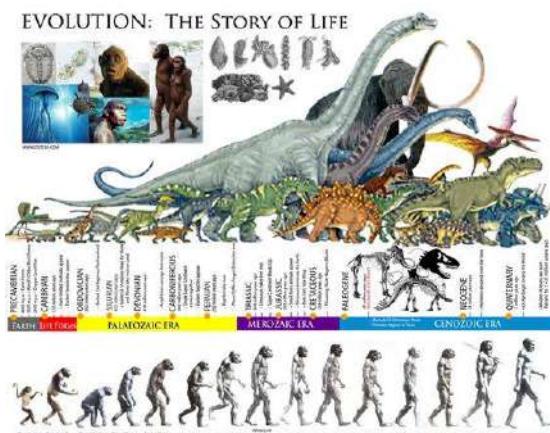
Some famous examples have been **Albert Einstein** (1921), **Richard Feynman** (1965), **Erwin Schrödinger** (1933), **Paul Dirac** (1933), **Lawrence M. Krauss** (2011), **Niels Bohr** (1922), **Peter Higgs** (2013), **John Bardeen** (**The only person receiving the Physics Nobel prize twice. 1956, 1972**), **Frederick Sanger** (**The only person receiving the Chemistry prize twice. 1958, 1980**), **Marie Curie** (1903, 1911), **Frédéric Joliot-Curie and Irène Joliot-Curie** (1935), **Milton Friedman** (1976), **John Harsanyi** (1994), **Friedrich Hayek** (1974), **John Forbes Nash, Jr.** (1994), **Amartya Sen** (1998), **Subrahmanyan Chandrasekhar** (1983), **Enrico Fermi** (1938), **C. V. Raman** (1930), **Eugene Wigner** (1963), **Steven Weinberg** (1979), **Chen-Ning Yang** (1957) etc

A bigger (incomplete) list can be seen at

https://en.wikipedia.org/wiki/List_of_nonreligious_Nobel_laureates

Important Scientists <http://www.physicsoftheuniverse.com/scientists.html>

<http://www.physicsoftheuniverse.com/facts.html>





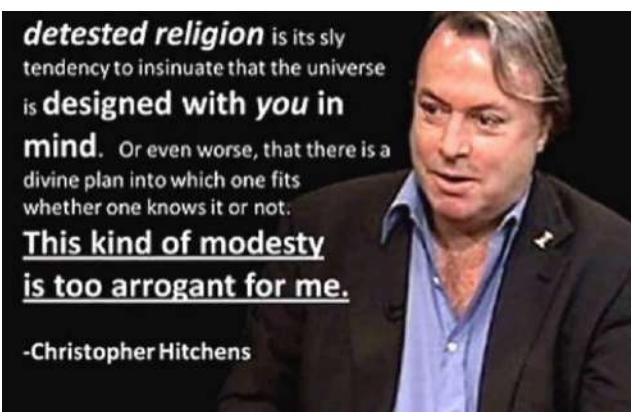
There is no God. There's no heaven.
There's no hell. There are no angels.
When you die, you go in the ground,
the worms eat you.

— *Madalyn Murray O'Hair* —

AZ QUOTES

(When the body is burnt, oxides are the ash. The gases and water vapor spread in the air)

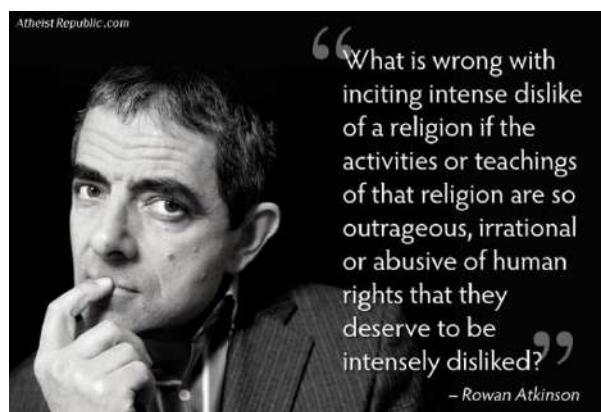
My personal favorites (among these Atheists) are **Richard Feynman**, **Peter Higgs**, **Lawrence Krauss**.



detested religion is its sly
tendency to insinuate that the universe
is **designed with you in**
mind. Or even worse, that there is a
divine plan into which one fits
whether one knows it or not.

This kind of modesty
is too arrogant for me.

-Christopher Hitchens



“What is wrong with
inciting intense dislike
of a religion if the
activities or teachings
of that religion are so
outrageous, irrational
or abusive of human
rights that they
deserve to be
intensely disliked?”

- Rowan Atkinson

Richard Feynman openly laughed (Publicly and in class) about Gods, Fairies etc. see <https://www.youtube.com/watch?v=j3mhkYbznBk>

and https://www.youtube.com/results?search_query=Richard+Feynman

https://www.youtube.com/watch?v=JzWzLyGuPRY&list=PL_6G_2_0gFDqFjq4gZbmDvJT4bnvnNwr-

Approx 200 years ago; around 1800, Pierre-Simon Laplace developed a **new branch of Mathematics**, **Perturbation theory**. Perturbation theory was investigated by the classical scholars – Laplace, Poisson, Gauss – as a result of which the computations could be performed with a **very high accuracy**. The discovery of the planet Neptune in 1848 by Urbain Le Verrier, based on the deviations in motion of the planet Uranus (he sent the coordinates to

Johann Gottfried Galle who successfully observed Neptune through his telescope), represented a triumph of perturbation theory.

Laplace was one the first persons who did **not** see or use "hand of God" (or role of God) to explain something. Newton's Gravitation equations for Two masses, were not enough to explain stability of multibody, rather multi planet and Sun system. Perturbation Theory could accommodate cumulative effects of many small forces.

While talking to Napoleon, (discussing the theory); Laplace said, (about God) "**that**" (God) hypothesis is **not** needed.

<http://www.naturalhistorymag.com/universe/211420/the-perimeter-of-ignorance>

https://en.wikipedia.org/wiki/Perturbation_theory

https://en.wikipedia.org/wiki/Pierre-Simon_Laplace

Peter Higgs was very unhappy about " Higgs Boson " being called "G..(I don't want to name this) Particle". **Stupid Journalists**, Media, and dumb people kept repeating that word, and Peter requested to refrain from using this word. Now for Madala Boson also the **Stupid Journalists**, Media, and dumb people are using that same G word.

Lawrence Krauss openly laughs and ridicules the Theists or any non–Atheists. The crap of Agnosticism does not work with me or Krauss.

Empty Space is not empty. Mass of Proton, Neutron is not sum of masses of Quarks

<https://archive.org/details/EmptySpacesNotEmptyMassOfProtonNeutronsNotSumOfMassesOfQuarks>

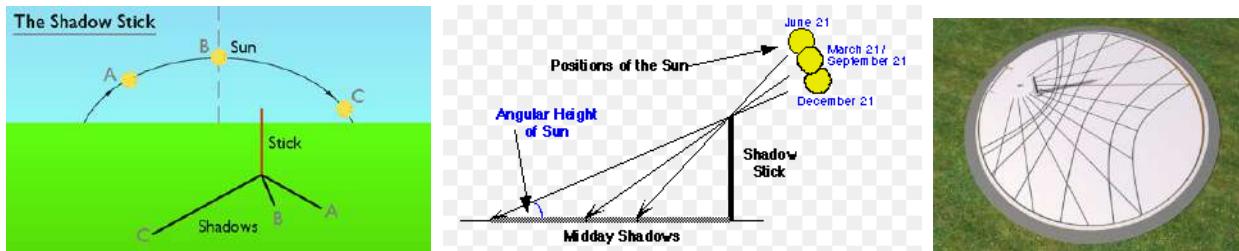
We are in Modern Times. I am lucky to learn the correct things quite early in my life, in a so " peaceful " society. When I was in standard 9, (in early 1980s), I was writing a book on Atheism. I was convinced to understand, learn, and imbibe the correct approach and knowledge.

But that was not the case previously. Copernicus used to discuss and explain people widely and randomly, that Earth is rotating around the Sun, and it is not a Geocentric" universe. Nicolaus Copernicus had to waste lot of time arguing, fighting and convincing the stupids.

Measuring something, which is very slow; is very difficult. I have asked lot of "educated / engineer / Software or IT (senior position) Parents" that " How do we know that Earth is moving around the Sun in 365 days or say 365.242196 days " ? **Believe me I never got an answer.** The Modern iPad / smartphone **community in general does not know how 365.24 days was measured almost thousand years ago !**

A metal triangle was set at top of buildings (Mosques or churches) and the position of the shadow was marked at a particular time. Say 8 AM each day. The position of the shadow varied each day. It was seen that after 365 days the shadow matched the position but after

sometime, not exactly at 8 AM but after a few hours (approx 6 hours) so at around 2 PM or slightly before.



See details of this at
<http://blog.world-mysteries.com/science/ancient-timekeepers-part-2-observing-the-sky/>

<http://blog.world-mysteries.com/science/ancient-timekeepers-part4-calendars/>

See the video https://www.youtube.com/watch?v=lhqzW97_47w

<https://thecuriousastronomer.wordpress.com/2012/10/>

Much tougher questions are “ How many different kind of years do we have ? ”

Or “ What is the difference between ‘ **Sidereal year** ’ and ‘ **Tropical year** ’ ”

Meteors were coming from sky. These were called ‘ shooting stars ’. Meteors often had Iron in them. Sidero is a combining form meaning “star,” “constellation,” used in the formation of compound words. Greeks used the word siderolite for Iron. Next the source of meteors; the sky itself was named the same. As year was measured using objects from sky; Sun and shadows; the year was named a “ **Sidereal Year** ”

To avoid embarrassing people; I don’t ask

See the answers in <https://www.youtube.com/watch?v=cGjP3vAZGa4>

<https://www.youtube.com/watch?v=qgsrVyW53DY>

It took many centuries to introduce the leap year corrections. A century is a leap year only if divisible by 400 and not the rule of divisible by 4. Year 1900 was not a Leap year. But year 2000 was. I have met computer Science guys who are aware that Microsoft Database SQL-server do not accept some old dates, while Oracle database does not accept some specific dates of the past. But none whom I met knew the detailed or actual reasons.

See <https://zookeepersblog.wordpress.com/everyone-must-know-about-the-calendar/>

“ **How do you prove that day and night is happening due to rotation of Earth around its own axis in contrast to Sun is rotating around Earth** ” ?

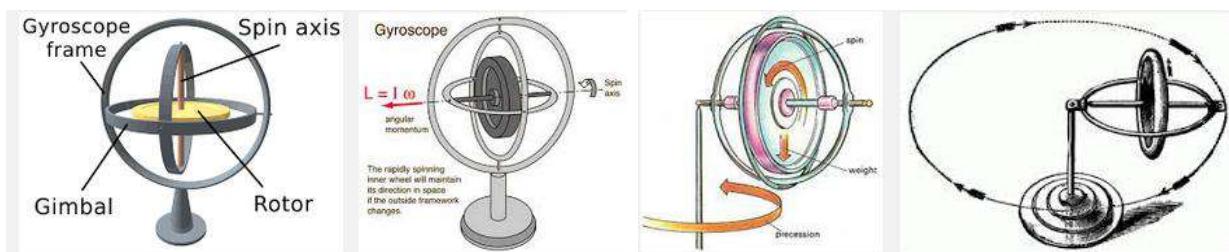
See <http://www.visual-arts-cork.com/prehistoric-art-timeline.htm>

No student from Bangalore, whom I met, answered this. Though conservation of Angular Momentum is in course. (I am being polite) Hardly met any parent who knew the explanation. See https://www.youtube.com/watch?v=iqpV1236_Q0

And <https://www.youtube.com/results?q=Foucault%27s+pendulum>

What about Gyroscopes ?

Approx 300 year back around 1750 the gyroscopes were made.



History of Gyroscope <http://www.gyroscopes.org/history.asp>

See about Gyroscopes in https://www.youtube.com/watch?v=cquivA_IpEsA

<https://www.youtube.com/watch?v=awXTZt86gz0>

<https://www.youtube.com/watch?v=zbdrqpXb-fY>

<https://www.youtube.com/watch?v=N92FYHHT1qM>

https://en.wikipedia.org/wiki/Earth%27s_orbit

<https://www.youtube.com/watch?v=ZcWsjlGPPFQ>

Must see

<https://www.youtube.com/watch?v=SnMmBmzoVQc&list=PL68IJE2PG4AnVVMS7WvOYbJDmqf4umHG1>

Must know ...

https://www.youtube.com/watch?v=zjV3PQ4f6IM&list=PLTve54sz-eh_P29Sbbv_j3bC970FaArOd

Tyco Brahe took the boldest step to create the " Foundation of Science ". Experiments or "Double blind experimental observations" are the supreme. The **Theory follows the experimental verification.**

[There are some universities who award M.Sc in Psychology. A psychologist may **guess** something **But that is not reality or truth.** Till something is experimentally verified it remains as a Perception. Truth is known only after experiments. Because the subject Psychology; completely stands of experimental verification; so the Master in Science degree.]

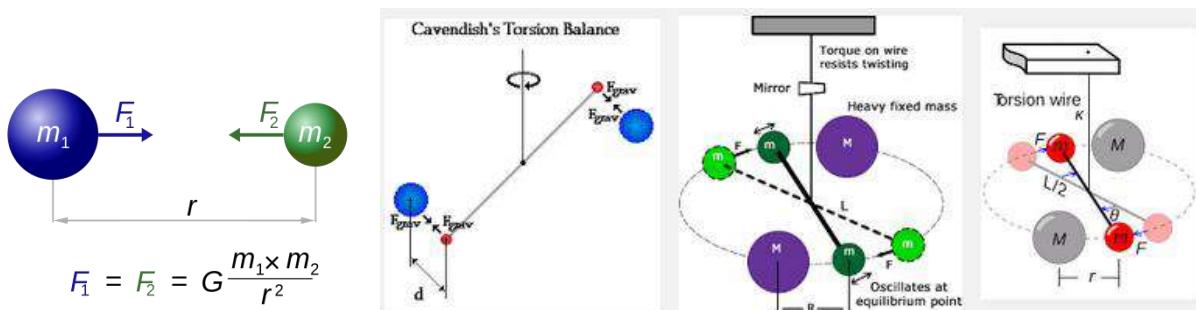


Galileo was the first person who wanted to experimentally verify the speed of light.



Tycho decided to observe the skies (around 1573). In those days sky was synonymous to God. He had the courage to [go to the King](#) to ask for donations to make an observatory. He said to the king that "he wants to observe the Gods and take conclusions ". [Salute to Tycho's paradigm that even Gods can be observed and conclusions can be drawn.](#)

[Amazing leap to start Science.](#)

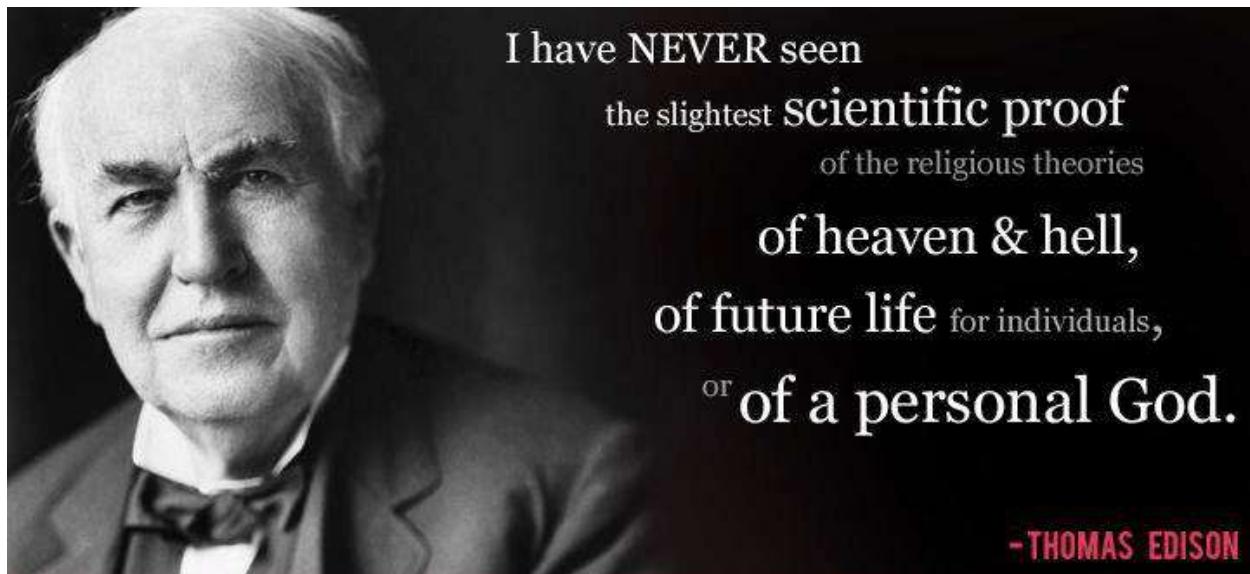


Since those days till now we observed and concluded about Kepler's Laws, Gravitation Laws, We concluded that there was no [Phlogiston](#) or Flogiston, Cavendish measuring value of G, measuring speed of light, X-Ray, [Electromagnetism / Maxwell's equations](#), Radioactivity, No Aether was " observed " in Michelson Morley's experiments, Protons, Neutrons, General Theory of Relativity, Slowing of clocks at high speed, Bending of space, [Bending of light and](#)

gravitational lens, YDSE, Quantum Mechanics, Ernst Ruska designed and built the first **electron microscope**, **Casimir Forces**, Virtual particles and more than 400 kinds of particles, Quarks, Unruh effect (an accelerating thermometer shows higher temperature), Negative Kelvin Temperature, Bose–Einstein condensates, Superconductivity, **Solution to EPR paradox by John Stewart Bell**, Violation of Parity in certain situations – Madam Wu, Yang and Lee, Quantum entanglement in Alain Aspect's Experiments, Black holes, mass of Neutrinos, Caesium Atomic Clocks, Dark Matter, Dark energy, Magnetic Monopole, Gravitational Waves, Nano Materials, Meta Materials, Quantum Computers

No God was observed, or **no role of God was observed**. There is no conspiracy theory going around in Science. Those who want to verify God have to die waiting

... Nothing ever will be reported regarding this illusion.



[**Stupids had proposed the phlogiston theory.** This was a superseded scientific theory that postulated that a fire–like element called phlogiston is contained within combustible bodies and released during combustion. The name comes from the Ancient Greek φλογιστόν phlogistón (burning up), from φλόξ phlóx (flame).]

In contrast see <http://www.americanscientist.org/issues/pub/burn-magnet-burn>

Some examples of stupidity to show / explain by contrasts; will be the right approach.

Aristotle used goat urine and Hippocrates recommended pigeon droppings. For what?



As a treatment for baldness. Men have never found baldness an appealing trait, in spite of stories that bald men are sexier. (Stories usually spread by bald men.) Virtually anything that can be done to a bald pate has been tried to stimulate hair growth. The ancient Egyptians were fond of rancid crocodile or hippo fat. If it smelled bad, surely it must do some good. It didn't. Cleopatra experimented with a goo made of ground horse teeth and deer marrow to spur Julius Caesar's dormant hair follicles into action. When this didn't work she traded him in for Mark Antony. During the Victorian era cold tea was brushed on the scalp, followed by citrus juice. In farming areas chickens were persuaded to leave deposits on a bald head and cows to lick it. Electric combs, suction caps and paint thinner have been tried. At a secluded farmhouse in Pennsylvania, Marcella Ferens rakes a glass instrument filled with a purple gas across the head to "sterilize the scalp." Then the subject holds a wire attached to some electrical machine while the operator holds a second wire as she massages the bald area with a secret formula. This forces the formula into the scalp. Some infomercials push shampoos with special emulsifiers to clean follicles as if baldness were due to plugged follicles. Others use jumbled language to promote spray paint to cover bald spots. The truth is that only Rogaine (minoxidil) rubbed on the scalp or Propecia (finasteride) taken orally have shown any effect in growing hair. Even with these the results are not impressive. The Bald Headed Men of America, headquartered appropriately in Morehead, North Carolina, was started when the founder was refused a job because he was bald. They take a different tack. If you want to waste your hormones growing hair...go ahead" Actually this is a wrong statement because it is high levels of dihydrotestosterone that can cause baldness. They are on firmer footing with their slogan. No rugs or drugs.

Aristotle used Goat Urine and Hippocrates recommended Pigeon droppings to cure baldness.

<http://dazeinfo.com/2010/06/22/superstitions-across-different-countries-an-overview/>

Australians bathed inside rotting whales to 'cure' rheumatism

The Australian National Maritime Museum has revealed that sufferers of rheumatism were once advised to sit inside the festering carcasses of whales in order to relieve their symptoms.

The museum has recently opened a new exhibit in Sydney, which seeks to uncover the diversity, origins and adaptation of whales, charting their development from land mammals to aquatic giants. The exhibition, entitled "Amazing Whales" also looks at the different relationships humans have had with the cetaceans, which includes their apparent medicinal qualities.

Those afflicted with rheumatism were advised to sit inside the belly of a dead whale for approximately 30 hours. If the patient could stay the course and withstand this bizarre practice, they were promised at least 12 months of relief from pain.

<http://www.wired.co.uk/article/whale-bath>

Weird Bizarre superstitions to cure disease

<http://www.historyextra.com/feature/animals/10-historical-superstitions-we-carry-today>

<http://listverse.com/2013/01/21/10-crazy-cures-for-the-black-death/>

Millions of People are making money out of superstitions of Fools

Rebirthing Therapy, Reiki, Energy-Deflecting Golfer Pendant, Maggot Debridement Therapy, Leech Therapy, Beer spas, Ozone Anti-Aging the list is very big.

<http://webcoist.momtastic.com/2010/07/05/12-most-bizarre-modern-alternative-medical-treatments/>

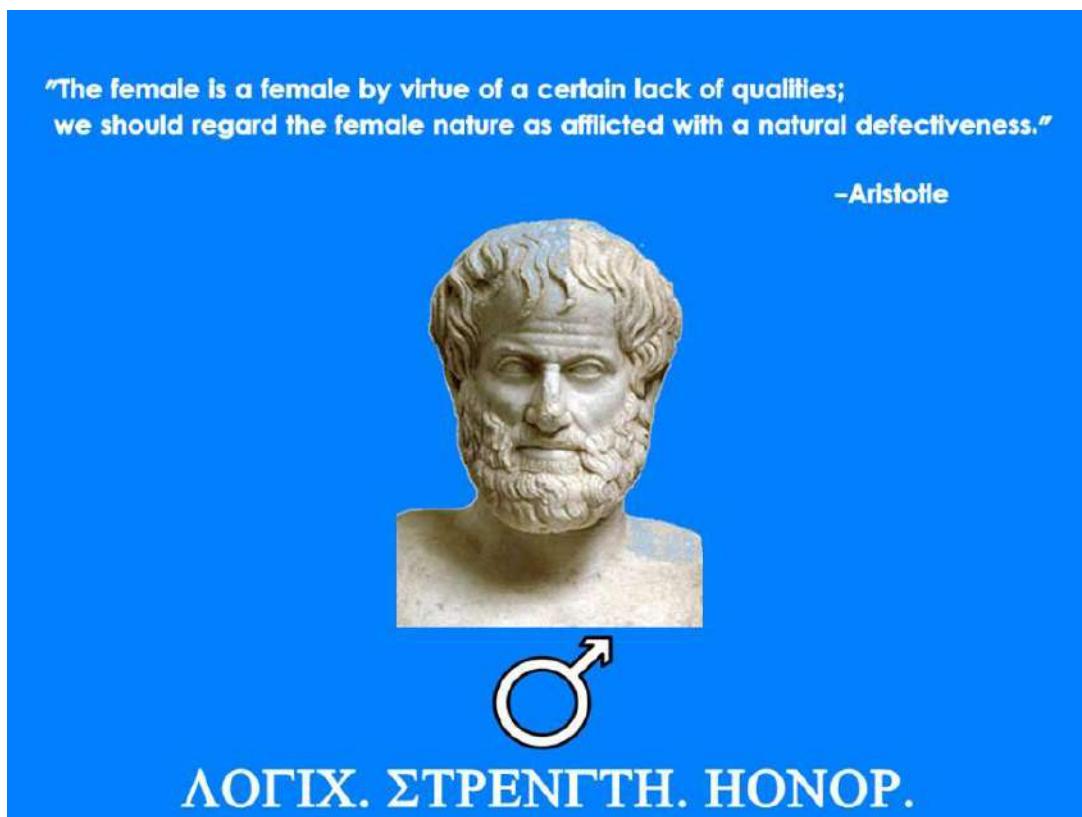
<http://oddrandomthoughts.com/strange-and-bizarre-medicine-and-cures/>

<http://www.stylist.co.uk/life/13-strange-superstitions>

So in simple words instead of taking opinions of Stupid Fools, or wasting any time arguing with them Let study science correctly, without bias !

Aristotle is yet Famous, because Girls come to know about his name in school text books. Though not sure why !

Aristotle told at-least one statement correct !

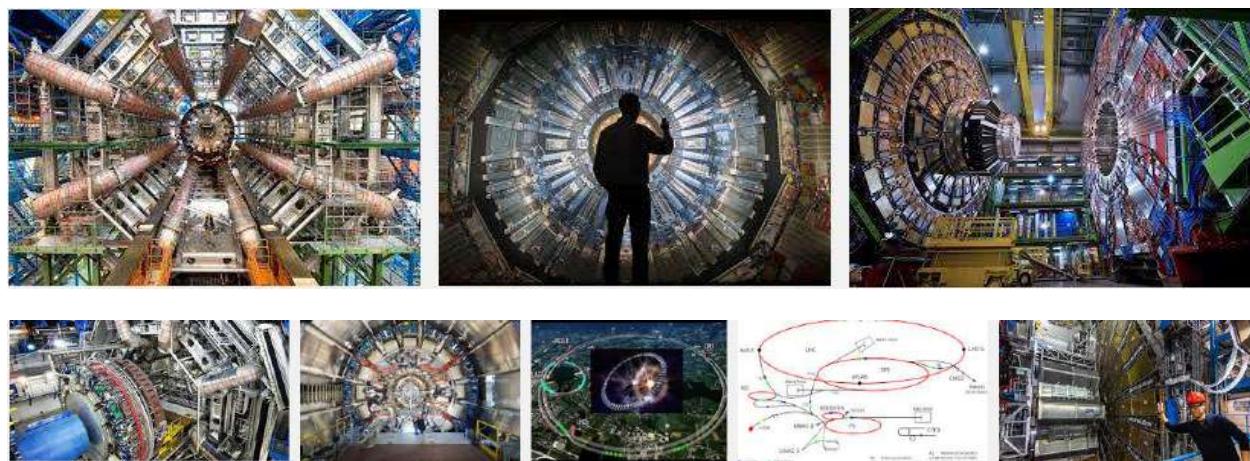




The monkeys in the previous page were all Female Monkeys

Aristotle was not correct (though not sure), Women are not missing anything No one is voting for Aristotle.

Not wrong as well (though not sure), very difficult to prove either way!



Most important physics experiments ([that a certain kind of Apes conducted](#)) can be seen at

See <http://www.explainthatstuff.com/great-physics-experiments.html>

<http://physics-animations.com/Physics/English/top10.htm>

https://en.wikipedia.org/wiki/List_of_experiments

<https://www.quora.com/What-are-some-of-the-most-important-experiments-in-physics>

Though my list will be as follows –

Michelson-Morley experiment proving there was no Aether, Measurement of e/m then e (charge of electron) and m (mass of electron), Fizeau's method of measuring the speed of light, Moseley 's experiment with X-Rays to discover Protons, Jagadish chandra Bose demonstrating controlled emission / transmission and receiving of Radio waves, Casimir experiments to show Casimir forces of virtual particles, Edington measuring bending of light, Flying atomic clocks in planes and confirming slowing down of time at high speeds, Victor Hess measured Radiation level variation at ground and high up in the atmosphere, Soviet physicist Sergey Vernov was the first to use radiosondes to perform cosmic ray readings with an instrument carried to high altitude by a balloon at heights up to 13.6 km, The proof of time dilation by Muon decay <https://debunkingrelativity.com/muons-time-dilation/> , Measurement of Space-time curvature near Earth and thereby the stress-energy tensor (which is related to the distribution and the motion of matter in space) in and near Earth https://en.wikipedia.org/wiki/Gravity_Probe_B , Detecting Gravitational Waves.

[In 1909 Theodor Wulf developed an electrometer, a device to measure the rate of ion production inside a hermetically sealed container, and used it to show higher levels of radiation at the top of the Eiffel Tower than at its base. However, his paper published in Physikalische Zeitschrift was not widely accepted. In 1911 Domenico Pacini observed simultaneous variations of the rate of ionization over a lake, over the sea, and at a depth of 3 meters from the surface. Pacini concluded from the decrease of radioactivity underwater that a certain part of the ionization must be due to sources other than the radioactivity of the Earth. In 1912, Victor Hess carried three enhanced-accuracy Wulf electrometers to an altitude of 5300 meters in a free balloon flight. He found the ionization rate increased approximately fourfold over the rate at ground level. Hess ruled out the Sun as the radiation's source by making a balloon ascent during a near-total eclipse. With the moon blocking much of the Sun's visible radiation, Hess still measured rising radiation at rising altitudes. He concluded "The results of my observation are best explained by the assumption that a radiation of very great penetrating power enters our atmosphere from above." In 1913-1914, Werner Kolhörster confirmed Victor Hess' earlier results by measuring the increased ionization rate at an altitude of 9 km. Hess received the Nobel Prize in Physics in 1936 for his discovery. Homi J. Bhabha derived an expression for the probability of scattering positrons by electrons,

a process now known as Bhabha scattering. His classic paper, jointly with Walter Heitler, published in 1937 described how primary cosmic rays from space interact with the upper atmosphere to produce particles observed at the ground level. Bhabha and Heitler explained the cosmic ray shower formation by the cascade production of gamma rays and positive and negative electron pairs. Soviet physicist Sergey Vernov was the first to use radiosondes to perform cosmic ray readings with an instrument carried to high altitude by a balloon. On 1 April 1935, he took measurements at heights up to 13.6 kilometers using a pair of Geiger counters in an anti-coincidence circuit to avoid counting secondary ray showers.]

See https://en.wikipedia.org/wiki/Cosmic_ray

<http://web.mit.edu/8.13/www/JLExperiments/JLExp14.pdf>

<http://web.mit.edu/lululiu/Public/pixx/not-pixx/muons.pdf>

https://en.wikipedia.org/wiki/Time_dilation

<http://www.physics.rutgers.edu/ugrad/389/muon/muonphysics.pdf>

<http://www2.fisica.unlp.edu.ar/~veiga/experiments.html>

Detecting Neutrons

Rutherford predicted the existence of the neutron in 1920. Twelve years later, his assistant James Chadwick found it. At Cambridge, Chadwick searched for the neutron. He tried in 1923, but did not find it. He tried again in 1928, with no success. In 1930, the German physicists Walther Bothe and Herbert Becker noticed something odd. When they shot alpha rays at beryllium (atomic number 4) the beryllium emitted a neutral radiation that could penetrate 200 millimeters of lead. In contrast, it takes less than one millimeter of lead to stop a proton. Bothe and Becker assumed the neutral radiation was high-energy gamma rays.

Marie Curie's daughter, Irene Joliot-Curie, and Irene's husband, Frederic, put a block of paraffin wax in front of the beryllium rays. They observed high-speed protons coming from the paraffin. They knew that gamma rays could eject electrons from metals. They thought the same thing was happening to the protons in the paraffin. Chadwick said the radiation could not be gamma rays. To eject protons at such a high velocity, the rays must have an energy of 50 million electron volts. An electron volt is a tiny amount of energy, only enough to keep a 75-watt light bulb burning for a tenth of a trillionth of a second. The alpha particles colliding with beryllium nuclei could produce only 14 million electron volts.

The law of conservation of energy states that energy can neither be created nor destroyed. It certainly looked as if energy was being created along with the neutral radiation. Chadwick had another explanation for the beryllium rays. He thought they were neutrons. He set up an experiment to test his hypothesis.

Chadwick put a piece of beryllium in a vacuum chamber with some polonium. The polonium emitted alpha rays, which struck the beryllium. When struck, the beryllium emitted the mysterious neutral rays.

Chadwick(the discoverer of the neutron) was a student of Rutherford (discoverer of the proton) who was the student of Thomson (the discoverer of the electron).

Weird World

In the path of the rays, Chadwick put a target. When the rays hit the target, **they knocked atoms out of it**. The atoms, which became electrically charged in the collision, flew into a detector. Chadwick's detector was a chamber filled with gas. When a charged particle passed through the chamber, it ionized the gas molecules. The ions drifted toward an electrode. **Chadwick measured the current flowing through the electrode. Knowing the current, he could count the atoms and estimate their speed.** Chadwick used targets of different elements, measuring the energy needed to eject the atoms of each. Gamma rays could not explain the speed of the atoms. The only good explanation for his result was a neutral particle. **To prove that the particle was indeed the neutron, Chadwick measured its mass.** He could not weigh it directly. Instead he measured everything else in the collision and used that information to calculate the mass.

For his mass measurement, Chadwick bombarded boron with alpha particles. Like beryllium, boron emitted neutral rays. Chadwick placed a hydrogen target in the path of the rays. When the rays struck the target, protons flew out. Chadwick measured the velocity of the protons.

Using the laws of conservation of momentum and energy, Chadwick calculated the mass of the neutral particle. It was 1.0067 times the mass of the proton. The neutral radiation was indeed the long–sought neutron.

