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This book provides a complete review of the material covered in two years course in physics. It is in the form of key points and MCQs that ranges from elementary and basic to advanced and sophisticated level. By using this book, you can prepare yourself for medical and engineering collages admission tests and at college level pysics examination.

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Key Points

Contents

Chapter No.1 Measurements

1.1 Physical Quantity

- A quantity which can be measured and by which various physical happenings can be explained and expressed in the form of laws is called a physical quantity. For example length, mass, time, force etc
- On the other hand various happenings in life e.g., happiness, sorrow etc. are not physical quantities because these can not be measured.
- physical quantity is represented completely by its magnitude and unit.
- Physical quantity (Q) = Magnitude × Unit
  P.Q = n x u
  For constant P.Q
  n α 1/u
- n u = constant, or n α 1/u
- Larger the unit, smaller will be the magnitude.

Types of Physical Quantities;
1) Fundamental Quantities
2) Derived Quantities
3) Supplementary Quantities

(1) Fundamental quantities :

Out of large number of physical quantities which exist in nature, there are only few quantities which are independent of all other quantities and do not require the help of any other physical quantity for their definition, therefore these are called absolute quantities. These quantities are also called fundamental or basic quantities, as all other quantities are based upon and can be expressed in terms of these quantities.

Fundamental Quantities are;

Unit and symbol of Fundamental quantities		
Quantity	Unit	Symbol
Length	Meter	M
Mass	Kilogram	Kg
Time	Second	S
Electric current	Ampere	A
Temperature	Kelvin	K
Amount of substance	Mole	Mol
Luminous intensity	Candela	cd

(2) Derived quantities :

All other physical quantities can be derived by suitable multiplication or division of different powers of fundamental quantities. These are therefore called derived quantities.

As length is defined as a fundamental quantity then area and volume are derived from length and are expressed in term of length with power 2 and 3 over the term of length.

$A = l \times b = L \times L = L^2$

$V = l \times b \times h = L \times L \times L = L^3$

(3) Supplementary quantities :

There are two supplementary Quantities which are:

(1) Plane angle

(2) Solid angle

1.2 System of Units

A complete set of units, both fundamental and derived for all kinds of physical quantities is called system of units.

- C.G.S (Centimeter-Grand-Second) system.
- F.P.S. (Foot-Pound-Second) system.
- M.K.S. (Meter-Kilogram--Second) system.
- M.K.S.A.(Meter-Kilogram-Second-Ampere) unit
- International system of units (SI)

Fundamental quantity	**CGS System unit**	**MKS system**	**FPS system**
Length	cm	m	Foot
Mass	g	kg	Pound
Time	s	s	S

(4) S. I. system :

It is known as International system of units, and is extended system of units applied to whole physics.

Unit and symbol of quantities		
Quantity	Unit	Symbol
Length	Meter	M
Mass	Kilogram	Kg
Time	Second	S
Electric current	Ampere	A
Temperature	Kelvin	K
Amount of substance	Mole	Mol
Luminous intensity	Candela	cd

Fundamental Units:

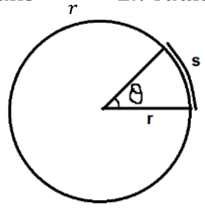
There are seven base fundamental quantities in this system.

Supplementary Units:

There are only two supplementary units which are Radian and steradian.

(1) Radian;

- angle at centre of circle by an arc of length equal to the radius of the circle.
- Number of radians $= \frac{arc\ length}{radius} = s/r$
- For 1 revolution
- Number of radians $= \frac{2\pi r}{r} = 2\pi$ radians



$\theta = \frac{s}{r}$

$\frac{\theta_1}{\theta_2} = \frac{s_1}{s_2}$ for constant r.

$\frac{\theta_1}{\theta_2} = \frac{r_2}{r_1}$ for constant s.

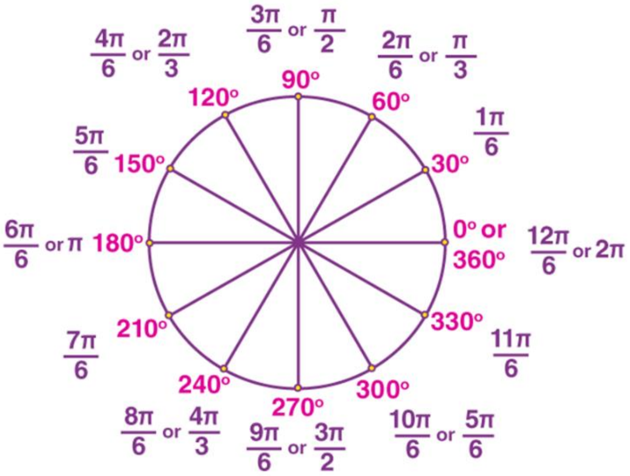
$\frac{s_1}{s_2} = \frac{r_1}{r_2}$ for constant θ.

- One circle $= 360^0 = 2\pi$ radian
- Minute and seconds is unit of both time and angle.
- $360^0 = 2\pi$ radian→ 1 radian $= 360/2\pi = 57.3^0$.
- One sphere has 4π steradian.
- 2π rad = 360 degree → 1 degree= $2\pi/360 = 0.017$

Degree:

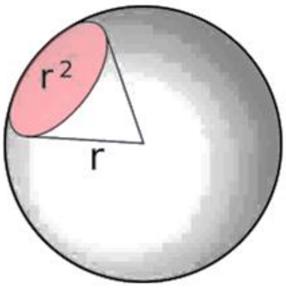
- Degree is the angle occupied by arc of 1/360 of circumference.
- 1 degree = 60 minute
- 1 minute = 60 seconds
- π= the circumference of the circle divided by the diameter of the same circle

$\pi = 2\pi r/2r = \pi$



(2) Steradian:

- Angle at centre of sphere by an area of its surface equal to the square of the radius to that sphere.
- One sphere has 4π steradian.



1 radian = 57.3^0.
$1^0 = 0.0174$ rad
second and minute are unit of time as well as plane angle.
1 Circle = 2π rad
1 Sphere = 4π sr

Derived Units:

- These are derived from base or supplementary units.
- The units of derived quantities are called derived units.
- Like ms, kg .m.s, kg s , kg/s , km/m.s

1.3 Practical Units

Apart from fundamental and derived units we also use practical units very frequently. These may be fundamental or derived units e.g.,

light year is a practical unit (fundamental) of distance while horse power is a practical unit (derived) of power. Practical units may or may not belong to a system but can be expressed in any system of units

e.g., 1 mile = 1.6 km = 1.6×10^3 m.

(1) Length

(i) 1 fermi = 1 fm = 10^{-15} m

(ii) 1 X-ray unit = 1XU = 10^{-13} m

(iii) 1 angstrom = 1Å = 10^{-10} m = 10^{-8} cm = 10^{-7} mm

(iv) 1 micron = 10^{-6} m

(v) 1 Light year = 1 ly = 9.46×10^{15} m

(vi) 1 Parsec = 1pc = 3.26 light year

(2) Mass

(i) Chandra Shekhar unit :

1 CSU = 1.4 times the mass of sun = 2.8×10^{30} kg

(ii) Metric tonne :

1 Metric tonne = 1000 kg

(iii) Quintal :

1 Quintal = 100 kg

(iv) Atomic mass unit (amu) : 1amu = 1.67 10^{-27} kg

Mass of proton or neutron is of the order of 1 amu

(3) Time

(i) Year :

It is the time taken by the Earth to complete 1 revolution around the Sun in its orbit.

(ii) Lunar month :

It is the time taken by the Moon to complete 1 revolution around the Earth in its orbit.

1 L.M. = 27.3 days.

iii) 1 Shake = 10^{-8} sec

Units of time
• Angstron
• Micron
• Light Year

Common Units Conversion

Energy	1 J = 0.2390 cal = 10^7 g 1 cal = 4.184 J 1 ev/atom = $1.6021892 \times 10^{-19}$J/atom=96.484 kJ/mol
Temperature	K = °C + 273.15 °C = 5/9 (F-32) °F = 9/5 (c) +32
Mass	1kg = 2.2046 lb 1lb = 453.59g = 0.45359 kg 1oz = 0.03250 lg = 28.350g 1ton = 2000 lb = 907.185 kg 1tone (metric) = 1000 kg= 2204.62 lb
Pressure	1 am =760 mmHg = 760 torr = 101.325

	kPa
Volume	1 mL = 0.001L = 1 cm^3 1 oz (fluid) = 0.031250 qt = 0.029573 L 1 qt = 0.946326 L 1 gal = 0.946 L
Length	1 mile = 1.60934 km 1 in.= 2.45cm 10 mm = 1 cm 1000mm = 1m 1000m = 1km 1m = 39.379 in. A=10^{-10} m = 10^{-8} cm

Units Conversion

Two ways OF Conversion

- Cross multiplication
- Conversion Factor ($\frac{new\ unit}{old\ unit}$)

Conversion Types

a) With prefixes (cm into m or m to cm)

b) Without prefixes (cm to feet)

For example: cm into m or m to cm

In conversion, the prefix

a) Disappear cm → m

simply put the value.

b) Appear m → cm

divide and multiply by what you want.

1.4 Dimensions

When a derived quantity is expressed in terms of fundamental quantities, it is written as a product of different powers of the fundamental quantities. The powers to which fundamental quantities must be raised in order to express the given physical quantity are called its dimensions.

To make it more clear, consider the physical quantity force

Force = mass x acceleration

Force = mass x $\frac{velocity}{time}$

Force = mass $\frac{\frac{length}{time}}{time}$

Force = mass $\frac{length}{time^2}$

Force = mass x length x time $^{-2}$

Here the physical quantity that is expressed in terms of the basic quantities is enclosed in square brackets to indicate that the equation is among the dimensions and not among the magnitudes.

Thus equation for force can be written in form of

Force = [MLT^{-2}]

Such an expression for a physical quantity in terms of the fundamental quantities is called the dimensional equation. If we consider only the R.H.S. of the equation, the expression is termed as dimensional formula.

Thus, dimensional formula for force is [MLT^{-2}].

Indicating Uncertanity:

Product and quotient rule

- A = B x C or A=B/C, then perncentage uncertainty in A =± [percentage uncertainty in B + percentage uncertainty in C]

Power rule

- For power rule relative uncertainty is multiplied by power.
- A = BC^n, the percentage uncertainty in A = ± [percentage uncertainty in B + n x percentage uncertainty in C]

Uncertanity in average values

- Find average
- Find deviation of each value from average value
- Find mean of deviation and this is uncertainty in average values

Uncertainty in timing experiments:

- If we are measuring time for vibration or counting process then fractional uncertainty is added to the resultant.
- Fractional uncertainty = $\frac{realtive\ error}{total\ vibrations\ count}$

Quantities Having same Dimensions	
Dimension	Quantity
T^{-1}	Frequency, angular frequency, angular velocity, velocity gradient and decay constant
$M^1 L^2 T^{-2}$	Work, internal energy, potential energy, kinetic energy, torque, moment of force
$M^1 L^{-1} T^{-2}$	Pressure, stress, Young's modulus, bulk modulus, modulus of rigidity, energy density
$M^1 L^{-1} T^{-1}$	Momentum, impulse
$M^0 L^1 T^{-2}$	Acceleration due to gravity, gravitational field intensity
$M^1 L^1 T^{-2}$	Thrust, force, weight, energy gradient
$M^1 L^2 T^{-1}$	Angular momentum and Planck's constant
$M^2 T^{-2}$	Surface tension, Surface energy (energy per unit area)
No dimension	Strain, refractive index, relative density, angle, solid angle, distance gradient, relative permittivity (dielectric constant), relative permeability etc.
$L^2 T^{-2}$	Latent heat and gravitational potential
T^1	$\frac{l}{g}$, $\sqrt{m/k}$, $\sqrt{\frac{R}{g}}$
T^1	$\frac{L}{R}$, $\sqrt{L\ C}$, RC
$L^2 T^{-2}$	I^2RT , $V^2 t/R$, VIt , q V , LI^2 , q^2/C, CV^2

Application of Dimensional Analysis

(1) To find the unit of a physical quantity in a given system of units

(2) To find dimensions of physical constant or coefficients.
(3) To convert a physical quantity from one system to the other.
(4) To check the dimensional correctness of a given physical relation.
(5) As a research tool to derive new relations.

Scientific Notation

- Writing number of power of ten is called scientific notation.
- There must be one significant figure to the left of decimal point.
  - ✓ $3000 \rightarrow 3 \times 10^3$
  - ✓ $0.003 \rightarrow 3 \times 10^{-3}$
  - ✓ $134.7 \rightarrow 1.347 \times 10^2$
  - ✓ $0.0023 \rightarrow 2.3 \times 10^{-2}$.