<http://ansnuclearcafe.org/2011/10/19/pioneers102011/>

100 Greatest Discoveries of Physics

<https://www.youtube.com/watch?v=Bpid0LBtqWg>

(As I write these words { 2016 } GUT [General Unified Theory] is being modified to introduce a 5th fundamental force, because some heavy particles have been observed at CERN and various other experiments and Producing Gravitational waves at will, without mass, Madala Bosons to explain Dark Matter)



Learn Science from <https://www.youtube.com/user/cassiopeia-project/videos>

Some easy Physics (much easier than IIT–JEE)

https://www.youtube.com/channel/UCLiSRiiRVQuDfgxI_QN_Fmw/videos

<https://www.youtube.com/watch?v=VCVTK5yo0g&list=PLB03A41EA88A8DE65>

<https://www.youtube.com/user/diggitydev/playlists>

<https://www.youtube.com/user/onlearningcurve/playlists>

<https://www.youtube.com/watch?v=qWu82nJS42I&list=PLF71B362214423F9D>

<https://www.youtube.com/user/FizziksGuy/playlists>

<https://www.youtube.com/watch?v=gIOTFjq76tM&list=PL3plurvlhuSANBIZa3u0RP9GFQprlSN11>

<https://www.youtube.com/watch?v=y7fXEKCP2XU&list=PL3plurvlhuSDjUvzNZwC1HBW9eY1qlDno>

<https://www.youtube.com/channel/UCiEHVhv0SBMpP75JbzJShqw/playlists>

(Pradeep Kshetrapal Sir's Videos are at –

<https://www.youtube.com/user/PradeepKshetrapal/videos>)

Lectures by Professor Robert Riggs

<https://www.youtube.com/watch?v=RWqAjFKH3o&list=PL01771E7CE99097F8>

Lectures by Professor Jerzy Wrobel

<https://www.youtube.com/watch?v=DFhdUQ9AZw4&list=PLEEB9EC9DD59D6D85>

Lectures by Yuri–Kolomensky

https://www.youtube.com/watch?v=KEiYSQnMHHQ&list=PL–XXv–cvA_iAKxxGD1tIWLS0DcieGLHh0

Physics Videos from Berkeley

<https://www.youtube.com/watch?v=a–0h–9KCGjo&list=PLr11xUV7FM0EDu3u28Zp3d4ffjpqROm5Y>

Lectures by Professor Muller

https://www.youtube.com/watch?v=6ysbZ_j2xi0&list=PL09717125E8C05BFC

Lectures by Steven W. Stahler

https://www.youtube.com/watch?v=Uc9Q5hNpv4Q&list=PL–XXv–cvA_iB1lYkU1YcdLCranBB0woKX

Lectures by Michel van Biezen

<https://www.youtube.com/watch?v=FkO6vyMqo8E&list=PLX2gX–ftPVXVCw9WxxEA4yD14k8yskTSj>

Dr. Don Lincoln of Fermilab <https://www.youtube.com/user/fermilab/videos>

Advance Physics Lectures by Leonard Susskind

https://www.youtube.com/watch?v=pyX8kQ–JzHI&list=PLQrxduI9Pds1fm91Dmn8x1lo–O_kpZGk8

A kid who wants more fun

https://www.youtube.com/watch?v=p_o4aY7xkXgf&list=PL908547EAA7E4AE74

https://www.youtube.com/watch?v=51GNAET2zFU&list=PLllVwaZQkS2rxqMXTH–cdE0LIX9Zi_oS1

<https://www.youtube.com/watch?v=h0hwuyOmd4k&list=PLSBNC6ROBP12PUanbUNaVLhNbJR6rgbmm>

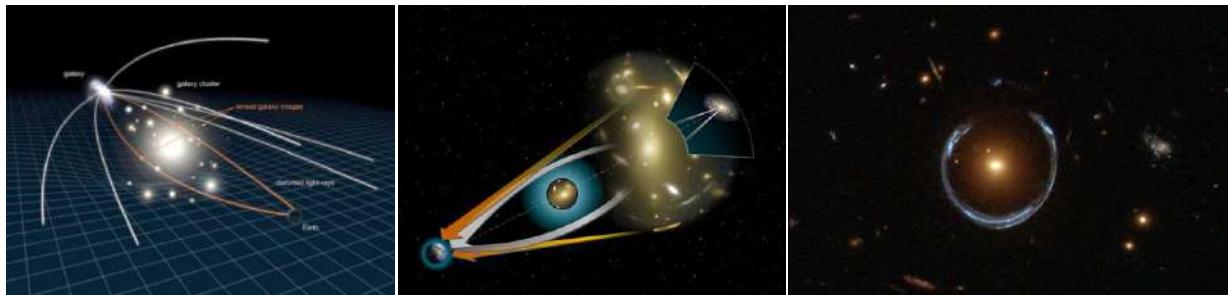
<https://www.youtube.com/user/dramaticphysics/playlists>

IIT-JEE is extremely tough for most humans. A productive PhD in Physics, or actually contributing to growth of the subject is much more tougher (than IIT JEE). { I personally know quite a few IIT-JEE single or double digit rankers, joining for PhD and then dropped out due to performance }. Most people have an illusion that they can argue with Scientists and imagine to ask some " smart " questions which the Scientists will not able to answer, so the argument is won, and existence of God is proved. As if Scientist are eagerly sitting or waiting to answer every crap asked. I can only say; that most scientists (since more than 100 years) have stopped wasting their time arguing or convincing fools. I am not a Scientist. Even being a simple teacher, I do not try to teach fools, or argue with anyone.

[For History of Physics I recommend

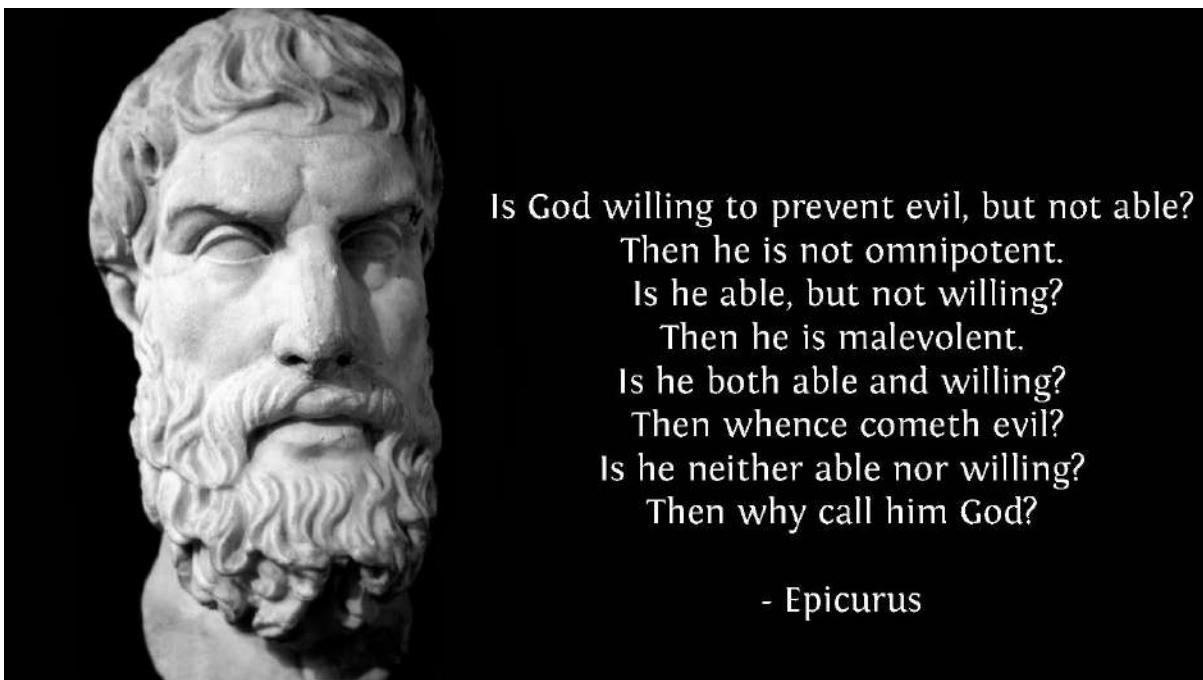
<http://www.historyworld.net/wrldhis/PlainTextHistories.asp?ParagraphID=kqq>]

[Gravitational lens and Einstein ring due to bending of light by mass]



Recall what I said at the beginning of the book " Someone will learn only by his hard work, his desire to learn. " No arguments or no 'time wasting' with fools. There is too much of good material (data, books, videos etc) out and free in this world. If someone wants to learn, can learn; **instead of wasting time arguing**. Since centuries stupids and/or fools are being eliminated in various exams. Entrance exam, is a misnomer. These are elimination tests. The society has systems of Interviews, Peer reviews, appraisals, Thesis evaluation etc... to eliminate crap, foolish things, and nonsense.



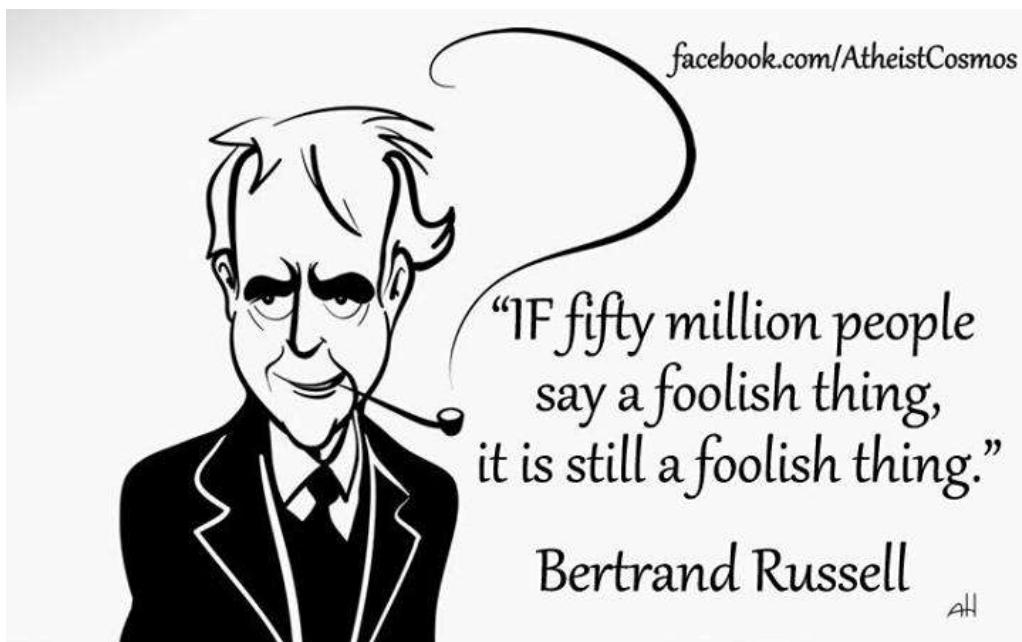


Is God willing to prevent evil, but not able?
Then he is not omnipotent.
Is he able, but not willing?
Then he is malevolent.
Is he both able and willing?
Then whence cometh evil?
Is he neither able nor willing?
Then why call him God?

- Epicurus

Religion and/or " war between religions " mostly to decide whose God is better; have killed millions. Instead of fighting and killing; to decide which custom to follow; how to dress; what rituals to do on a daily basis; better to spend time experimenting and developing new things, new technologies, new ideas. Scientists (**the men**) are busy; and **always will be busy!** **Rather, in war; with new frontiers of knowledge;** not in arguments, verbal wars, or physical wars. Atheism is the most peaceful Doctrine.

"Bertrand Arthur William Russell" the famous Philosopher, Mathematician, Logician, received 1950 Nobel Prize for Literature.



So those who want to learn can continue learning ...

See https://www.youtube.com/results?search_query=History+of+science

See

https://www.youtube.com/results?search_query=history+of+science+the+complete+full+documentary+

I will choose only two extreme examples of what Human beings have “ **seen** “ by now ...

For far and big) Very powerful cameras ready with video recording facilities were scanning the sky. Coincidentally the “place or region “ a camera was looking had an event (many million years back though) of a black hole devouring a star.

<https://www.youtube.com/watch?v=O3Z5AS3TTS4>

<https://www.youtube.com/watch?v=x7ZX10UbMus>

For small) Photographs of molecules and subsequently atoms

<https://www.youtube.com/watch?v=yqLlglaz1L0>

<https://www.youtube.com/watch?v=ofp-OHlq6Wo>

<https://www.youtube.com/watch?v=oSCX78-8-q0>

<https://www.youtube.com/watch?v=RTLeWIqynW4>

<https://www.youtube.com/watch?v=J3xLuZNKhIY>

<https://www.youtube.com/watch?v=SMgi2j9Ks9k>

https://www.youtube.com/watch?v=V0KjXsGRvoA&list=PLC3E0tG-9im_kuMwYIM7-NZR62VyWZ6rl

—
Entertainment and relaxed mind is required. Students can improve Visual Presentation skills by watching "Two men and wardrobe" by Roman Polanski

<https://www.youtube.com/watch?v=Cs2RZewMuAg>

Imagine a world where Millions of People have “ **better** “ Visual story telling or Visual presentation skills than Roman Polanski or say Jim Jarmusch ...

<https://www.youtube.com/watch?v=wJS2mC-7LSM>

Enjoy

Spoon Feeding Series – Roorkey Chemistry Question Paper and Solution

Some concepts which are topic or chapter independent and must know for all.

1) **First Law of Statistics** - Larger is the dataset for analysis better is the result. Also the data must be widely varying from widely spread sources. Else biased or concentrated data will not give correct results / conclusions. There are elaborate mathematical rules to select the sample size, select distributions, sampling techniques, measure of Biases and / or confidence level of the conclusions. The best possible result can be obtained by measuring all / total population. Often this is just not possible. Opposite to this is Hasty Generalization.

2) Several things just can't be measured. Say for example if a shopkeeper wants to know why people are not coming to his shop; he only has to guess. May be people do not like the outside look of the shop, may be they don't like the lighting, may be they don't like his face or caste ... We can only guess. A small shopkeeper can never go to all people in the town to ask why they are not coming to his shop.

3) Various kinds of analysis can be given / produced / projected in a biased way. Say for example in a Engineering class there are 50 Boys and 4 girls. 2 boys and 2 girls marry. Someone reports that 50% girls fall in love and have love marriages with batch-mates while only 4% Boys do so. Even if the data-size was 5000 Boys and 400 girls where 200 girls marry their batch-mates; the conclusions are not correct.

Regarding Probability

1) For most events (close to 100%) in this world the Probability just cannot be measured. We have no data regarding the probability. We will never have. There is an obscure theorem regarding probability... “if the data to calculate probability is not available then the probability should be considered as 0.5 meaning 50% i.e. either it can happen or cannot happen.”

Let me elaborate this with some examples. If you just now go out of your home to the street, what is the probability of seeing a Man with a Green T-Shirt ?

If a truck is carrying 23 sheep and a sheep jumps out of the truck when the truck is crossing near your home ?

I had seen a radioactivity problem asked in an exam... if the rate of decay now is 31 disintegrations per microsecond, then in next 1 second what is the probability of a particular atom getting disintegrated ? [Let us assume it is told that we have 8.7 moles of the radioactive material. Though it may be given or not, it is irrelevant]

The answer in this case is 50%. A particular atom may or may not decay.

It is 50% probability that a Man is wearing Blue T-Shirt or Black ... We have no data whom we will meet, how often he wears T-Shirt, How many T-Shirt of what colour he has, or what is considered as a T-Shirt and what is not. No one ever will have any data of this kind.

2) In some rare cases even if we have data we cannot conclude anything on the probability. Say you want to hire a car to go to the airport. The car rental owner is a great friend of yours and shares all data. He says... on average the cars get a puncture every 345 hours (**as per data of several decades**). I have 7 cars which did not get any puncture even though these are running for 400, 500 etc hours. All more than 345 hours. And 2 more cars, one 200 hours since last puncture and another one 10 hours since last puncture.

Which car do you choose ?

First of all there will be no car rental guy who will tell you this kind of data. Also it makes no difference to the journey regarding the car you choose. Probability and data do not help on specific future events.

3) In some very small number of cases even if you have long term probability data, the Probability values mean nothing. Say you know that when you eat out on average for every 13 eating you get a stomach upset. Now your friends want to treat you tomorrow and all will eat out. Will you go ?

The probability questions that we see in standard 10 to 12 with dice, coins horses etc are limited to give you some concepts. Even the Bay's rule etc. The probability concepts are valid only for large number of events such as patient inflow in a very large hospital, Quality defects in millions of things being manufactured, or say in Quantum Mechanics Probability of events where 10 to the power 25 particles involved in every nano second.

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Regarding Holistic picture and Systems thinking

Human beings are in general prone to reductionism; assuming repeated specific / fixed outcome; assuming predictability etc. “Systems Thinking” is only few decades old idea. We often miss out the Holistic picture for boundaries of chaos, Strange attractors; effects of small perturbations etc.

See

<https://www.youtube.com/watch?v=IhbLNBoQk&list=PLhsldCVDmWaOoNsTnVYzr-HuS-lR11Zei>

See <https://www.youtube.com/watch?v=WrdSkqRypsg>

See <https://www.youtube.com/watch?v=c0gDLEHbYCK>

See <https://www.youtube.com/watch?v=R6NnCOs20GQ&list=PL66DBF862753B9A75&index=7>

See <https://www.youtube.com/watch?v=aAJkLh76QnM>

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God is not an intelligent Designer

Several parts of the bodies human and animals have imperfections.

See <https://www.youtube.com/watch?v=c01a1Ek-HD0>

See <https://www.youtube.com/watch?v=lIEoO5KdPvg>

See <https://www.youtube.com/watch?v=-OCMx2VuP1U>

See <https://www.youtube.com/watch?v=dzYgScf47EI>

See <https://www.youtube.com/watch?v=ujYNSDYIZKw>

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Books –

General Physics by Landau, Akhiezer, Lifshitz

This was my first book of Physics book. Nobel Laureate L D Landau did a great job.

<https://archive.org/details/GeneralPhysics>

Books by another Nobel Laureate Richard Feynman

<https://archive.org/details/RichardFeynman>

Physics book

https://archive.org/stream/ost-physics-physics_grade_10-12/Physics_Grade_10-12#page/n7/mode/2up

Conceptual Physics by Crowell

<https://archive.org/stream/ConceptualPhysics/PhysicsCrowell#page/n1/mode/2up>

Derivations are given at

https://archive.org/stream/ModernCollegePhysics_201510/ModernCollegePhysics#page/n0/mode/2up

College Physics

<https://archive.org/stream/ost-physics-col11406/col11406#page/n5/mode/2up>

https://archive.org/stream/CollegePhysics_201505/College%20Physics#page/n0/mode/2up

Irodov

https://archive.org/stream/IrodovProblemsInGeneralPhysics/Irodov-Problems_in_General_Physics#page/n0/mode/2up

<https://archive.org/stream/IrodovBasicLawsOfElectromagnetism/irodov--basic--laws--of--electromagnetism#page/n0/mode/2up>

Every student already have so many Indian Text Books, guides, Coaching Material etc

Halliday, Resnick and Walker

<https://archive.org/stream/FundamentalsOfPhysicsHallidayResnickWalker/Fundamentals%20of%20Physics--Halliday%2CResnick%2CWalker#page/n0/mode/2up>

Everyone talks about Double Slit experiment ? Did anyone imagine of Triple Slit experiment ?

<https://www.youtube.com/watch?v=bKjgNznlkcl>

Planck Space and Quantum Gravity

<https://www.youtube.com/watch?v=VhHE86d-Th8>

https://www.youtube.com/watch?v=XDAJinQL2c0&list=PLSfQvTxRM27MCjhxFYkLxg5ZuL9cAXh_&index=2

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Gravitation

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<https://archive.org/stream/ost--physics--col11406/col11406#page/n199/mode/2up>

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Beyond Big Bang and Dark Flow

https://www.youtube.com/watch?v=Hik8hJ0_T9Q

Dark Matter and Dark Energy

https://www.youtube.com/watch?v=wOK_htkd-OI

<https://www.youtube.com/watch?v=GFxPMMkhHuA>

<https://www.youtube.com/watch?v=aMWCKcn7TD4>

https://www.youtube.com/watch?v=5LW_2J2qs0Y

<https://www.youtube.com/watch?v=8sUfiP9AUSo>

<https://www.youtube.com/watch?v=l-VjLG702Go>

<https://www.youtube.com/watch?v=ZMgrAnX3ViE>

<https://www.youtube.com/watch?v=rLWfsTB85PM>

<https://www.youtube.com/watch?v=ZV-LcRVB5U8>

<https://www.youtube.com/watch?v=YI-fgVLf6zc>

<https://www.youtube.com/watch?v=lrTfHSP9U1E>

<https://www.youtube.com/watch?v=w0bqnAdr1A0>

Quantum Gravity

https://www.youtube.com/watch?v=vNb3iM_268I

<https://www.youtube.com/watch?v=CbPWYjnQIO8>

<https://www.youtube.com/watch?v=9crggox5rbc>

<https://www.youtube.com/watch?v=WQU9yOtWrQk>

<https://www.youtube.com/watch?v=VhHE86d-Th&list=PLSfQvTxRM27MCjhxFYkLxg5ZuL9cAXh>

<https://www.youtube.com/watch?v=FqwXeeXnDZg>

Cassiopeia Project Quantum Electrodynamics

<https://www.youtube.com/watch?v=KZ67q4pv0HI>

Quantum Mechanics

<https://www.youtube.com/watch?v=JKGZDhQoR9E>

<https://www.youtube.com/watch?v=3gldMEAQk0&index=3&list=PLd4qF6QzoiUfiwlBLClKpAVWkr4-ViyQn>

<https://www.youtube.com/user/viascience/videos>

Time Dilation

<https://www.youtube.com/watch?v=YRwZ55zjzxc>

<https://www.youtube.com/watch?v=fUKN5oaP52s>

Space+Time Relativity

<https://www.youtube.com/watch?v=LOpPK6sZL5s>

<https://www.youtube.com/watch?v=iu7LDGhSi1A>

<https://www.youtube.com/watch?v=rKbJjzmFCco>

<https://www.youtube.com/watch?v=vk3KrP5F1Ao>

<https://www.youtube.com/watch?v=HHRK6ojWdtU>

https://www.youtube.com/watch?v=aZrjMmMBa_8

Gravity as you have in your Course

<https://www.youtube.com/user/mathdude2012/search?query=Gravity>

<https://www.youtube.com/user/tdewitt451/search?query=Gravity>

<https://www.youtube.com/user/bhswarthout/search?query=Gravity>

<https://www.youtube.com/user/brightstorm2/search?query=Gravity>

<https://www.youtube.com/user/SciencePi/search?query=Gravity>

<https://www.youtube.com/user/DrPhysicsA/search?query=Gravity>

<https://www.youtube.com/user/DoodleScience/search?query=Gravitation>

<https://www.youtube.com/user/bozemanbiology/search?query=Gravitation>

<https://www.youtube.com/user/windhorsage/search?query=Gravity>

<https://www.youtube.com/channel/UChOGuWbAlGw3dPYPlbiFaaw/search?query=Gravitation>

<https://www.youtube.com/user/lasseviren1/search?query=Gravity>

<https://www.youtube.com/user/onlearningcurve/search?query=Gravity>

And Finally with Love

<https://www.youtube.com/user/mrlovescience/search?query=Gravity>

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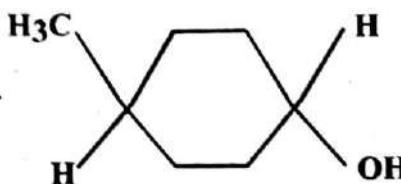
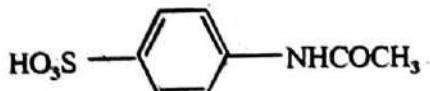
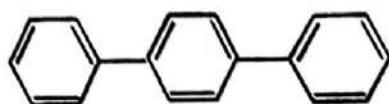
Roorkey 1999 Chemistry

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ROORKEE CHEMISTRY 1999 QUESTIONS

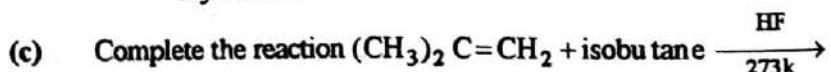
1. (a) An organic compound C_8H_{18} on monochlorination gives a single monochloride. Write the structure of hydrocarbon.
 (b) Write the structures of possible major monosubstituted products formed when Br^+ attacks the following molecules. Justify your answer.



2. (a) Dehydration of

Gives a compound which exists in two isomeric forms. Give the structure of both the isomers

- (b) Explain in not more than 2,3
 (i) Aniline does not undergo Friedel-Crafts reaction
 (ii) Mineral acid is added in excess in diazotisation of arylamines



3. An organic compound (A) $C_9H_{12}O$ was subjected to a series of tests in the laboratory. It was found that this compound
 (i) Rotates the plane of polarized light
 (ii) Evolves hydrogen gas with sodium
 (iii) Reacts with I_2 and $NaOH$ to produce a pale yellow solid compound
 (iv) Does not react with Br_2/CCl_4 .
 (v) Reacts with hot $KMnO_4$ to form compound (B), $C_7H_6O_2$ which can also be synthesized by the reaction of benzene and carbonyl chloride followed by hydrolysis.

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- (vi) Loses optical activity as result of formation of compound (C) on being heated with HI and P.
- (vii) Reacts with Lucas reagent in about 5 min.
Give structures of (A) to (C) with proper reasoning and draw Fischer projections for (A). Give reactions for the steps wherever possible.
4. An organic compound (A) of molecular weight 135 on boiling with NaOH evolves a gas which gives white dense fumes on bringing a rod dipped in HCl near it. The alkaline solution thus obtained on acidification gives the precipitate of a compound (B) having molecular weight 136. Treatment of (A) with HNO_2 also yields (B), whereas its treatment with Br_2/KOH gives (C). Compound (C) reacts with cold HNO_2 to give (D), which gives red colour with ceric ammonium nitrate. On the other hand (E) an isomer of (A) on boiling with dil. HCl gives an acid (F), having molecular weight 136. On oxidation followed by heating, (F) gives an anhydride (G) which condenses with benzene in presence of AlCl_3 to give anthraquinone. Give structures of (A) to (G) with proper reasoning.
5. An organic compound (A), $\text{C}_5\text{H}_8\text{O}_3$ on heating with soda lime gives (B), which reacts with HCN to give (C). The compound (C) reacts with thionyl chloride to produce (D) which on reaction with KCN gives compound (E). Alkaline hydrolysis of (E) gives a salt (F) which on heating with soda lime produces *n*-butane. Careful oxidation of (A) with dichromate gives acetic acid and malonic acid. Give structures of (A) to (F) with proper reasoning.
6. Identify (A) to (K) as reactant, reagent, product or name of the reaction in following.
- (i) $3(\text{CH}_3)_2\text{C}=\text{O} \xrightarrow{\text{(A)}}$ (B) Aldol condensation.
- (ii) $\text{CH}_3\text{COCl} + \text{H}_2 \xrightarrow{\text{(C)}}$ (D) Rosenmund's reaction
- (iii) $\text{E} \xrightarrow[\text{C}_2\text{H}_5\text{ONa}]{\text{NH}_2\text{NH}_2} \text{CH}_3\text{CH}_2\text{CH}_3$ (F)
- (iv) $\text{C}_6\text{H}_5\text{OH} \xrightarrow[\text{HCl}]{\text{(G)}}$ (H₁) + (H₂) Eib's oxidation
- (v) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow[\text{HCl}]{\text{(J)}}$ (K) Gattermann reaction
7. (a) Catalytic dehydrogenation of methylcyclohexane, obtained from petroleum, gives a liquid which on treatment with chlorosulphonic acid at 370 K yields a mixture of two isomers (A) and (B), $\text{C}_7\text{H}_7\text{SO}_2\text{Cl}$. The major isomer (A) reacts with ammonia to form (C), which on oxidation with permanganate

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gives compound (D). On heating compound (D) gives well known sweetening agent (E). The minor isomer (B) also reacts with ammonia to give a compound (F) which on treatment with NaClO/NaOH gives an antiseptic (G). Identify (A) to (G) with proper reasoning.

- (b) Which of the following has larger dipole moment? Explain
1-Butyne or 1-Butene
8. (a) Fill up the banks
- (i) Pressure has no effect on the reaction in which $\Delta n = \dots$
 - (ii) Conc. HNO_3 on dehydration with P_4O_{10} gives.....
 - (iii) Sulphur reduces hot conc. H_2SO_4 to..... and hot conc. HNO_3 to.....
 - (iv) Radioactive isotope ^{11}C decays by..... emission whereas ^{14}C decays by emission.
 - (v) Ferric ions can be distinguished from ferrous ions by KCNS test in which ferric ions give..... colour due to the formation on.....
- (b) Complete and balance the following chemical equations.
- (i) $Au + HCl + HNO_3 \longrightarrow \dots + \dots + H_2O$
 - (ii) $C + HNO_3$ (Conc) $\longrightarrow CO_2 + \dots H_2O$
 - (iii) $Sn + KOH$ (hot) $+ H_2O \longrightarrow \dots + \dots$
 - (iv) $Cu(OH)_2 + NH_4NO_3 + NH_4OH$ (aq.) $\longrightarrow \dots + H_2O$
9. Pyrolusite on heating with KOH in the presence of air gives a dark green compound (A). The solution of (A) on treatment with H_2SO_4 gives a purple coloured compound (B), which gives following reaction.
- (i) KI on reaction with alkaline solution of (B) changes into a compound (C)
 - (ii) The colour of the compound (B) disappears on treatment with the acidic solution of $FeSO_4$
 - (iii) With conc H_2SO_4 compound (B) gives (D) which can decompose to yield (E) and oxygen.
Identify (A) to (E) and write balanced chemical equations for the formation of (A) and (B) and for the steps (i) to (iii)
10. 12.0 g of an impure sample of arsenious oxide was dissolved in water containing 7.5 g of sodium bicarbonate and the resulting

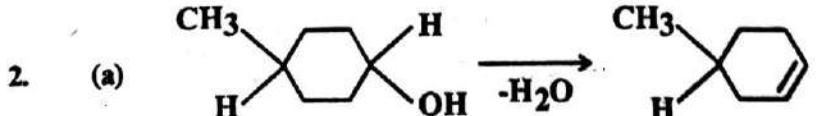
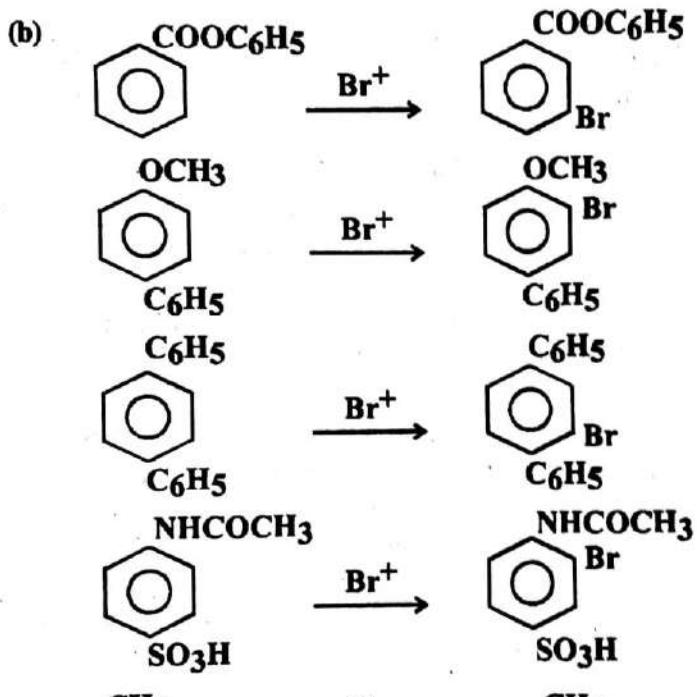
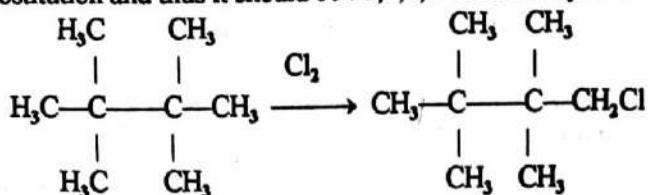
INSIGHT-ROORKEE CHEMISTRY 1999 QUESTIONS 33

- solution was diluted to 250 ml 25 ml of this solution was completely oxidised by 22.4 ml of a solution of iodine. 25 ml of this iodine solution reacted with same volume of a solution containing 24.8g of sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$) in one litre. Calculate the percentage of arsenious oxide in the sample.(Atomic mass of As =75)
11. The K_p value of the reaction $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ at 460 °C is 49. If the initial partial pressure of H_2 and I_2 is 0.5 atm respectively, determine the partial pressure of each gas at equilibrium.
12. The freezing point of a solution containing 50 cm³ of ethylene glycol in 50 g of water is found to be -34 °C. Assuming ideal behaviour, calculate the density of ethylene glycol. (K_f for water = 1.89 kg mol⁻¹)
13. Two buffers, (X) and (Y) of pH 4.0 and 6.0 respectively are prepared from acid HA and the salt NaA. Both the buffers are 0.50 M in HA. What would be the pH of the solution obtained by mixing equal volumes of the two buffers? ($K_{\text{HA}} = 1.0 \times 10^{-5}$)
14. A mixture in which the mole ratio of H_2 and O_2 is 2 : 1 is used to prepare water by the reaction
- $$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{H}_2\text{O}(\text{g})$$
- The total pressure in the container is 0.8 atm at 20° C before the reaction. Determine the final pressure at 120°C after reaction assuming 80% yield of water.
15. Calculate the value of $\log K_p$ for the reaction
- $$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$
- at 25° C. The standard enthalpy of formation of $\text{NH}_3(\text{g})$ is -46 kJ and standard entropies of $\text{N}_2(\text{g})$, $\text{H}_2(\text{g})$ and $\text{NH}_3(\text{g})$ are 191, 130, 192 JK⁻¹ mol⁻¹ respectively. ($R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$).
16. Determine the concentration of NH_3 solution whose one litre can dissolve 0.10 mole AgCl. K_{sp} of AgCl and K_f of Ag (NH_3)₂⁺ are $1.0 \times 10^{-10} \text{ M}^2$ and $1.6 \times 10^{-7} \text{ M}^{-2}$ respectively.

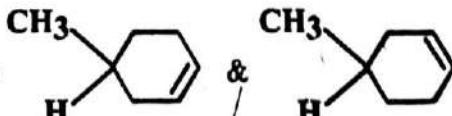
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1. (a) The alkane having C_8H_{18} structure gives only single monochloride on substitution and thus it should be : 2,3,3,3-tetra methyl butane



The two forms are

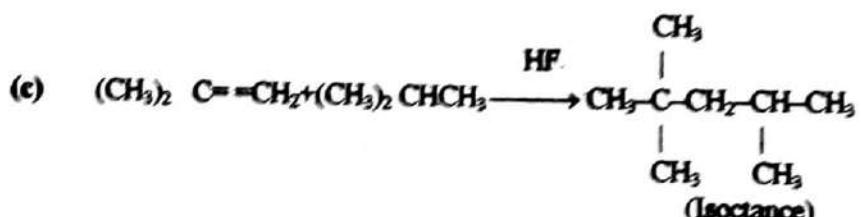


- (b) (i) Aniline no doubt undergoes Friedel-Craft's reaction. It is nitrobenzene which do not show Friedel-Craft's reaction. Questions is wrong. However, the yield in Aniline is poor during Friedel-Craft's reaction. This is due to the fact that Aniline is Lewis base and AlCl_3 is Lewis acid & the two react to give $\text{C}_6\text{H}_5\text{NH}_2\text{AlCl}_3$.

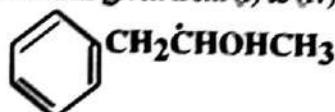
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and thus resists the attack of carbocation. Also formation of carbocation is hindered since aniline reacts with AlCl_3 .

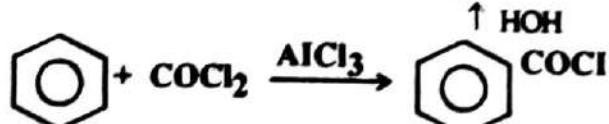
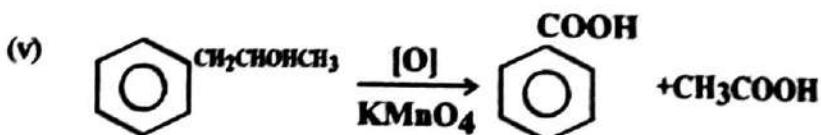
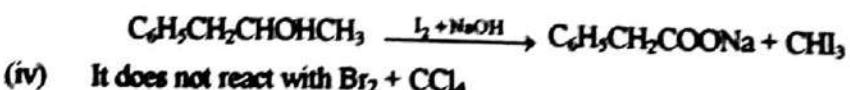
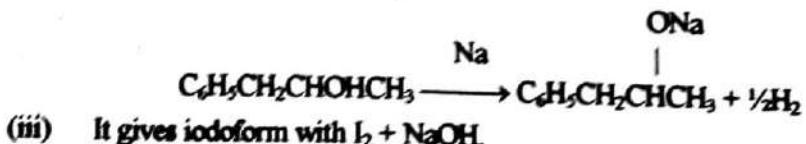
- (ii) $\text{C}_6\text{H}_5\text{NH}_2 \xrightarrow{\text{NaNO}_2 + 2\text{HCl}} \text{C}_6\text{H}_5\text{N}=\text{NCl}$. The reaction requires $\text{HNO}_2 + \text{HCl}$ and thus mineral acid, say HCl is needed in more amount. $\text{NaNO}_2 + \text{HCl} \longrightarrow \text{NaCl} + \text{HNO}_2$. The excess of mineral acid resists the hydrolysis of salt formed. Also it prevents coupling (If excess of aniline is there coupling may take place).



3. The statements given from (i) to (iv) suggest A to be:



- (i) It is optically active, has C^+ centre.
(ii) It reacts with Na to give H_2

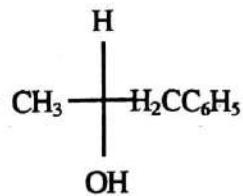
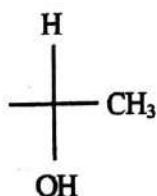


Optically inactive (1-phenyl propane)

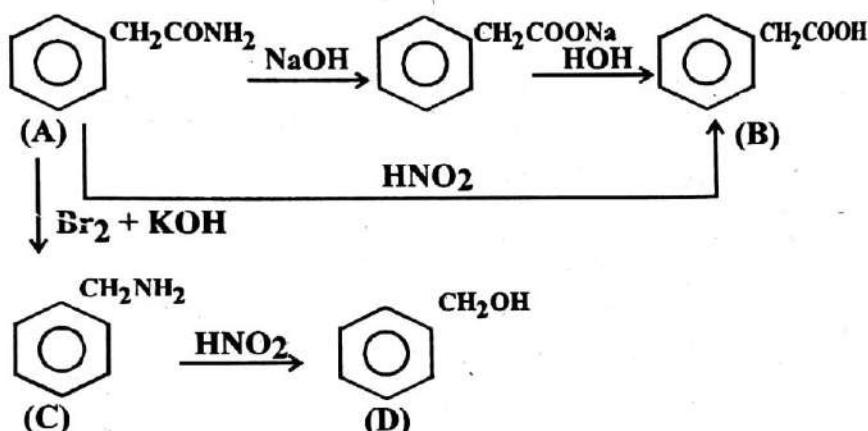
INSIGHT-ROORKEE CHEMISTRY 1999 SOLUTIONS 36

(vii) Being secondary alcohol, it gives test with Lucas reagent in about 5 minutes.

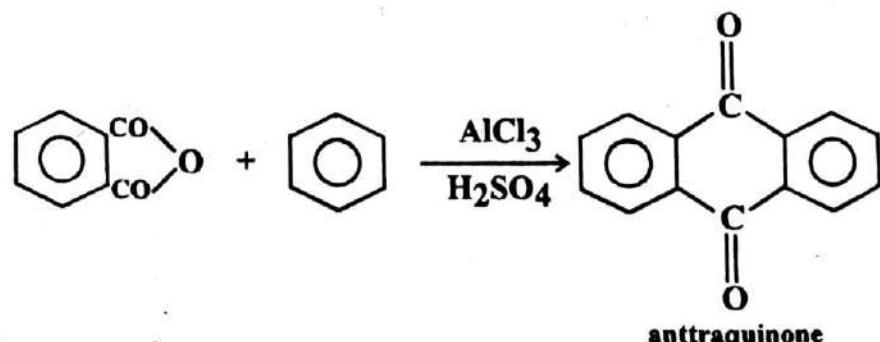
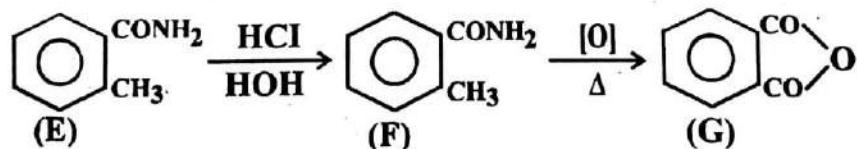
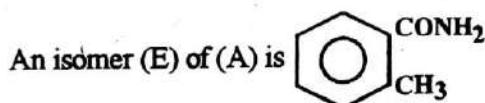
Fisher projections are $C_6H_5CH_2$



4. The statements provided suggest (A) to be $C_6H_5CH_2CONH_2$ having mol. wt. = 135. The reaction are

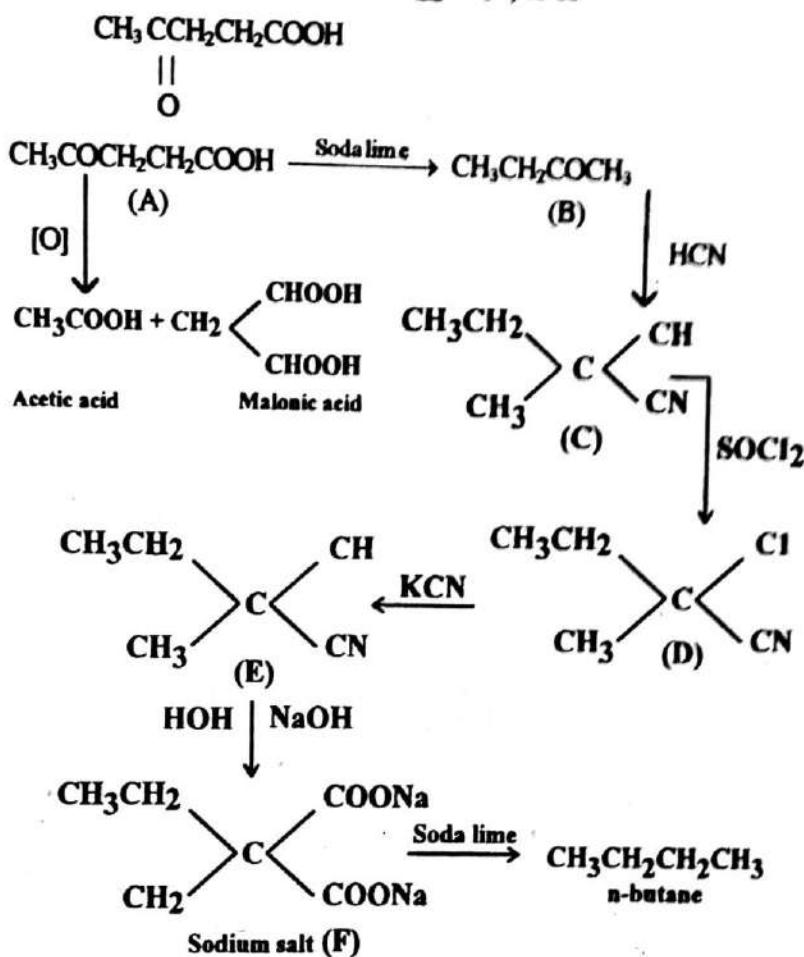


gives red colour with ceric ammonium nitrate.



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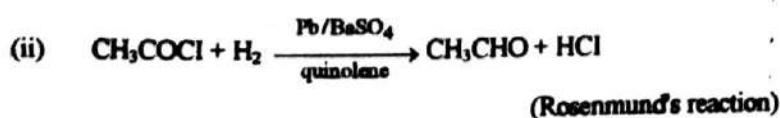
5. The statements given in problem suggest (A) to be



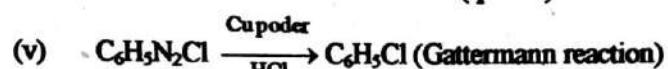
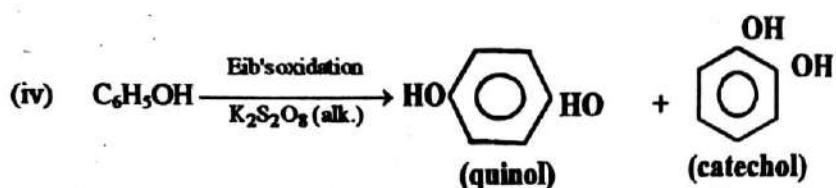
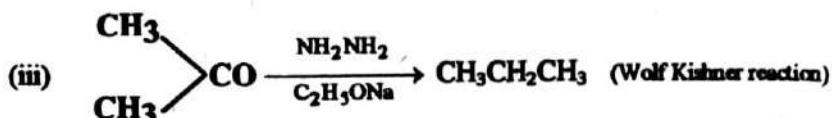
6. (i) 

$$\text{or } 3\text{CH}_3\text{COCH}_3 \xrightarrow[\Delta]{\text{conc. H}_2\text{SO}_4} \begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{C}_6\text{H}_4 \\ | \\ \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$$

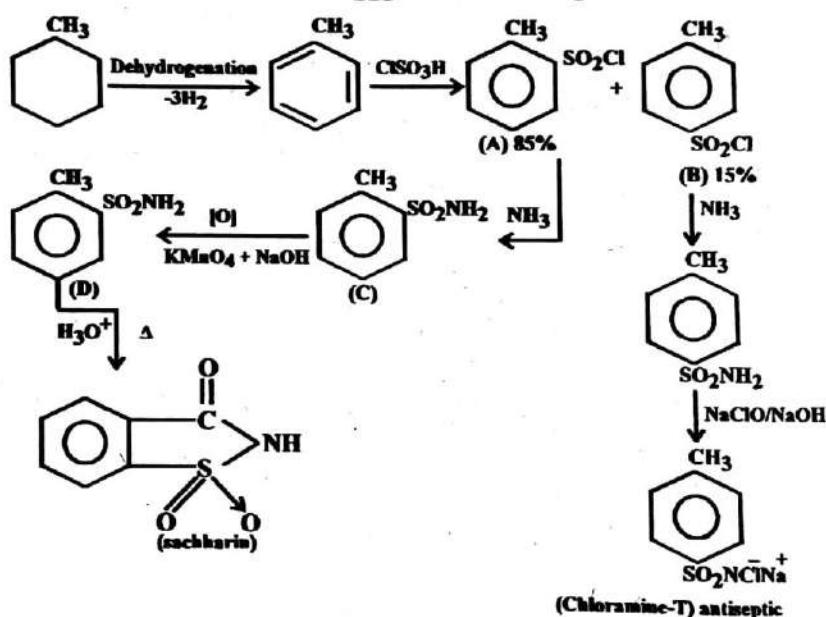
(mesitylene)



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7. (a) The given statements suggest that following reactions



- (b) 1-Butyne has more dipole moment because sp hybridised carbon has more electronegativity in comparison to 1-butene (sp² hybridised carbon). It is evidenced by acidic nature of butyne-1.



8. (a) (i) $\Delta n = \text{Zero}$
 (ii) N_2O_5 and HPO_3 ($4\text{HNO}_3 + \text{P}_4\text{O}_{10} \longrightarrow$)
 (iii) SO_2 & NO_2 $(\text{S} + 2\text{H}_2\text{SO}_4 \longrightarrow 3\text{SO}_2 + 2\text{H}_2\text{O})$
 $(\text{S} + 6\text{HNO}_3 \longrightarrow \text{H}_2\text{SO}_4 + 6\text{NO}_2 + 2\text{H}_2\text{O})$

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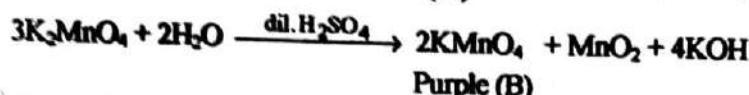
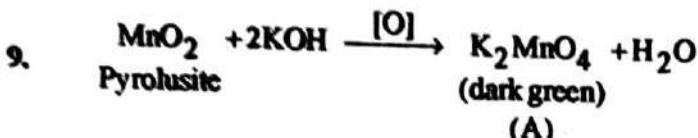
- (b)

 - (iv) Positron and β -particle

$${}^6C^{11} \longrightarrow {}^5B^{11} + {}_1e^0$$

$${}^6C^{14} \longrightarrow {}^7N^{14} + {}_1e^0 + \bar{\nu}_{\text{antineutrino}}$$
 - (v) Red. Fe (CNS)₃

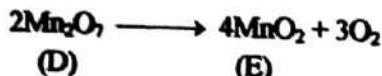
$$[Fe^{3+} + 3KCN \rightarrow Fe(CNS)_3 + 3K^+]$$
 - (i) Au + 4HCl + HNO₃ \longrightarrow HAuCl₄ + NO + 2H₂O
 - (ii) C + 4HNO₃ (conc.) \longrightarrow CO₂ + 4NO₂ + 2H₂O
 - (iii) Sn + 2KOH(hot) + H₂O \longrightarrow K₂SnO₃ + 2H₂
 - (iv) Cu(OH)₂ + 2NH₄NO₃ + 2NH₄OH_{aq} \longrightarrow Cu(NH₃)₄(NO₃)₂ + 4H₂O



- प्राप्ति (D)

 - $2\text{KMnO}_4 + \text{KI} + \text{H}_2\text{O} \longrightarrow \text{KIO}_3 + 2\text{MnO}_2 + 2\text{KOH}$
 - $2\text{KMnO}_4 + 8\text{H}_2\text{SO}_4 + 10\text{FeSO}_4 \longrightarrow 2\text{MnSO}_4 + \text{K}_2\text{SO}_4 + 5\text{Fe}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$
 - $2\text{KMnO}_4 + (\text{conc.}) \text{H}_2\text{SO}_4 \longrightarrow \text{K}_2\text{SO}_4 + \text{Mn}_2\text{O}_7 + \text{H}_2\text{O}$

(D)



10. Sample of As_2O_3 = 12.0 g; It reacts with NaHCO_3 to give Na_3AsO_3 . Its reaction with I_2 shows the changes:



$$\text{M eq. of As}_2\text{O}_3 \text{ in } 25 \text{ ml} = \text{M eq. of I}_2 = 22.4 \times N \quad (1)$$

Also N of I_2 can be evaluated as:

Meq. of I₂ = Meq. of hypo = N × V

$$\text{[The reaction are : } \text{I}_2 + 2\text{e} \longrightarrow 2\text{I}^-$$

$$2\text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + 2\text{e}^-$$

$$\therefore N \times 25 = \frac{24.8}{248 \times 1} \times 25 \quad \therefore N_{I_2} = \frac{N}{10}$$

$$\therefore \text{Mol. of As}_2\text{O}_3 \text{ in } 25 \text{ ml} = 242.4 \times 1/10 = 2.42$$

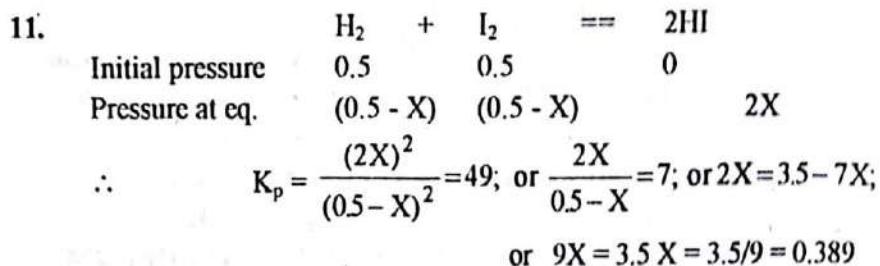
$$\text{Mol. of As}_2\text{O}_3 \text{ in } 250 \text{ ml} = 2.24 \times 250/25 = 22.4$$

$$\text{or } w/E.wt \times 1000 = 22.4 \quad \frac{w}{(198/4)} \times 1000 = 22.4$$

$$\therefore w_{\text{As}_2\text{O}_3} = \frac{22.4 \times 198}{4 \times 1000} = 11088 \text{ g}$$

$$\therefore \% \text{ of } \text{As}_2\text{O}_3 = \frac{11088}{12} \times 100 = 9.24$$

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At equilibrium $P'_{\text{H}_2} = 0.5 - 0.389 = 0.111 \text{ atm},$
 $P'_{\text{I}_2} = 0.5 - 0.389 = 0.111 \text{ atm}$
 $P'_{\text{HI}} = 0.389 \times 2 = 0.778 \text{ atm}$

12. Given ethylene glycol = 50 cm³; $K_f = 1.86 \text{ K mol}^{-1} \text{ kg}$
 \therefore wt. of glycol = $50 \times d$, where d is density of glycol.

$$\Delta T_f = 34^\circ\text{C}$$

$$\Delta T_f = \frac{1000 K_f \times w}{m \times W}, \quad 34 = \frac{1000 \times 1.86 \times 50 \times d}{62 \times 50}$$

$$\therefore d = 1.133 \text{ g/cm}^3$$

13. pH of buffer is given by:

$$\text{pH} = -\log K_a + \log [\text{Salt}/[\text{Acid}]$$

For I $4 = -\log 1.0 \times 10^{-5} + \log [\text{Salt}]/[0.5]$

$\therefore \log [\text{Salt}]/0.5 = -1 \quad \text{or} \quad [\text{Salt}] = 0.1 \times 0.5 = 0.05 \text{ M}$

For II $6 = -\log 1.0 \times 10^{-5} + \log [\text{salt}]/0.5;$

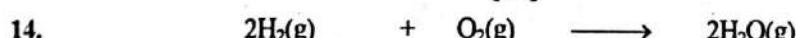
$\therefore \log [\text{salt}]/0.5 = 1 \quad \therefore [\text{salt}] = 10 \times 0.5 = 5 \text{ M}$

Now the two buffers (I NaA = 0.05M and HA = 0.5 M) and (II NaA = 5M and HA = 0.5 M) are mixed in equal proportion.

$$\text{Thus new conc. of NaA in mixed buffer} = \frac{0.5 \times V + 5 \times V}{25} = \frac{5.05}{2}$$

$$\text{new conc. of HA in mixed buffer} = \frac{0.5 \times V + 0.5 \times V}{25} = 0.5 \text{ M}$$

$$\text{Thus pH} = -\log 1.0 \times 10^{-5} + \log \frac{[5.05/2]}{[0.5]} \quad \text{pH} = 5 + 0.7033 = 5.7033$$



Initial moles	2a	a	O
---------------	----	---	---

Final moles	(2a-2X)	(a-X)	2X
-------------	---------	-------	----

Given $2X = 2a \times 80/100 = 1.6a \quad \therefore X = 0.8a$

Thus after the reaction H₂ left = $2a - 1.6a = 0.4a$ moles, O₂ left = 0.2 moles

H₂O formed = 1.6a moles

\therefore Total moles at 120° C in gaseous phase = $0.4a + 0.2a + 1.6a = 2.2a$

Now gives at initial conditions P = 0.8 atm, T = 293 K

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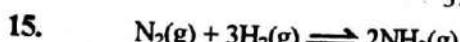
$$\therefore P \times V = nRT, \quad 0.8 \times V = 3a \times R \times 293$$

$$\therefore V = \frac{3a \times R \times 293}{0.8} \text{ litre}$$

The volume of container remains constant and therefore. After the reaction using, $P \times V = n RT$

$$P \times \frac{3a \times R \times 293}{0.8} = 2.2a \times R \times 393$$

$$\therefore P = \frac{393 \times 0.8 \times 2.2}{3 \times 293} = 0.787 \text{ atm}$$



$$\text{At equilibrium } -\Delta G^\circ = 2.303 RT \log K_p \quad \dots\dots(1)$$

$$\text{Also } \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$\text{Given } \Delta H^\circ \text{ for } NH_3 = -46 \text{ kJ} \quad \therefore \Delta H^\circ \text{ for reaction} = -46 \times 2 \text{ kJ}$$

$$\text{and } \Delta S^\circ_{\text{reaction}} = 2 \times S^\circ_{NH_3} - S^\circ_{N_2} - 3 \times S^\circ_{H_2}$$

$$= 2 \times 192 - 191 - 3 \times 130 = -197 \text{ J}$$

$$\text{Also } T = 273 + 25 = 298 \text{ K}$$

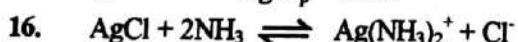
$$\text{Thus } \Delta G^\circ = -92 \times 10^3 - 298 \times (-197) = -92000 + 58706$$

$$\Delta G^\circ = -33294 \text{ J}$$

Thus from (1)

$$+ 33294 = 2.303 \times 298 \times 8.3 \log K_p$$

$$\therefore \log K_p = 5.845$$



$$K_{sp} = [Ag^+] [Cl^-]$$



$$K_f = \frac{[Ag(NH_3)_2^+]}{[Ag]^+ [NH_3]^2}$$

$$\text{By (I) and (II)} \quad K_{sp} \times K_f = \frac{[Ag(NH_3)_2^+][Cl^-]}{[NH_3]^2}$$

$$\text{or } 1 \times 10^{-10} \times 1.6 \times 10^{-7} = \frac{a \times a}{[NH_3]^2}$$

Given solubility of $AgCl = 0.1 \text{ M}$

$$\therefore a = 0.1 \text{ M for } Ag(NH_3)_2^+ \text{ and } Cl^-$$

$$\therefore [NH_3]^2 = \frac{0.1 \times 0.1}{1.6 \times 10^{-3}} = 6.25 \quad \therefore [NH_3] = 2.5 \text{ M}$$

Also 0.2 M NH_3 is required to dissolve 0.1 M Ag^+ and therefore

$$[NH_3] = 2.5 + 0.2 = 2.7$$

Appendix :

The word Appendix is from mid 16 th century Latin word Appendere meaning hang upon. Apart from the hanging body part; which is not needed by us now; We all know; it also means, supplementary material at the end of a book, article, document, or other text, usually of an explanatory, statistical, or bibliographic nature.

[in simple words Appendix is extra, and may not exactly be needed].

Almost all authors, including me, feel, that something more can be here. Not everything was supposed to be at the beginning. It is not possible to put everything at the beginning, nor that should be done.

I reserved this place for my personal idea, and lots of reading that I did regarding that.

When I was **in school** (1980s) it occurred to me, why not in movies, we keep a “smell track” as well. Everyone knows history of movies Then came talkies, then color, music, dance ... song sequels.

Well, why not a hero and heroine, as they dance in a park, (with melodious song, and enchanting music) they be in various parts of the beautiful gardens. At various parts they get nice smells, and the “smell track” emits the smells for the Audience.



Technically this needed many steps or parts. Sniffers as “cameras of Smells”, smell spectrum definition, (similar to RGB where combination in various ratio can give us various colour, combination of some smell blocks may give various smells), emitting the required smell, and flushing the molecules out of the room, to allow next smell sequel to come etc.

Many years later (in 1990s) in a movie hall in Chennai **some great minds** conducted an experimental show. Many kinds of essence sticks, and smell sources such as scents, were taken in various combinations. A smell emitter blew the “smell”, time to time as per the sequence in the movie. The exhaust fans kept flushing out the “older” molecules!

This is pretty costly, clumsy, and surely slow. The scan rate we have in ultrafast cameras can be crore frames per second. While scanning smell, say in a scene of cooking, or eating, or in a

park, it has to be very slow. May be, a change of smell once a minute be tolerable. If it is a “smell music” ... then every 5–10 seconds a change may be tried.

A Japanese company made a cellphone which emitted different smells depending on the calling id. Commonly we can set different ring tones for every caller. In this equipment an old deaf man could set an “obnoxious smell” for the calls from his wife. Let people decide the smell which represent various characters in their life.

[A (software) virus may emit smells in random from a phone of this kind.... Particularly Badboo. Or “remains” of a sweet smell may tell who called even if the caller history is cleaned]

<https://www.techinasia.com/japan-chatperf>

<https://www.techinasia.com/scentee-mobile-app-that-emits-smell>

<http://www.japantimes.co.jp/news/2013/10/16/business/corporate-business/firm-wants-your-smartphone-to-smell/#.V9bjr63yDIU>



(Cyrano – is a “digital smell speaker” and the endeavor from Harvard professor and serial inventor, David Edwards) <http://www.hotsaucedrops.com/?author=91>

<https://textually.org/textually/archives/2007/01/014726.htm>

<http://www.theneweconomy.com/technology/using-mobiles-to-smell-how-technology-is-giving-us-our-senses-video>

Extremely sensitive smell sensors are available.

<http://www.japantimes.co.jp/news/2016/06/23/world/science-health-world/nose-job-smells-smart-sensors-last-frontier/#.V9bkGa3yDIU>

<https://books.google.co.in/books?id=odT-BAAAQBAJ&pg=PA8&lpg=PA8&dq=smell+spectrum+detection+and+reproduction&source=bl&ots=a4pyDI8CZy&sig=kZ---x5qeo3V4tKlzV7vkyGrgpA&hl=en&sa=X&ved=0ahUKEwjelb7xq4rPAhUDpJQKHS7pDyEQ6AEISjAJ#v=onepage&q=smell%20spectrum%20detection%20and%20reproduction&f=false>

<http://www.extremetech.com/extreme/146986-olfactory-breakthrough-a-theory-of-quantum-smell>

Quantum smelling Devices, and various kinds of Artificial Nose have been made

<http://www.enose.nl/rd/technology/>

<https://www.theguardian.com/science/2014/apr/02/electronic-noses-explainer-sniffing-disease>

<http://www.popsci.com/science/article/2013-01/bolstered-new-study-quantum-smell-theory-olfactory-sense-gains-traction>



Luca Turin in king of Smell

Luca is one of the very rare persons, who has understood the secrets of smell, the best!

https://www.ted.com/talks/luca_turin_on_the_science_of_scent?language=en

<http://www.sjsu.edu/faculty/watkins/turin.htm>

You can go to market, and buy a few different kinds of scents, then make a combination. If you give this combination to Luca, he can make 3 or 4 different molecules which will smell the same. It is your choice to synthesize one or more kind of molecules, as production cost / efficiency / complexity / raw material availability etc.

About cryptochromes

Magnetic sensing is a type of sensory perception that has long captivated the human imagination, although it seems inaccessible to humans. Over the past 50 years, scientific studies have shown that a wide variety of living organisms have the ability to perceive magnetic fields and can use information from the earth's magnetic field in orientation behavior. Examples abound: salmon (*Oncorhynchus nerka*), sea turtles (*Dermochelys coriacea*), spotted newts (*Notophthalmus viridescens*), lobsters (*Panulirus argus*), honeybees (*Apis mellifera*), and fruitflies (*Drosophila melongaster*) can all perceive and utilize geomagnetic field information. But perhaps the most well-studied example of animal magnetoreception is the case of migratory birds (e.g. European robins (*Erythacus rubecula*), silvereyes (*Zosterops l. lateralis*), garden warblers (*Sylvia borin*)), who use the earth's magnetic field, as well as a variety of other environmental cues, to find their way during migration.

<https://www.sciencedaily.com/releases/2016/06/160606100519.htm>

The avian magnetic compass is a complex entity with many surprising properties. The basis for the magnetic sense is located in the eye of the bird, and furthermore, it is light-dependent, i.e., a bird can only sense the magnetic field if certain wavelengths of light are available. Specifically, many studies have shown that birds can only orient if blue light is present. The avian compass is also an inclination-only compass, meaning that it can sense changes in the inclination of magnetic field lines but is not sensitive to the polarity of the field lines. Under normal conditions, birds are sensitive to only a narrow band of magnetic field strengths around the geomagnetic field strength, but can orient at higher or lower magnetic field strengths given accommodation time.

The blue light receptors cryptochromes mediate various light responses in plants. The photoexcited cryptochrome molecules undergo a number of biophysical and biochemical changes, including electron transfer, phosphorylation, and ubiquitination, resulting in conformational changes to propagate light signals. Two modes of cryptochrome signal transduction have been recently discovered, the CIB (cryptochrome-interacting basic-helix-loop-helix 1)-dependent CRY2 regulation of transcription and the SPA1/COP1 (SUPPRESSOR OF PHYA /CONSTITUTIVELY PHOTOMORPHOGENIC1)-dependent cryptochrome regulation of proteolysis. Both cryptochrome signaling pathways rely on blue light-dependent interactions between the cryptochrome photoreceptor and its signaling proteins to modulate gene expression changes in response to blue light, leading to altered developmental programs of plants.

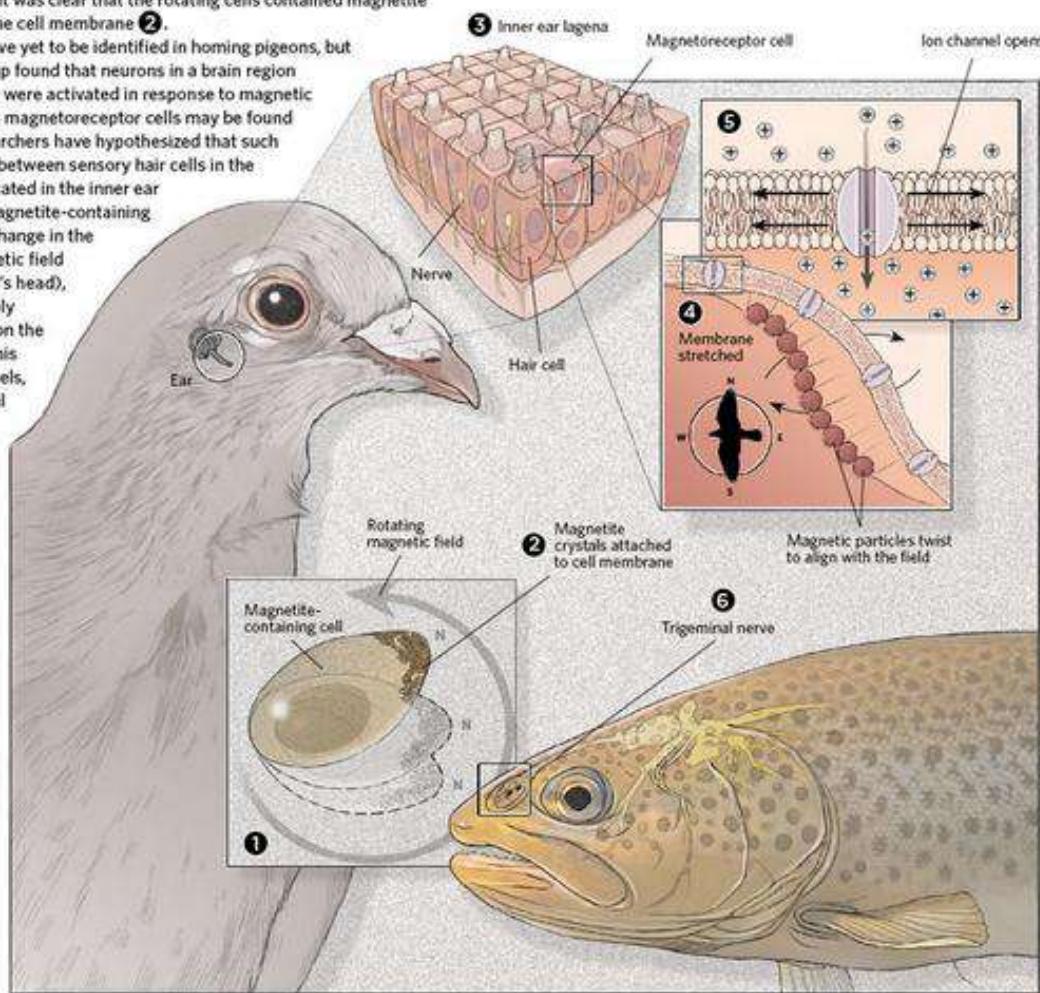
Cryptochromes (from the Greek κρυπτός χρώμα, "hidden colour") are a class of flavoproteins that are sensitive to blue light. They are found in plants and animals. Cryptochromes are involved in the circadian rhythms of plants and animals, and in the sensing of magnetic fields in a number of species.