S.I. Prefixes

In physics we deal from very small (micro) to very large (macro) magnitudes, as one side we talk about the atom while on the other side of universe, e.g. , the mass of an electron is 9.1×10^{-31} kg while that of the sun is 2×10^{30} kg. To express such large or small magnitudes we use the following prefixes

Prefixes and symbol		
Prefix	Symbol	Power of 10
Atto	a	10^{-18}
Femto	f	10^{-15}
pico	p	10^{-12}
Nano	n	10^{-9}
Micro	μ	10^{-6}
Milli	m	10^{-3}
Centi	c	10^{-2}
Deci	d	10^{-1}
Deca	da	10^{1}
Hecto	h	10^{2}
Kilo	k	10^{3}
Mega	M	10^{6}
Gega	G	10^{9}
Tera	T	10^{12}
Peta	P	10^{15}
Exa	E	10^{18}

Conventions for using SI units

- Full name of the unit does not begin with a capital letter even if named after a scientific
  - Newton → scientist ,
  - newton→ unit of forces
- Symbol of unit named after scientist start with Capital letter
  - N for newton,
  - Pa for pascal ,
  - Hz for hertz
- Prefixes are written before units
  - m m , μ m
- More than one prefixes are not allowed
  - $1\mu\mu$F may be written as 1pF.
- Power is applied to all bases
  - $1\ Km^2 = 1\ K^2\ m^2 = 1 \times 10^8\ m^2$.

Significant Figures

Significant figures in the measured value of a physical quantity tell the number of digits in which we have confidence. Larger the number of significant figures obtained in a measurement, greater is the accuracy of the measurement. The reverse is also true.

The following rules are observed in counting the number of significant figures in a given measured quantity.

(1) All non-zero digits are significant.
Example :
- ✓ 42.3 has three significant figures.
- ✓ 243.4 has four significant figures.
- ✓ 24.123 has five significant figures.

(2) A zero becomes significant figure if it appears between two nonzero digits.
Example :
- ✓ 5.03 has three significant figures.
- ✓ 5.604 has four significant figures.
- ✓ 4.004 has four significant figures.

(3) Leading zeros or the zeros placed to the left of the number are never significant.
Example :
- ✓ 0.543 has three significant figures.
- ✓ 0.045 has two significant figures.
- ✓ 0.006 has one significant figure.

(4) Trailing zeros or the zeros placed to the right of the number are significant.
Example :
- ✓ 4.330 has four significant figures.
- ✓ 433.00 has five significant figures.
- ✓ 343.000 has six significant figures.

(5) In exponential notation, the numerical portion gives the number of significant figures.
Example :
- ✓ 1.32×10^{-2} has three significant figures.
- ✓ 1.32×10^{4} has three significant figures.

Rounding Off

While rounding off measurements, we use the following rules by convention:
(1) If the digit to be dropped is less than 5, then the preceding digit is left unchanged.
Example :
7.82 is rounded off to 7.8,
again 3.94 is rounded off to 3.9.
(2) If the digit to be dropped is more than 5, then the preceding digit is raised by one.
Example :
6.87 is rounded off to 6.9,
again 12.78 is rounded off to 12.8.
(3) If the digit to be dropped is 5 followed by digits other than zero, then the preceding digit is raised by one.

Example :
16.351 is rounded off to 16.4,
6.758 is rounded off to 6.8.
(4) If digit to be dropped is 5 or 5 followed by zeros, then preceding digit is left unchanged, if it is even.
Example :
3.250 becomes 3.2 on rounding off,
12.650 becomes 12.6 on rounding off.
(5) If digit to be dropped is 5 or 5 followed by zeros, then the preceding digit is raised by one, if it is odd.
Example :
3.750 is rounded off to 3.8,
again 16.150 is rounded off to 16.2.

Significant Figures in Calculation:

In most of the experiments, the observations of various measurements are to be combined mathematically, i.e., added, subtracted, multiplied or divided to achieve the final result. Since, all the observations in measurements do not have the same precision, it is natural that the final result cannot be more precise than the least precise measurement. The following two rules should be followed to obtain the proper number of significant figures in any calculation.

(1) Addition or subtraction: The result of an addition or subtraction in the number having different precisions should be reported to the same number of decimal places as present in the number having the least number of decimal places. The rule is illustrated by the following examples :

(i) 33.3 ← (has only one decimal place)
3.11
+ 0.313

36.723← (answer should be reported to one decimal place)
Answer = 36.7

(ii) 3.1421
0.241
+ 0.09 ← (has 2 decimal places)

3.4731 ←(answer should be reported to 2 decimal places)

Answer = 3.47

(iii) 62.831 ← (has 3 decimal places)
– 24.5492

38.2818 ← (answer should be reported to 3 Decimal places after rounding off)
Answer = 38.282

(2) Multiplication or division: The answer to a multiplication or division is rounded off to the same number of significant figures as possessed by the least precise term used in the calculation. The rule is illustrated by the following examples :

(i) 142.06
x 0.23 ← (two significant figures)

32.6738 □ (answer should have two significant figures)
Answer = 33

(ii) 51.028
x 1.31 ← (three significant figures)

66.84668
Answer = 66.8

(iii) $\frac{0.90}{4.26}$ = 0.2112676

Answer = 0.21 because 0.90 has two significant figures.

Errors and Uncertainty

- All physical measurements are uncertain to some extent.
- Difficult to eliminate all possible errors or uncertainties.
- The error may occur due to
  - ✓ Negligence or inexperience of a person
  - ✓ The faulty apparatus
  - ✓ Inappropriate method or technique.
- The uncertainty may occur due to:
  - ✓ Inadequacy or limitation of an instrument,
  - ✓ Natural variations of the object,
  - ✓ Natural imperfections of a person's senses.
- However, the uncertainty is also usually described as an error in a measurement.
- There are two major types of errors.
  ❶ Random error
  ❷ Systematic error

Random error:
- Def: Different values under the same conditions.
- Reason: some unknown causes.
- Reduce: Taking an average can reduce the effect of random errors.

Systematic error:
- Def: an effect that influence all measurements of a particular quantity equally.
- Reason:
- zero error of instruments,
- poor calibration of instruments
- Incorrect markings etc.
- Reduce: Comparing the instruments with another which is known to be more accurate.

- Thus for systematic error, a correction factor can be applied.

Precision and Accuracy:

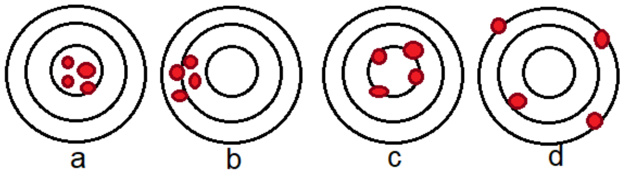
- Measurement should be precise and accurate.

Accuracy:

- Closeness of value to standard or known.
- Show how measure value agree with actual(true) value. And the true value comes theoretically/experimentally.
- 7 m/s^2 is not accurate value of g.
- The accepted value of g is $9.8 m/s^2$

Precision:

- Closeness of 2 or more values to each other.
- If we get 3.2 kg each time it means it is precise.
- Depends on instruments and techniques.
- Independent of accuracy.



a) Accurate + Precise
b) Not accurate while Precise
c) Accurate but Not Precise only
d) Not Accurate & Not Precise

Student 1 (m/s^2)	Student 2 (m/s^2)	Student 3 (m/s^2)	Student 4 (m/s^2)
9.80 9.79 9.81 9.80 9.80	9.71 9.70 9.69 9.70 9.70	9.78 9.84 9.80 9.76 9.82	9.61 9.82 9.74 8.30 7.00
<g> = 9.80 m/s^2	<g> = 9.70 m/s^2	<g> = 9.8 m/s^2	<g> = 8.69 m/s^2
Precise + Accurate	Precise + NotAccurate	Not Precise + Accurate	Not Precise + NotAccurate

- ✓ Precision $\alpha \frac{1}{\text{error}}$
- ✓ Accuracy $\alpha \frac{1}{\text{relative error}}$
- ✓ Relative error = $\frac{error}{measure\ value}$
- ✓ Precision → closeness with each other.
- ✓ Accuracy → closeness to standard value.

Uncertainties

- The quantification or magnitude of error or doubt in measurement is called uncertainty.
- It estimate how small or large the error is.
- For example, when the length of an object is recorded as 25.5 cm by using a metre rod having smallest division in millimetre, it is', the difference of two readings of the initial and final positions. The uncertainty in the single reading as discussed before is taken as i 0.05 cm which is now doubled and is called absolute uncertainty equal to: 0.1cm.
- Absolute uncertainty, in fact, is equal to the least count of the measuring instrument.
- A precise measurement is the one which has less absolute uncertainty and an accurate measurement is the one which has less fractional or percentage uncertainty or error.
- Absolute uncertainty, in fact, is equal to the least count of the measuring instrument.
- Fractional uncertainty = $\frac{least\ count}{value}$
- Percentage uncertainity = $\frac{L.C}{value} x\ 100$

ASSESSMENT OF TOTAL UNCERTAINTY IN THE FINAL RESULT

- To assess the total uncertainty or error, it is necessary to evaluate the likely uncertainties in all the factors involved in that calculation. The maximum possible uncertainty or error in the final result can be found as follows.
- For addition and Subtraction
- For multiplication and division
- For power factor
- For uncertainty in the average value of any measurements.
- For the uncertainty in a timing experiment

(1) For addition and Subtraction

- Absolute uncertaintites are added:
- for example, the distance x determined by the difference between two separate position measurements.
- $X_1 = 10.5 \pm 0.1$ cm
- $x_2 = 26.8 \pm 0.1$ cm
- $X = x_2 - x_1 = 16.3 \pm 0.2$ cm

2) For multiplication and division

- Percentage uncertaintites are added.
- For example the maximum possible uncertainty in the value of resistance R if % uncertainty inV is 2% and I is 6%.
  Hence total uncertainty R when V is divided by I is 2+6 = 8%.
  R= 6.19 ohm + 8% uncertainity = 6.2 + 0.5 ohms

3) For power factor

- Multiply the percentage uncertainty by that power.
- For example, in the calculation of the volume of a sphere using $V = \frac{4}{3}\pi r^3$
  %age uncertainty in V= 3 x % age uncertainty in radius.

4) For uncertainty in the average value of any measurements.

- Find the average value of measured values.

- Find deviation of each measured value from the average value.
- The mean deviation is the uncertainty in the average value.
- For example, the six readings of the micrometer screw gauge to measure the diameter of a wire in mm are

  Readings: 1.20, 1.22, 1.23, 1.19, 1.22, 1.21
- average = $\frac{1.20+1.22+1.23+1.19+1.22+1.21}{6}$ = 1.21 mm (reading without uncertainity)

  The deviation of the readings, which are the difference without regards to the sign, between each reading and average value are

  Deviations: 0.01, 0.01, 0.02, 0.02, 0.01, 0,

  Mean of deviations = $\frac{0.01+0.01+0.02+0.02+0.01+0}{6}$ = 0.01 mm (uncertainity)

  Thus, likely uncertainty in the mean diametre 1.21 mm is 0.01 mm recorded as 1.21 + 0.01 mm.

5) For the uncertainty in a timing experiment

- The uncertainty in the time period of a vibrating body is 5 found by dividing the- least count of timing device by the number of vibrations.
- For example, the time of 30 vibrations of a simple pendulum recorded by a stopwatch accurate upto one tenth of a second is 54.6 s, the period.

  $T = \frac{54.6s}{30} = 1.82\ s$ with uncertainty $\frac{0.1s}{30}$ = 0.003 s

  $thus\ period\ T\ is\ quoted\ as\ T = 1.82 + 0.003\ s$

  Hence, it is advisable to count large number of swings to reduce timing uncertainty.