THE BIOLOGY OF MAGNETORECEPTION

One theory for the mechanism behind the magnetic sense is that animals have cells containing collections of magnetite crystals that respond to external magnetic fields. Those cells have proven hard to find, but last year researchers found cells in the snouts of rainbow trout that, when suspended in liquid, rotated in sync with a rotating magnetic field ①. On closer inspection, it was clear that the rotating cells contained magnetite crystals attached to the cell membrane ②.

Magnetic cells have yet to be identified in homing pigeons, but last year another group found that neurons in a brain region linked to the inner ear were activated in response to magnetic fields, suggesting that magnetoreceptor cells may be found in the inner ear. Researchers have hypothesized that such cells may be situated between sensory hair cells in the lagena, a structure located in the inner ear ③. If so, when the magnetite-containing structure aligns to a change in the direction of the magnetic field (in relation to the bird's head), it would twist and apply mechanical pressure on the cell membrane ④.

This would open ion channels, changing the electrical potential across the membrane ⑤ and triggering a nerve impulse. The same signal transduction mechanism could also work in the trout because their magnetic cells are locked in a matrix within the olfactory epithelium, where mechanosensitive neurons connect to the brain via the trigeminal nerve ⑥. But it's not yet clear whether these magnetic cells are neurons,



So Cryptochromes are photoreceptors that regulate entrainment by light of the circadian clock in plants and animals. They also act as integral parts of the central circadian oscillator in animal brains and as receptors controlling photomorphogenesis in response to blue or ultraviolet (UV-A) light in plants. Cryptochromes are probably the evolutionary descendants of DNA photolyases, which are light-activated DNA-repair enzymes, and are classified into three groups — plant cryptochromes, animal cryptochromes, and CRY-DASH proteins. Cryptochromes and photolyases have similar three-dimensional structures, characterized by an α/β domain and a helical domain. The structure also includes a chromophore, flavin adenine dinucleotide (FAD). The FAD-access cavity of the helical domain is the catalytic site of photolyases, and it is predicted also to be important in the mechanism of cryptochromes. Cryptochromes are photolyase-like blue light receptors originally discovered in *Arabidopsis* but later found in other plants, microbes, and animals. *Arabidopsis* has two cryptochromes, CRY1 and CRY2, which mediate primarily blue light inhibition of hypocotyl elongation and photoperiodic control of floral initiation, respectively. In addition, cryptochromes also

regulate over a dozen other light responses, including circadian rhythms, tropic growth, stomata opening, guard cell development, root development, bacterial and viral pathogen responses, abiotic stress responses, cell cycles, programmed cell death, apical dominance, fruit and ovule development, seed dormancy, and magnetoreception. Cryptochromes have two domains, the N-terminal PHR (Photolyase–Homologous Region) domain that bind the chromophore FAD (flavin adenine dinucleotide), and the CCE (CRY C-terminal Extension) domain that appears intrinsically unstructured but critical to the function and regulation of cryptochromes. Most cryptochromes accumulate in the nucleus, and they undergo blue light–dependent phosphorylation or ubiquitination. It is hypothesized that photons excite electrons of the flavin molecule, resulting in redox reaction or circular electron shuttle and conformational changes of the photoreceptors. The photoexcited cryptochrome are phosphorylated to adopt an open conformation, which interacts with signaling partner proteins to alter gene expression at both transcriptional and posttranslational levels and consequently the metabolic and developmental programs of plants.



Cryptochromes are widely distributed in bacteria and eukaryotes but are not found in archaea, although archaea do have a CPD photolyase. Cryptochromes have now been found in various animal lineages, including insects, fish, amphibians, and mammals. Animal cryptochromes act as components of the circadian clock that control daily physiological and behavioral rhythms and as photoreceptors that mediate entrainment of the circadian clock to light.

<http://www.ks.uiuc.edu/Research/cryptochrome/>

<https://genomebiology.biomedcentral.com/articles/10.1186/gb-2005-6-5-220>

About Spintronics

Spintronics (a portmanteau meaning spin transport electronics), also known as spinelectronics or fluxtronics, is the study of the intrinsic spin of the electron and its associated magnetic moment, in addition to its fundamental electronic charge, in solid-state devices.

Spintronics differs from the older magnetoelectronics, in that spins are manipulated by both magnetic and electrical fields.

Spintronics emerged from discoveries in the 1980s concerning spin-dependent electron transport phenomena in solid-state devices. This includes the observation of spin-polarized electron injection from a ferromagnetic metal to a normal metal by Johnson and Silsbee (1985) and the discovery of giant magnetoresistance independently by Albert Fert et al. and Peter Grünberg et al. (1988). The origins of spintronics can be traced to the ferromagnet/superconductor tunneling experiments pioneered by Meservey and Tedrow and initial experiments on magnetic tunnel junctions by Julliere in the 1970s. The use of semiconductors for spintronics began with the theoretical proposal of a spin field-effect-transistor by Datta and Das in 1990 and of the electric dipole spin resonance by Rashba in 1960.

Conventional electronic devices rely on the transport of electrical charge carriers – electrons – in a semiconductor such as silicon. Now, however, physicists are trying to exploit the 'spin' of the electron rather than its charge to create a remarkable new generation of 'spintronic' devices which will be smaller, more versatile and more robust than those currently making up silicon chips and circuit elements. The potential market is worth hundreds of billions of dollars a year.

All spintronic devices act according to the simple scheme: (1) information is stored (written) into spins as a particular spin orientation (up or down), (2) the spins, being attached to mobile electrons, carry the information along a wire, and (3) the information is read at a terminal. Spin orientation of conduction electrons survives for a relatively long time (nanoseconds, compared to tens of femtoseconds during which electron momentum decays), which makes spintronic devices particularly attractive for memory storage and magnetic sensors applications, and, potentially for quantum computing where electron spin would represent a bit (called qubit) of information.

<http://phys.org/news/2015-09-shift-electronics-spintronics-possibilities-faster.html>

<http://www.spintronicbbsr.org/>

About Excitons

Exciton, the combination of an electron and a positive hole (an empty electron state in a valence band), which is free to move through a nonmetallic crystal as a unit. An exciton is a bound state of an electron and an electron hole which are attracted to each other by the electrostatic Coulomb force. It is an electrically neutral quasiparticle that exists in insulators, semiconductors and in some liquids. The exciton is regarded as an elementary excitation of condensed matter that can transport energy without transporting net electric charge.

Because the electron and the positive hole have equal but opposite electrical charges, the exciton as a whole has no net electrical charge (though it transports energy). This makes excitons difficult to detect, but detection is possible by indirect means.

Also read about polaron, magnon, phonon

When an electron in an exciton recombines with a positive hole, the original atom is restored, and the exciton vanishes. The energy of the exciton may be converted into light when this happens, or it may be transferred to an electron of a neighbouring atom in the solid. If the energy is transferred to a neighbouring electron, a new exciton is produced as this electron is forced away from its atom.

An exciton can form when a photon is absorbed by a semiconductor. This excites an electron from the valence band into the conduction band. In turn, this leaves behind a positively charged electron hole (an abstraction for the location from which an electron was moved). The electron in the conduction band is then effectively attracted to this localized hole by the repulsive Coulomb forces from large numbers of electrons surrounding the hole and excited electron. This attraction provides a stabilizing energy balance. Consequently, the exciton has slightly less energy than the unbound electron and hole. The wave–function of the bound state is said to be hydrogenic, an exotic atom state akin to that of a hydrogen atom. However, the binding energy is much smaller and the particle's size much larger than a hydrogen atom. This is because of both the screening of the Coulomb force by other electrons in the semiconductor (i.e., its dielectric constant), and the small effective masses of the excited electron and hole. The recombination of the electron and hole, i.e. the decay of the exciton, is limited by resonance stabilization due to the overlap of the electron and hole wave functions, resulting in an extended lifetime for the exciton.

The electron and hole may have either parallel or anti–parallel spins. The spins are coupled by the exchange interaction, giving rise to exciton fine structure. In periodic lattices, the properties of an exciton show momentum (k –vector) dependence.

The concept of excitons was first proposed by Yakov Frenkel in 1931, when he described the excitation of atoms in a lattice of insulators. He proposed that this excited state would be able to travel in a particle–like fashion through the lattice without the net transfer of charge.

About Bohr Magneton

The Bohr Magneton is the magnitude of the magnetic dipole moment of an orbiting electron with an orbital angular momentum of \hbar . According to the Bohr model, this is the ground state, i.e. the state of lowest possible energy. In the summer of 1913, this value was naturally obtained by the Danish physicist Niels Bohr as a consequence of his atom model. In 1920, Wolfgang Pauli gave the Bohr magneton its name in an article where he contrasted it with the Magnetons of the experimentalists which he called the Weiss Magnetons.

The idea of elementary magnets is due to Walther Ritz (1907) and Pierre Weiss. Already before the Rutherford model of atomic structure, several theorists commented that the magneton should involve Planck's constant h . By postulating that the ratio of electron kinetic energy to orbital frequency should be equal to h , Richard Gans computed a value that was twice as large as the Bohr Magneton in September 1911. At the First Solvay Conference in November that year, Paul Langevin obtained a submultiple. The Romanian physicist Stefan Procopiu had obtained the expression for the magnetic moment of the electron in 1911. The value is sometimes referred to as the "Bohr-Procopiu magneton" in Romanian scientific literature.

About Enrico Fermi (1938 Nobel Prize in Physics)



Enrico Fermi was born in Rome on 29th September, 1901, the son of Alberto Fermi, a Chief Inspector of the Ministry of Communications, and Ida de Gattis. He attended a local grammar school, and his early aptitude for mathematics and physics was recognized and encouraged by his father's colleagues, among them A. Amidei. In 1918, he won a fellowship of the Scuola Normale Superiore of Pisa. He spent four years at the University of Pisa, gaining his doctor's degree in physics in 1922, with Professor Puccianti. **He was an Atheist.**

Soon afterwards, in 1923, he was awarded a scholarship from the Italian Government and spent some months with Professor Max Born in Göttingen. With a Rockefeller Fellowship, in 1924, he moved to Leyden to work with P. Ehrenfest, and later that same year he returned to Italy to occupy for two years (1924–1926) the post of Lecturer in Mathematical Physics and Mechanics at the University of Florence.

In 1926, Fermi discovered the statistical laws, nowadays known as the «Fermi statistics», governing the particles subject to Pauli's exclusion principle (now referred to as «fermions», in contrast with «bosons» which obey the Bose–Einstein statistics).

In 1927, Fermi was elected Professor of Theoretical Physics at the University of Rome (a post which he retained until 1938, when he – immediately after the receipt of the Nobel Prize – emigrated to America, primarily to escape Mussolini's fascist dictatorship).

During the early years of his career in Rome he occupied himself with electrodynamic problems and with theoretical investigations on various spectroscopic phenomena. But a capital turning-point came when he directed his attention from the outer electrons towards the atomic nucleus itself. In 1934, he evolved the β –decay theory, coalescing previous work on radiation theory with Pauli's idea of the neutrino. Following the discovery by Curie and Joliot of artificial radioactivity (1934), he demonstrated that nuclear transformation occurs in almost every element subjected to neutron bombardment. This work resulted in the discovery of slow neutrons that same year, leading to the discovery of nuclear fission and the production of elements lying beyond what was until then the Periodic Table.

In 1938, Fermi was without doubt the greatest expert on neutrons, and he continued his work on this topic on his arrival in the United States, where he was soon appointed Professor of Physics at Columbia University, N.Y. (1939–1942).

Upon the discovery of fission, by Hahn and Strassmann early in 1939, he immediately saw the possibility of emission of secondary neutrons and of a chain reaction. He proceeded to work with tremendous enthusiasm, and directed a classical series of experiments which ultimately led to the atomic pile and the first controlled nuclear chain reaction. This took place in Chicago on December 2, 1942 – on a squash court situated beneath Chicago's stadium. He subsequently played an important part in solving the problems connected with the development of the first atomic bomb (He was one of the leaders of the team of physicists on the Manhattan Project for the development of nuclear energy and the atomic bomb.)

In 1944, Fermi became an American citizen, and at the end of the war (1946) he accepted a professorship at the Institute for Nuclear Studies of the University of Chicago, a position which he held until his untimely death in 1954. There he turned his attention to high-energy physics, and led investigations into the pion–nucleon interaction.

During the last years of his life Fermi occupied himself with the problem of the mysterious origin of cosmic rays, thereby developing a theory, according to which a universal magnetic field – acting as a giant accelerator – would account for the fantastic energies present in the cosmic ray particles.

Professor Fermi was the author of numerous papers both in theoretical and experimental physics. His most important contributions were:

"Sulla quantizzazione del gas perfetto monoatomico", Rend. Accad. Naz. Lincei, 1935 (also in Z. Phys., 1936), concerning the foundations of the statistics of the electronic gas and of the gases made of particles that obey the Pauli Principle.

Several papers published in Rend. Accad. Naz. Lincei, 1927–28, deal with the statistical model of the atom (Thomas–Fermi atom model) and give a semiquantitative method for the

calculation of atomic properties. A resumé of this work was published by Fermi in the volume: Quantentheorie und Chemie, edited by H. Falkenhagen, Leipzig, 1928.

"Über die magnetischen Momente der Atomkerne", Z. Phys., 1930, is a quantitative theory of the hyperfine structures of spectrum lines. The magnetic moments of some nuclei are deduced therefrom.

"Tentativo di una teoria dei raggi β ", Ricerca Scientifica, 1933 (also Z. Phys., 1934) proposes a theory of the emission of β -rays, based on the hypothesis, first proposed by Pauli, of the existence of the neutrino.

The Nobel Prize for Physics was awarded to Fermi for his work on the artificial radioactivity produced by neutrons, and for nuclear reactions brought about by slow neutrons. The first paper on this subject "Radioattività indotta dal bombardamento di neutroni" was published by him in Ricerca Scientifica, 1934. All the work is collected in the following papers by himself and various collaborators: "Artificial radioactivity produced by neutron bombardment", Proc. Roy. Soc., 1934 and 1935; "On the absorption and diffusion of slow neutrons", Phys. Rev., 1936. The theoretical problems connected with the neutron are discussed by Fermi in the paper "Sul moto dei neutroni lenti", Ricerca Scientifica, 1936.

His Collected Papers are being published by a Committee under the Chairmanship of his friend and former pupil, Professor E. Segrè (Nobel Prize winner 1959, with O. Chamberlain, for the discovery of the antiproton).

Fermi was member of several academies and learned societies in Italy and abroad (he was early in his career, in 1929, chosen among the first 30 members of the Royal Academy of Italy).

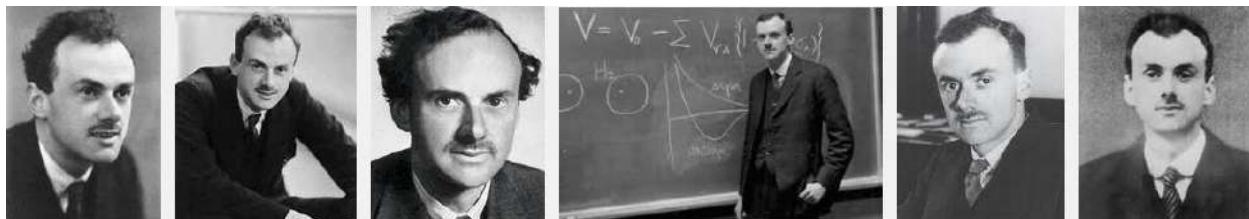
As lecturer he was always in great demand (he has also given several courses at the University of Michigan, Ann Arbor; and Stanford University, Calif.). He was the first recipient of a special award of \$50,000 – which now bears his name – for work on the atom.

Professor Fermi married Laura Capon in 1928. They had one son Giulio and one daughter Nella. His favourite pastimes were walking, mountaineering, and winter sports.

He died in Chicago on 28th November, 1954.

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About Paul Dirac (1933 Nobel Prize in Physics)



Paul Adrien Maurice Dirac was born on 8th August, 1902, at Bristol, England, his father being Swiss and his mother English. He was educated at the Merchant Venturer's Secondary School, Bristol, then went on to Bristol University. Here, he studied electrical engineering, obtaining the B.Sc. (Engineering) degree in 1921. He then studied mathematics for two years at Bristol University, later going on to St. John's College, Cambridge, as a research student in mathematics. He received his Ph.D. degree in 1926. The following year he became a Fellow of St.John's College and, in 1932, Lucasian Professor of Mathematics at Cambridge.

Paul Dirac was an Atheist.

Dirac's work has been concerned with the mathematical and theoretical aspects of quantum mechanics. He began work on the new quantum mechanics as soon as it was introduced by Heisenberg in 1925 – independently producing a mathematical equivalent which consisted essentially of a noncommutative algebra for calculating atomic properties – and wrote a series of papers on the subject, published mainly in the Proceedings of the Royal Society, leading up to his relativistic theory of the electron (1928) and the theory of holes (1930). This latter theory required the existence of a positive particle having the same mass and charge as the known (negative) electron. This, the positron was discovered experimentally at a later date (1932) by C. D. Anderson, while its existence was likewise proved by Blackett and Occhialini (1933) in the phenomena of "pair production" and "annihilation".

The importance of Dirac's work lies essentially in his famous wave equation, which introduced special relativity into Schrödinger's equation. Taking into account the fact that, mathematically speaking, relativity theory and quantum theory are not only distinct from each other, but also oppose each other, Dirac's work could be considered a fruitful reconciliation between the two theories.

Dirac's publications include the books Quantum Theory of the Electron (1928) and The Principles of Quantum Mechanics (1930; 3rd ed. 1947).

He was elected a Fellow of the Royal Society in 1930, being awarded the Society's Royal Medal and the Copley Medal. He was elected a member of the Pontifical Academy of Sciences in 1961.

Dirac has travelled extensively and studied at various foreign universities, including Copenhagen, Göttingen, Leyden, Wisconsin, Michigan, and Princeton (in 1934, as Visiting Professor). In 1929, after having spent five months in America, he went round the world, visiting Japan together with Heisenberg, and then returned across Siberia.

In 1937 he married Margit Wigner, of Budapest.

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http://www.celebatheists.com/wiki/Main_Page gives names of Hundreds of Atheists.

Douglas Adams, Ayaan Hirsi Ali, Woody Allen, Fred Armisen, Lance Armstrong, Darren Aronofsky, Isaac Asimov, Julian Assange, Dan Barker, Dave Barry, Ingmar Bergman, Pierre Berton, Niels Bohr, Richard Branson, Derren Brown, Kari Byron, James Cameron, Asia Carrera, George Carlin, John Carmack, Adam Carolla, John Carpenter, Asia Carrera, Fidel Castro, Noam Chomsky, Jeremy Clarkson, Billy Connolly, Francis Crick, David Cronenberg, David Cross, Alan Cumming, Rodney Dangerfield, Richard Dawkins, Daniel Dennett, Ani DiFranco, Micky Dolenz, Albert Einstein, Harlan Ellison, Paul Erdős, Richard Feynman, Harvey Fierstein, Reginald Finley, Barney Frank, Morgan Freeman, Larry Flynt, Dave Foley, Arian Foster, Jodie Foster, Janeane Garofalo, Bill Gates, Bob Geldof, Ricky Gervais, Ira Glass, James Gleick, Robert Heinlein, Ernest Hemingway, Katharine Hepburn, Christopher Hitchens, Jamie Hyneman, Eddie Izzard, Penn Jillette, Billy Joel, Ana Kasparian, Diane Keaton, Skandar Keynes, Michael Kinsley, Keira Knightley, Kramer, John Landis, Hugh Laurie, Artie Lange, Richard Leakey, Bruce Lee, Tom Lehrer, John Lennon, Tom Leykis, James Lipton, H.P. Lovecraft, Ernst Mach, Seth MacFarlane, Bill Maher, John Malkovich, Barry Manilow, Todd McFarlane, Sir Ian McKellen, Arthur Miller, Frank Miller, Claude Monet, Julianne Moore, Rafael Nadal, Randy Newman, Mike Nichols, Jack Nicholson, Gary Numan, Bob Odenkirk, Patton Oswalt, Camille Paglia, Trey Parker, PewDiePie, Steven Pinker, Brad Pitt, Joaquin Phoenix, Paula Poundstone, Terry Pratchett, Robin Quivers, Daniel Radcliffe, James Randi, Ron Reagan Jr., Rob Reiner, Keanu Reeves, Rick Reynolds, Gene Roddenberry, Henry Rollins, Andy Rooney, Salman Rushdie, Adam Savage, Brian Sapient, Erwin Schrödinger, Bob Simon, Steven Soderbergh, Annika Sorenstam, George Soros, Richard Stallman, Howard Stern, Matt Stone, Julia Sweeney, Teller, Studs Terkel, Pat Tillman, Tool, Alan Turing, Eddie Vedder, Jesse Ventura, Gore Vidal, Vincent van Gogh, Kurt Vonnegut Jr., Steven Weinberg, Joss Whedon, Ted Williams, Steve Wozniak, HUNDREDS MORE...

World's Greatest Scientists are all Atheists

See <https://www.youtube.com/watch?v=UKbslSOfrRo>

<https://www.youtube.com/watch?v=GdqC2bVLesQ>

<https://www.youtube.com/watch?v=BCUmeE8sIVo>

https://www.youtube.com/watch?v=YUe0_4rdj0U

<https://www.youtube.com/watch?v=eY1pDkP9Qxk>

<https://www.youtube.com/watch?v=XYohZRivNhl>

<https://www.youtube.com/watch?v=f4tbDI3K1ZU>

About Coriolis Force or Coriolis Effect

An effect whereby a mass moving in a rotating system experiences a force (the Coriolis force) acting perpendicular to the direction of motion and to the axis of rotation. On the earth, the effect tends to deflect moving objects to the right in the northern hemisphere and to the left in the southern and is important in the formation of cyclonic weather systems.

Gaspard-Gustave de Coriolis was a French mathematician, mechanical engineer and scientist. He is best known for his work on the supplementary forces that are detected in a rotating frame of reference, leading to the Coriolis effect. He was the first to coin the term "work" for the transfer of energy by a force acting through a distance.

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/fw/crls.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/fw/crls.rxml)

https://en.wikipedia.org/wiki/Coriolis_force

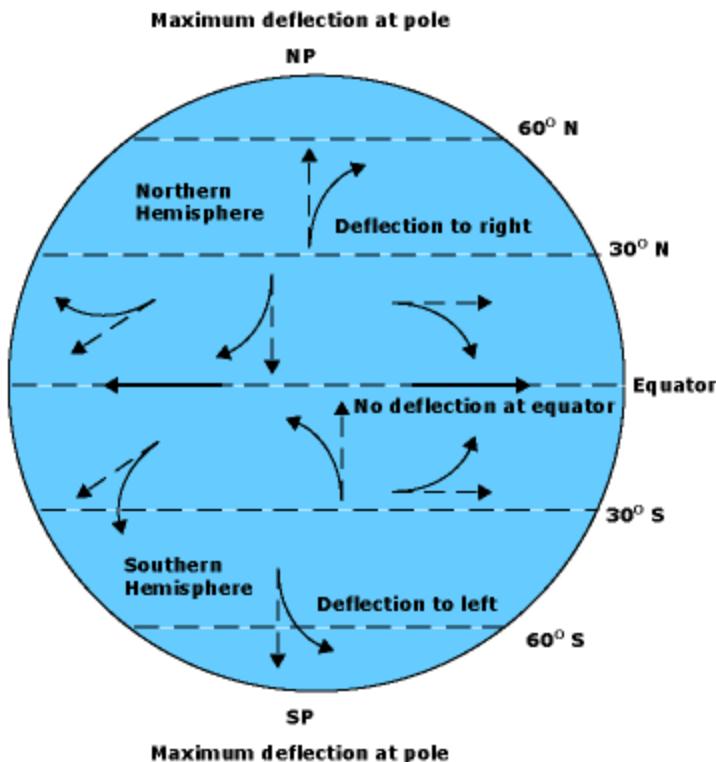
<https://www.youtube.com/watch?v=aeY9tY9vKgs>

<http://geography.about.com/od/physicalgeography/a/coriolis.htm>

https://www.youtube.com/watch?v=_sayCU1TNyg

<https://www.youtube.com/watch?v=i2mec3vgeal>

<http://www.universetoday.com/73828/what-is-the-coriolis-effect/>



About Parapsychology by Dr Dean Radin

Dean Radin is a researcher and author in the field of parapsychology.

He has been Senior Scientist at the Institute of Noetic Sciences (IONS), in Petaluma, California, USA, since 2001, served on dissertation committees at Saybrook Graduate School and Research Center, and former President of the Parapsychological Association. He is also co–editor–in–chief of the journal Explore: The Journal of Science and Healing.

Radin's ideas and work have been criticized by scientists and philosophers skeptical of paranormal claims.

Parapsychology is a field of study concerned with the investigation of paranormal and psychic phenomena which include telepathy, precognition, clairvoyance, psychokinesis, near–death experiences, reincarnation, apparitional experiences, and other paranormal claims. It is often identified as pseudoscience.

Parapsychology research is largely conducted by private institutions in several countries and funded through private donations, and the subject rarely appears in mainstream science journals. Most papers about parapsychology are published in a small number of niche journals. Parapsychology has been criticised for continuing investigation despite being unable to provide convincing evidence for the existence of any psychic phenomena after more than a century of research.

It has been noted that most academics do not take the claims of parapsychology seriously.

Para is from Greek, and means "beside, closely related to, beyond..." The term parapsychology was coined in or around 1889 by philosopher Max Dessoir. It was adopted by J. B. Rhine in the 1930s as a replacement for the term psychical research in order to indicate a significant shift toward experimental methodology and academic discipline. The term originates from the Greek: παρά para meaning "alongside", and psychology.

In parapsychology, psi is the unknown factor in extrasensory perception and psychokinesis experiences that is not explained by known physical or biological mechanisms. The term is derived from the Greek ψ psi, 23rd letter of the Greek alphabet and the initial letter of the Greek ψυχή psyche, "mind, soul". The term was coined by biologist Berthold P. Wiesner, and first used by psychologist Robert Thouless in a 1942 article published in the British Journal of Psychology.

The Parapsychological Association divides psi into two main categories: psi–gamma for extrasensory perception and psi–kappa for psychokinesis. In popular culture, "psi" has become more and more synonymous with special psychic, mental, and "psionic" abilities and powers.

https://www.youtube.com/watch?v=qw_O9Qiwqew

<https://en.wikipedia.org/wiki/Parapsychology>

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<https://www.youtube.com/watch?v=VgEmZ2xwZec>

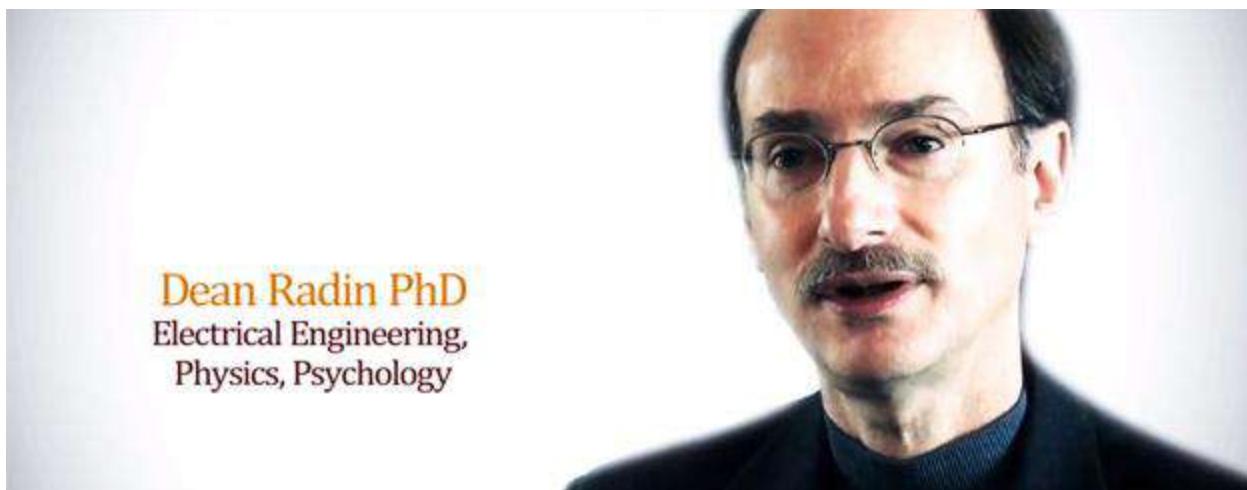
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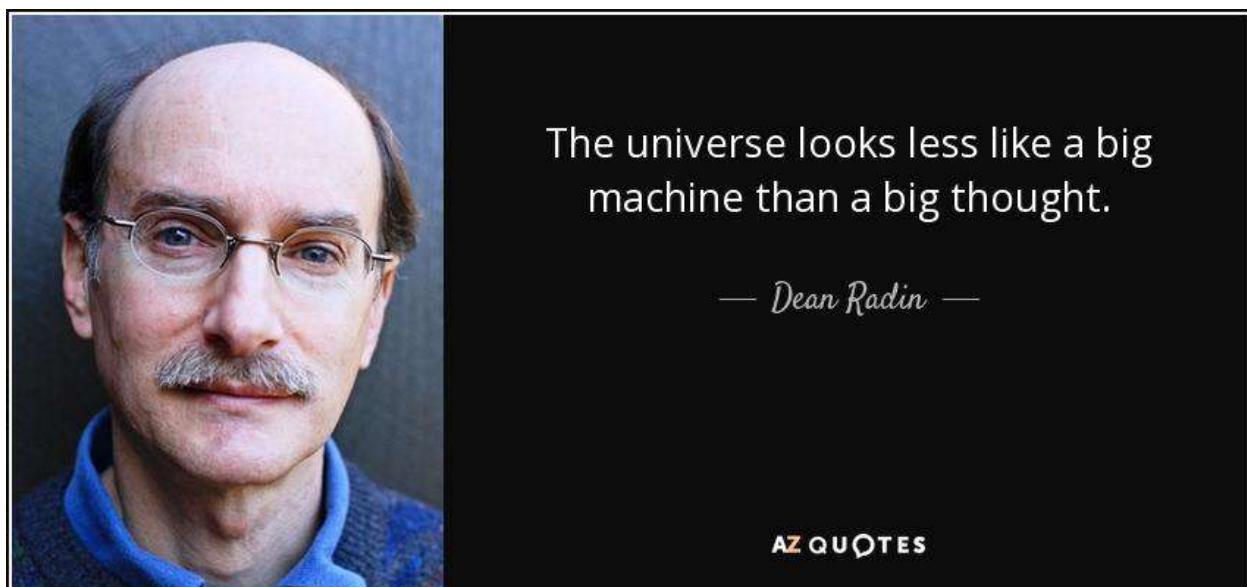
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<http://www.deanradin.com/>

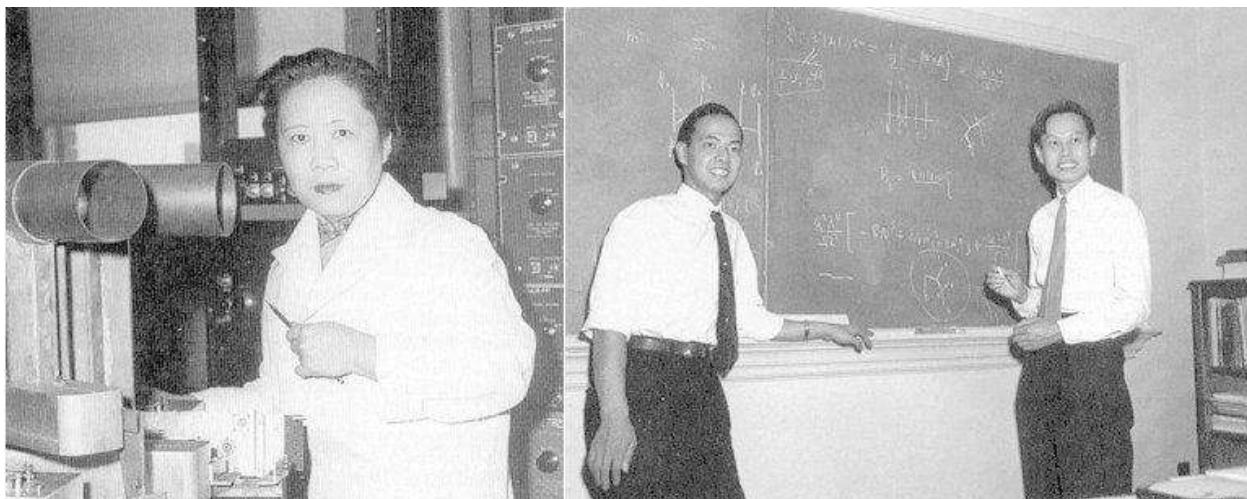


Most important <https://www.youtube.com/watch?v=W5KNNR-yPMM>



About Parity Violation – Space is not Perfectly Symmetric – Yang Lee (Nobel Physics 1957)

Chinese Physicists Yang and Lee; received Nobel Prize for one of the quickest; the gap between Theoretical Prediction to Experimental confirmation being shortest.



C. S. Wu

T. D. Lee

C. N. Yang

Yang and Lee Predicted broken Symmetry. Experimental proof by Chien Shiung Wu et al. came within 2 years. Asymmetry is used by charges and dipoles for extracting and pouring out Electromagnetic energy from the vacuum, yet not one current Electrical Engineering or classical electromagnetics textbook mentions the energy implications of dipolar asymmetry. Nor do they mention that every charge and dipole freely pours out real observable EM energy continuously, with no observable energy input.

In 1943 Tsung Dao Lee was a student in the Kweichow province of China. It was the time of the Sino–Japanese War, and the Japanese invasion of the mainland forced Lee to move to Kunming. There he attended the National Southwest University where he met Chen Ning Yang. Lee and Yang had only a nodding acquaintance then. In 1946 both students received fellowships to study in the United States. Yang had pursued Enrico Fermi from Columbia to the University of Chicago – he was to have a close association with Fermi. Lee, on the other hand, had little choice. Only one school in the U.S. then allowed an undergraduate to work towards the PhD without the intermediate degrees, the University of Chicago. The two graduate students fast became friends.

For a while Yang had tried experimental physics, but it was not to be. Other graduate students had teased him, "Where there was a bang, there was Yang". Yang eventually did his doctoral thesis under the supervision of Edward Teller. Lee on the other hand knew he was a theorist from the start. He did his doctoral thesis under Fermi. Yang recalls Fermi's advice on his career: As a young man, work on practical problems; do not worry about things of fundamental importance. For all of his admiration of Fermi, Yang chose to ignore this bit of advice. Both Lee and Yang graduated and for awhile worked as staff members at the Institute

for Advanced Study in Princeton. Lee had become a reputable theoretical physicist, invoking praise from J. Robert Oppenheimer as "one of the most brilliant theoretical physicists then known". Thus the individual physicists T. D. Lee and C. N. Yang had established their reputations by 1956, when their work together would help clear a mystery known as the theta–tau puzzle and topple of the most fundamental conservation laws.

The Theta–Tau Puzzle

Within the cosmic rays in which C. F. Powell had discovered the pi meson (pion) were other new particles. In 1949 Powell identified a cosmic ray particle which disintegrated into three pions. He dubbed this new particle the tau meson. Another particle called the theta meson was also discovered. It disintegrated into two pions. Both particles disintegrated via the weak force. Now, a problem arose when the masses and the lifetimes of the tau and theta particles were considered. The two particles turned out to be indistinguishable other than their mode of decay. Their masses and lifetimes were identical, within the experimental uncertainties. Were they in fact the same particle? The problem itself was not that the tau and theta, if indeed they were the same particle, decayed in two different modes, one by two pions, the other by three pions. The problem dealt with the more fundamental parity conservation law. In 1953 the physicist R. H. Dalitz argued that since the pion has parity of -1 , two pions would combine to produce a net parity of $(-1)(-1) = +1$, and three pions would combine to have total parity of $(-1)(-1)(-1) = -1$. Hence, if conservation of parity holds, the theta should have parity of $+1$, and the tau of -1 . Hence, they could not be the same particle. Thus was born the theta–tau puzzle. Its resolution would involve an almost unacceptable proposition to the physicists of the time.

The Beginnings of Doubt

The events which led to the publication of Lee and Yang's historic paper, Question of Parity Conservation in Weak Interactions, began at the International Conference on High Energy Physics at the University of Rochester in April 1956. Lee and Yang attended the conference with a proposal for ending the theta–tau puzzle. Their idea was that certain kinds of elementary particles occur in two forms with different parities. The idea was called parity doubling. Also attending the conference was the theoretical physicist Richard Feynman, who is renowned for his development of the field of physics called quantum electrodynamics. Feynman's roommate at the conference was the experimentalist Martin Block. Block suggested to Feynman on the first night of the conference that parity just may not be conserved in certain interactions. The next day, following Yang's presentation of the parity doubling idea, Feynman brought up the question of non–conservation of parity. Feynman himself later said, "I thought the idea (of parity violation) unlikely, but possible, and a very exciting possibility." Indeed Feynman later made a fifty dollar bet with a friend that parity would not be violated. Yang's reply was that he and Lee had considered the idea but had arrived at no conclusions. During the discussion, Wigner, who had formulated the law of conservation of parity in the first place, also suggested that perhaps it did not hold in weak interactions.

Lee and Yang pursued the question further after the conference. "Early in May, when they were sitting in the White Rose Cafe near the corner of Broadway and 125th Street, in the vicinity of Columbia University, it suddenly struck them that it might be profitable to make a careful study of all known experiments involving weak interactions". After several weeks of reviewing past experiments, they had come to two conclusions:

"Past experiments on the weak interactions had actually no bearing on the question of parity conservation."

"In strong interactions, ... there were indeed many experiments that established parity conservation to a high degree of accuracy..."

As Yang commented in his Nobel lecture, "The fact that parity conservation in the weak interactions was believed for so long without experimental support was very startling. But what was more startling was the prospect that a space-time symmetry law which the physicists have learned so well may be violated. This prospect did not appeal to use."

The Proposed Experiment

When Lee and Yang's paper appeared in the October 1, 1956 issue of The Physical Review, physicists were not immediately prompted into action. The proposition of parity nonconservation was not unequivocally denied; rather, the possibility appeared so unlikely that experimental proof did not warrant immediate attention. The physicist Freeman Dyson wrote of his reaction to the paper: "A copy of it was sent to me and I read it. I read it twice. I said, 'This is very interesting,' or words to that effect. But I had not the imagination to say, 'By golly, if this is true it opens up a whole new branch of physics.' And I think other physicists, with very few exceptions, at that time were as unimaginative as I.". Hence, the initial reaction among most physicists to verifying parity conservation was not enthusiastic.

In their paper, Lee and Yang stated, "To decide unequivocally whether parity is conserved in weak interactions, one must perform an experiment to determine whether weak interactions differentiate the right from the left.". And they proposed several experiments. One of the simplest experiments (conceptually) involved measurements on the beta decay of cobalt-60. The idea involved orienting cobalt nuclei with a strong magnetic field so that their spins are aligned in the same direction. Beta rays (electrons) are emitted at the poles of the nuclei. A mirror image of the system would also show beta rays being emitted from the poles of the mirror cobalt nuclei, the only difference being that the north and south poles of the mirror nuclei would be reversed since they spin in opposite direction of their real counterparts. Hence parity conservation demands that the emitted beta rays be equally distributed between the two poles. If more beta particles emerged from one pole than the other, it would be possible to distinguish the mirror image nuclei from their counterparts. Thus an anisotropy in the emitted beta rays would be tantamount to parity violation.

Madame Chien Shiung Wu

Another immigrant was now to play the next major role, Madame Chien–Shiung Wu. Arriving at Berkely in 1936 from Shanghai, Wu was one of the most ardently pursued coeds on campus. But she was also a hard worker who abhorred the marked absence of women from the American scientific establishment. She says, "... it is shameful that there are so few women in science... In China there are many, many women in physics. There is a misconception in America that women scientists are all dowdy spinsters. This is the fault of men. In Chinese society, a woman is valued for what she is, and men encourage her to accomplishments --- yet she retains eternally feminine.". In this view, there is a clear distinction between American and Chinese cultures. Yang, too, had to come to terms with the differences between the two cultures. In his Nobel address, he says, "I am heavy with awareness of the fact that I am in more than one sense a product of both the Chinese and Western cultures, in harmony and in conflict... I am as proud of my Chinese heritage and background as I am devoted to modern science, a part of human civilization of Western origin...". Returning to Madame Wu, the physicist Emile Segre', one of her teachers, said of her, "She is a slave driver. She is the image of the militant woman so well known in Chinese literature as either empress or mother." But by 1956 she had a world-wide reputation for her work on beta decay. Beta decay involves the weak interaction. Wu's experiments were highly regarded for their simplicity and elegance. At the time Lee and Yang considered the question of parity, Wu was a professor at Columbia and a long time friend of both men. She was the first to act on the proposed experiment involving beta decay in cobalt 60.

Even before Lee and Yang's paper had been submitted to The Physical Review, Lee had discussed the experiment with Wu. At the time, Wu and her husband had planned a trip to Europe and the Far East. But she chose instead to remain and perform the experiment rather than lose the opportunity to other physicists who might recognize its importance. However, the experiment could not be performed with only her expertise. Reaching the low temperatures necessary to be able to orient the cobalt nuclei spins required equipment few laboratories possessed. Nevertheless, one such laboratory existed in the United States --- the Cryogenics Physics Laboratory at the National Bureau of Standards in Washington. Early in June of 1956, Wu sought the help of Ernest Ambler at NBS. Ambler accepted enthusiastically. Indeed his doctoral thesis dealt with the orientation of cobalt–60 nuclei. In addition, Ralph Hudson, with expertise in cryogenics, and Raymond Hayward and Dale Hoppes, with experience in radiation detection, joined the team. By early October they began to assemble and test their equipment. The same month saw the publication of Lee and Yang's paper.

Lederman, who worked with Columbia's cyclotron, realized that he could perform an independent test of parity with the cyclotron. His experiment, which involved the decay of pi and mu mesons, had also been proposed by Lee and Yang in their paper. Soon, Lederman, along with his graduate students, Marcel Weinrich, and Richard Garwin began their experiments. At the same time, the group under Wu was running into problems. Wanting to verify their results from December 27, they repeated the experiment. Their original finding of a large asymmetry in the beta ray distribution was not consistently reproducible. However, after a week of solving problems with the apparatus, consistent results were obtained. And the results pointed to parity violation. Much consideration was given to the question of the

origin of the beta ray asymmetry —— was it really an indication of the failure of parity or some result intrinsic to the experiment? "The group worked around the clock, assembling the apparatus many times, and took their breaks for a few hours sleep when the superfluid helium spoiled their vacuum by finding its way around the stopper at the bottom of the cryostat. Hoppes then slept beside the apparatus, telephoning to the others as soon as its temperature was low enough to begin their experiments again. Finally, on Januray 9th, at 2 o'clock in the morning, Hudson brought out a bottle of Chateau Lafite–Rothschild, 1949, and they drank to the overthrow of the law of parity"

Broken symmetry essentially means that something virtual (shadowy, but real in a special sense and widely used in physics; it has real physical consequences, since it creates all the forces of nature) has become observable (real in the ordinary everyday sense that it can be detected, measured, observed, and used.). The broken symmetry of the end charges of a dipole rigorously means that, once the charges are forcibly separated to form that dipole, the dipole (its end charges) continuously absorbs virtual (fleeting) photons from the seething vacuum, coherently integrates these "photon pieces" into real observable photons, and re–emits the resulting real EM energy in the form of real observable photons in all directions at the speed of light.

That's why a dipolar permanent magnet, with opposite magnetic charges on its ends locked in there by the material itself, continuously exhibits magnetic field in the space surrounding it (out to the ends of the universe, if the magnet has been around long enough). There is a continuous and steady stream of EM energy, extracted directly from the vacuum and integrated into observable magnetic field energy, pouring forth from the dipolarity of that magnet. At any external point in that stream, the steady flow will give a steady or "static" reading for the magnetic field and thus for the intensity of the flow at that point.

Actually there is no such thing as a "static" field or potential in the universe; simply check out Whittaker's 1903 decomposition of the "electrostatic" scalar potential into bidirectional longitudinal EM waves, and his 1904 decomposition of any field and wave pattern into two such potentials comprised of bidirectional longitudinal EM waves. The 1904 paper founded what today is known as superpotential theory.

[https://en.wikipedia.org/wiki/Parity_\(physics\)](https://en.wikipedia.org/wiki/Parity_(physics))



About String Theory

I am least interested in String theory. The reasons will be soon clear to the reader. Since 1970 s I may have read more than 200 Popular Science articles, on String theory; in various magazines. What a waste of time! and quite foolish act in my part to read so many. I should have stopped bothering about String theory much earlier if the right information was given in these articles. The authors / writers often hide or not tell some information, about the string theory; which are its limitations.

[You may read about String theory as given below, or directly go to the last part / Paragraph (marked in Red)]

String theory is a theoretical framework in which the point-like particles of particle physics are replaced by one-dimensional objects called strings. String theory is a mathematical theory of particle physics which models all the subatomic particles in the universe (protons, neutrons, electrons, quarks, photons, etc) as bits of vibrating string. Since last 50 years not a single experiment has verified any of the predictions / explanations of String Theory. Not even got any hint regarding its predictions. So it is a theoretical framework, but with no experimental backup.

Strings and membranes

When the theory was originally developed in the 1970s, the filaments of energy in string theory were considered to be 1-dimensional objects: strings. (One-dimensional indicates that a string has only one dimension, length, as opposed to say a square, which has both length and height dimensions.) These strings came in two forms – closed strings and open strings. An open string has ends that don't touch each other, while a closed string is a loop with no open end. It was eventually found that these early strings, called Type I strings, could go through five basic types of interactions. The interactions are based on a string's ability to have ends join and split apart. Because the ends of open strings can join together to form closed strings, you can't construct a string theory without closed strings. The closed strings have properties that make physicists believe they might describe gravity. Instead of just being

a theory of matter particles, physicists began to realize that string theory may just be able to explain gravity and the behavior of particles.

Over the years, it was discovered that the theory required objects other than just strings. These objects can be seen as sheets, or branes. Strings can attach at one or both ends to these branes. Quantum gravity

Modern physics has two basic scientific laws: quantum physics and general relativity. These two scientific laws represent radically different fields of study. Quantum physics studies the very smallest objects in nature, while relativity tends to study nature on the scale of planets, galaxies, and the universe as a whole. (Obviously, gravity affects small particles too, and relativity accounts for this as well.) Theories that attempt to unify the two theories are theories of quantum gravity, and the most promising of all such theories today is string theory.

Unification of forces

Hand-in-hand with the question of quantum gravity, string theory attempts to unify the four forces in the universe – electromagnetic force, the strong nuclear force, the weak nuclear force, and gravity – together into one unified theory. In our universe, these fundamental forces appear as four different phenomena, but string theorists believe that in the early universe (when there were incredibly high energy levels) these forces are all described by strings interacting with each other.

Supersymmetry

All particles in the universe can be divided into two types: bosons and fermions. String theory predicts that a type of connection, called supersymmetry, exists between these two particle types. Under supersymmetry, a fermion must exist for every boson and vice versa. **Unfortunately, experiments have not yet detected these extra particles.**

Supersymmetry is a specific mathematical relationship between certain elements of physics equations. It was discovered outside of string theory, although its incorporation into string theory transformed the theory into supersymmetric string theory (or superstring theory) in the mid–1970s.

Supersymmetry vastly simplifies string theory's equations by allowing certain terms to cancel out. Without supersymmetry, the equations result in physical inconsistencies, such as infinite values and imaginary energy levels.

Because scientists haven't observed the particles predicted by supersymmetry, this is still a theoretical assumption. Many physicists believe that the reason no one has observed the particles is because it takes a lot of energy to generate them. (Energy is related to mass by Einstein's famous $E = mc^2$ equation, so it takes energy to create a particle.) They may have existed in the early universe, but as the universe cooled off and energy spread out after the big bang, these particles would have collapsed into the lower–energy states that we observe

today. (We may not think of our current universe as particularly low energy, but compared to the intense heat of the first few moments after the big bang, it certainly is.)

String Theory Lovers, **hope** that astronomical observations or experiments with particle accelerators will uncover some of these higher–energy supersymmetric particles, providing support for this prediction of string theory.

Extra dimensions

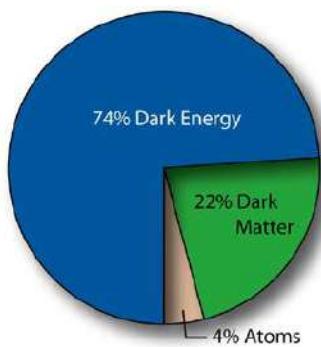
Another mathematical result of string theory is that the theory only makes sense in a world with more than three space dimensions! (Our universe has three dimensions of space – left/right, up/down, and front/back.) Two possible explanations currently exist for the location of the extra dimensions:

The extra space dimensions (generally six of them) are curled up (compactified, in string theory terminology) to incredibly small sizes, so we never perceive them.

We are stuck on a 3–dimensional brane, and the extra dimensions extend off of it and are inaccessible to us.

A major area of research among string theorists is on mathematical models of how these extra dimensions could be related to our own. Some of these recent results have predicted that scientists **may** soon be able to detect these extra dimensions (if they exist) in upcoming experiments, because they may be larger than previously expected.

25 years (or 50 years) and 11 dimensions later, **no luck with experiments**. String theorists have fallen into an elegance trap and that trap is a product of theorists attacking mathematics the way experimentalists attack data. The problem with that is math is not data. The aggressive take–no–prisoners sociology of experimental physics has a natural constraint: results. Hypotheses may be as bold and counter–intuitive as you like because at the end of the week, we'll see what comes out of the accelerator. But when your research is pure math, you have to be more conservative, staying within the bounds of established observation and suggesting experiments to be done before you proceed further. In their quest for the elegant theory of everything, string theorists have broken free of these constraints and in doing so, of science itself. So complete is this break with science, in fact, that prominent string theorists opining that perhaps it is science itself which needs to change to accommodate string theory and that quaint traditions like experiment and result should make room for the notion that every self–consistent mathematical model is in fact a physically real universe and for the anthropic principle, which is a polite term for intelligent design. So much for "elegance".



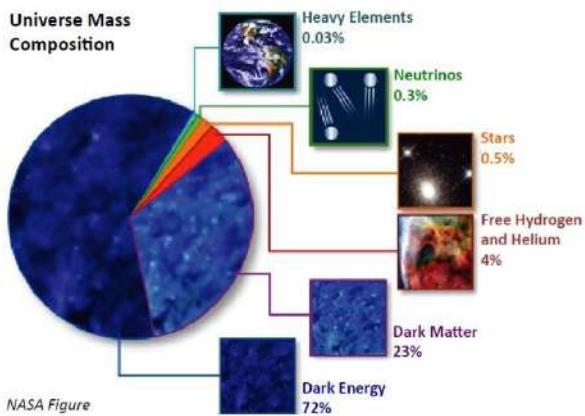
In physical cosmology and astronomy, dark energy is an unknown form of energy which is hypothesized to permeate all of space, tending to accelerate the expansion of the universe. Dark energy is the most accepted hypothesis to explain the observations since the 1990s indicating that [the universe is expanding at an accelerating rate](#). Assuming that the standard model of cosmology is correct, the best current measurements indicate that dark energy contributes 68.3% of the total energy in the present-day observable universe. The mass-energy of dark matter and [ordinary \(baryonic\) matter](#) contribute 26.8% and [4.9%](#), respectively, and other components such as neutrinos and photons contribute a very small amount. Again, on a mass-energy equivalence basis, the density of dark energy ($\sim 7 \times 10^{-30} \text{ g/cm}^3$) is very low, much less than the density of ordinary matter or dark matter within galaxies. However, it comes to dominate the mass-energy of the universe because it is uniform across space.

In quintessence models of dark energy, the observed acceleration of the scale factor is caused by the potential energy of a dynamical field, referred to as quintessence field. Quintessence differs from the cosmological constant in that it can vary in space and time. In order for it not to clump and form structure like matter, the field must be very light so that it has a large Compton wavelength.

No evidence of quintessence is yet available, but it has not been ruled out either. It generally predicts a slightly slower acceleration of the expansion of the universe than the cosmological constant. Some scientists think that the best evidence for quintessence would come from violations of Einstein's equivalence principle and variation of the fundamental constants in space or time. Scalar fields are predicted by the Standard Model of particle physics and string theory, but an analogous problem to the cosmological constant problem (or the problem of constructing models of cosmological inflation) occurs: renormalization theory predicts that scalar fields should acquire large masses.

Some theorists think that dark energy and cosmic acceleration are a failure of general relativity on very large scales, larger than superclusters. However most attempts at modifying general relativity have turned out to be either equivalent to theories of quintessence, or inconsistent with observations. Other ideas for dark energy have come from string theory, brane cosmology and the holographic principle, but have not yet proved; as compelling as

quintessence and the cosmological constant. In other hand, M.R. Khoshbin—e—Khoshnazar believes that a model discretization of the universe could explain the origin of dark energy.



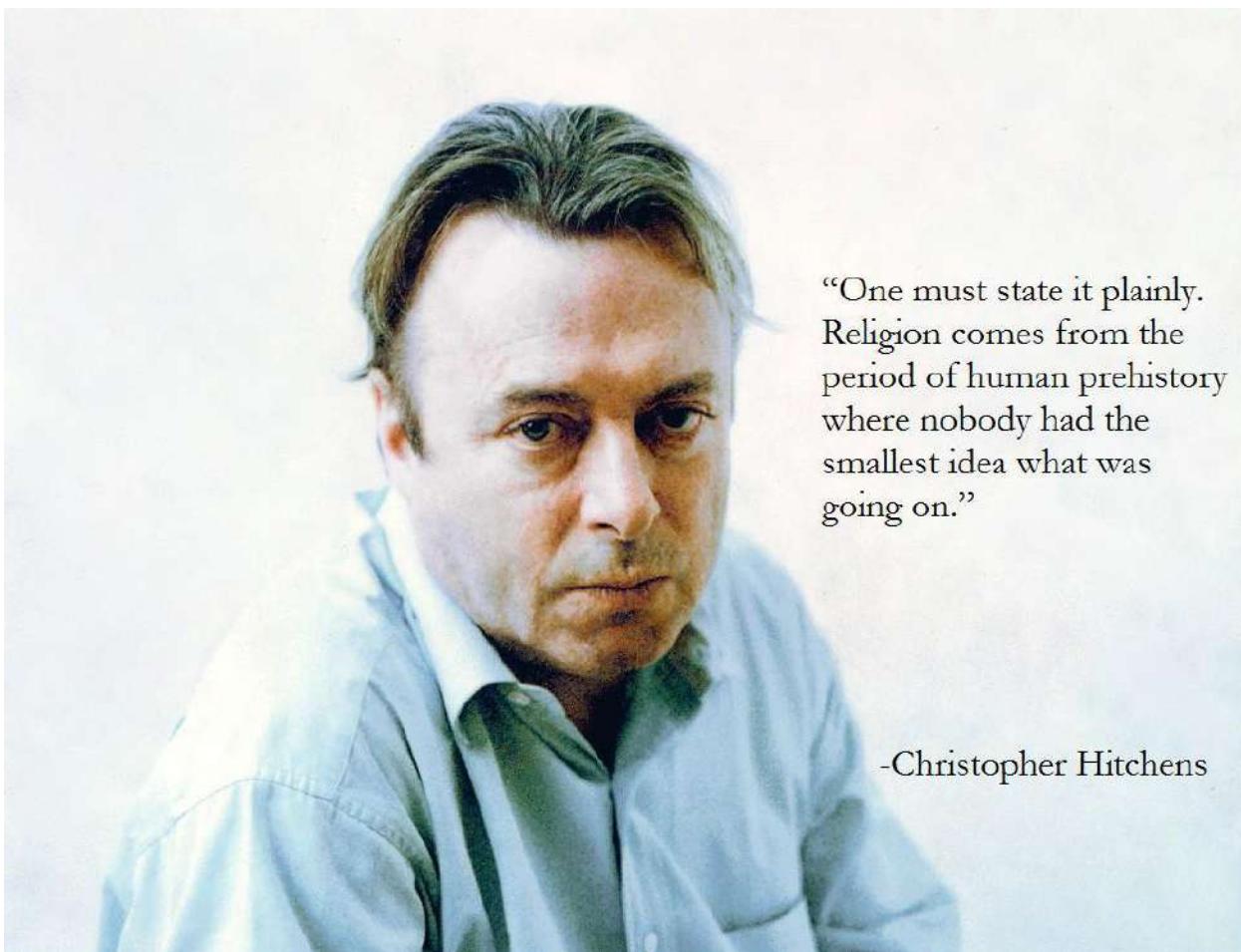
If an Atom is of the size of Earth, the Nucleus is of the size of an Apple! Physicists say, in Science videos. To draw an analogy, Physicists say... If the atom is of the size of Universe, the string is of the size of a tree! This needs 10^{18} times more energy than present technology allows us to verify. I read somewhere that if a [huge particle accelerator like a ring around the Earth](#) or say along the perimeter of Earth is made ([which is just not possible](#)), then the experiments may hint about the ranges which String theory is talking about.

The Mathematical elegance that String Theory was so excited about, [did not predict Dark Matter, Dark energy etc.](#) Today we know that more than 95% of the Universe is of Dark Matter + Dark Energy. Many simple and "normal" calculations explain all these [without Multiple Universe](#). These calculations have last 100 years of experimental backup, and [Madala Boson](#) is being used to explain Dark World. Physicists are doing fine with 4 dimensions. (x, y, z and time). Since 1910s Einstein's equations gave relations between space and time. Since then time is the 4 rth dimension. We did not require any more dimensions to explain experimental observations, for last 100 years!

If I have 100 hours or 1000 hours of time, it will be much more useful and profitable for me to read, research and do Business with [Artificial Chlorophyll](#), Bio-Batteries, Bacteria Motors / energy, Desalination technologies for cheap potable water from sea, etc; rather than wasting time in high Energy Physics, or Theoretical constructs of Modification of Superstring theory!

—

[About Christopher Hitchens \(1949-2011 \)](#)

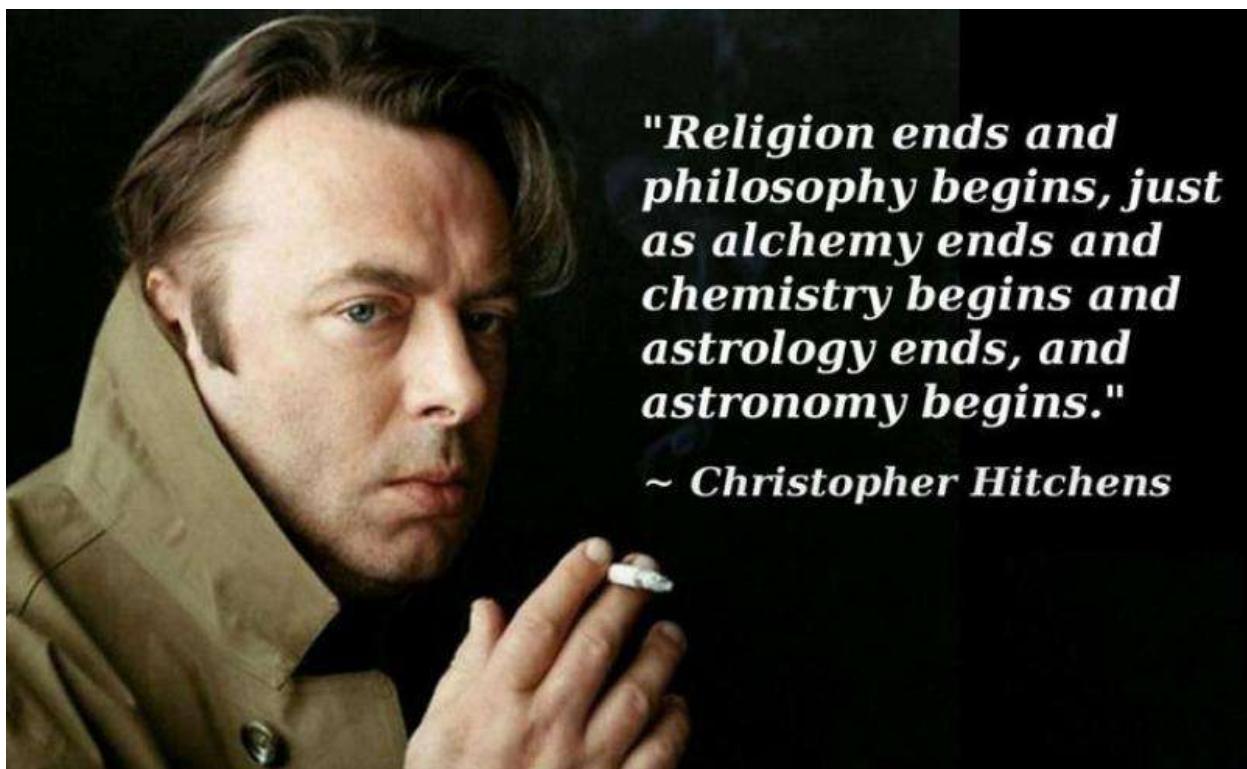


“One must state it plainly. Religion comes from the period of human prehistory where nobody had the smallest idea what was going on.”

-Christopher Hitchens

Christopher was an Anglo-American author, columnist, essayist, orator, religious and literary critic, social critic, and journalist. He contributed to *New Statesman*, *The Nation*, *The Atlantic*, *London Review of Books*, *The Times Literary Supplement*, *Slate*, and *Vanity Fair*. Hitchens was the author, co-author, editor or co-editor of over 30 books, including five collections of essays, on a range of subjects, including politics, literature, and religion. A staple of talk shows and lecture circuits, his confrontational style of debate made him both a lauded and controversial figure and public intellectual. Known for his contrarian stance on a number of issues, Hitchens criticised such public and generally popular figures as Mother Teresa, Bill Clinton, Henry Kissinger, and Diana, Princess of Wales. He was the elder brother of the conservative journalist and author Peter Hitchens.

A writer who could match the volume of exquisitely crafted columns, essays, articles, and books he produced over the past four decades. He wrote often—constantly, in fact, and right up to the end—and he wrote fast; frequently without the benefit of a second draft or even corrections. Christopher was the beau ideal of the public intellectual. You felt as though he was writing to you and to you alone. And as a result many readers felt they knew him.



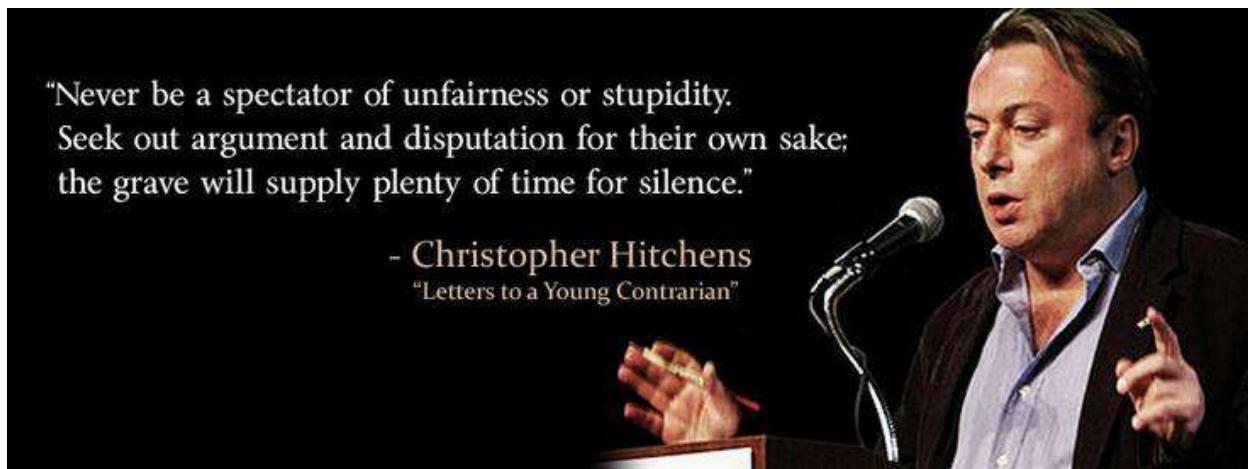
"Religion ends and philosophy begins, just as alchemy ends and chemistry begins and astrology ends, and astronomy begins."

~ Christopher Hitchens

He was a legend on the speakers' circuit, and could debate just about anyone on anything. He won umpteen awards—although that was not the sort of thing that fueled his work—and in the last decade he wrote best-sellers, including a memoir, *Hitch-22*, that finally put some money into his family's pocket. In the last weeks of his life, he was told that an asteroid had been named after him. He was pleased by the thought, and inasmuch as the word is derived from the Greek, meaning “star-like,” and asteroids are known to be volatile, it is a fitting honor.

Having long described himself as a socialist, a Marxist and an anti-totalitarian, Hitchens began his break from the established political left after what he called the "tepid reaction" of the Western left to the controversy over *The Satanic Verses*, followed by the left's embrace of Bill Clinton, and the antiwar movement's opposition to NATO intervention in Bosnia and Herzegovina in the 1990s.

An atheist, and a self-described antitheist, Hitchens viewed the concept of a god or a supreme being as a totalitarian belief that destroys individual freedom, and argued free expression and scientific discovery should replace religion as a means of teaching ethics and defining human civilisation. In 2007, Hitchens published his most popular book, *God Is Not Great: How Religion Poisons Everything*, which was a New York Times bestseller.



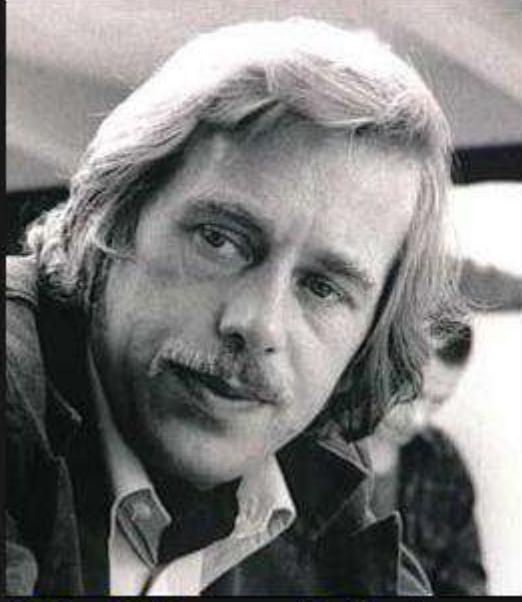
About Sir Nicholas Winton (1909 - 2015)



Sir Nicholas George Winton was a British humanitarian who organized the rescue of 669 children, most of them Jewish, from Czechoslovakia on the eve of the Second World War in an operation later known as the Czech Kindertransport (German for "children transportation"). Winton found homes for the children and arranged for their safe passage to Britain. The world found out about his work over 40 years later, in 1988. The British press dubbed him the "British Schindler". On 28 October 2014, he was awarded the highest honour of the Czech Republic, the Order of the White Lion (1st class), by Czech President Miloš Zeman.

About Vaclav Havel (1936 - 2011)

Playwright, poet, essayist, dissident, human rights activist, and statesman are but a few of the monikers that have been used to describe Václav Havel, ...