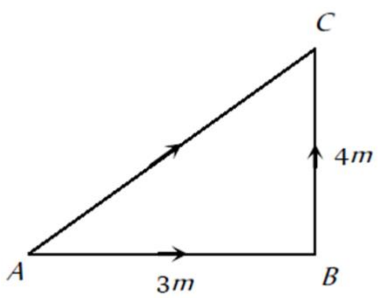
PHYSICAL QUANTITY	SYMBOL	DIMENSION	MEASUREMENT UNIT	UNIT
Area	A	L^2	square meter	m^2
Volume	V	L^3	cubic meter	m^3
velocity	v	L/T	meter per second	m/sec
angular velocity	w	T^{-1}	radians per second	1/sec
acceleration	a	LT^{-2}	meter per square second	m/sec^2
angular acceleration	a	T^{-2}	radians per square second	$1/sec^2$
Force	F	MLT^{-2}	Newton	$Kg\ m/sec^2$
Energy	E	ML^2T^{-2}	Joule	$Kg\ m^2/sec^2$
Work	W	ML^2T^{-2}	Joule	$Kg\ m^2/sec^2$
Heat	Q	ML^2T^{-2}	Joule	$Kg\ m^2/sec^2$
Torque	t	ML^2T^{-2}	Newton meter	$Kg\ m^2/sec^2$
Power	P	ML^2T^{-3}	watt or joule/sec	$Kg\ m^2/sec^3$
Density	D or ρ	ML^{-3}	kilogram per cubic meter	Kg/m^3
pressure	P	$ML^{-1}T^{-2}$	Newton per square meter	$Kg\ m^{-1}/sec^2$
impulse	J	MLT^{-1}	Newton second	Kg m/sec
Inertia	I	ML^2	Kilogram square meter	$Kg\ m^2$
luminous flux	f	C	lumen (4Pi candle for point source)	cd sr
illumination	E	CL^{-2}	lumen per square meter	$cd\ sr/m^2$
Entropy	S	$ML^2T^{-2}K^{-1}$	joule per degree	$Kg\ m^2/sec^2K$
Volume rate of flow	Q	L^3T^{-1}	cubic meter per second	m^3/sec
Kinematic viscosity	n	L^2T^{-1}	square meter per second	m^2/sec
Dynamic viscosity	m	$ML^{-1}T^{-1}$	Newton second per square meter	Kg/m sec
Specific weight	g	$ML^{-2}T^{-2}$	Newton per cubic meter	$Kg\ m^{-2}/sec^2$
Electric current	I	QT^{-1}	Ampere	C/sec
emf, voltage, potential	E	$ML^2T^{-2}Q^{-1}$	Volt	$Kg\ m^2/sec^2C$
resistance or impedance	R	$ML^2T^{-1}Q^{-2}$	ohm	$Kgm^2\ /secC^2$
Electric conductivity	s	$M^{-2}L^{-2}TQ^2$	mho	$secC^2/Kg\ m^3$
capacitance	C	$M^{-1}L^{-2}T^2\ Q^2$	Farad	sec^2C^2/Kgm^2
inductance	L	ML^2Q^{-2}	Henry	$Kg\ m^2\ /C^2$
Current density	J	$QT^{-1}L^{-2}$	ampere per square meter	$C/sec\ m^2$
Charge density	r	QL^{-3}	coulomb per cubic meter	C/m^3
magnetic flux, Magnetic induction	B	$MT^{-1}Q^{-1}$	weber per square meter	Kg/sec C

Magnetic intensity	H	$QL^{-1}T^{-1}$	ampere per meter	C/m sec
magnetic vector potential	A	$MLT^{-1}Q^{-1}$	weber/meter	Kg m/sec C
Electric field intensity	E	$MLT^{-2}Q^{-1}$	volt/meter or newton/coulomb	Kg m/sec^2 C
Electric displacement	D	QL^{-2}	coulomb per square meter	C/m^2
Permeability	m	MLQ^{-2}	henry per meter	Kg m/C^2
permittivity,	e	$T^2Q^2M^{-1}L^{-3}$	farad per meter	sec^{2}C^2/Kgm^3
Dielectric constant	K	$M^0L^0T^0$	None	None
Frequency	f/n/υ	T^{-1}	Hertz	sec^{-1}
angular frenuency	ω	T^{-1}	radians per second	sec^{-1}
Wave length	λ	L	Meters	M

Chapter No.3 FORCE AND MOTION

1.1 Displacement (d) and Distance(s):

- The original path is called distance
- The shortest distance between two points is called displacement. OR Displacement is the change in position vector i.e. A vector joining initial to final position.

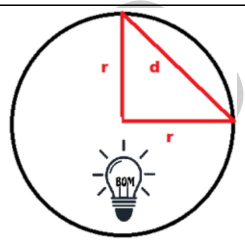


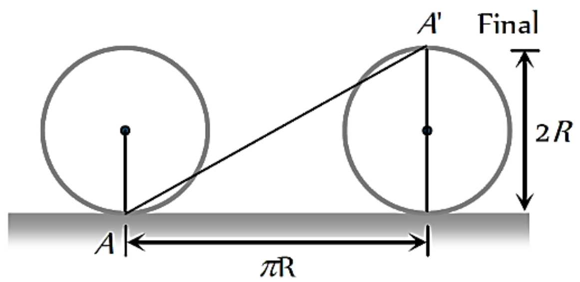
- Distance is 3+4= 7m

displacement : $\vec{AC} = \vec{AB} + \vec{BC} \Rightarrow |\ AC|$

$= \sqrt{(AB)^2 + (BC)^2 + 2(AB)(BC)\cos 90^o} = 5\ m$

- Displacement is a vector quantity
- Dimension : [L]
- Unit : metre (S.I.)

	s = 2πr and d = 0
	$d^2 = r^2 + r^2 \rightarrow d = \sqrt{2}r$
	For half circle: d = 2r and s = πr , $\frac{s}{d} = \frac{\pi}{2}, \frac{d}{s} = \frac{2}{\pi}$
	For ¾ circle: d = $\sqrt{2}r$, $s = \frac{3\pi r}{2}$
	For linear motion: s = d and s:d = 1:1

1)	**The numerical ratio of displacement to the distance covered is always** **Ans: Since displacement is always less than or equal to distance, but never greater than distance. Hence numerical ratio of displacement to the distance covered is always equal to or less than one.**
2)	A body moves 6 m north. 8 m east and 10 m vertically upwards, what is its resultant displacement from initial position Ans; $r = xi + yj + zk \rightarrow r = \sqrt{x^2 + y^2 + z^2}$ $r = \sqrt{6^2 + 68^2 + 10^2} = 10\sqrt{2}$ m
3)	A wheel of radius 1 meter rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of the wheel initially in contact with the ground is Ans; Horizontal distance covered by the wheel in half revolution = πR  So the displacement of the point which was initially in contact with ground = AA' = $\sqrt{(\pi R)^2 + (2R)^2}$ $= R\sqrt{\pi^2 + 4} = \sqrt{\pi^2 + 4}$ (as R = 1m)
4)	A man goes 10 m towards North, then 20 m towards east then displacement is Ans; $r = xi + yj + zk = \sqrt{x^2 + y^2 + z^2}$ $r = \sqrt{6^2 + 68^2 + 10^2} = 10\sqrt{2}$ m
5)	An athlete complete one round of a circular track of radius R in 40 sec. what will be his displacement at the end of 2 min. 20 sec Ans; Total time of motion is 2 min 20 sec = 140 sec. As time period of circular motion is 40 sec so in 140 sec. athlete will complete 3.5 revolution i.e., He will be at diametrically opposite point i.e., displacement = 2R.

	Distance	Displacement
	Actual path	Shortest path
	Scalar	Vector

	Can't be zero	Can be zero
	Can't be –ive	Can be negative

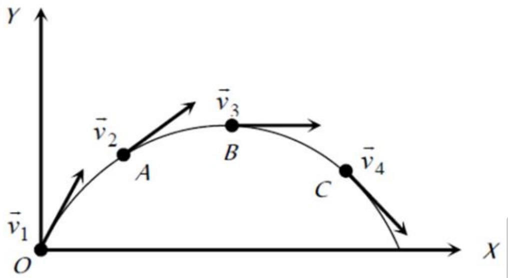
Speed and Velocity

- $speed = \frac{distance}{time}$
- $velocity(\vec{v}) = \frac{displacement}{time}$
- $distance \rightarrow scalar$, speed → scalar
- $displacement$ → vector , velocity → Vector
- Dimension for both speed & velocity: [LT⁻¹]
- Unit : metre/second (S.I.), cm/second (C.G.S.)

	Speed	Velocity
	Distance/time	**Displacement/time**
	Scalar	Vector
	Cant be zero	Can be zero
	Cant be –ive	Can be negative
	[LT⁻¹]	[LT⁻¹]

Direction of Velocity:

Direction of these velocities can be found out by drawing a tangent on the trajectory at a given point.



Types of velocity:

(a) Uniform velocity :

if magnitudes as well as direction of its velocity remains same and this is possible only when the particles moves in same straight line without reversing its direction.

(b) Non-uniform velocity:

if either of magnitude or direction of velocity changes or both of them change.

(c) Instantaneous velocity :

rate of change of position vector of particles with time at a certain instant of time.

(d) Average velocity:

the ratio of displacement to time taken by the body.

Average velocity $= \frac{displacement}{time\ taken}$

Velocity	Speed x direction
Uniform velocity	Speed constant x Direction fixed
Variable velocity	Speed variable x Direction fixed
Variable velocity	Speed constant x Direction changes
Variable velocity	Speed variable x Direction changes

Different cases of Average velocity

1) General:

$$v_{avg} = \frac{s_1+s_2}{t_1+t_2} = \frac{v_1t_1+v_2t_2}{t_1+t_2}$$

2) Equal Distance different time

$$v_{avg} = \frac{s+s}{t_1+t_2} = \frac{2s}{\frac{s}{v_1}+\frac{s}{v_2}} = \frac{2}{\frac{1}{v_1}+\frac{1}{v_2}}$$

$$v_{avg} = \frac{2v_1v_1}{v_1+v_2}$$

3) Equal time different distance

$$v_{avg} = \frac{s_1+s_2}{t+t} = \frac{v_1t+v_2t}{2t}$$

$$v_{avg} = \frac{v_1+v_2}{2}$$

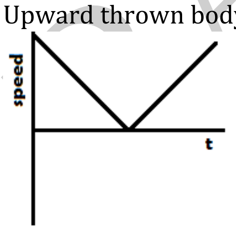
	$v_{avg} = \frac{s_1+s_2}{t_1+t_2} = \frac{v_1t_1+v_2t_2}{t_1+t_2}$
	$v_{avg} = \frac{2v_1v_1}{v_1+v_2}$
	$v_{avg} = \frac{v_1+v_2}{2}$

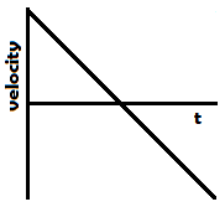
6)	Entry Tests Important Cases/MCQs
7)	Object covers 30m distance in 7s and then further 20 m in 3s. the average speed of the object is: $v_{avg} = \frac{s_1+s_2}{t_1+t_2} = \frac{30+20}{7+3} = 5m/s$
8)	If object move the following speed 6m/s for 1s, 8m/s for 3s and 12m/s for 6s in a straight line. Then average speed will be: $v_{avg} = \frac{s_1+s_2+s_3}{t_1+t_2+t_3} = \frac{v_1t_1+v_2t_2+v_3t_3}{t_1+t_2+t_3} = 10\ m/s$
9)	A train has a speed of 60 km/h. for the first one hour and 40 km/h for the next half hour. Its average speed in km/h is Ans: Distance travelled by train in first 1 hour is 60 km and distance in next 1/2 hour is 20 km/ So average speed $= \frac{Total\ distance}{Total\ time} = \frac{60+20}{3/2}$ = 53.33 km/hour
10)	A train takes 1 hour to go from one station to the other. It travels at a speed of 30km/h for first half hour and a speed of 50 km/h for the next half hour. The average speed of the train is: $v_{avg} = \frac{v_1+v_2}{2} = 80/2 = 40$ km/h
11)	A person travels along a straight road for half the distance with velocity v_1 and the remaining half distance with velocity v_2 The average velocity is given by Ans: As the total distance is divided into two equal parts therefore distance averaged speed = $\frac{2v_1v_2}{v_1+v_2}$
12)	A car travels from A to B at a speed of 20 km / hr and returns at a speed of 30 km / hr. The average speed of the car for the whole journey is Ans; Distance average speed = $\frac{2v_1v_2}{v_1+v_2} = \frac{2x20x30}{20+30}$ $= \frac{120}{5} = 24$ km/hr
13)	A boy walks to his school at a distance of 6 km with constant speed of 2.5 km/hour and walks back with a constant sped of 4 km/hr. his average speed for round trip expressed in km/hour, is

	Ans: Distance average speed = $\frac{2v_1v_2}{v_1+v_2} = \frac{2x2.5x4}{2.5+4}$ $= \frac{200}{65} = \frac{40}{13}$km/hr
14)	A car travels the first half of a distance between two places at a speed of 30 km/hr and the second half of the distance at 50 km/hr. The average speed of the car for the whole journey is Ans; Distance average speed = $\frac{2v_1v_2}{v_1+v_2} = \frac{2x2.5x4}{30+50}$ $= \frac{75}{2} = 37.5$ km/hr
15)	Object move from A to B position along straight line with speed of 40 km/h and then comes back from B to A with speed of 60 km/hr. The average speed of the object is: $v_{avg} = \frac{2*40*60}{40+60} = 48\ km/hr$
16)	A 150 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 850 meters is Ans; Total distance to be covered for crossing the bridge = length of train + length of bridge = 150m + 850 m = 1000 m $Time = \frac{Distance}{Velocity} = \frac{1000}{45x\frac{5}{18}}$= 80 sec
17)	A particle moves along a semicircle of radius 10 m in 5 seconds. The average velocity of the particle is Ans; Velocity of particle = $\frac{Total\ displacment}{Total\ time}$ $= \frac{Diameter\ of\ circle}{5} = \frac{2x10}{5} = 4$ m/s
18)	The ratio of the numerical values of the average velocity and average speed of a body is always Ans; $\frac{\lvert Average\ velocity\rvert}{\lvert Average\ speed\rvert} = \frac{\lvert Displacement\rvert}{\lvert distance\rvert} < 1$ Because displacement will either be equal or less than distance.

Displacement-time graph

- Displacement-time graph is called Velocity
- Displacement-time graph may be Negative
- Distance-time graph can never be Negative
- Slope = Δy/Δx → v = s/t → Tan θ = v =s/t
- Slope of displacement time graph gives us velocity.
- Upward thrown body against the gravity:





Note:

- The slope will give the y-axis value/ x-axis value.
- The area will give the product of y-axis value and x-axis value.

Acceleration

- **Definition:** The time rate of change of velocity of an object is called acceleration of the object.
- **Equation:** a = $\frac{v}{t}$
- **Unit:** m/s^2
- **Dimension:** LT^{-2}
- It is a vector quantity. It's direction is same as that of change in velocity (Not of the velocity)

Possible ways of velocity change:

1) Only velocity direction changes → Uniform circular motion.
2) Only velocity magnitude changes → Motion under gravity
3) Both velocity magnitude & direction changes → Projectile motion

Types of acceleration:

Uniform acceleration:

if magnitude and direction of the acceleration remains constant during particle motion.

Non-Uniform acceleration:

if either magnitude or direction or both of them change during motion.

Graphical representation of acceleration with velocity time graph

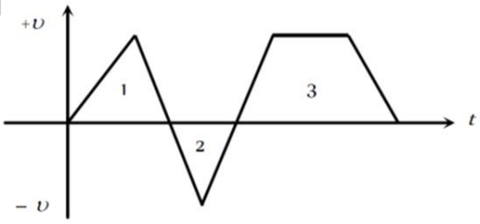
The graph is plotted by taking time t along x-axis and velocity of the particle on y-axis.

Calculation of Distance and displacement :

- Area under velocity time graph gives us distance or displacement.

Total displacement = $A_1 + A_2 + A_3$

Area above time axis is taken as positive, while area below time axis is taken as negative



- Slope of tangent on velocity-time graph represents the acceleration of the particle.

$$acceleration = \frac{change\ in\ velocity}{time\ taken}$$

Equations of Motions;

- $v_f = v_i + at$
- $s = v_it + \frac{1}{2}at^2$
- $2as = v_f^2 - v_i^2$

Conditions

- Motion on 1-line
- Acceleration must be uniform

For motion under gravity:

- $v_f = v_i + gt$
- $s = v_it + \frac{1}{2}gt^2$
- $2gh = v_f^2 - v_i^2$

For free fall motion, distance in nth second:

- $s = v_i t + \frac{1}{2}gt^2 \rightarrow s = \frac{1}{2}gt^2 \rightarrow \boxed{s \propto t^2}$ or $\boxed{s = 5t^2}$
- Ratio of total distance cover

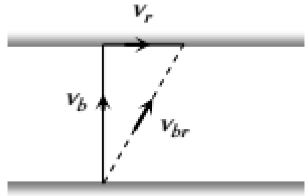
Time	1	2	3	4	5
Distance	5	20	45	80	125
	1	4	9	16	25

- Ratio of distance cover in each second:

Time	1	2	3	4	5
Distance	S_1	S_2-S_1	S_3-S_2	S_4-S_3	S_5-S_4
	5	15	25	35	45
	1	3	5	7	9

- $S_2 = 3S_1$, $S_3 = 5S_1$, $S_4 = 7S_1$
- $S_n = (2n-1)S_1$
- For free fall: $S_n = (2n-1)5$ (here $S_1 = 5m$)
- Also $\frac{s_1}{s_2} = \frac{5}{15} = \frac{1}{3}$
- $s_1 : s_2 : s_3 = 1:3:5:7$

	For n^{th} second: $S_n = (2n-1)S_1$ (nth means specific time)
	For time t: $s = 5t^2$
	• $s_1 : s_2 : s_3 : s_4 = 1:3:5:7:9$

Relative Velocity Important Points	
1)	A 150 m long train is moving to north at a speed of 10 m/s. a parrot flying towards south with a speed of 5 m/s crosses the train. The time ________ the parrot the cross to train would be: Ans: v = 5 – (-10) = 5 + 10 = 15 m/sec. Time taken by the parrot = $\frac{d}{v_{rel}} = \frac{150}{15}$ = 10 sec
2)	A moves with 65 km/h while B is coming back of A with 80 km/h. The relative velocity of B with respect to A is Ans: $v_B + v_A = v_B + v_A = 80 + 65 = 145$ km/hr.
3)	A thief is running away on a straight road on a jeep moving with a speed of 9 m/s. a police man chases him on a motor cycle moving at a speed of 10 m/s. If the instantaneous separation of jeep from the motor cycle is 100 m, how long will it take for the policemen to catch the thief Ans: v = 10-9=1 m/s Instantaneous separation = 100 m Time = $\frac{distance}{velocity} = \frac{100}{1} = 100\ sec.$
4)	A 120 m long train is moving towards west with a speed of 10 m/s. a bird flying towards east with a speed of 5 m/s crosses the train. The time taken by the bird to cross the train will be Ans; v = 10 + 5 = 15 m/s. t = $\frac{12}{15}$ = 8 sec
5)	A boat cross a river with a velocity of 8 km/h. if the resulting velocity of boat is 10 km/h then the velocity of river water is Ans: $v_{br} = v_b + v_r$ $v_{br} = \sqrt{v_b^2 + v_r^2}$ $10 = \sqrt{8^2 + v_r^2}$ $v_r = 6km/$hr. 

Newton's laws of motion

Inertia:

(1) Inherent property of all the bodies by virtue of which they cannot change their state of rest or uniform motion along a straight line by their own is called inertia.
(2) Inertia is not a physical quantity, it is only a property of the body which depends on mass of the body.
(3) Inertia has no units and no dimensions
(4) Two bodies of equal mass, one in motion and another is at rest, possess same inertia because it is a factor of mass only and does not depend upon the velocity.

1.3.1 Newton's first law of motion

- If no net force acts on a body, then the velocity of the body cannot change i.e. the body cannot accelerate.
- Newton's first law defines inertia and is rightly called the law of inertia.

Types of Inertia:

- Inertia are of three types :
  a) Inertia of Rest
  b) Inertia of Motion
  c) Inertia of Direction

(a) Inertia of rest :

It is the inability of a body to change by itself, its state of rest. This means a body at rest remains at rest and cannot start moving by its own.

(b) Inertia of Motion :

It is the inability of a body to change by itself its state of uniform motion i.e., a body in uniform motion can neither accelerate nor retard by its own.

Example :

© Inertia of direction :

It is the inability of a body to change by itself it's direction of motion.

	Entry Tests MCQs/Cases
1)	A person who is standing freely in bus, thrown backward, when bus starts suddenly
2)	When a horse starts suddenly, the rider tends to fall backward on account of inertia of rest of upper part of the body as explained above.
	If we place a coin on smooth piece of card board covering a glass and strike the card board piece suddenly with a finger. The cardboard slips away and

	the coin falls into the glass due to inertia of rest.
4)	The dust particles in a carpet falls off when it is beaten with a stick.
5)	Due to inertia, leaves from tree fall after motion.
6)	When a bus or train stops suddenly, a passenger sitting inside tends to fall forward.
7)	A person jumping out of a moving train may fall forward.
8)	When a stone tied to one end of a string is whirled and the string breaks suddenly, the stone flies off along the tangent to the circle.
9)	The rotating wheel of any vehicle throw out mud, if any, tangentially, due to directional inertia.
10)	When a car goes round a curve suddenly, the person sitting inside is thrown outwards.
11)	A rider on horse back falls when horse starts running all of a sudden because Inertia of rest keeps the upper part of body at rest whereas lower part of the body moves forward with the horse
12)	When a train stops suddenly, passengers in the running train feel an instant jerk in the forward direction because Upper part of the body continues to be in the state of motion whereas the lower part of the body in contact with seat remains at rest
13)	Inertia is that property of a body by virtue of which the body is Unable to change by itself the state of rest and of uniform linear motion
14)	A man getting down a running bus falls forward because Due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road
15)	A person sitting in an open car moving at constant velocity throws a ball vertically up into air. The ball fall Exactly in the hand which threw it up
16)	A particle is moving away with a constant speed along a straight line path. a force is not required to Keep it moving with uniform velocity
17)	When a bus suddenly takes a turn, the passengers are thrown outward because of Inertia of motion

1.3.2 Newton's second law of motion

- The rate of change of linear momentum of a body is directly proportional to the external force applied on the body and this change takes place always in the direction of the applied force.
- If a body of mass m, moves with velocity v then its linear momentum can be given by p = mv and if force (F) is applied on a body, then

$F = \frac{\Delta P}{\Delta t} = \frac{m\Delta v}{\Delta t} = m\frac{\Delta v}{\Delta t}$

$F = ma$ $\quad\quad$ * $a = \frac{\Delta v}{\Delta t}$

- When a force is applied on mass, it produces acceleration. The acceleration is directly proportional to the force applied of mass remains constants.

Force

- Force is an external effect in the form of a push or pull which

(i) Produces or tries to produce motion in a body at rest.
(ii) Stops or tries to stop a moving body.
(iii) Changes or tries to change the direction of motion of the body.

- Dimension : Force = mass x acceleration

  Force = $[M] \times [LT^{-2}]$

  Force = MLT^{-2}

- **Units:**

a) newton (N): One Newton is that force which produces an acceleration of $1 m/s^2$ in a body of mass 1 Kilogram.

  1Newton = $1kg\ m/s^2$.

b) Dyne; One dyne is that force which produces an acceleration of $1cm/s^2$ in a body of mass 1 gram.

  1 dyne = $1g\ m/s^2$.

c) Kilogram-force : It is that force which produces an acceleration of $9.8m / s^2$ in a body of mass 1 kg

  1 kg-f = 9.80 Newton

d) Gram-force : It is that force which produces an acceleration of $980cm / s^2$ in a body of mass 1gm.

  1 gm-f = 980 Dyne

F = ma

a) formula is valid only if force is changing the state of rest or motion and the mass of the body is constant and finite.

b) No force is required to move a body uniformly along a straight line with constant speed. F = ma as a = 0 so F = 0

c) When force is written without direction then positive force means repulsive while negative force means attractive.

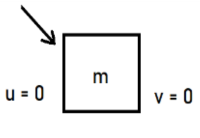
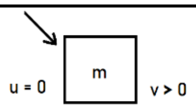
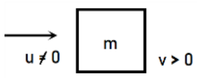
Example : Positive force – Force between two similar charges

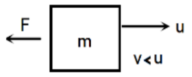
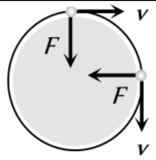
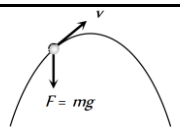
  Negative force – Force between two opposite charges

- Out of so many natural forces, for distance 10×10^{-15} metre, nuclear force is strongest while gravitational force weakest.

  $F_{nuclear} > F_{electromagnetic} > F_{gravitational}$

-

Various condition of force application:		
1)		Body remains at rest. Here force is trying to change the state of rest.
2)		Body starts moving. Here force changes the state of rest.
3)		In a small interval of time, force increases the magnitude of speed and direction of motion remains same.

4)		In a small interval of time, force decreases the magnitude of speed and direction of motion remains same.
5)		In uniform circular motion only direction of velocity changes, speed remains constant. Force is always perpendicular to velocity.
6)		In non-uniform circular motion, elliptical, parabolic or hyperbolic motion force acts at an angle to the direction of motion. In all these motions. Both magnitude and direction of velocity changes.