Vaclav Havel
The dissident - 1979

"Because the regime is captive to its own lies, it must falsify everything. It falsifies the past. It falsifies the present, and it falsifies the future. It falsifies statistics.

"It pretends not to possess an omnipotent and unprincipled police apparatus. It pretends to respect human rights. It pretends to prosecute no one. It pretends to fear nothing. It pretends to pretend nothing."

1936 to 2011 Persuasion Redefined

Vaclav Havel was a Czech writer, philosopher, political dissident, and statesman. From 1989 to 1992, he served as the last president of Czechoslovakia. He then served as the first president of the Czech Republic (1993-2003) after the Czech-Slovak split. Within Czech literature, he is known for his plays, essays, and memoirs.

His educational opportunities limited by his bourgeois background, Havel first rose to prominence within the Prague theater world as a playwright. Havel used the absurdist style in works such as *The Garden Party* and *The Memorandum* to critique communism. After participating in Prague Spring and being blacklisted after the invasion of Czechoslovakia, he became more politically active and helped found several dissident initiatives such as Charter 77 and the Committee for the Defense of the Unjustly Prosecuted. His political activities brought him under the surveillance of the secret police and he spent multiple stints in prison, the longest being nearly four years, between 1979 and 1983.

Havel's Civic Forum party played a major role in the Velvet Revolution that toppled communism in Czechoslovakia in 1989. He assumed the presidency shortly thereafter, and was reelected in a landslide the following year and after Slovak independence in 1993. Havel was instrumental in dismantling the Warsaw Pact and expanding NATO membership eastward. Many of his stances and policies, such as his opposition to Slovak independence, condemnation of the Czechoslovak treatment of Sudeten Germans after World War II, and granting of general amnesty to all those imprisoned under communism, were very controversial domestically. As such, he continually enjoyed greater popularity abroad than at

home. Havel continued his life as a public intellectual after his presidency, launching several initiatives including the Prague Declaration on European Conscience and Communism, the VIZE 97 Foundation, and the Forum 2000 annual conference.

Havel's political philosophy was one of anti-consumerism, humanitarianism, environmentalism, civil activism, and direct democracy. He supported the Czech Green Party from 2004 until his death. He received numerous accolades during his lifetime including the Presidential Medal of Freedom, the Gandhi Peace Prize, the Philadelphia Liberty Medal, the Order of Canada, the Four Freedoms Award, the Ambassador of Conscience Award, and the Hanno R. Ellenbogen Citizenship Award. The 2012–2013 academic year at the College of Europe was named in his honour. He is considered by some to be one of the most important intellectuals of the 20th century.

During the first week of the invasion of Czechoslovakia, Havel assisted the resistance by providing an on-air narrative via Radio Free Czechoslovakia station (at Liberec). Following the suppression of the Prague Spring in 1968, he was banned from the theatre and became more politically active. Short of money, he took a job in a brewery, an experience he wrote about in his play *Audience*. This play, along with two other "Vaněk" plays (so-called because of the recurring character Ferdinand Vaněk, a stand-in for Havel), became distributed in samizdat form across Czechoslovakia, and greatly added to Havel's reputation of being a leading dissident (several other Czech writers later wrote their own plays featuring Vaněk). This reputation was cemented with the publication of the Charter 77 manifesto, written partially in response to the imprisonment of members of the Czech psychedelic rock band The Plastic People of the Universe. (Havel had attended their trial, which centered on the group's non-conformity in having long hair, using obscenities in their music, and their overall involvement in the Czech underground). Havel co-founded the Committee for the Defense of the Unjustly Prosecuted in 1979. His political activities resulted in multiple stays in prison, and constant government surveillance and questioning by the secret police, (Státní bezpečnost). His longest stay in prison, from May 1979 to February 1983, is documented in letters to his wife that were later published as *Letters to Olga*.

He was known for his essays, most particularly *The Power of the Powerless*, in which he described a societal paradigm in which citizens were forced to "live within a lie" under the communist regime. In describing his role as a dissident, Havel wrote in 1979: "...we never decided to become dissidents. We have been transformed into them, without quite knowing how, sometimes we have ended up in prison without precisely knowing how. We simply went ahead and did certain things that we felt we ought to do, and that seemed to us decent to do, nothing more nor less."

About Irena Sendler (1910 - 2003)



Irena Sendler (née Krzyżanowska), also referred to as Irena Sendlerowa in Poland, nom de guerre "Jolanta", was a Polish nurse and social worker who served in the Polish Underground in German-occupied Warsaw during World War II, and was head of the children's section of Żegota, the Polish Council to Aid Jews (Polish: Rada Pomocy Żydom), which was active from 1942 to 1945.

Assisted by some two dozen other Żegota members, Sendler smuggled approximately 2,500 Jewish children out of the Warsaw Ghetto and then provided them with false identity documents and shelter outside the Ghetto, saving those children from the Holocaust. With the exception of diplomats who issued visas to help Jews flee Nazi-occupied Europe, Sendler saved more Jews than any other individual during the Holocaust.

The German occupiers eventually discovered her activities and she was arrested by the Gestapo, tortured, and sentenced to death, but she managed to evade execution and survive the war. In 1965, Sendler was recognised by the State of Israel as Righteous among the Nations. Late in life she was awarded the Order of the White Eagle, Poland's highest honor, for her wartime humanitarian efforts.

Jewish children were placed with Polish families, the Warsaw orphanage of the Sisters of the Family of Mary, or Roman Catholic convents such as the Little Sister Servants of the Blessed Virgin Mary Conceived Immaculate. Sendler worked closely with a group of about 30 volunteers, mostly women, who included Zofia Kossak-Szczucka, a resistance fighter and writer, and Matylda Getter, Mother Provincial of the Franciscan Sisters of the Family of Mary.

"Every child saved with my help is the justification of my existence on this Earth, and not a title to glory." (Irena Sendler)

According to American historian Deborah Dwork, Sendler was "the inspiration and the prime mover for the whole network that saved those 2,500 Jewish children." About 400 of the children were directly smuggled out by Sendler herself. She and her co-workers buried lists of the hidden children in jars in order to keep track of their original and new identities. The aim was to return the children to their original families when the war was over.

In 1943 Sendler was arrested by the Gestapo and severely tortured. The Gestapo beat her brutally, fracturing her feet and legs in the process. Despite this, she refused to betray any of her comrades or the children they rescued, and was sentenced to death by firing squad. Żegota saved her life by bribing the guards on the way to her execution. After her escape, she hid from the Germans, but returned to Warsaw under a fake name and continued her involvement with the Żegota. During the Warsaw Uprising, she worked as a nurse in a public hospital, where she hid five Jews. She continued to work as a nurse until the Germans left Warsaw, retreating before the advancing Soviet troops.

After the war, she and her co-workers gathered all of the children's records with the names and locations of the hidden Jewish children and gave them to their Żegota colleague Adolf Berman and his staff at the Central Committee of Polish Jews. However, almost all of the children's parents had been killed at the Treblinka extermination camp or had gone missing.

After the war, Sendler was imprisoned from 1948 to 1949 and brutally interrogated by the communist secret police (Urząd Bezpieczeństwa) due to her connections with Poland's principal resistance organisation, the Home Army (AK), which was loyal to the wartime Polish government in exile. As a result, she gave birth prematurely to her son, Andrzej, who did not survive. Although she was eventually released and agreed to join the communist party (PZPR), her ties to the AK meant that she was never made into a hero. In fact, in 1965 when Sendler was recognized by Yad Vashem as one of the Polish Righteous among the Nations, Poland's communist government did not allow her to travel abroad at that time to receive the award in Israel; she was able to do so only in 1983. She was later employed as a teacher and vice-director in several Warsaw medical schools, and worked for the Ministries of Education and Health. She was also active in various social work programs. She helped organize a number of orphanages and care centers for children, families and the elderly, as well as a center for prostitutes in Henryków. However, she was forced into early retirement for her public declarations of support for Israel in the 1967 Israeli–Arab War (countries of the Soviet–controlled Eastern Bloc, including Poland, broke off diplomatic relations with Israel in the aftermath of this war). Sendler resigned her PZPR membership following the events of March 1968 in Poland.

In 1980 she joined the Solidarity movement.

Since Many years there are too many articles on Women Sex Predators, and aggressive women



Sex education: Why ARE so many female teachers having affairs with their teenage students... and is the 'cougar effect' to blame?

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Motherly Love Redefined ...

<http://crimeblog.dallasnews.com/2016/05/prosper-woman-who-had-sex-with-sons-teenage-friend-headed-to-prison.html/>

<http://www.wtol.com/story/6975375/mother-sentenced-for-having-sex-with-son>

<http://www.dailymail.co.uk/news/article-2716412/Mother-jailed-having-sex-12-year-old-SON-partner-watched-told-webcam.html>

<http://www.dreamindemon.com/2012/05/18/mistie-atkinson-mother-pleads-guilty-sex-teenage-son/>

<http://patch.com/california/dixon/vacaville-mom-convicted-sex-son-seeks-retrial-0>

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http://articles.orlandosentinel.com/1996-10-27/news/9610260994_1_extorting-endangerment-elementary-school-principal

<http://www.independent.ie/irish-news/incest-mother-is-convicted-of-sex-assault-on-her-two-sons-26462211.html>

http://canadiancrc.com/newspaper_articles/Tor_Star_Mother_confesses_sex_with_sons_030CT04.aspx

SEX WITH MY STUDENTS: THE TEACHERS WHO HAVE BEEN ARRESTED, CHARGED OR JAILED OVER THE PAST SCHOOL YEAR

Angela New, 39, from Gladewater, Texas, was arrested last week after school chiefs at Union Grove High School, where she taught English received a tip off about an alleged affair between her and an 18-year-old student.

Had the offence taken place a month later - after the teen graduated - she might not have been charged as he was no longer a full-time student and at the age of consent.

April Alexander, 26, from Irving, Texas, was last week arrested after being accused of having sex with a 16-year old student on more than 25 occasions.

The teen, now 18, told police he and the biology teacher had sex on more than two dozen occasions at MacArthur High School in Irving and in Alexander's car.



Brittni Colleps, 27, from Arlington, Texas, was arrested last week after being accused of having sex with five of her teenage students during an orgy at her home.

The English teacher and girl's basketball coach at Kennedale High School allegedly invited the boys to her home while her husband was away with the military and the sex romp was allegedly filmed on the students' cell phones. The married mother-of- three faces up to ten years in jail.



Michelle McCutchan, 38, was jailed in Checotah, Oklahoma, after admitting making a sex tape with her daughter's 16-year-old boyfriend.



The mother-of-one confessed to having sex with the teen on at least five occasions and setting up a video camera to film two of the romps.

<http://www.thedailybeast.com/articles/2014/06/10/canada-s-newest-refugee-a-florida-mom-convicted-of-unlawful-sex-with-a-minor.html>

<http://www.ibtimes.co.uk/us-idaho-lawsuit-reveals-sexual-assault-by-staff-male-teen-s-juvenile-detention-centers-1494582>

<http://www.mirror.co.uk/news/world-news/biology-teacher-who-sex-five-8850667>

<http://www.littlethings.com/foster-child-wwyd/>

<https://www.youtube.com/watch?v=htrItTarozA>

<https://www.youtube.com/watch?v=MC7hfCaRHIQ>

<http://www.gympietimes.com.au/news/roma-mother-guilty-of-bruising-sons-genitals/3089847/>

<http://www.breitbart.com/big-government/2016/09/14/mother-arranged-rape-murder-10-yr-old-daughter-allegedly-said-liked-watch/>

<http://thesmokinggun.com/buster/cigarette/cigarette-in-eye-628759#>

SEX WITH MY STUDENTS: THE TEACHERS WHO HAVE BEEN ARRESTED, CHARGED OR JAILED OVER THE PAST SCHOOL YEAR

Nicole Chapman, 28, was this month jailed for 10 to 12 months earlier this month for having sex with a 19-year-old special needs student in North Carolina.

Bizarrely the teenager's mother approved of the relationship between her son and the ex North Shelby teacher and told local TV: 'I ain't no victim. If it is love, man, it's love. Nobody can stop this.'

Marie L Fisher, 21, was last month charged with having a sexual relationship with a 15-year-old boy after sending him explicit text messages.

Fisher, who worked in the Special Education Department at Reeds High School in Sparks, Nevada, is alleged to have sent him a photo of her 'half naked breast' and later slept with him.



Bethyl Shepherd, 34, who worked in the same department as Fisher, was arrested last month after officials found out about an alleged threesome with two 17-year-old students.

Shepherd, who had taught at the school for 10 years, claimed one of the teens forced her to have sex while the other watched.



Barbara Anderson, 37, a teacher at a Washington State school, was arrested in March after allegedly having sex with a 17-year-old student.



The pupil in question told his uncle he was 'getting laid by a teacher,' according to court documents. She sent almost 800 text messages to the boy between January 15 and February 21, including more than 100 texts in one 24-hour period.



<http://equalitycanada.com/why-are-so-many-women-raping-boys-research-into-female-perpetrated-sexual-violence/>

<http://www.theindychannel.com/news/local-news/teacher-accused-of-sex-with-student-10-times-reaches-plea-deal-for-1-count-of-child-seduction>

<http://www.news.com.au/world/florida-mum-rachael-leahy-ordered-hit-on-exhusband-david-leahy/news-story/11b25d3fd6c5e007132d7fe28a4f7de1>

<http://www.9news.com.au/national/2016/09/14/07/26/poisoned-meatball-accused-due-in-vic-court/>

http://www.bostonherald.com/news/local_coverage/2016/09/saugus_mom_pleads_guilty_to_rape_of_two_teenage_boys

<http://www.express.co.uk/news/world/656971/Bullies-bikinis-attacked-sunbathing-victim-filmed-assault>

<http://www.bustle.com/articles/123975-6-signs-you-have-a-toxic-mother>

<http://txktoday.com/news/new-boston-woman-pleads-guilty-to-sexually-assaulting-13-year-old-boy/>

SEX WITH MY STUDENTS: THE TEACHERS WHO HAVE BEEN ARRESTED, CHARGED OR JAILED OVER THE PAST SCHOOL YEAR

Jamie Waite, 35, a swimming instructor at a school in Utah, was arrested in March for allegedly having sexual relations with a 17-year-old student.

Police in Utah arrested the teacher after a tip off from friends of the student who claimed the pair were having a relationship.

Deborah J Cox, 58, of Naperville became involved with the boy while he was at Neuqua Valley High School, police said.

The teacher's aide, had been the boy's personal academic tutor for several years, before she was arrested in March for having an alleged sexual relationship with him.



Carrie Shafer, 38, a biology teacher, was caught in March by police partially naked in a car with one of her students.

An arrest report revealed the married mother-of-two, from Kentucky, was in a compromising position with a 17-year-old student from her school in Louisville. Police said the windows of the car were 'steamed up' and both occupants were partially clothed.



Gail Gagne, 29, a weight room supervisor at Cretin-Derham Hall High School, Minnesota, was sentenced to two years probation in February after having sex with a then 16-year-old student - both at her home in Bloomington and at a nearby hotel.



<http://www.ibtimes.co.uk/married-teacher-who-had-affair-14-year-old-pupil-sent-him-video-online-charged-rape-1579807>

<http://www.dailymail.co.uk/news/article-3782055/Furious-bride-24-bit-fiance-s-ear-slashed-face-broken-glass-wedmin-meetings-went-horribly-wrong.html>

<http://www.nydailynews.com/news/national/conn-woman-drowned-baby-shorter-sentence-article-1.2783131>

<https://www.theguardian.com/commentisfree/2015/oct/06/children-older-women-abused-jade-hatt>

<http://thechannelhiphop.com/boyfriend-saw-his-girlfriend-having-sex-with-two-dogs-and-called-the-police/>

<http://www.telegraph.co.uk/news/uknews/law-and-order/5251042/Rise-of-ladette-culture-as-241-women-arrested-each-day-for-violence.html>

<http://www.thespectrum.com/story/news/2016/06/07/18-year-old-laverkin-woman-arrested-having-sex-15-year-old-boys/85571780/>

http://www.huffingtonpost.com/2013/11/09/nicole-kurowski-teacher-sex_n_4241276.html

SEX WITH MY STUDENTS: THE TEACHERS WHO HAVE BEEN ARRESTED, CHARGED OR JAILED OVER THE PAST SCHOOL YEAR

Chanda Frank, 34, a physical education coach at Haywood High in Brownsville, was charged with sexual battery in February, after allegedly fondling a 14-year-old female student on her softball team.



It happened at least twice between the dates of August 2010 and February 2011, according to court documents.

Stacy Schuler, 32, of Mason, Ohio, was charged with committing sex acts with students from her high school football team in February.



She faces 19 felony counts of sexual battery involving five male students, three misdemeanor charges of serving alcohol to underage youths and more than 96 years in prison if convicted.

Ashley Blumenshine, 27, a PE and dance teacher was arrested in January behind a department store in Plainfield, Illinois, after police caught her in a car with a 16-year-old boy student.



Police believe they had had sex shortly before the officers arrived and say the relationship may have gone on for more than a month.

Courtney Bowles, 31, a teacher who advised colleagues on how to avoid affairs with students, was caught having sex with a teenager in her car.



Bowles was found by a police officer lying naked on top of the boy, who was also naked, from her school in Colorado. A partly consumed bottle of vodka was also found in the car with the couple.

<http://www.craveonline.com/site/1062074-uk-teacher-had-sex-with-15-year-old-more-than-50-times-claimed>

<http://www.sun-sentinel.com/local/broward/fl-female-bank-robbers-20160722-story.html>

<http://www.heraldsun.com.au/news/law-order/fight-to-extradite-ultraorthodox-jewish-school-principal-accused-of-molesting-and-raping-students-dropped/news-story/194cad2f934cca5858500ffebf4858c4>

<https://www.theguardian.com/society/2009/oct/04/uk-female-child-sex-offenders>

<http://www.adelaidenow.com.au/news/south-australia/woman-who-tried-to-kill-exs-new-girlfriend-unable-to-show-empathy-for-her-victim-court-told/news-story/7b22da29e8cc18e413269a0be58800b0>

<https://www.youtube.com/watch?v=syWtUykS7L0>

https://www.youtube.com/watch?v=3g_OPKvDgpU

<https://www.youtube.com/watch?v=VPl5PkjVs3A>

<https://www.youtube.com/watch?v=AFk1FyKDYec>

<https://www.youtube.com/watch?v=oIn5OfNFa5I>

SEX WITH MY STUDENTS: THE TEACHERS WHO HAVE BEEN ARRESTED, CHARGED OR JAILED OVER THE PAST SCHOOL YEAR

Marcie Lynn Rousseau, 34, had sex with a 16-year-old student at least 100 times.

The Michigan English teacher was sent to prison last December to serve a minimum of four years having pleaded guilty to all the charges.

But her defence lawyer said of the student: 'He took part in this also ... He courted her, bought her lunch, brought her flowers.'

Jennifer Riojas, 27, a science teacher in Fort Worth, Texas, was pregnant when arrested for sexual assault in November after allegedly having sex with a 16-year-old student.

The pupil told police they met in motels and even had sex when he was in a hospital bed recovering from a football injury.



Megan Baumann, 28, is currently serving three years in prison after pleading guilty to various sex charges involving three male students.

The social sciences teacher had sex with one and sent him naked pictures of herself by text. The former Tennessee teacher sent texts of her breasts and pubic region to another while she fondled the third while he was clothed.



Carlie Rose Attebury, 31, a former California marching band teacher, denied having sex with a 15-year-old student but admits having sex with two former students when they were 18. Attebury said that she hugged the 15-year-old boy as she did any 'band kid'. She was sentenced to 16 months in prison in March.



<http://www.dailymail.co.uk/news/article-3274956/Disturbing-rise-women-child-sex-predators-s-punished-leniently-men.html?ito=social-facebook>

<https://www.youtube.com/watch?v=L5gWMO2JPa4>

<https://www.youtube.com/watch?v=76rAn4JZfiA>

<https://www.youtube.com/watch?v=W5RJBcsQq7Q>

<https://www.youtube.com/watch?v=yXAM83Lq8d0>

<https://www.youtube.com/watch?v=XfxkVjawYYg>

https://www.youtube.com/watch?v=4_Uum7tEUqg

<https://www.youtube.com/watch?v=D3ILPAUmPrw&list=PLfqvIEGoZYGzaCWw7VPYrY6sCtkbxOat8>

<https://www.youtube.com/watch?v=H6a9Szp8FwY>

https://www.youtube.com/watch?v=p_GLJUPrtNU

<https://www.youtube.com/watch?v=8uDEB2KG9XU>

SEX WITH MY STUDENTS: THE TEACHERS WHO HAVE BEEN ARRESTED, CHARGED OR JAILED OVER THE PAST SCHOOL YEAR

Elizabeth Colleen Wallis, 34, was sentenced in March to four months in the Yuba County Jail for having sex with a former underage special needs student now 17.



Wallis a teacher's assistant at Yuba Gardens Intermediate School in Olivehurst, California, came to the attention of police when they were notified of the alleged inappropriate relationship by a concerned family member of Wallis.

The boy's mother had indicated that her son was in love with Wallis.

Kimme Woolf, was a 29-year-old math teacher at Perrin High School in Perrin, Texas, when she was arrested for allegedly committing sexual assault on a male student, 16, and having an improper relationship with another, 18, last November.



Woolf is alleged to have slept with both boys after they repeatedly asked for sex. She is also thought to have performed oral sex on both.

Felecia Killings, 27, an English teacher at Rodriguez High School in Fairfield, California was arrested in November on allegations of having sex with a 16-year-old student.



Police believe the alleged relations took place at Killings' home.

Sara Leann Dwiggins, 24, a math teacher at South Creek Middle School in Williamston, North Carolina, was arrested on allegations of having sex with a 14-year-old former student. She has been charged with two counts of statutory rape and two counts of sex offence with a student.



Gina Watring, 40, was jailed for five years last September after admitting having sex with a boy, 10, at the primary school in Durham, North Carolina. The mother-of-two had faced up to 70 years after being charged with dozens of offences.



A Psychologist has an explanation ...

<http://www.dailymail.co.uk/news/article-1391626/Whats-wrong-female-teachers-American-as-schools-summer-young-teacher-arrested-sex-16-year-old-student--latest-dozen-cases-school-year.html>

https://www.youtube.com/watch?v=vWikSI0j_wA

A Mother Who Killed Her 5 Children

<https://www.youtube.com/watch?v=Mp-zuabUeXU>

<https://www.youtube.com/watch?v=tz7DCorxLbo>

<https://www.youtube.com/watch?v=jf6VU5meuho>

<https://www.youtube.com/watch?v=gEP0k4ZMFfk>

<https://www.youtube.com/watch?v=vfVFklqG0NM>

Why are Modern Women so aggressive ?



Why are modern women so aggressive? The dark side of equality

Gemma Dawson, 27, from Wakefield, (left), Jo Scott, 51, from Sussex, (centre) and Annmarie Fisher, 32, from Iver, (right) reveal what makes them angry and why.

DAILYMAIL.CO.UK

<https://www.theguardian.com/education/2006/jan/23/pupilbehaviour.schools>



Female Sex Predators: A Crime Epidemic

13 hrs - 0

More perverts



Model walks topless through New York in support of Free The Nipple

Model Emily Bloom, 23, has bravely walked topless through New York City in support of the Free The Nipple campaign for gender equality, leaving passers-by...

DAILYMAIL.CO.UK

See <https://www.facebook.com/WomenCriminals/>



North Carolina woman, 45, arrested for having sex with adult son

A 45-year-old North Carolina woman and her 25-year-old son have been arrested for having sex with each other.

NYDAILYNEWS.COM

Girl rushes field at college world series, proceeds to grab every player's butt.



Frank Meza

If a man would have done that to a woman's soccer or volleyball game he would have been jailed as a sex offender and sued for sexual harassment faster than you could say "feminism isn't about equality".

See <https://www.facebook.com/groups/499811210056249/>

Published on Sep 14, 2016 | Updated 3 days ago | By Susmita Pathak Mishra | In Featured, World News

Police have charged a North Carolina mom-son pair with **incest** after an August report claimed that they had sex with each other.

Forty-four-year-old Melissa Nell Kitchens shared a sexual relationship with 25-year-old son Shaun Thomas Pfieffer. As soon as the matter became known to the police, Buncombe County Police started investigating, after which the duo was arrested. Both suspects are due to appear in court later in September.

“Can’t get over how handsome you are and I’m about to cry,” one of the Facebook posts of Kitchens stated. The post was accompanied by the picture of her son. “Things are very stressful and I love you and I respect any decision — as long as you’re happy and safe ... I miss you and wish I had more time with you.”

The **arrest** warrants stated the counts of charges on the suspects. Mother and son have both been charged with one count of incest. Where the mother had sex with her son, who is already married to Shannon Roman and has a young son, the son is also due to face charges of indecent liberties with a child. The latter incident took place on August 13 when Pfieffer communicated threats and behaved disruptively.

<http://www.australianetworknews.com/melissa-kitchens-incest-american-mom-sex-son-25-gets-arrested/>

<http://www.irishtimes.com/news/crime-and-law/waterford-mother-convicted-of-child-cruelty-following-seven-week-trial-1.2657598>

<http://www.fox19.com/story/32236822/convicted-sex-offender-asks-mother-of-14-year-old-i-want-her-what-do-you-want-for-it>

<http://www.insideedition.com/headlines/16733-mom-and-female-partner-convicted-of-t torturing-murdering-2-year-old-son-who-fell-off>

<https://www.rt.com/uk/354212-wales-mother-porn-court/>

<http://q13fox.com/2016/02/04/marysville-mother-convicted-of-sex-crimes-involving-daughter/>

<http://www.charlotteobserver.com/news/local/crime/article77122242.html>

http://www.omaha.com/bellevue-mom-convicted-of-sexually-abusing-son-gets--/article_1393b0df-a383-58c3-a8e7-e5af713cc630.html

http://www.huffingtonpost.in/entry/wisconsin-mom-sentenced-sex-crimes-toddler_n_6237550

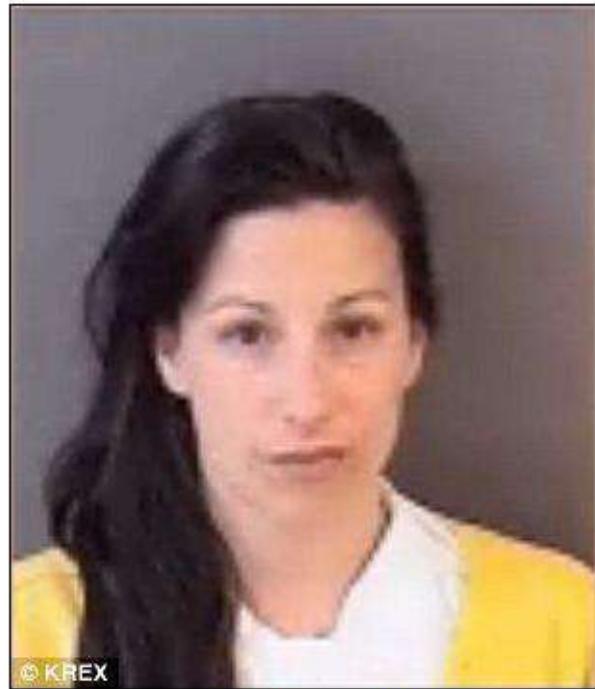
A mother accused of sexually seducing her underage son's friend during a sleepover, telling him he could 'pretend to be 18 for the night,' was arrested March 1.

36-year-old Wendy Crowell now faces seven criminal charges, six of which are felonies, tied to sexual assault on a minor between 15 and 16 years old.

SCROLL DOWN FOR VIDEO

When a police detective questioned Crowell at her Grand Junction, Colorado home, she claimed she exchanged texts with all her son's friends.

A gut feeling led the boy's mother to suspect a possible relationship between her son and Crowell.



© KREX

Naughty mom: Wendy Cowell of Grand Junction, Colorado is accused of having sex with her son's underage friend multiple times

<http://www.dailymail.co.uk/news/article-2287494/Grand-Junction-mom-Wendy-Cowell-sex-sons-underage-best-friend.html>

<http://www.vindy.com/news/2011/oct/06/pa-mom-sentenced-for-sex-with-son8217s-t/>

<http://www.murfreesboropost.com/mother-convicted-of-raping-son-years-ago-cms-41753>

<http://www.digitaljournal.com/article/294597>

<http://cnews.canoe.com/CNEWS/Crime/2014/08/05/21854361.html>

<http://www.politicsforum.org/forum/viewtopic.php?t=121028>

<http://www.complex.com/pop-culture/2012/08/orange-county-mother-convicted-for-crossing-line-with-sons-friend>

<http://www.usatoday.com/story/sports/nfl/2015/08/21/molly-shattuck-ravens-cheerleader-sentenced-rape-boy/32108039/>

POLICE: DELCO MOM HAD SEX WITH SON'S TEEN FRIEND

Police: Delco mom had sex with son's teen friend
none

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February 23, 2012 6:58:14 AM PST

Action News

UPPER CHICHESTER, Pa. - February 22, 2012 -- A Delaware County mother, accused of having sex with her son's 15-year-old friend, is out of jail and awaiting an arraignment.

A judge has agreed to place 34-year-old Teri Mezzatesta on an electronic monitoring system so she can take care of her disabled grandmother at her Upper Chichester home.

Mezzatesta faces charges of statutory sexual assault, a second-degree felony, and false swearing in official matters by falsely incriminating another.

Mezzatesta claims she was sexually assaulted.

Mezzatesta was arrested on January 27 after, according to the affidavit, her son went to school officials about what he allegedly saw on the night of November 15.

In the affidavit, the 14-year-old son tells police he witnessed his mother having sexual intercourse with his 15-year-old friend who was

<http://6abc.com/archive/8554005/>

<http://bossip.com/920633/hide-ya-kids-cali-mom-sentenced-6-years-in-prison-for-sexing-sons-12-year-old-friend-43081/>

<http://wncn.com/2016/07/02/ga-mom-sentenced-after-teen-naked-twister-party-with-sex-and-drugs/>

<http://www.chron.com/news/houston-texas/houston/article/Mother-who-supplied-drugs-in-prom-death-pleads-7431853.php>

http://www.starherald.com/news/local_news/sidney-mom-sentenced-in-molestation-of-son/article_09b03185-47a1-51a2-a6b6-98adc270d8ed.html

http://www.twcnews.com/archives/nys/central-ny/2007/12/14/mom-sentenced-in-sex-abuse-case-NY_38392.old.html

<http://wtvr.com/2015/08/23/molly-shattuck-oldest-ravens-cheerleader-rapes-sons-15-year-old-friend/>

http://maddad0467.newsvine.com/_news/2011/10/07/8203176-mom-sentenced-for-three-some-with-sons-friends

<http://www.dispatch.com/content/stories/local/2012/09/05/mother-sentenced-for-raping-her-baby.html>

news24 archives

Breaking News. First.

Mom 'had sex with son'

2010-01-28 10:02

Omaha - A 41-year-old US woman is accused of having sex nightly with her teenage son when he was in seventh and eighth grades, officials said on Wednesday.

Omaha Police said the now 15-year-old boy reported the alleged abuse last week to a counsellor, who notified authorities. The boy told police his mother was addicted to prescription drugs when the alleged abuse took place in 2008 and 2009 while he lived with her in Omaha.

The woman, who lives in the state of Nebraska, was arrested on Monday, according to Officer Michael Pecha. She made an initial appearance on Wednesday in court and her bond was set at \$30 000.

The Associated Press is not identifying the woman to protect her son's identity as a possible victim of sexual assault.

The teen has a younger brother, but authorities do not suspect the younger boy suffered any abuse, Douglas County Attorney Don Kleine said.

The boy's father told Omaha television station WOWT this week that he had previously had a feeling something was wrong, but didn't learn about the alleged abuse until a few weeks ago. He said his son is receiving counselling.

The woman will be represented by a public defender's office, but an attorney wasn't to be assigned to her case until Thursday. A preliminary hearing to discuss details of the charge against her was scheduled for February 8.

<http://www.news24.com/world/news/mom-had-sex-with-son-20100128>

<http://nypost.com/2016/04/09/mom-and-son-admit-to-incest-go-into-hiding-to-avoid-jail/>

<http://www.cbc.ca/news/canada/windsor/mom-gets-1-year-for-sex-with-foster-son-1.1121822>

<http://www.mcclatchydc.com/news/breaking/mc-allentown-verdict-woman-accused-molesting-boy-20160309-story.html>

http://www.nytimes.com/2015/10/25/magazine/the-strange-case-of-anna-stubblefield.html?_r=0

<http://www.norwalkreflector.com/Local/2015/09/21/Sex-offender-039-s-mom-talks-about-2009-juvenile-court-case>

<http://abcnews.go.com/US/hummer-mom-christine-hubbs-force-sex-teen-boys/story?id=13541399>

OC mom had sex with son's underage teammates,

by AP September 20 2011

SHARE



A 44-year-old Orange County woman had sex with at least two boys on her son's hockey team, investigators say. Both team members were under 18.

Orange County sheriff's spokesman Jim Amormino says one of the boys is under 16 years old and the other is under 14.

Amormino tells a local wire service that Kathia Maria Davis of Laguna Niguel was arrested last week and she was booked for investigation of unlawful sex and lewd acts with a minor. She was released after posting \$25,000 bail.

Davis was initially suspected of having sex with one boy. Amormino said Monday that a second boy has now surfaced and there may be a third.