1) A bullet of mass 5 gm moving with velocity 100 m/sec, penetrates the wooden block upto 6 cm. then the average force imposed by the bullet on the block is
Ans) $\boldsymbol{u = 100\ m\ /\ s}$, v = 0, s = 0.06 m
Retardation = $\boldsymbol{a} = \frac{u^2}{2s} = \frac{(100)^2}{2x0.06} = \frac{1x10^6}{12}$
Force = ma = $\frac{5\ x\ 10^{-3} x\ 1\ x\ 10^6}{12} = \frac{5000}{12} = \boldsymbol{417\ N}$

2) Newton's second law gives the measure of
Ans) Force

3) A force of 100 dynes acts on mass of 5 gm for 10 sec. the velocity produced by
Ans) Acceleration = $\frac{F}{m} = \frac{100}{5} = \mathbf{20}$ cm/s²
Now v = at = 20 x 10 = 200 cm/s

4) An object will continue moving uniformly until
Ans) The resultant force on it is zero

5) A rocket is ejecting 0.05 kg of gases per second at a velocity of 400 m/sec. the accelerating force on the rocket is
Ans) $F = ma = m\left(\frac{v}{t}\right) = v\left(\frac{m}{t}\right)$
$$F = u\left(\frac{dm}{dt}\right) = 400\ x\ 0.05 = 20\ N$$

6) If the tension in the cable of 1000 kg elevator is 1000 kg weight, the elevator
Ans) Since T = mg, it implies that elevator may be at rest or in uniform motion.

7) In doubling the mass and acceleration of the mass, the force acting on the mass with respect to the previous value
Ans) Increases four times b/c Force = mass x acceleration. If mass and acceleration both are doubled then force will become four times.

8) A force of 5 N acts on a body of weight 9.8 N. What is the acceleration produced in m/sec²
Ans) As weight = 9.8 N
Mass = 1 kg
Acceleration = $\frac{Force}{Mass} = \frac{5}{1}$ = 5 m/s²

9) A body of mass 40 gm is moving with a constant velocity of 2 cm/sec on a horizontal frictionless table. The force on the table is
Ans) Force on the table = mg = 40 x 980 = 39200 dyne

10) When 1 N force acts on 1 kg body that is able to move freely, the body receives
Ans) $\boldsymbol{a} = \frac{F}{m} = \frac{1N}{1kg} = 1$ m/s²

11) An object with a mass 10 kg moves at a constant velocity of 10 m/sec. a constant force then acts for 4 second on the object and gives it a speed of 2 m/sec in opposite direction. The acceleration produced in it, is
Ans) $\boldsymbol{a} = \frac{v_2 - v_1}{t} = \frac{(-2)-(+10)}{4} = \frac{-12}{4} =$ -3 m/s²

12) In a rocket of mass 1000 kg fuel is consumed at a rate of 40 kg/s. the velocity of the gases ejected from the rocket is 5 x 10⁴ m/s. the thrust on the rocket is
Ans) Thrust F = u $\left(\frac{dm}{dt}\right)$ = 5 x 10⁴ x 40 = 2 x 10⁶ N

13) A ball of mass 0.2 kg moves with a velocity of 20 m/sec and it stops in 0.1 sec, then the force on the ball is
Ans) $\boldsymbol{F = ma} = \frac{m\Delta v}{\Delta t} = \frac{0.2x20}{0.1} = \boldsymbol{40\ N}$

14) A vehicle of 100 kg is moving with a velocity of 5 m/sec. to stop it in $\frac{1}{10}$ sec, the required force in opposite direction is
Ans) $\boldsymbol{F = m}\left(\frac{dv}{dt}\right) = \frac{100x5}{0.1} = \boldsymbol{5000\ N}$

15) If force on a rocket having exhaust velocity of 300 m/sec is 210 N, then rate of combustion of the fuel is
Ans) $\boldsymbol{F = u}\left(\frac{dm}{dt}\right) => \frac{dm}{dt} = \frac{F}{u} = \frac{210}{300} = \mathbf{0.7}$ kg/s

16) The average resisting force that must act on a 5 kg mass to reduce its speed from 65 cm/s to 15 cm/s in 0.2 s is
Ans) $\boldsymbol{F = m}\left(\frac{v-u}{t}\right) = \frac{5(65-15)x10^{-2}}{0.2} =$ 12.5 N

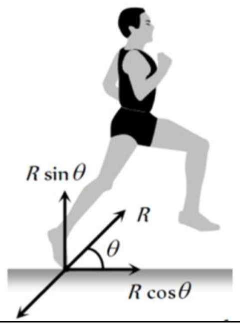
17) A body of mass 2 kg is moving with a velocity 8 m/s on a smooth surface. If it is to be brought to rest in 4 seconds, then the force to be applied is
Ans) $\boldsymbol{F = ma} = \frac{m(u-v)}{t} = \frac{2x(8-0)}{4} =$ 4N

18) A force of 10 Newton acts on a body of mass 20 kg for 10 seconds. change in its momentum is
Ans) $dp = F\ x\ dt = 10\ x\ 10 = 100\ kg$ m/s

19) A player caught a cricket ball of mass 150 gm moving at the rate of 20 m/sec, if the catching process be completed in 0.1 sec the force of the blow exerted by the ball on the hands of player is
Ans Force exerted by the ball
ð F = m $\left(\frac{dv}{dt}\right) = 0.15\ x \frac{20}{0.1} = 30\ N$

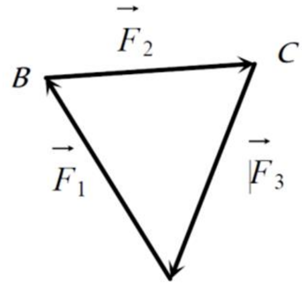
1.4.3 Newton's third law of motion

To every action, there is always an equal (in magnitude) and opposite (in direction) reaction.

1)	When a body exerts a force on any other body, the second body also exerts an equal and opposite force on the first.
2)	Forces in nature always occurs in pairs. A single isolated force is not possible.
3)	Any agent, applying a force also experiences a force of equal magnitude but in opposite direction. The force applied by the agent is called Action' and the counter force experienced by it is called 'Reaction'.
4)	Action and reaction never act on the same body. If it were so, the total force on a body would have always been zero i.e. the body will always remain in equilibrium.
5)	While walking a person presses the ground in the backward direction (action) by his feet. The ground pushes the person in forward direction with an equal force (reaction). The component of reaction in horizontal direction makes the person move forward. 
6)	Driving a nail into a wooden block without holding the block is difficult.
7)	Swimming is possible on account of : Third law of motion
8)	When we jump out of a boat standing in water it moves : Backward
9)	A cannon after firing recoils due to: Newton's third law of motion
10)	Newton's third law of motion leads to the law of conservation of : Momentum
11)	A cold soft drink is kept on the balance. When the cap is open, then the weight: First increase then decrease

Equilibrium of Concurrent Force

- If all the forces working on a body are acting on the same point, then they are said to be concurrent.
- A body, under the action of concurrent forces, is said to be in equilibrium, when there is no change in the state of rest or of uniform motion along a straight line.
- The necessary condition for the equilibrium of a body under the action of concurrent forces is that the vector sum of all the forces acting on the body must be zero.
- Mathematically for equilibrium $F_{net} = 0$
- Three concurrent forces will be in equilibrium, if they can be represented completely by three sides of a triangle taken in order. Angle in this case is 120^0.



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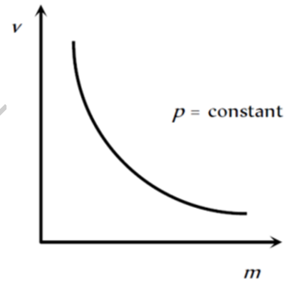
1.4 Linear Momentum

- Linear momentum of a body is the quantity of motion contained in the body.
- It is measured in terms of the force required to stop the body in unit time.
- It is also measured as the product of the mass of the body and its velocity.
  - i.e., Momentum = mass x velocity.
  - If a body of mass m is moving with velocity v then its linear momentum p is given by p = mv
- It is a vector quantity and it's direction is the same as the direction of velocity of the body.
- Units : kg-m/sec [S.I.], g-cm/sec [C.G.S.]
- Dimension : [MLT^{-1}]



1.5 Impulse(J):

- When a large force works on a body for very small time interval, it is called impulsive force.
- J = Ft
- Impulse is a vector quantity and its direction is same as that of force.
- Dimension : [$ML^{-2}T$]
- Units : Newton-second or Kg m s^{-0} (S.I.)

Dyne-second or gm-cm- s^{-1} (C.G.S.)

- The impulse of a force is equal to the change in momentum. This statement is known as Impulse momentum theorem.
- Examples :
  Hitting, kicking, catching, jumping, diving, collision etc. In all these cases an impulse acts diluted) and vice-versa.

1)	In hitting or kicking a ball we decrease the time of contact so that large force acts on the ball producing greater acceleration.
2)	In catching a ball a player by drawing his hands backwards increases the time of contact and so, lesser force acts on his hands and his hands are saved from getting hurt.

3)	In jumping on sand (or water) the time of contact is increased due to yielding of sand or water so force is decreased and we are not injured. However if we jump on cemented floor the motion stops in a very short interval of time resulting in a large force due to which we are seriously injured.
4)	An athlete is advised to come to stop slowly after finishing a fast race, so that time of stop increases and hence force experienced by him decreases.
5)	China wares are wrapped in straw or paper before packing.

1.6 Law of conservation of momentum

If no external force acts on a system (called isolated) of constant mass, the total momentum of the system remains constant with time.

- According to this law for a system of particles **F = ΔP**/Δt
- In the absence of external force **F**= 0 then **p** = constant

i.e., $P_1 + P_2 + P_3 + \ldots\ldots = \text{constant}$.

or $mv_1 + mv_2 + mv_3 + \ldots\ldots = \text{constant}$

This equation shows that in absence of external force for a closed system the linear momentum of individual particles may change but their sum remains unchanged with time.

- Law of conservation of linear momentum is independent of frame of reference, though linear momentum depends on frame of reference.
- Conservation of linear momentum is equivalent to Newton's third law of motion.

For a system of two particles in absence of external force, by law of conservation of linear momentum.

$P_1 + P_2$ constant.

$mv_1 + mv_2 =$ constant

diving by t,both sides

$mv_1/t + mv_2/t =$ constant

$ma_1 + ma_2 =$ constant

$F_1 + F_2 = 0$

$F_1 = - F_2$

i.e. for every action there is an equal and opposite reaction which is Newton's third law of motion.

- Practical applications of the law of conservation of linear momentum.

(i) When a man jumps out of a boat on the shore, the boat is pushed slightly away from the shore.

(ii) A person left on a frictionless surface can get away from it by blowing air out of his mouth or by throwing some object in a direction opposite to the direction in which he wants to move.

(iii) Recoiling of a gun : For bullet and gun system, the force exerted by trigger will be internal so the momentum of the system remains unaffected.

Let mg mass of gun, m_b mass of bullet,
v_g velocity of gun, v_b velocity of bullet
Initial momentum of system = 0 , because velocity of gun and bullet are zero.
Final momentum of system = $m_g v_g + m_b v_b$
So according to law of conservation of momentum
$m_g v_g + m_b v_b = 0$
$v_b = - (m_g v_g) / m_b$

Here negative sign indicates that the velocity of recoil is opposite to that of gun.

- $v_g \propto 1 / m_g$, i.e. higher the mass of gun, lesser the velocity of recoil of gun.
- While firing the gun must be held tightly to the shoulder, this would save hurting the shoulder because in this condition the body of the shooter and the gun behave as one body. Total mass become large and recoil velocity becomes too small.

vg $\propto 1 /(m_g + m_{mas})$

Conservation of Linear Momentum and Impulse

1)	A player caught a cricket ball of mass 150 gm moving at a rate of 20 m/s. if the catching process be completed in 0.1s, then the force of the blow exerted by the ball on the hands of the player is Ans) = $\frac{mdv}{dt} = \frac{0.15\ x\ 20}{0.1} = 30N$
2)	A rocket has a mass of 100 kg. 90% of this is fuel. It ejects fuel vapours at the rate of 1 kg/sec with a velocity of 500 m/sec relative to the rocket. It is supposed that the rocket is outside the gravitational field. The initial upthrust on the rocket when it just starts moving upwards is Ans) $F = u\left(\frac{dm}{dt}\right) = 500\ x\ 1 = 500\ N$
3)	In which of the following cases forces may not be required to keep the Ans) If momentum remains constant then force will be zero because F = $\frac{dP}{dt}$
4)	A wagon weighing 1000 kg is moving with a velocity 50 km/h on smooth horizontal rails. A mass of 250 kg is dropped into it. The velocity with which it moves now is Ans) According to principle of conservation of linear momentum 1000 x 50 = 1250 x v → V = 40 km/hr
5)	If a force of 250 N act on body, the momentum acquired is 125 kg m/s. what is the period for which force acts on the body Ans) Change in momentum = impulse $\rightarrow \Delta p = F\ x\ \Delta t$ $\rightarrow \Delta t = \frac{\Delta p}{F} = \frac{125}{250} = 0.5$ sec

6) A ball of mass 150g starts moving with an acceleration of 20 m/s^2. When hit by a force, which acts on it 0.1 sec. the impulsive force is
Ans) Impulse = Force x time = m a t
= 0.15 x 20 x 0.1 = 0.3 N-s

7) A body, whose momentum is constant, must have constant
Ans) For a given mass P $\propto v$. If the momentum is constant then it's velocity must have constant.