<http://www.scpr.org/news/2011/09/19/28941/oc-mom-had-sex-sons-underage-teammates-authorities/>

<http://gasmicgore.com/forum/archive/index.php/t-3786.html>

http://lancasteronline.com/news/mom-sentenced-for-prostituting-son/article_d035429a-9354-5d37-8d17-0815efd0a3c2.html

<http://www.mercurynews.com/2009/12/15/north-carolina-mom-sentenced-for-putting-son-in-boiling-water/>

http://us.geosnews.com/p/us/oh/cuyahoga-county/cleveland/appellate-court-again-rules-mom-convicted-of-helping-son-in-madison-township-murder-should-get-new-trial_4970914

<https://www.propublica.org/article/false-rape-accusations-an-unbelievable-story>

<http://world.sports--news.com/news/lacey-spears-a-mother-accused>

<http://archive.decaturdaily.com/decaturdaily/news/070621/mom.shtml>

<http://www.tdcaa.com/node/3056>

<http://www.pravdareport.com/news/world/americas/04-11-2005/69955-0/>

Idaho mom had sex with son's friends

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Idaho mom had sex with son's friends

by **Abcshanghai** » Sat Jan 05, 2013 3:16 pm

http://www.cbsnews.com/2300-504083_162-10014846.html

I don't know about you guys but when was 15 I wanted to bang everything that moves.

Come to think about it I still want to bang everything that moves, but it still has to pass the ugly meter unless I'm drunk.

I don't feel the 15 year old boys are the victims. Its like bringing rights. Hey I banged your mom, no seriously I literally banged your mom.

The victim is the mother in jail and her son having to live with out his mother and being stigmatized by his mother in jail.

The boys with so much testosterone in them thats what they do.

What's the big deal? Its most boys fantasy to have sex with an older women.

I remember in 6th grade my teachers name was Mrs. Rucker and oh boy did I want to...we'll you know. and she had a big old rack.

<http://www.shanghaiexpat.com/phpbbforum/idaho-mom-had-sex-with-son-s-friends-t151005.html>

<http://www.newsgrilio.com/articles/248052-mom-drunkenly-let-a-convicted-sex-offender-who-exposed-himself-to-girls-under-13-give-her-three-children-permanent-tattoos.html>

<https://traffickalerts.wordpress.com/2015/01/15/incest-mom-sentenced-to-219-year-in-prison-over-alabama-sex-ring/>

<http://www.dailymail.co.uk/femail/article-2081674/Poppy-Burge-gets-liposuction-voucher-Human-Barbie-mum-Sarah-Christmas.html>

<http://www.nydailynews.com/news/national/florida-mom-charged-setting-fight-daughter-amp-classmate-article-1.1012931#ixzz1kx3LwRVQ>

<https://uk.style.yahoo.com/blogs/yahoo-lifestyles/mother-gives-botox-injections-her-eighth-old-daughter-184941192.html>

About Fallacies and Logic

Hasty Generalisation is one of the most common Fallacies practiced by Human Beings. This is (often) the case; because 2 of the important “ theorems ” of Statistics are NOT appreciated.

Two of these theorems of Statistics being -

S1 - Larger the sample size better the observation. As the sample size approaches the “ Total Population ” the reality is manifested better.

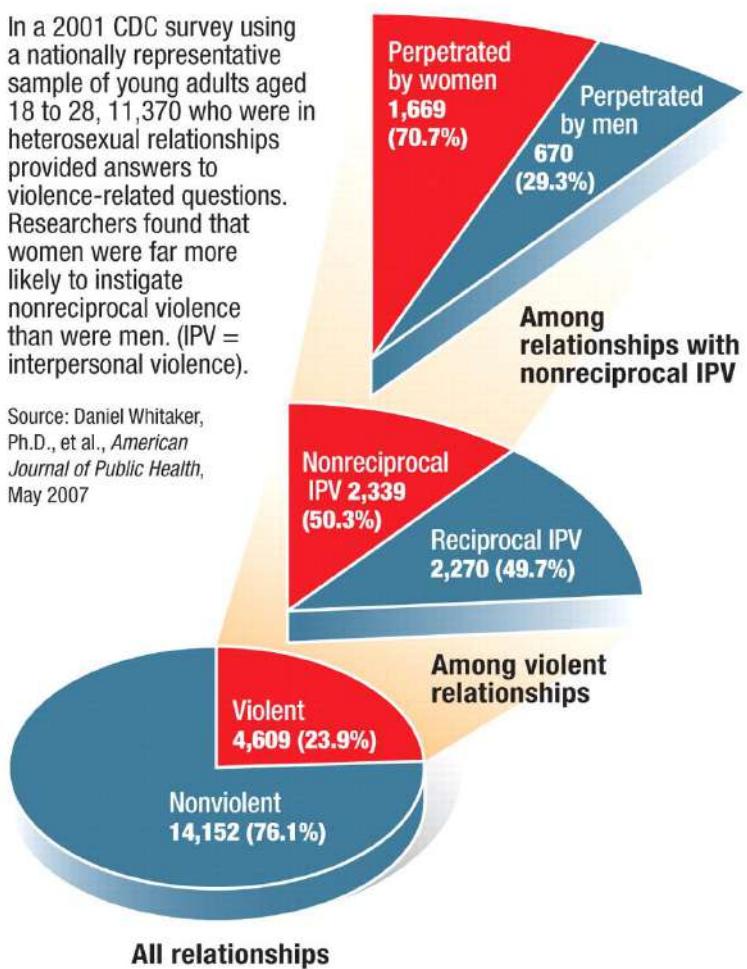
S2 - The sample types should vary widely. Wider is the variation the random noise is eliminated the most.

It is fallacious to generalize with a very few observations or by personal experience / perception. [Before seeing the Statistics below, try to answer from your perception ... “who amongst Men and Women instigate violence ?“]

Women Often the Aggressors

In a 2001 CDC survey using a nationally representative sample of young adults aged 18 to 28, 11,370 who were in heterosexual relationships provided answers to violence-related questions. Researchers found that women were far more likely to instigate nonreciprocal violence than were men. (IPV = interpersonal violence).

Source: Daniel Whitaker, Ph.D., et al., *American Journal of Public Health*, May 2007



Also it is known from study of Psychology that (often) people tend to justify their perception and actions ‘ more than required ‘ to avoid being seen as foolish.

People give asymmetrical importance to their opinions and emphasize it too much.

Daniel Kahneman got Nobel Prize in Economics for his work on “ Behavioral Finance ”. He had shown that people are NOT “ equi-proportionate ” in their choices, actions and decisions.

There have been interesting developments in “ Game theory ” also giving insights on “ sub-optimal ” choices that people make in their decisions.

An unbiased statistical experiment with sample size larger than the minimum required, and varying widely can throw light on the REALITY.

There are many types of Fallacies, namely -

1) Post Hoc

2) Poisoning the Well

3) Bandwagon

Etc ...

18 types of Logical Fallacies are described at <http://kspope.com/fallacies/fallacies.php>

42 types of Fallacies are described at <http://www.nizkor.org/features/fallacies/>

One of the ways of classifying the fallacies is -

1) Formal Fallacies

2) Informal Fallacies

3) Aristotelian Fallacies

3.1 - Material Fallacies

3.2 - Verbal Fallacies

3.3 - Logical Fallacies

A nice list of Fallacies is given at http://en.wikipedia.org/wiki/List_of_fallacies

The following Cognitive Traps we succumb to -

1) Availability Bias - This causes us to base our decisions on information that are more readily available than doing an exhaustive search. If someone asks you the question ... In English do we have more words starting with R or more words where R is in the 3rd place ? The correct way to answer this is I do not know, we have to search / analyze and see. But as we tend to remember words by their first alphabet we tend to recall words starting with R but hardly can remember words such as FoRt, MaRt, FeRtilizer etc. (It seems after an exhaustive search it is found that we have more WoRds where R is in the 3rd place than in 1st place !)

2) Hindsight Bias - (ex post) - This causes us to attach higher probability to events after they have happened than we did before they happened. This bias also lasts for only a small amount of time such as few days or weeks. In 1970s at Howrah station (Calcutta / Kolkata) a passenger train could not brake in time and dashed at the end of the line (Platform) to stop. [Similar to Chennai / Madras the rail ends one way at Howrah station. The trains do not cross through the station but comes and returns the same way.] This crash caused the first bogie to get mutilated very badly and a few people died. Now this first bogie generally is very crowded, as people want to rush out and run a smaller distance to reach the office / Business. For next few days the first bogie was almost empty in local trains, and slowly was forgotten. In history of Howrah station this type of accident may have happened only 3 - 4 times. Except the one mentioned above the other crashes were minor in nature. So the “

Hindsight Bias “explains why people were too cautious for a few days to keep the first bogie empty and then slowly forget.

3) The problem of Induction - This causes us to formulate general rules on the basis of insufficient information. (Hasty Generalization). CPI / CPM parties have been ruling West Bengal for decades so often many outsiders term all Bengalis as communists. I have even seen the following type of conversation sequence ... In a training program the trainer gave me a Red pen and jokingly said you will like this colour ! As I asked why do you think so ? He said : You are a Bengali, so you are a communist. Red is the colour of communists ! So you should like it !

4) The fallacy of Conjunction - (or Disjunction) - This causes us to overestimate the probability of 10 events each with 90% probability, will ALL occur, while underestimating the probability that at least 1 of the 10 events with just 10% probability is quite likely to occur. In fact human beings in general are not good as estimating probability or estimating the occurrence frequency of an event.

5) Confirmation Bias - This inclines us to look for confirming evidence of an initial hypothesis, rather than falsifying evidence that would disprove it. Often when the Media / Press wants to malign someone (Character Assassination) then keeps giving biased Negative evidences to paint the character. The readers / TV viewers refer to only this propaganda rather than search opposite evidences of their own.

6) Contamination Effects - This causes us to allow irrelevant but proximate information to influence a decision.

7) The Affect Heuristic - This causes us preconceived value-judgments interfere with our assessment of costs and benefits.

8) Scope Neglect - This prevents us from proportionately adjusting what we should be willing to sacrifice to avoid harms of different orders of magnitude. As the stock market rises, a prudent investor should switch part of equity systematically to Debt funds (say MIPs) and at the peak day should exit all equity to put all her investments into Liquid / Debt funds. But in practice how many people does this ? The peak of Equity market is peak because majority are buying more equity than are selling !

9) Overconfidence in Calibration - This leads us to underestimate the confidence intervals within which our estimates will be robust. (to mixup best case scenario with most probable scenario).

10) Bystander Apathy - This inclines us to abdicate individual responsibility when in a crowd. John Darley & Bibb Latane - Bad Samaritan explanation. Victims chance of being helped within 45 secs was 50% in case of 1 bystander while 0% in case of 5 or more bystander. In the industry, “

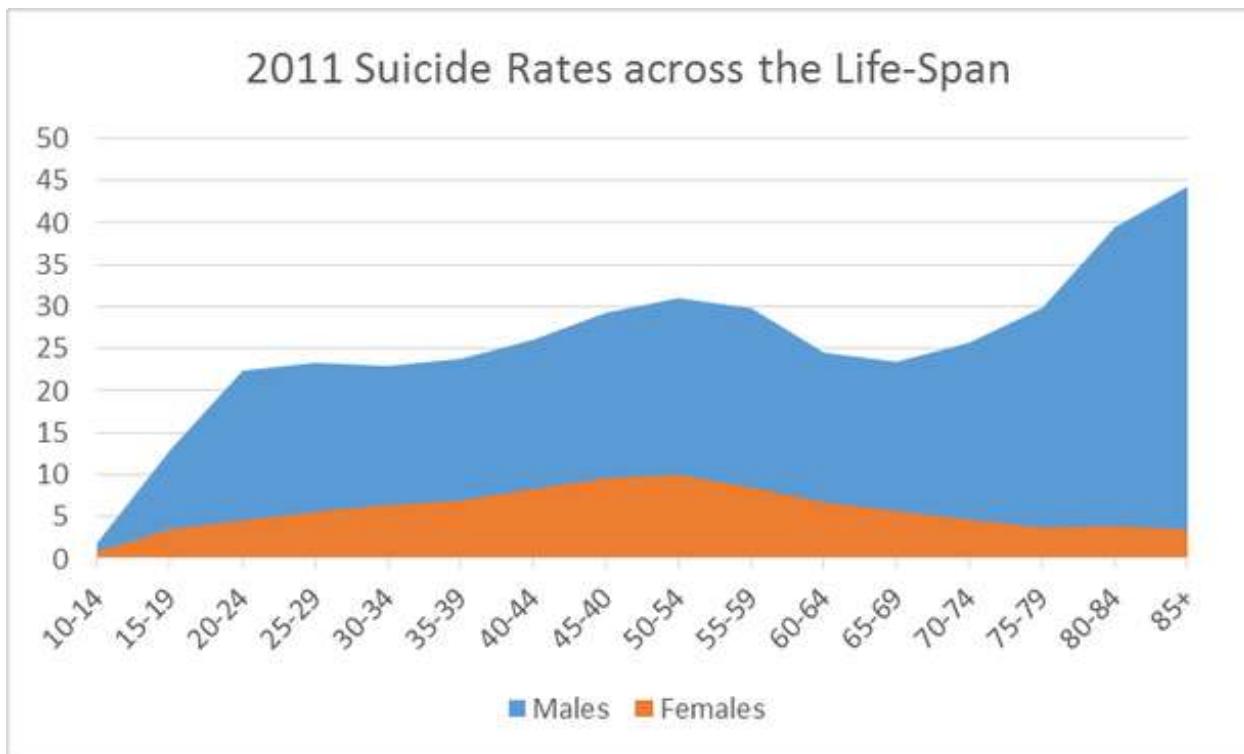
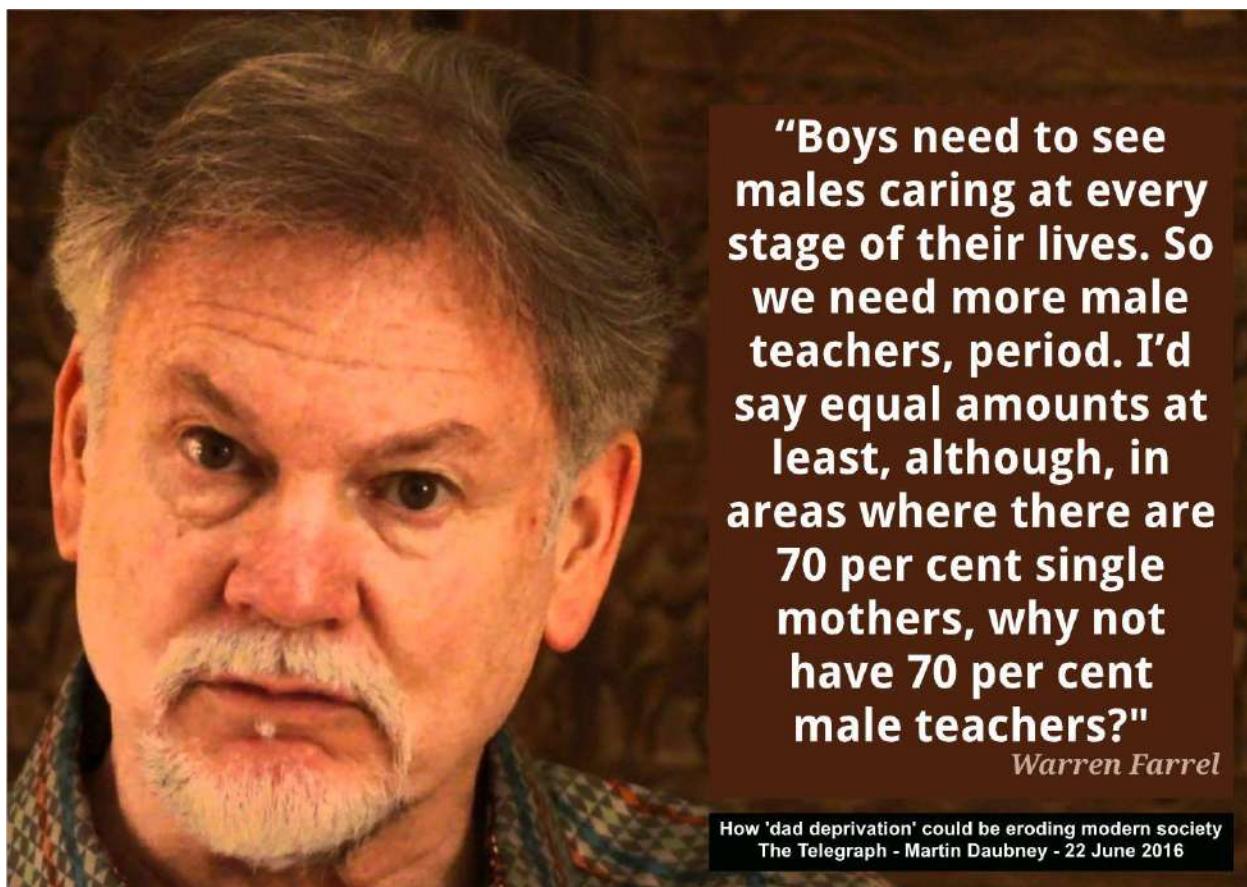
Group email “is great for Information propagation but not for seeking help. Only handful people are active in Discussion groups. Individual emails evoke better response.

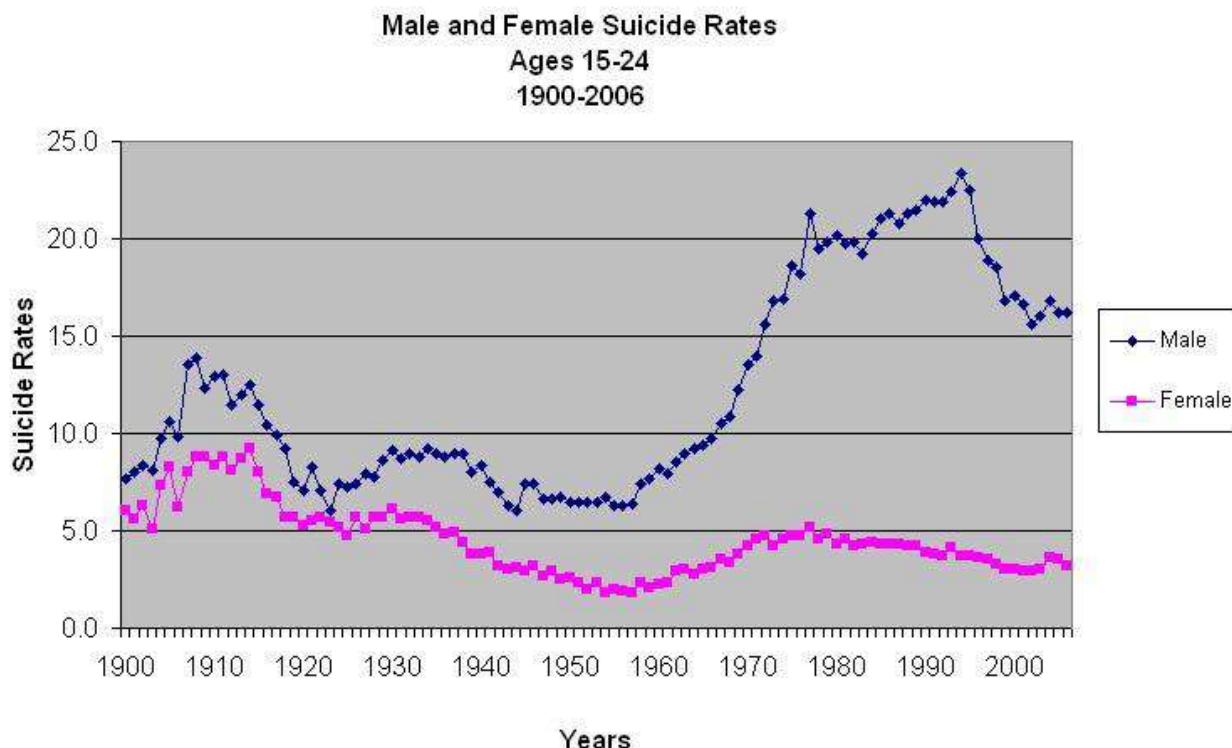
Some of the psychological traps that affect way people make business decisions ...

- The anchoring trap - Leads to give disproportionate weight to first information or a few first information. Can be avoided by circulating the agenda beforehand.
- The status quo trap - Momentum , culture , heritage problem.
- Sunk–Cost trap - This inclines us to perpetuate the mistakes of the past.
- The confirming evidence trap - This leads us to seek out information supporting an existing predilection and to discount opposing information
- The framing Trap - This occurs when we misstate a problem, undermining the entire decision - making process.
- The prudence tap - This leads us to be overcautious when we make estimates about uncertain events.
- The recallability trap - This leads us to give undue weight to recent, dramatic events.

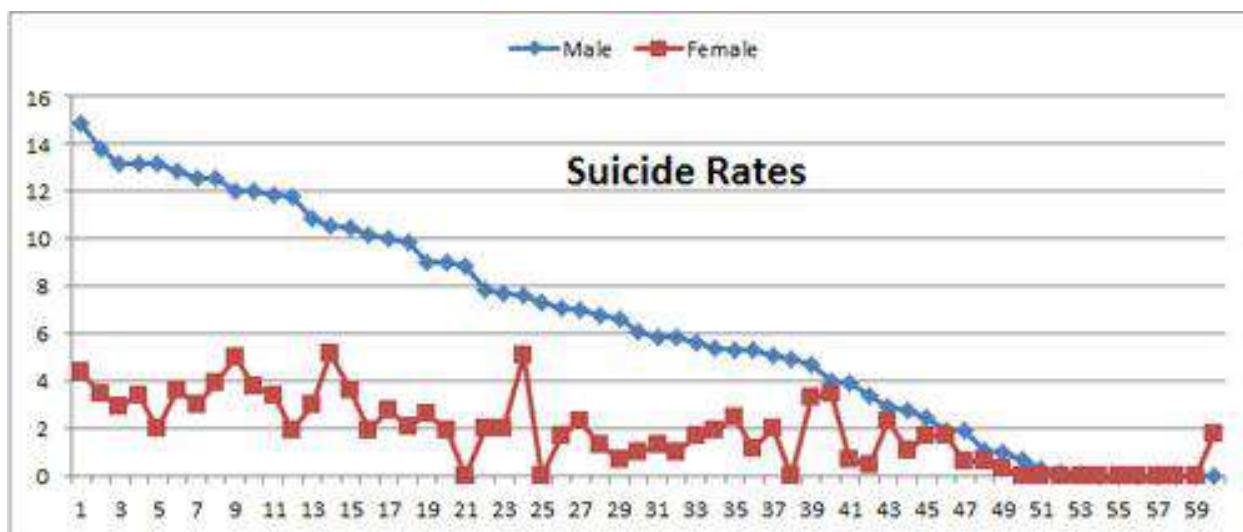
For example Dr Warren Farrell is not limited or trapped with traditional Biases

See ... what he says ...





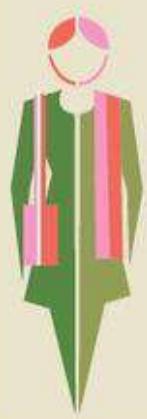
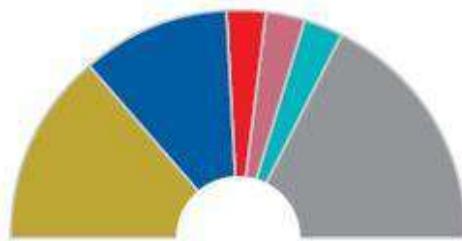
How many people are bothered about Male suicide rate being so high ? Worldwide average rate (of all ages combined) of Male suicide rate is 4 times higher than that of Women. Does anyone care ? Most people are Biased to assume Men are Disposable.



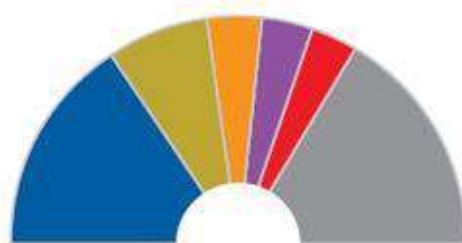
VIOLENT END: THE CAUSES OF MORTALITY



TOP 5 CAUSES OF UNNATURAL DEATH AMONG MEN



TOP 5 CAUSES OF UNNATURAL DEATH AMONG WOMEN



SOURCE: NATIONAL CRIME RECORDS BUREAU

STATS ON SUICIDES

SUICIDES ACCORDING TO SOCIAL STATUS

Status	Male	Female	Transgender	TOTAL	% Share
Un-Married	17,999	9,820	6	27,825	21.1
Married	59,744	27,064	0	86,808	65.9
Widowed/ Widower	1,410	1,304	—	2,714	2.1
Divorcee	551	417	—	968	0.7
Separated	599	316	1	916	0.7
Total (including other & no status)	89,129	42,521	16	1,31,666	100.0

To recall standard integrals

$f(x)$	$\int f(x)dx$	$f(x)$	$\int f(x)dx$
x^n	$\frac{x^{n+1}}{n+1} \quad (n \neq -1)$	$[g(x)]^n g'(x)$	$\frac{[g(x)]^{n+1}}{n+1} \quad (n \neq -1)$
$\frac{1}{x}$	$\ln x $	$\frac{g'(x)}{g(x)}$	$\ln g(x) $
e^x	e^x	a^x	$\frac{a^x}{\ln a} \quad (a > 0)$
$\sin x$	$-\cos x$	$\sinh x$	$\cosh x$
$\cos x$	$\sin x$	$\cosh x$	$\sinh x$
$\tan x$	$-\ln \cos x $	$\tanh x$	$\ln \cosh x$
cosec x	$\ln \tan \frac{x}{2} $	cosech x	$\ln \tanh \frac{x}{2} $
sec x	$\ln \sec x + \tan x $	sech x	$2 \tan^{-1} e^x$
$\sec^2 x$	$\tan x$	$\operatorname{sech}^2 x$	$\tanh x$
cot x	$\ln \sin x $	$\coth x$	$\ln \sinh x $
$\sin^2 x$	$\frac{x}{2} - \frac{\sin 2x}{4}$	$\sinh^2 x$	$\frac{\sinh 2x}{4} - \frac{x}{2}$
$\cos^2 x$	$\frac{x}{2} + \frac{\sin 2x}{4}$	$\cosh^2 x$	$\frac{\sinh 2x}{4} + \frac{x}{2}$

$f(x)$	$\int f(x)dx$	$f(x)$	$\int f(x)dx$
$\frac{1}{a^2+x^2}$	$\frac{1}{a} \tan^{-1} \frac{x}{a}$ $(a > 0)$	$\frac{1}{a^2-x^2}$ $\frac{1}{x^2-a^2}$	$\frac{1}{2a} \ln \left \frac{a+x}{a-x} \right \quad (0 < x < a)$ $\frac{1}{2a} \ln \left \frac{x-a}{x+a} \right \quad (x > a > 0)$
$\frac{1}{\sqrt{a^2-x^2}}$	$\sin^{-1} \frac{x}{a}$ $(-a < x < a)$	$\frac{1}{\sqrt{a^2+x^2}}$ $\frac{1}{\sqrt{x^2-a^2}}$	$\ln \left \frac{x+\sqrt{a^2+x^2}}{a} \right \quad (a > 0)$ $\ln \left \frac{x+\sqrt{x^2-a^2}}{a} \right \quad (x > a > 0)$
$\sqrt{a^2-x^2}$	$\frac{a^2}{2} \left[\sin^{-1} \left(\frac{x}{a} \right) + \frac{x\sqrt{a^2-x^2}}{a^2} \right]$	$\sqrt{a^2+x^2}$ $\sqrt{x^2-a^2}$	$\frac{a^2}{2} \left[\sinh^{-1} \left(\frac{x}{a} \right) + \frac{x\sqrt{a^2+x^2}}{a^2} \right]$ $\frac{a^2}{2} \left[-\cosh^{-1} \left(\frac{x}{a} \right) + \frac{x\sqrt{x^2-a^2}}{a^2} \right]$

Some series Expansions –

$$\frac{\pi}{2} = \left(\frac{2}{1}\frac{2}{3}\right)\left(\frac{4}{3}\frac{4}{5}\right)\left(\frac{6}{5}\frac{6}{7}\right)\left(\frac{8}{7}\frac{8}{9}\right)\dots$$

$$\pi = \frac{4}{1} - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} - \frac{4}{11} + \frac{4}{13} - \dots$$

$$\frac{\pi}{4} = \frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \dots$$

$$\pi = \sqrt{12} \left(1 - \frac{1}{3 \cdot 3} + \frac{1}{5 \cdot 3^2} - \frac{1}{7 \cdot 3^3} + \dots \right)$$

$$\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \dots = \sum_{n=1}^{\infty} \frac{1}{n^2}$$

$$\int_0^{\pi/2} \log \sin x \, dx = -\frac{\pi}{2} \log 2 = \frac{\pi}{2} \log \frac{1}{2}$$

Solve a series problem

If $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots$ upto $\infty = \frac{\pi^2}{6}$, then value of

$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$ up to ∞ is

- (a) $\frac{\pi^2}{4}$ (b) $\frac{\pi^2}{6}$ (c) $\frac{\pi^2}{8}$ (d) $\frac{\pi^2}{12}$

Ans. (c)

Solution We have $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$ upto ∞

$$= \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} + \frac{1}{6^2} \dots \text{ upto } \infty$$

$$- \frac{1}{2^2} \left[1 + \frac{1}{2^2} + \frac{1}{3^2} + \dots \right]$$

$$= \frac{\pi^2}{6} - \frac{1}{4} \left(\frac{\pi^2}{6} \right) = \frac{\pi^2}{8}$$

$$1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \frac{1}{5^2} - \frac{1}{6^2} + \dots \infty = \frac{\pi^2}{12}$$

$$\frac{1}{2^2} + \frac{1}{4^2} + \frac{1}{6^2} + \dots \infty = \frac{\pi^2}{24}$$

$$\frac{\sin \sqrt{x}}{\sqrt{x}} = 1 - \frac{x}{3!} + \frac{x^2}{5!} - \frac{x^3}{7!} + \frac{x^4}{9!} - \frac{x^5}{11!} + \dots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots = \sum_{k=0}^n \frac{(-1)^k x^{2k}}{(2k)!}$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots = \sum_{k=0}^n \frac{(-1)^k x^{2k+1}}{(2k+1)!}$$

$$\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \dots = \sum_{k=0}^n \frac{x^{2k}}{(2k)!}$$

$$\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \dots = \sum_{k=0}^n \frac{x^{2k+1}}{(2k+1)!}$$

$$\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots \quad (-1 \leq x < 1)$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \frac{62x^9}{2835} \dots +$$

$$\frac{2^{2n} (2^{2n}-1) B_n x^{2n-1}}{(2n)!} + \dots \quad |x| < \frac{\pi}{2}$$

$$\sec x = 1 + \frac{x^2}{2} + \frac{5x^4}{24} + \frac{61x^6}{720} + \dots + \frac{E_n x^{2n}}{(2n)!} + \dots \quad |x| < \frac{\pi}{2}$$

$$\csc x = \frac{1}{x} + \frac{x}{6} + \frac{7x^3}{360} + \frac{31x^5}{15120} + \dots +$$

$$\frac{2(2^{2n-1}-1) B_n x^{2n-1}}{(2n)!} + \dots \quad 0 < |x| < \pi$$

$$\cot x = \frac{1}{x} - \frac{x}{3} - \frac{x^3}{45} - \frac{2x^5}{945} - \dots - \frac{2^{2n} B_n x^{2n-1}}{(2n)!} - \dots \quad 0 < |x| < \pi$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \dots$$

$$\sec x = 1 + \frac{x^2}{2} + \frac{5x^4}{4} + \dots$$

$$\log(\cos x) = -\frac{x^2}{2} - \frac{2x^4}{4} - \dots$$

$$\log(1 + \sin x) = x - \frac{x^3}{2} + \frac{x^5}{6} - \frac{x^7}{12} + \dots$$

$$\sin^{-1} x = x + \frac{1}{2} \frac{x^3}{3} + \frac{1 \cdot 3}{2 \cdot 4} \frac{x^5}{5} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \frac{x^7}{7} + \dots \quad |x| < 1$$

$$\cos^{-1} x = \frac{\pi}{2} - \sin^{-1} x$$

$$= \frac{\pi}{2} - \left(x + \frac{1}{2} \frac{x^3}{3} + \frac{1 \cdot 3}{2 \cdot 4} \frac{x^5}{5} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \frac{x^7}{7} + \dots \right) \quad |x| < 1$$

$$\tan^{-1} x = \begin{cases} x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots & |x| < 1 \\ \pm \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \dots & \begin{cases} + \text{ if } x \geq 1 \\ - \text{ if } x \leq -1 \end{cases} \end{cases}$$

$$\sec^{-1} x = \cos^{-1} \left(\frac{1}{x} \right)$$

$$= \frac{\pi}{2} - \left(\frac{1}{x} + \frac{1}{2 \cdot 3x^3} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 5x^5} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 7x^7} + \dots \right) \quad |x| > 1$$

$$\csc^{-1} x = \sin^{-1}(1/x)$$

$$= \frac{1}{x} + \frac{1}{2 \cdot 3x^3} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 5x^5} + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 7x^7} + \dots \quad |x| > 1$$

$$\cot^{-1} x = \frac{\pi}{2} - \tan^{-1} x$$

$$= \frac{\pi}{2} - \left(x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots \right) \quad |x| < 1$$

$$= \begin{cases} p\pi + \frac{1}{x} - \frac{1}{3x^3} + \frac{1}{5x^5} + \dots & \begin{cases} p = 0 \text{ if } x \geq 1 \\ p = 1 \text{ if } x \leq -1 \end{cases} \end{cases}$$

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots = \sum_{n=0}^{\infty} \frac{x^n}{n!}$$

$$\ln x = 2 \left[\frac{x-1}{x+1} + \frac{1}{3} \left(\frac{x-1}{x+1} \right)^3 + \frac{1}{5} \left(\frac{x-1}{x+1} \right)^5 + \dots \right]$$

$$= 2 \sum_{n=1}^{\infty} \frac{1}{2n-1} \left(\frac{x-1}{x+1} \right)^{2n-1} \quad (x > 0)$$

$$\ln x = \frac{x-1}{x} + \frac{1}{2} \left(\frac{x-1}{x} \right)^2 + \frac{1}{3} \left(\frac{x-1}{x} \right)^3 + \dots$$

$$= \sum_{n=1}^{\infty} \frac{1}{n} \left(\frac{x-1}{x} \right)^n \quad (x > \frac{1}{2})$$

$$\ln x = (x-1) - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3 - \dots$$

$$= \sum_{n=1}^{\infty} (-1)^{n-1} \frac{1}{n} (x-1)^n \quad (0 < x \leq 2)$$

$$\ln(1+x) = x - \frac{1}{2}x^2 + \frac{1}{3}x^3 - \dots$$

$$= \sum_{n=1}^{\infty} (-1)^{n-1} \frac{1}{n} x^n \quad (|x| < 1)$$

$$\log_e(1-x) = -x - \frac{x^2}{2} - \frac{x^3}{3} - \frac{x^4}{4} - \dots \infty \quad (-1 \leq x < 1)$$

$$\log_e(1+x) - \log_e(1-x) =$$

$$\log_e \frac{1+x}{1-x} = 2 \left(x + \frac{x^3}{3} + \frac{x^5}{5} + \dots \infty \right) \quad (-1 < x < 1)$$

$$\log_e \left(1 + \frac{1}{n} \right) = \log_e \frac{n+1}{n} = 2 \left[\frac{1}{2n+1} + \frac{1}{3(2n+1)^3} + \frac{1}{5(2n+1)^5} + \dots \infty \right]$$

$$\log_e(1+x) + \log_e(1-x) = \log_e(1-x^2) = -2 \left(\frac{x^2}{2} + \frac{x^4}{4} + \dots \infty \right) \quad (-1 < x < 1)$$

$$\log 2 = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \dots = \frac{1}{1 \cdot 2} + \frac{1}{3 \cdot 4} + \frac{1}{5 \cdot 6} + \dots$$

Important Results

(i) (a) $\int_0^{\pi/2} \frac{\sin^n x}{\sin^n x + \cos^n x} dx = \frac{\pi}{4} = \int_0^{\pi/2} \frac{\cos^n x}{\sin^n x + \cos^n x} dx$

(b) $\int_0^{\pi/2} \frac{\tan^n x}{1 + \tan^n x} dx = \frac{\pi}{4} = \int_0^{\pi/2} \frac{dx}{1 + \tan^n x}$

(c) $\int_0^{\pi/2} \frac{dx}{1 + \cot^n x} = \frac{\pi}{4} = \int_0^{\pi/2} \frac{\cot^n x}{1 + \cot^n x} dx$

(d) $\int_0^{\pi/2} \frac{\tan^n x}{\tan^n x + \cot^n x} dx = \frac{\pi}{4} = \int_0^{\pi/2} \frac{\cot^n x}{\tan^n x + \cot^n x} dx$

(e) $\int_0^{\pi/2} \frac{\sec^n x}{\sec^n x + \operatorname{cosec}^n x} dx = \frac{\pi}{4} = \int_0^{\pi/2} \frac{\operatorname{cosec}^n x}{\sec^n x + \operatorname{cosec}^n x} dx$ where, $n \in R$

(ii) $\int_0^{\pi/2} \frac{a^{\sin^n x}}{a^{\sin^n x} + a^{\cos^n x}} dx = \int_0^{\pi/2} \frac{a^{\cos^n x}}{a^{\sin^n x} + a^{\cos^n x}} dx = \frac{\pi}{4}$

(iii) (a) $\int_0^{\pi/2} \log \sin x dx = \int_0^{\pi/2} \log \cos x dx = -\frac{\pi}{2} \log 2$

(b) $\int_0^{\pi/2} \log \tan x dx = \int_0^{\pi/2} \log \cot x dx = 0$

(c) $\int_0^{\pi/2} \log \sec x dx = \int_0^{\pi/2} \log \operatorname{cosec} x dx = \frac{\pi}{2} \log 2$

(iv) (a) $\int_0^{\infty} e^{-ax} \sin bx dx = \frac{b}{a^2 + b^2}$

(b) $\int_0^{\infty} e^{-ax} \cos bx dx = \frac{a}{a^2 + b^2}$

(c) $\int_0^{\infty} e^{-ax} x^n dx = \frac{n!}{a^{n+1}}$

$$\int \frac{dx}{\sqrt{x^2 - a^2}} = \ln \left(x + \sqrt{x^2 - a^2} \right) + C$$

$$\int \frac{dx}{\sqrt{x^2 + a^2}} = \ln \left(x + \sqrt{x^2 + a^2} \right) + C$$

$$\int \frac{dx}{x^2 - a^2} = \frac{1}{2a} \ln \left(\frac{x-a}{x+a} \right) + C$$

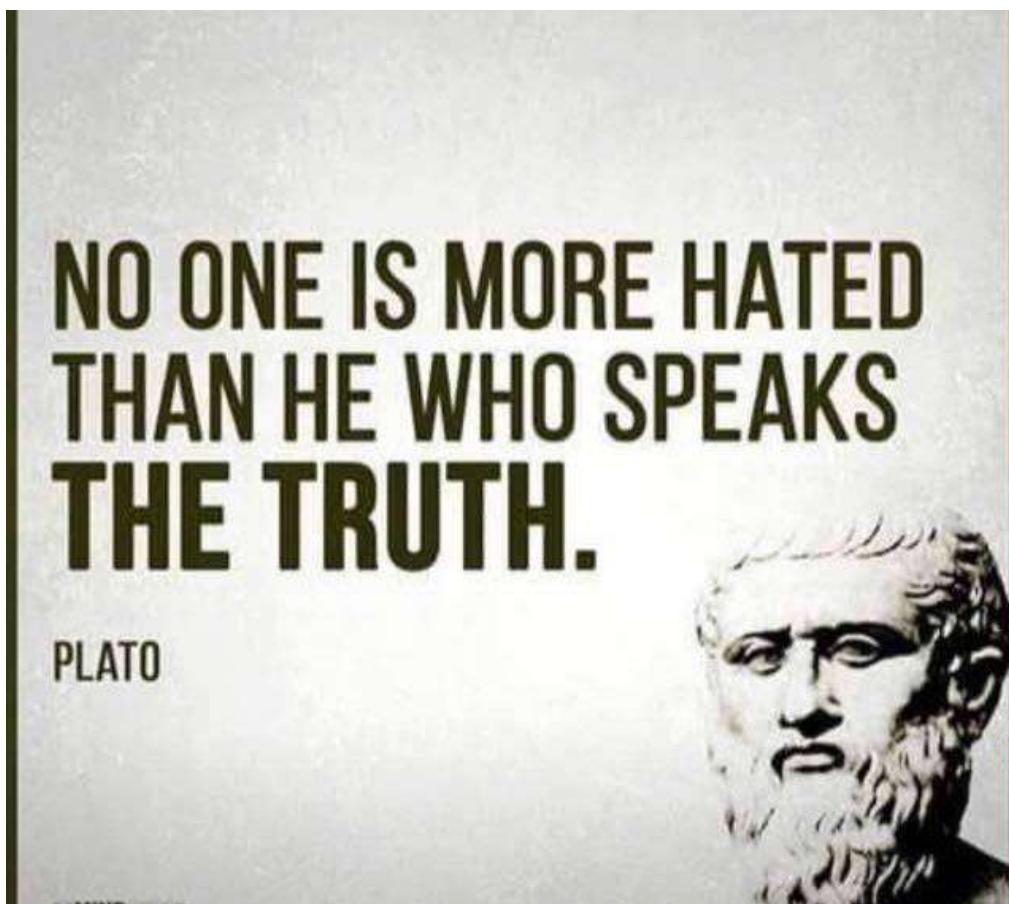
$$\int \frac{dx}{a^2 - x^2} = \frac{1}{2a} \ln \left(\frac{a+x}{a-x} \right) + C$$

$$\int \sqrt{a^2 - x^2} dx = \frac{x}{2} \sqrt{a^2 - x^2} + \frac{a^2}{2} \sin^{-1} \left(\frac{x}{a} \right) + C$$

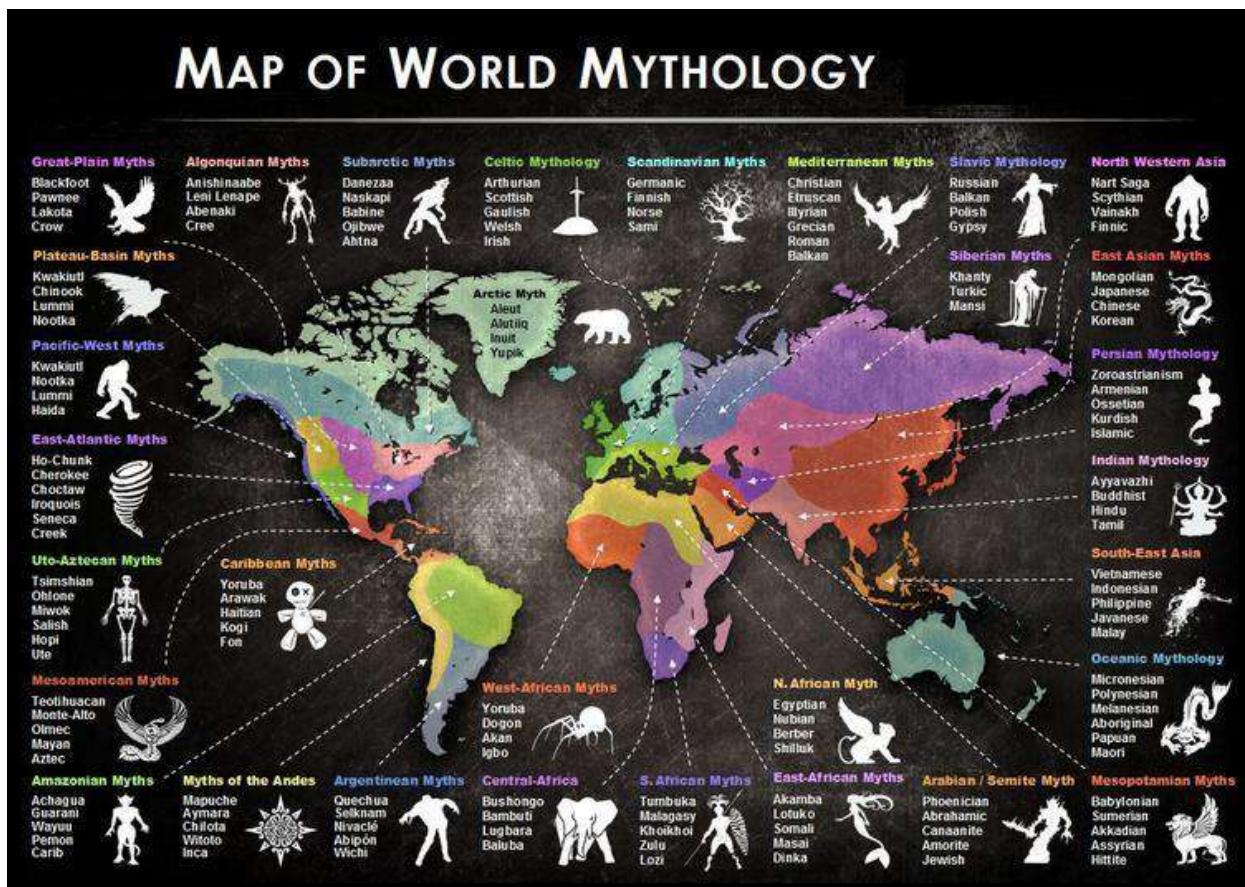
$$\int \sqrt{a^2 + x^2} dx = \frac{x}{2} \sqrt{a^2 + x^2} + \frac{a^2}{2} \sinh^{-1} \left(\frac{x}{a} \right) + C$$

$$\int \sqrt{x^2 - a^2} dx = \frac{x}{2} \sqrt{x^2 - a^2} - \frac{a^2}{2} \cosh^{-1} \left(\frac{x}{a} \right) + C$$

Plato and many others, since long told something about Truth ...



So I “lied” on a few things in this Book ! :—{D



$$\text{Given: } a = b$$

$$a^2 = ab$$

$$a^2 - b^2 = ab - b^2$$

$$(a+b)(a-b) = b(a-b)$$

$$(a+b) = b$$

$$a+a = a$$

$$2a = a$$

$$2 = 1 !!!$$

$$-20 = -20$$

$$16 - 36 = 25 - 45$$

$$4^2 - (4)(9) = 5^2 - (5)(9)$$

$$4^2 - (4)(9) + \frac{81}{4} = 5^2 - (5)(9) + \frac{81}{4}$$

$$4^2 - 2(4)\left(\frac{9}{2}\right) + \left(\frac{9}{2}\right)^2 = 5^2 - 2(5)\left(\frac{9}{2}\right) + \left(\frac{9}{2}\right)^2$$

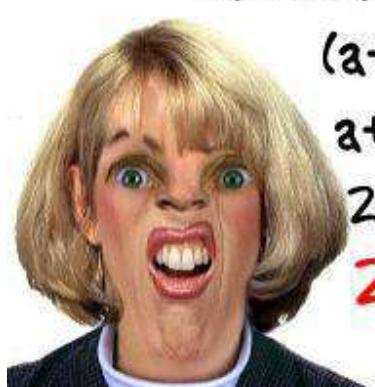
$$\left(4 - \frac{9}{2}\right)^2 = \left(5 - \frac{9}{2}\right)^2$$

$$4 - \frac{9}{2} = 5 - \frac{9}{2}$$

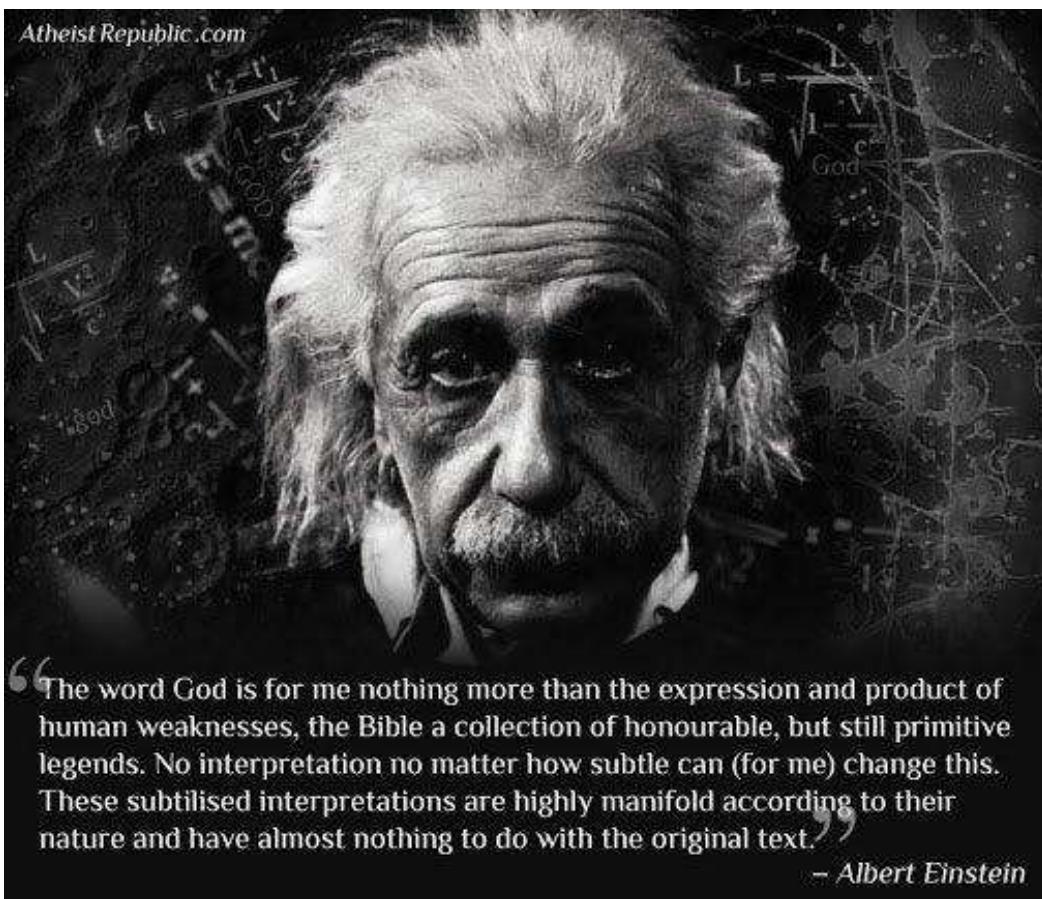
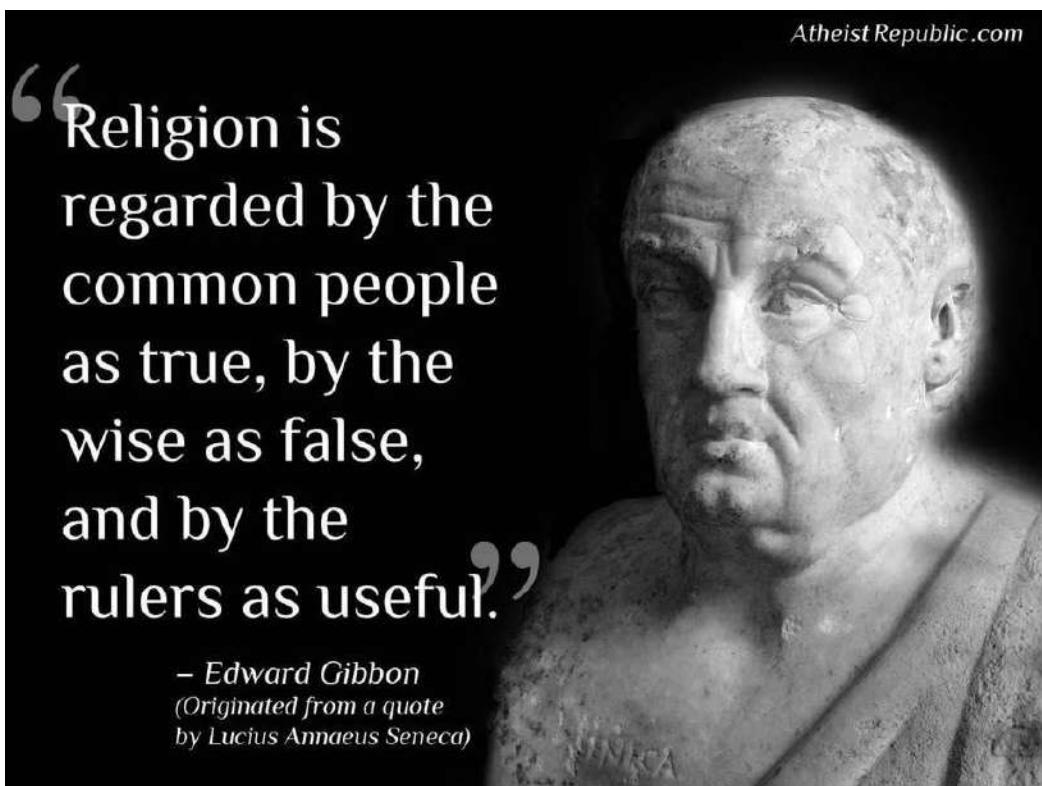
$$4 = 5$$

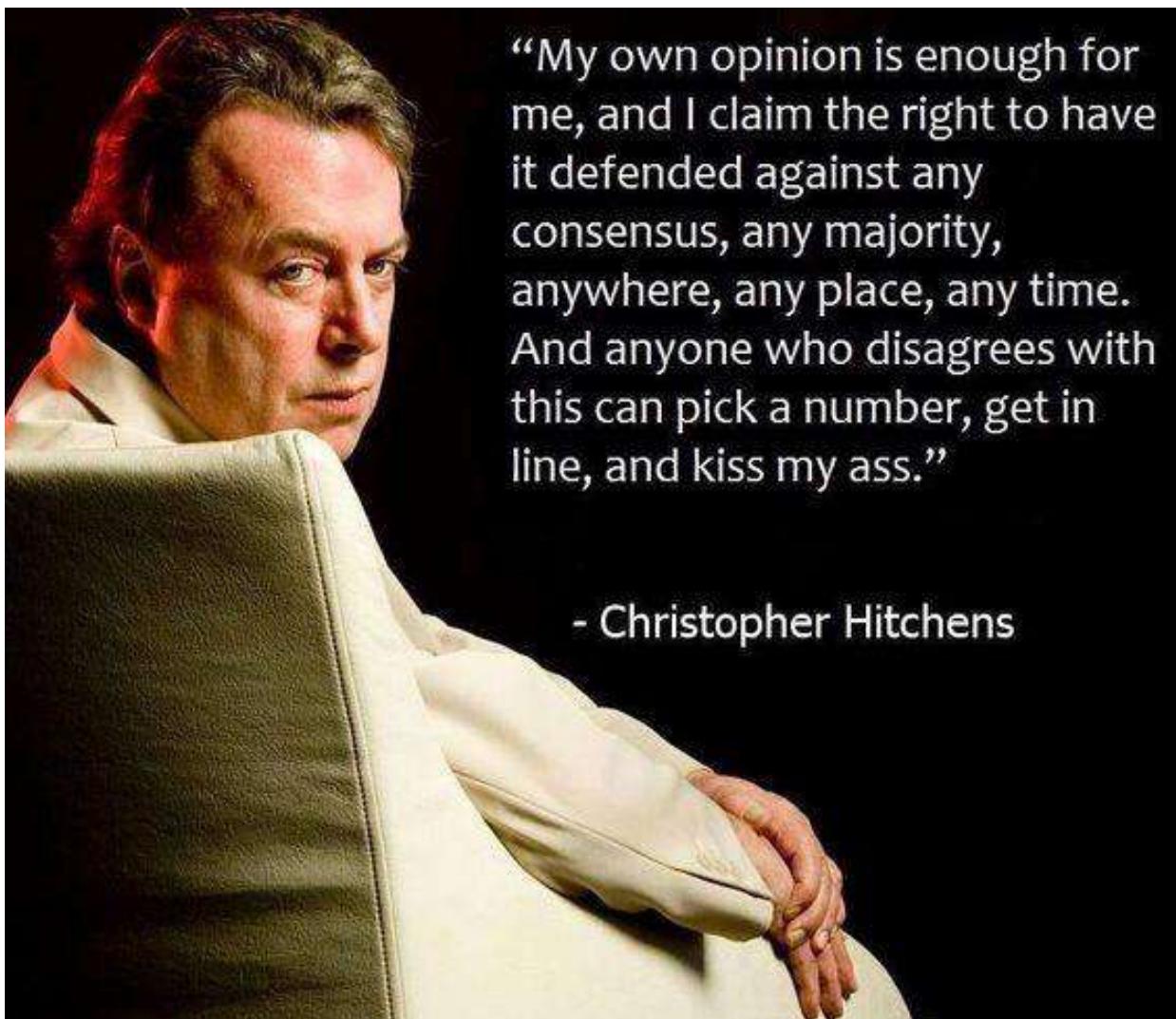
$$4 - 4 = 5 - 4$$

$$0 = 1$$



"Logic of Religion and Mythology" is like above ...

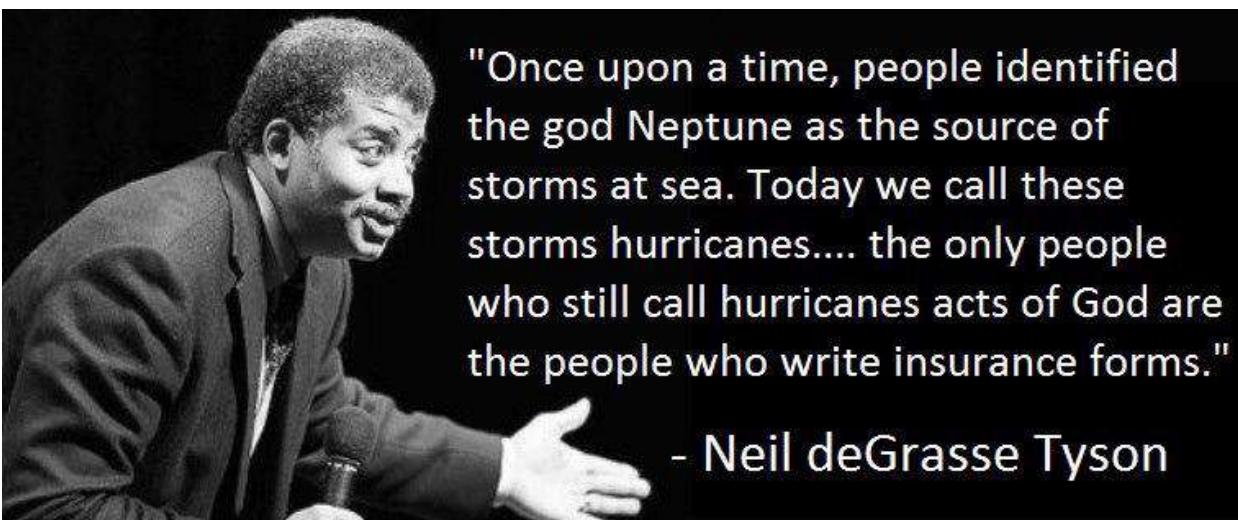




“My own opinion is enough for me, and I claim the right to have it defended against any consensus, any majority, anywhere, any place, any time. And anyone who disagrees with this can pick a number, get in line, and kiss my ass.”

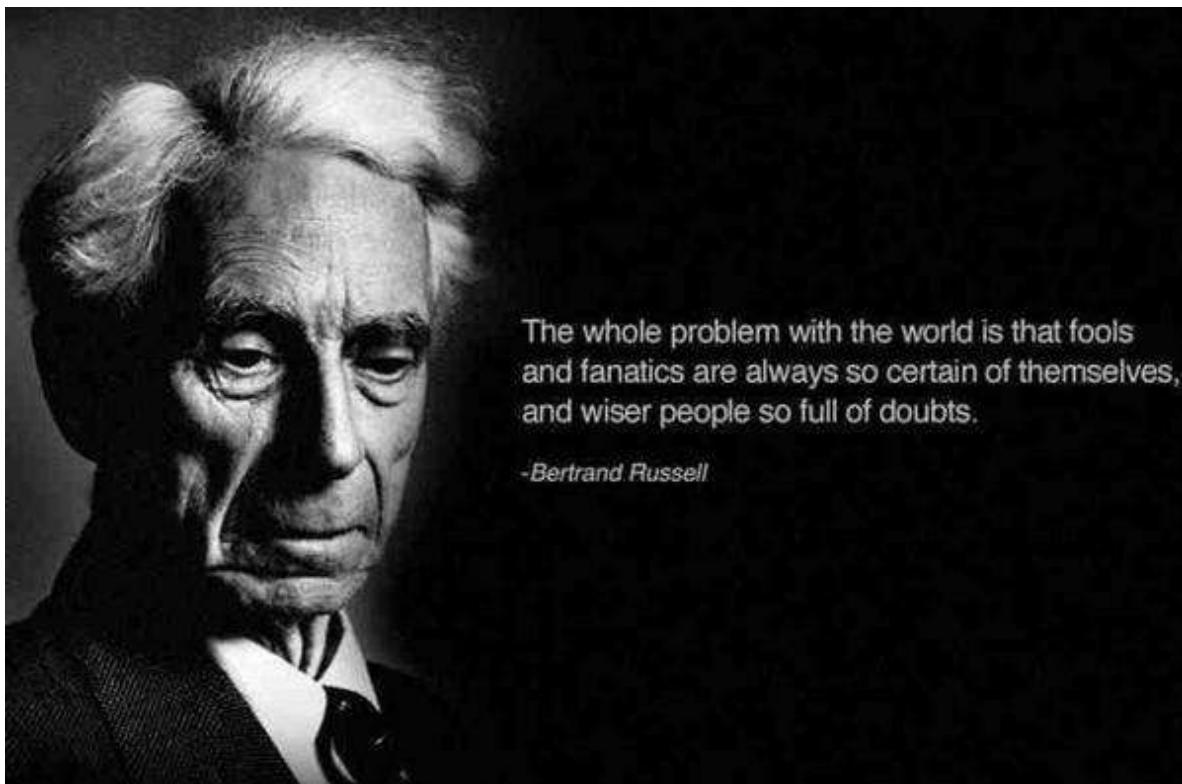
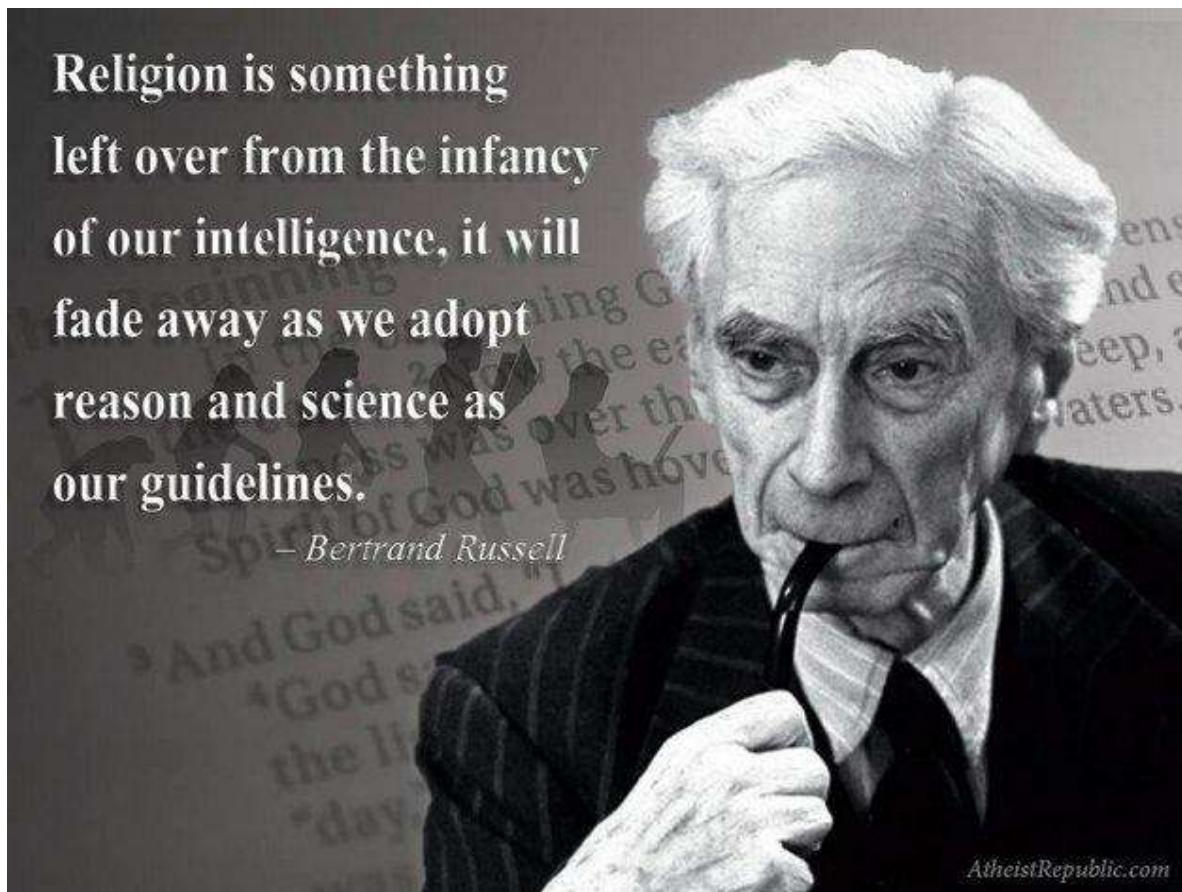
- Christopher Hitchens

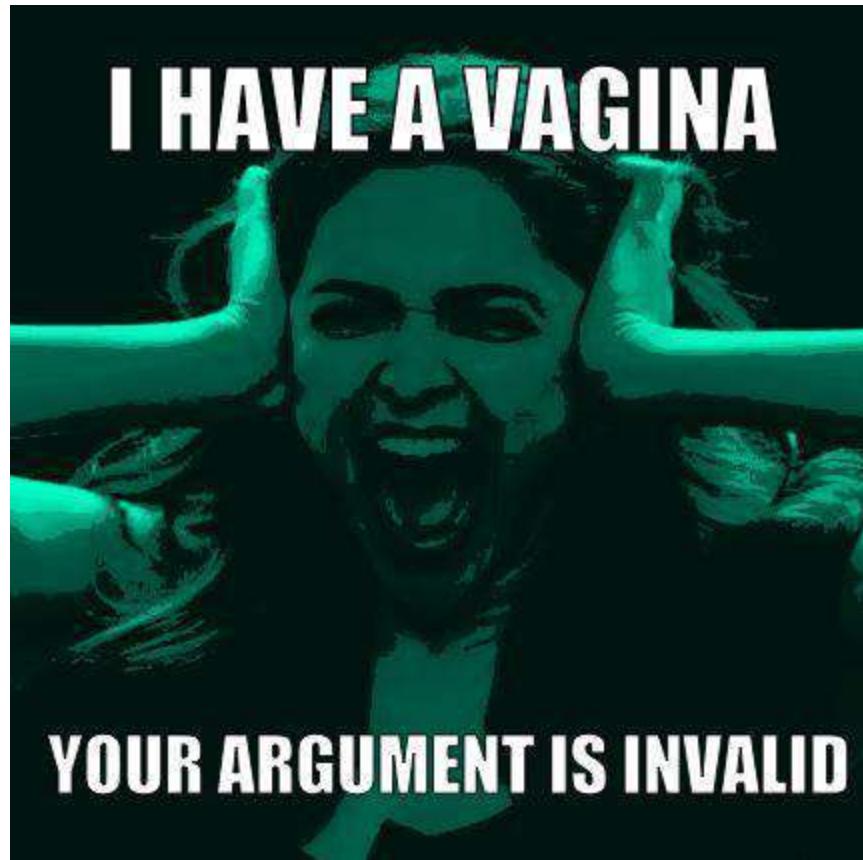
(Some people may agree that I am much more Polite, than Christopher Hitchens ... May be I achieved much lesser because of that!)



"Once upon a time, people identified the god Neptune as the source of storms at sea. Today we call these storms hurricanes.... the only people who still call hurricanes acts of God are the people who write insurance forms."

- Neil deGrasse Tyson







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Good Luck to you for your Preparations, References, and Exams

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