8) A rocket of mass 1000 kg exhausts gases at a rate of 4 kg/sec with a velocity 3000 m/s. the thrust developed on the rocket is
Ans) $F = u\left(\frac{dm}{dt}\right) = 3000 \ x \ 3 = 12000 \ N$

9) The momentum is most closely related to
Ans) Impulse

10) Rocket engines lift a rocket from the earth surface because hot gas with high velocity
Ans) React against the rocket and push it up. It worked on the principle of conservation of momentum.

11) A force of 50 dynes is acted on a body of mass 5 g which is at rest for an interval of 3 seconds, then impulse is
Ans) Impulse, I = F x $\Delta t = 50 \ x \ 10^{-5} x \ 3 = 1.5 \ x \ 10^{-3}$N-s

12) A body of mass M at rest explodes into three pieces, two of which of mass M/4 each are thrown off in perpendicular directions with velocities of 3 m/s and 4 m/s respectively. the third piece will be thrown off with a velocity of
Ans) Momentum of one piece = $\frac{M}{4} x \ 3$
Momentum of the other piece = $\frac{m}{4} x \ 4$
Resultant momentum = $\sqrt{\frac{9M^2}{16} + M^2} = \frac{5M}{4}$
The third piece should also have the same momentum. Let its velocity be v, then
$\frac{5M}{4} = \frac{M}{2} x \ v \ or \ v = \frac{5}{2}$ =2.5 m/sec

13) The momentum of a system is conserved
Ans) In the absence of an external force on the system

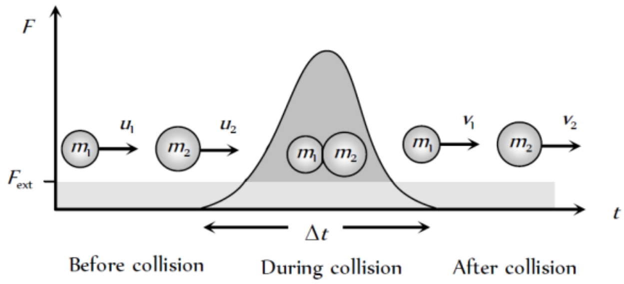
14) A bullet of mass 0.1 kg is fired with a speed of 100 m/sec, the mass of gun is 50 kg. the velocity of recoil is
Ans) According to principle of conservation of linear momentum $m_G v_G = m_B v_B$
$\rightarrow v_G = \frac{m_B v_B}{m_G} = \frac{0.1 \ x \ 10^2}{50}$ = 0.2 m/

15) A bullet mass 10 gm is fired from a gun of mass 1 kg. if the recoil velocity is 5 m/s, the velocity of the muzzle is
Ans) $m_G v_G = m_B v_B \ \ \rightarrow v_B = \frac{m_G v_G}{m_B} = \frac{1 \ x \ 5}{10 \ x \ 10^{-3}}$ = 500 m/s

1.7 Collision:

Collision is an isolated event in which a strong force acts between two or more bodies for a short time as a result of which the energy and momentum of the interacting particle change. In collision particles may or may not come in real touch e.g. in collision between two billiard balls or a ball and bat, there is physical contact while in collision of alpha particle by a nucleus (i.e. Rutherford scattering experiment) there is no physical contact.

(1) Stages of collision :
There are three distinct identifiable stages in collision, namely, before, during and after. In the before and after stage the interaction forces are zero. Between these two stages, the interaction forces are very large and often the dominating forces governing the motion of bodies. The magnitude of the interacting force is often unknown, therefore, Newton's second law cannot be used, the law of conservation of momentum is useful in relating the initial and final velocities.



(2) Momentum & Energy conservation in Collision:
(i) Momentum conservation :
In a collision, the effect of external forces such as gravity or friction are not taken into account as due to small duration of collision (Δt) average impulsive force responsible for collision is much larger than external force acting on the system and since this impulsive force is 'Internal' therefore the total momentum of system always remains conserved.
(ii) Energy conservation :
In a collision 'total energy' is also always conserved. Here total energy includes all forms of energy such as mechanical energy, internal energy, excitation energy, radiant energy or even mass energy.
These laws are the fundamental laws of physics and applicable for any type of collision but this is not true for conservation of kinetic energy.
(3) Types of collision :
On the basis of conservation of kinetic energy.

(i) Elastic collision:
If in a collision, kinetic energy after collision is equal to kinetic energy before collision, the collision is said to be perfectly elastic.
In an elastic collision both kinetic energy and momentum is Conserved

Examples :
(1) Collision between atomic particles
(2) Bouncing of ball with same velocity after the collision with earth.

(ii) Inelastic collision:
If in a collision two bodies stick together or move with same velocity after the collision, the collision is said to be perfectly inelastic.
In an inelastic collision momentum is conserved but kinetic energy is not Conserved

Example :
Collision between a bullet and a block of wood into which it is fired. When the bullet remains embedded in the block.

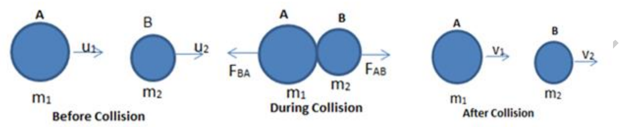
Elastic collision

- In an elastic collision both kinetic energy and momentum is Conserved
- A collision in which both K.E and momentum is conserved is called Elastic collision
- The relation between range and maximum range $R = R_0 \sin 2\theta$
- Newtonian physics does not hold true in case of Atomic particles
- The conservation of linear momentum holds true in case of Atomic physics
- The collisions between atomic particles, nuclear particles and fundamental particles are Truly elastic collision

Elastic collision in one dimension

- The type of collision in which before and after collision appear on singe line Head-on collision
- The relative speed of approach is equal to relative speed of separating for two Bodies colliding elastically
- A system in which no external agency exerts any force is called Isolated system

Elastic collision in one dimension under different cases



According to law of conservation of momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \quad \text{... (i)}$$

$$\Rightarrow m_1(u_1 - v_1) = m_2(v_2 - u_2) \quad \text{...(ii)}$$

According to law of conservation of kinetic energy

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 \quad \text{...(iii)}$$

$$\Rightarrow m_1(u_1^2 - v_1^2) = m_2(v_2^2 - u_2^2) \quad \text{...(iv)}$$

Dividing equation (iv) by equation (ii)

$$v_1 + u_1 = v_2 + u_2 \quad \text{...(v)}$$

$$\Rightarrow u_1 - u_2 = v_2 - v_1 \quad \text{...(vi)}$$

Relative velocity of separation is equal to relative velocity of approach.

- After collision, the velocity of two body will be,

$$v_1 = \left(\frac{m1-m2}{m1+m2}\right)u_1 + \left(\frac{2m2}{m1+m2}\right)u_2$$

$$v_2 = \left(\frac{2m1}{m1+m2}\right)u_1 + \left(\frac{m2-m1}{m1+m2}\right)u_2$$

1) When both the colliding bodies are of the same mass, i.e., $m_1 = m_2 = m$, then,

$$v_1 = \left(\frac{m1-m2}{m1+m2}\right)u_1 + \left(\frac{2m2}{m1+m2}\right)u_2 \rightarrow v_1 = u_2$$

$$v_2 = \left(\frac{2m1}{m1+m2}\right)u_1 + \left(\frac{m2-m1}{m1+m2}\right)u_2 \rightarrow v_2 = u_1$$

Thus, if the balls of same masses collides each other, they will **interchange** their velocities after collision.

2) When the body B of mass m_2 is initially at rest and m1=m2 , i.e., $u_2 = 0$, then,

$$v_1 = \left(\frac{m1-m2}{m1+m2}\right)u_1 + \left(\frac{2m2}{m1+m2}\right)u_2$$

$$v_2 = \left(\frac{2m1}{m1+m2}\right)u_1 + \left(\frac{m2-m1}{m1+m2}\right)u_2$$

the equation becomes

$$\boxed{\begin{aligned} v_1 &= \left(\frac{0}{m+m}\right)u_1 + \left(\frac{2m}{m+m}\right)(0) = 0 \\ v_2 &= \left(\frac{2m}{2m}\right)u_1 + \left(\frac{m-m}{m+m}\right)(0) = u_1 \end{aligned}}$$

Thus, if the balls of same masses collides each other, they will **interchange** their velocities after collision like the above case.

Thus, the ball of mass m_1 , after collision, will come to stop and will takes of the velocity of m_1.

3) When a light body collides with the massive body at rest. Like cycle to truck.
In this case initial velocity $v_2 = 0$ and $m_2 >> m_1$, under these conditions m_1 can be neglected as compared to m_2 i.e., $m_1 \approx 0$
After collision, the velocity of two body will be,

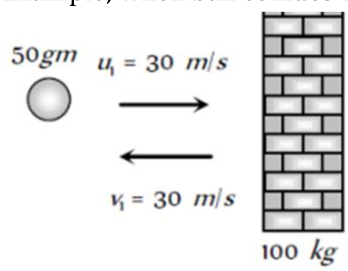
$$v_1 = \left(\frac{m1-m2}{m1+m2}\right)u_1 + \left(\frac{2m2}{m1+m2}\right)u_2$$

$$v_2 = \left(\frac{2m1}{m1+m2}\right)u_1 + \left(\frac{m2-m1}{m1+m2}\right)u_2$$

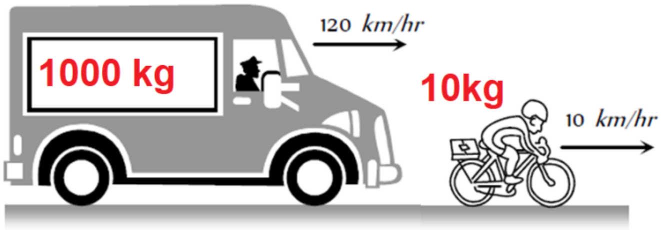
the equation becomes:

$$\boxed{\begin{aligned} v_1 &= \left(\frac{0-m2}{m1+m2}\right)u_1 + \left(\frac{2m2}{m1+m2}\right)0 = -v_1 \\ v_2 &= \left(\frac{2(0)}{m1+m2}\right)u_1 + \left(\frac{m2-m1}{m1+m2}\right)(0) = 0 \end{aligned}}$$

Thus, the body of mass m_1 will bounce back with the same velocity while m_2 will remain stationary.
Example; when ball collides with wall,



4) When a massive body colloids with the light stationary body.



In this case initial velocity $v_2=0$ and $m_1 >>m_2$. Under these conditions m_2 can be neglected as compared to m_1 i.e., $m_2 \approx 0$.

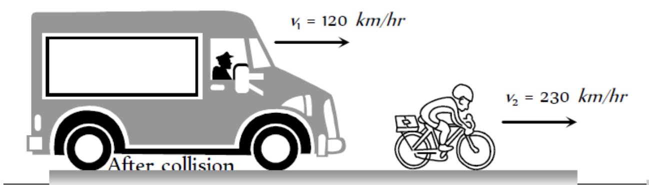
$v_1 = (\frac{m1-m2}{m1+0})u_1 + (\frac{2m2}{m1+0})u_2$

$v_1 = (\frac{m1-0}{m1+m2})u_1 + (\frac{2(0)}{m1+m2})(0) = u_1$

$v_2 = (\frac{2m1}{m1+m2})u_1 + (\frac{m2-m1}{m1+m2})u_2$

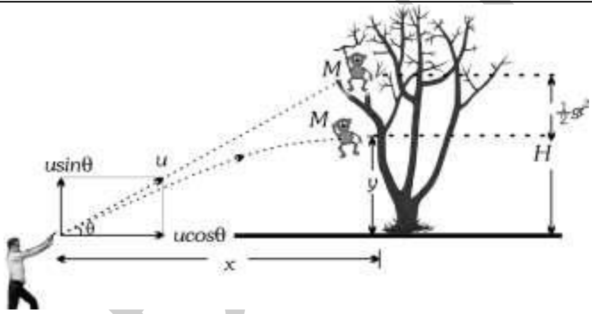
$v_2 = (\frac{2m1}{m1+0})u_1 + (\frac{0-m1}{m1+0})(0) = 2u_1$

Thus, there will be no change in the velocity of massive body, and the lighter body will move in forward direction with twice the velocity of incident body.



	Elastic Head on Collision	
	$m_1 = m_2$	$v_1' = v_2$ & $v_2' = v_1$
	$m_1 = m_2$, $v_2 = 0$	$v_1' = 0$ & $v_2' = v_1$
	$m_1 >>> m_2$, $v_2 = 0$	$v_1' = v_1$ & $v_2' = 2v_1$
	$m_1 <<< m_2$, $v_2 = 0$	$v_1' = -v_1$ & $v_2' = 0$

1.8 Projectile motion



A hunter aims his gun and fires a bullet directly towards a monkey sitting on a distant tree. If the monkey remains in his position, he will be safe but at the instant the bullet leaves the barrel of gun, if the monkey drops from the tree, the bullet will hit the monkey because the bullet will not follow the linear path.

A body which is in flight through the atmosphere under the effect of gravity alone and is not being propelled by any fuel is called projectile.

Such a two motion in which horizontal acceleration is zero while vertical acceleration is only due to gravity.

Few examples:

(i) A bomb released from an aeroplane in level flight

(ii) A bullet fired from a gun

(iii) An arrow released from bow

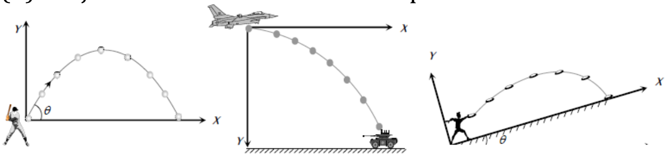
(iv) A Javelin thrown by an athlete

Types of Projectile Motion

(1) Oblique projectile motion

(2) Horizontal projectile motion

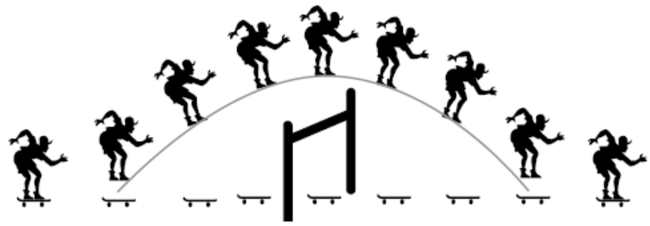
(3) Projectile motion on an inclined plane



Olique Projectile: In projectile motion, horizontal component of velocity (u cosθ), acceleration (g) and mechanical energy remains constant while, speed, velocity, vertical component of velocity (u sin θ), momentum, kinetic energy and potential energy all changes. Velocity, and KE are maximum at the point of projection while minimum (but not zero) at highest point.

Example : When a man jumps over the hurdle leaving behind its

skateboard then vertical component of his velocity is changing, but not the horizontal component which matches with the skateboard velocity. As a result, the skateboard stays underneath him, allowing him to land on it.



$a_x = 0 \rightarrow Fx = 0 \rightarrow Vx =$ constant

$a_y = 0 \rightarrow Fy = 0 \rightarrow$ Vy is not constant

MCQs
If stone is dropped from moving train, it will follow → parabolic path

Assumptions of Projectile Motion

(1) There is no resistance due to air.

(2) The effect due to curvature of earth is negligible.

(3) The effect due to rotation of earth is negligible.

(4) For all points of the trajectory, the acceleration due to gravity 'g' is constant in magnitude and direction.

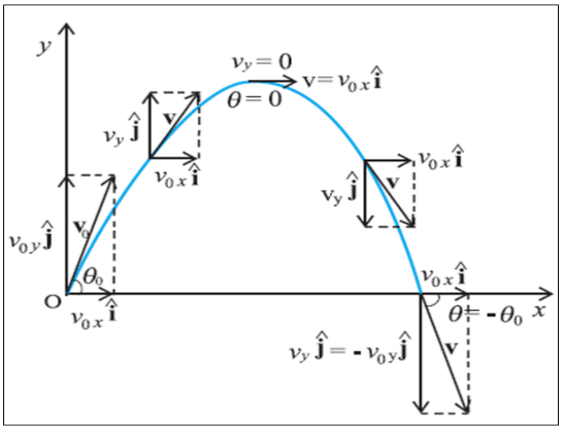
Characteristics of projectile motion

- Projectile motion is two dimensional under an action of Gravity
- The vertical component of velocity in projectile at highest points is Zero
- The horizontal component of velocity of projectile remains Constant
- In projectile motile motion, the upward quantities are taken Positive while the downward quantities are taken as negative.
- As gravitational acceleration acts downwards so take it negative always.

Examples of Projectile:

a) football kicked by a player (Oblique projectile)

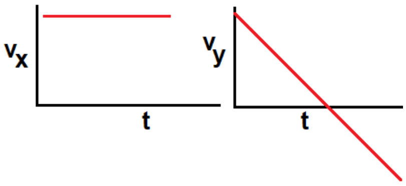
b) bomb dropped by plane (Horizontal projectile)



Vx = Vi cosθ,   Vy = Visinθ
Fx = 0,   Fy = Fg
Ax = 0,   ay = -g

MCQs
If $v_i = 3\hat{\imath} + 4\hat{\jmath}$ at projection point then at landing point velocity will be ___________
→ $v_f = 3\hat{\imath} - 4\hat{\jmath}$

Velocity of Projectile Motion:



- Velocity of projectile is never zero at any point of protectory.
- Velocity is minimum at highest point because vertical component is zero.
- Velocity is maximum *at* both projection and landing point.

$$v_f = \sqrt{{v_{fx}}^2 + {v_{fy}}^2}$$
$$v_{fx} = v_{ix} + a_x t = v_{ix} = v_i cos\theta$$
$$v_{fy} = v_{iy} + a_y t = v_i \sin\theta - gt$$

Velocity at any instant be like:

$$v_f = \sqrt{{v_i}^2 + g^2t^2 - 2v_i sin\theta gt}$$

Magnitude of velocity: v = $\sqrt{{v_{fx}}^2 + {v_{fy}}^2}$

Direction: Tan θ = $\frac{v_{fy}}{v_{fx}}$

Velocity at highest point

$$v_f = \sqrt{{v_{fx}}^2 + {v_{fy}}^2}$$
$$v_H = \sqrt{{v_{fx}}^2} = v_{fx} = v_{ix} + a_x t = v_{ix} = v_i cos\theta$$

Different Cases:

$v_H = v_i cos\theta$

Angle in degree	value
30	0.8 or 80%vi
45	0.7 or 70% vi
60	0.5 or 50% vi

Momentum at highest point

$P_H = mv_h = mv_i cos\theta = p_i \cos\theta$

Angle in degree	value
30	0.8 or 80% Pi
45	0.7 or 70% Pi
60	0.5 or 50% Pi

Kinetic Energy at highest point

K.E = $\frac{1}{2}mv_h^2 = \frac{1}{2}mv_i^2 \cos^2\theta$ = $K.E_i \cos^2\theta$

Angle in degree	value
30	0.7 or 70K.Ei
45	0.5 or 50% K.Ei
60	0.25 or 25% K.Ei

Potential Energy at highest point

$P.E_h$ = mgH

$P.E_h$ = mg $(\frac{v_i^2 \sin^2\theta}{2g})$ = $K.E_i \sin^2\theta$

Angle in degree	value
30	0.25 or 80K.Ei
45	0.5 or 70% K.Ei
60	0.7 or 50% K.Ei

MCQs
A particle is projected at 60 degree to the horizontal axis with Kinetic energy K. The kinetic energy at highest point i
a) K/2 b) K c) 0 **d) K/4**

On Top	
Velocity	$v_i cos\theta$
Kinetic Energy	$K.E_i \cos^2\theta$
Potential Energy	$K.E_i \sin^2\theta$
Momentum	$p_i \cos\theta$

Time of flight

The total time taken by the projectile to go up and come down to the same level from which it was projected is called time of flight.

For vertical upward motion

0 = u sin θ – gt → t = u sin θ /g

Time of flight = T = 2t = 2u sin θ /g

(i) Time of flight can also be expressed as : *T = 2u*$_y$*/g*

(ii) For complementary angles of projection θ and 90^0– θ

(a) Ratio of time of flight = $\frac{T_1}{T_2} = \frac{\frac{2usin\theta}{g}}{\frac{2usin90-\theta}{g}} = Tan\ \theta$

(b) Multiplication of time of flight =$T_1 T_2 = \frac{2usin\theta}{g}\frac{2ucos\theta}{g}$= 2R/g

Time from projection point to landing point.

T = $\frac{2v_i sin\theta}{g}$

t α sin θ , t α vi

$\frac{t1}{t2} = \frac{sin\ \theta1}{sin\theta2}$, $\frac{t1}{t2} = \frac{v1}{v2}$, $\frac{t1}{t2} = \frac{v1\ sin\ \theta1}{v2\ sin\theta2}$

Horizontal range :

It is the horizontal distance travelled by a body during the time of flight. So by using second equation of motion in x-direction

v=s/t → s = v x T

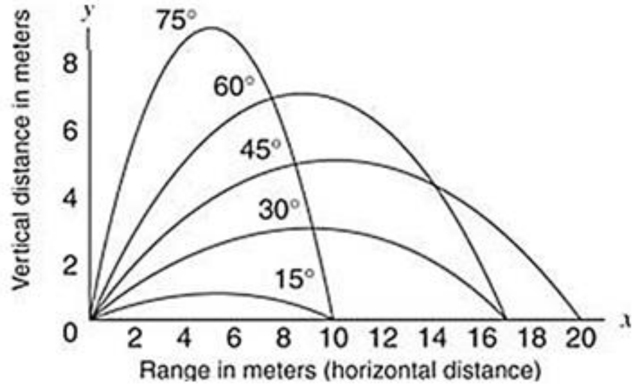
R = u cosθ x *T = u*^{2}sin2θ/g

(i) Range of projectile can also be expressed as :

R = u cosθ × T =

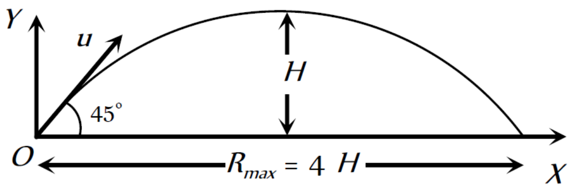
R = u cosθ x *x 2usinθ/g = 2u*$_x$*u*$_y$*/g*

(where u_x and u_y are the horizontal and vertical component of initial velocity)
(ii) If angle of projection is changed from θ to θ' = (90 – θ) then range remains unchanged.



Complementary means that there sum will be equal to 90, A projectile has same range at angles of complementary angles, though time of flight, maximum height and trajectories are different.
$R = u^2 \sin 2\theta / g$

- If θ =0 then R = $Vi^2 \sin 2(0)/g = Vi^2 \sin 0/g = Vi^2 (0)/g$ =0
- If θ =45 then R = $Vi^2 \sin 2(45)/g = Vi^2 \sin 90/g = Vi^2 (1)/g$
  = Vi^2 /g → range is maximum at 45^0.
- if θ=90 then R = $Vi^2 \sin 2(90)/g = Vi^2 \sin 180/g = Vi^2 (0)/g$ =- 0 = 0
- Maximum Range: $R = u^2/g$
- 45^0 → H = $Vi^2 \sin^2 45/2g = Vi^2\, 0.5/2g = Vi^2/4g = R_{max}/4$



If $R = H$ then $\theta = \tan^{-1}(4)$ or $\theta = 76^o$.

If $R = 4H$ then $\theta = \tan^{-1}(1)$ or $\theta = 45^o$

Maximum height

It is the maximum height from the point of projection, a projectile can reach.
$2as = v_f^2 - v_i^2 \rightarrow -2gH = -$
$H = \frac{vi sin^2\theta}{2g}$
H α $\sin^2 \theta$. max at 90^0
H α vi
$\frac{H_1}{H_2} = \frac{v_1}{v_2}$
$\frac{H_1}{H_2} = \frac{sin^2\theta_1}{sin^2\theta_2}$

Horizontal range

Horizontal and Vertical Distance

Consider a ball is thrown horizontally from certain height. It is observed that the ball travel forward as well as falls downward, until it strikes something. There is no horizontal force acting on the object, so a_x =0. Thus the horizontal velocity v_x will remain unchanged. The horizontal distance covered by the object can be find out by using the 2nd equation of motion:
$S = v_{ix}t + ½a_x t^2$
$S = v_{ix}t + ½a\,(0)\, t^2$
$S = v_{ix}t + 0$
$S = v_{ix}t$

- if body is falling under the force of gravity then the distance(s) travelled by the body is
  $S = v_i t + ½at^2$
  as $v_i = 0$
  so $s = ½at^2$

$s = ½gt^2$

Height of projectile

- H = $Vi^2 \sin^2 \theta/2g$
- If θ =0 then H= $Vi^2 \sin^2 \theta/2g = Vi^2 \sin^2 0/2g = Vi^2 (0)/2g = 0$
- If θ =45 then H= $Vi^2 \sin^2 45/2g$
- H= $Vi^2 \sin^2 1/2g$
- H= $Vi^2 /2g$
- if θ=90 then H= $Vi^2 \sin^2 \theta/2g = Vi^2 \sin^2 0/2g = Vi^2 (0)/2g = 0$

Range of projectile

- R= $Vi^2 \sin 2\theta/g$
- The range of projectile is the same for two angles which are mutually Complementary

Time of projectile

- T= 2Vi sin θ/g
- Rime to reach highest point=T' = T/2= 2Vi sin θ/2g = Vi sin θ/g
- T' = Vi sin θ/g
- If θ =0 then T= 2Vi sin 0/g = T= 2Vi (0)/g = 0
- If θ =45 then 2Vi sin 45/g = T= 2Vi (0.5)/g = Vi/g
- if θ=90 then 2Vi sin 90/g = T= 2Vi (1)/g = 2Vi/g

Relationship between time of flight and height

- $T = \sqrt{\frac{8H}{g}}$ or H = $gT^2/8$

Derivation
T= 2Vi sin θ/g squaring both sides $T^2 = 4Vi^2 \sin^2 \theta/g^2$ x ing and Deviding right hand side by 2 $T^2 = \frac{2}{2}(4Vi^2 \sin^2 \theta/g^2) = 8(Vi^2 \sin^2 \theta/2g^2)$ $T^2 = \frac{8}{g}(4Vi^2 \sin^2 \theta/g) = \frac{8}{g}(H)$ $T = \sqrt{\frac{8H}{g}}$ or H = $gT^2/8$

- Time to submit relation: $T = \sqrt{\frac{2h}{g}}$

Velocity

- The vertical velocity of projectile at its maximum height is Zero
- The velocity of projectile at its maximum height is Minimum
- To find velocity if initial velocity and time are given

$V_f = V_i + at \rightarrow V_f = V_i - gt$

$76^0 \rightarrow R = H$
$45^0 \rightarrow R = R_{max}$
$R_{max} = 4H$
$T = \sqrt{\frac{8H}{g}}$ or $H = gT^2/8$
$H \alpha v_i^2$, $R \alpha v_i^2$, $T \alpha v_i$

Range Height Relation

$$\frac{R}{H} = \frac{V_0^2 \sin 2\theta}{g} \cdot \frac{2g}{V_0^2 \sin^2\theta}$$

$$\therefore \frac{R}{H} = \frac{2\sin 2\theta}{\sin^2\theta}$$

For maximum range $\theta = 45^0$

$$\therefore \frac{R}{H} = \frac{2\sin 90^\circ}{\sin^2 45^\circ}$$

$$\therefore \frac{R}{H} = \frac{2(1)}{\left(\frac{1}{\sqrt{2}}\right)^2}$$

$$\therefore \frac{R}{H} = \frac{2}{\left(\frac{1}{2}\right)}$$

$$\therefore \frac{R}{H} = 4$$

$\therefore R = 4H$

$\theta = ?$

when $h = R$

$h = R$ — (i)

As $h = \frac{V_i^2 \sin^2\theta}{2g}$ — (ii)

$R = \frac{V_i^2 \sin 2\theta}{g}$ — (iii)

Putting values in (1) we have

$$\frac{V_i^2 \sin^2\theta}{2g} = \frac{V_i^2 \sin 2\theta}{g}$$

$$\frac{\sin^2\theta}{2} = 2\sin\theta\cos\theta$$

$\because \sin 2\theta = 2\sin\theta\cos\theta$

$$\frac{\sin^2\theta}{2} = 2\sin\theta\cos\theta$$

$$\frac{\sin\theta}{\cos\theta} = 4$$

$\tan\theta = 4$

$\theta = \tan^{-1}(4)$

$= 75.96$

$\theta = 76^\circ$

Complementary Angles
θ and $90 - \theta$
$\theta_1 + \theta_2 = 90$
$45 + \theta$ and $45 - \theta$
R is same for any complementary angles.

1) If projectile is thrown with 19.6m/s at 30^0 with x-axis, time taken to reach to highest point

Ans; $t = T/2 = \frac{v i \sin\theta}{g}$

2) Two ball projected at 30^0 and 60^0 such that their heights attained are same, what must be the ration of initial velocity.

Ans; $H = \frac{v i \sin^2\theta}{2g} \rightarrow \frac{v_{30}}{v_{60}} = \frac{\sin^2 60}{\sin^2 30}$

3) A projectile fired with initial velocity u at some angle θ has a range R. if the initial velocity be doubled at the same angle of projection, thent he range will be

Ans) 4R , As $R = \frac{u^2 \sin 2\theta}{g}$

$H \propto u^2$. if initial velocity be doubled then range will become four times.

4) If the initial velocity of a projectile be doubled, keeping the angle of projection same, the maximum height reached by it will

Ans) Be quardrupled

$H = \frac{u^2 \sin^2\theta}{2g}$, $H \propto u^2$. If initial velocity be doubled then maximum height reached by the projectile will quadrupled.

5) In the motion of a projectile freely under gravity, its

Ans) Total energy is conserved, An external force by gravity is present throughout the motion so momentum will not be conserved.

6) The range of a projectile for a given initial velocity is maximum when the angle of projection is 45°. The range will be minimum, if the angle of projection is

Ans) 90°

$Range = \frac{u^2 \sin 2\theta}{g}$; where $\theta = 90°$, R = 0 i.e. the body will fall at the point of projection after completing one dimensional motion under gravity.

7) A ball is thrown upwards and it returns to ground describeing a parabolic path. which of the following remains constant

Ans) Horizontal components of velocity

Because there is no accelerating or retarding force available in horizontal motion.

8) At the top of the trajectory of a projectile, the directions of its velocity and acceleration are

Ans) Perpendicular to each other

Direction of velocity is always tangent to the path so at the top of trajectory, it is in horizontal direction and acceleration due to gravity is always in verticaly downward direction. It means angle between v and g are perpendicular to each other.

9) The range of a particle when launched at an angle of 15° with the horizontal is 1.5 km. what is the range of the projectile when launched at an angle of 45° to the horizontal

Ans)3.0 km

$$R_{15°} = \frac{u^2 \sin(2x15°)}{g} = \frac{u^2}{2g} = 1.5\ km$$

$$R_{45°} = \frac{u^2 \sin(2x45°)}{g} = \frac{u^2}{g} = 1.5\ x\ 2 = 3\ km$$

10) A projectile thrown with a speed v at an angle θ has a range R on the surface of earth. For same v and θ, its range on the surface of moon will be

Ans) Range is given by $R = \frac{u^2 \sin 2\theta}{g}$

On moon $g_m = \frac{g}{6}$. hence $R_m = 6R$

11) At the top of the trajectory of a projectile, the acceleration is

Ans) g. Acceleration through out the projectile motion remains constant and equal to g.

12) A football player throws a ball with a velocity of 50 metre/sec at an angle 30 degrees from he horizontal. The ball remains in the air for (g = 10 m/s2)

Ans) Time of flight = $\frac{2u\sin\theta}{g} = \frac{2x50x\sin 30}{10} = 5s$

13) A body of mass 0.5 kg is projected under gravity with a speed of 98 m/s at an angle of 30° with the horizontal. The change in momentum (in magnitude) of the body is

Ans) Change in momentum = 2mu $\sin\theta$

= 2 x 0. 5 x 98 x sin30 = 45 N-s

---

14) Two bodies are projected with the same velocity. If one is projected at an angle of 30° and the other at an angle of 60° to the horizontal, the ratio of the maximum heights reached is

Ans) 1 : 3 $As\ h = \frac{u^2 \sin^2\theta}{2g}$

$\frac{H_1}{H_2} = \frac{\sin^2\theta_1}{sin\theta_2} = \frac{\sin^2\theta_1}{sin\theta_2} = \frac{\sin^2 30°}{\sin^2 60} = \frac{1/4}{3/4}$

---

15) If time of flight of projectile is 10 seconds. Range is 500 meters. The maximum height attained by it will be

Ans) 125 m

$T = \frac{2usin\theta}{g}$ = 10 sec => u sinθ = 50 m/s

$$H = \frac{u^2\sin^2\theta}{2g} = \frac{(usin\theta)^2}{2g} = \frac{50\ x\ 50}{2\ x\ 10} = 125\ m$$

---

16) If a body A of mass M thrown with velocity V at an angle of 30° to the horizontal and another body B of the same mass is thrown with the same speed at an angle of 60° to the horizontal. The ratio of horizontal range of A to B will be

Ans)1 : 1, For complementary angles range will be equal.

---

17) A bullet is fired from a cannon with velocity 500 m/s. if the angle of projection is 15° and g = 10 m/s2. Then the range is

Ans) $R = \frac{u^2 sin2\theta}{g} = \frac{(500)^2 x\ sin30°}{10} = 12.5\ x\ 10^3$m

---

18) A ball thrown by a body is caught by another after 2 sec. some distance away in the same level. If the angle of projection is 30, the velocity of projection is

Ans) 19.6 m/s

$T = \frac{2usin\theta}{g} => u = \frac{T\ x\ g}{2\ sin\theta} = \frac{2\ x\ 9.8}{2\ x\ sin30}$ = 19.6 m/s

---

19) A particle covers 50 m distance when projected with an initial speed. On the same surface it will cover a distance, when projected with double the initial speed.

Ans) $R = \frac{u^2 sin2\theta}{g} = R \propto u^2$. So if the speed of projection doubled, the range will becomes four times, i.e., 4 x 50 = 200 m

---

20) A ball is thrown upwards at an angle of 60° the horizontal. It falls on the ground at a distance of 90 m. if the ball is thrown with the same initial velocity at an angle 30°, it will fall on the ground at a distance of

Ans) 90m, Range will be equal for complementary angles.

---

21) Four bodies P, Q, R and S are projected with equal velocities having angle of projection 15, 30, 45 and 60 with the horizontal respectively. the body having shortest range is

Ans) P, When the angle of projection is very far from 45°then range will be minimum

---

22) For a projectile, the ratio of maximum height reached to the square of flight time is (g = 10 ms)

Ans) 5 : 4, $H = \frac{u^2\sin^2\theta}{2g}$ and $T = \frac{2usin\theta}{g}$

So $\frac{H}{T^2} = \frac{u^2\sin^2\theta/2g}{4u^2\sin^2\theta/g^2} = \frac{g}{8} = \frac{5}{4}$

23) Which of the following sets of factors will affect the horizontal distance covered by an athlete in a long-jump even

Ans) The direction in which he leaps and the initial speed because Range = $\frac{u^2\ sin2\theta}{g}$. It is clear that range is proportional to the direction (angle) and the initial speed.

---

24) A ball thrown by one player reaches the other in 2 sec. the maximum height attained by the ball above the point of projection will be about

Ans) $\frac{2u\ sin\theta}{g} = 2$ sec => u $sin\theta = 10$

$H = \frac{u^2\sin^2\theta}{2g} = \frac{100}{2g} = 5m$

---

25) In a projectile motion, velocity at maximum height is

Ans) $ucos\theta$, Only horizontal component of velocity ($u\ cos\theta$)

---

26) If two bodies are projected at 30 and 60 respectively, with the same velocity, then

Ans) Their ranges are same b/c For complementary angle range is same.

---

27) A body is thrown with a velocity of 9.8 m/s making an angle of 30 with the horizontal. It will hit the ground after a time

Ans) T = $\frac{2usin\theta}{g} = \frac{2x9.8xsin30}{9.8} = 1s$

---

28) For a given velocity , a projectile has the same range R for two angles of projection if t and t are the times of flight in the two cases then

Ans) $t_1 t_2 \propto R$ For same range angle of projection should be θ and 90-θ

So, time of flights $t_1 = \frac{2u\ sin\theta}{g}$ and

$t_2 = \frac{2usin(90-\theta)}{g} = \frac{2u\ cos\theta}{g}$

By multiplying = $t_1 t_2 = \frac{4u^2\ sin\theta cos\theta}{g^2}$

$t_1 t_2 = \frac{2}{g}\frac{u^2 sin2\theta}{g} = \frac{2R}{g} => t_1 t_2 \propto R$

---

29) A cricketer can throw a ball to a maximum horizontal distance of 100 m. with the same effort, he throws the ball vertically upward. The maximum height attained by the ball is

Ans) 50 m, Maximum range = $\frac{u^2}{g} = 100\ m$

Maximum height = $\frac{u^2}{2g} = \frac{100}{2} = 50\ m$

---

30) A cricketer can throw a ball to a maximum horizontal distance of 100 m. the speed with which he throw the ball is (to the nearest integer)

Ans) 23 ms b/c $R_{max} = \frac{u^2}{g} = 100 => u = 10\sqrt{10} =$ 32 m/s

---

31) Two bodies are thrown up at angle of 45 and 60, respectively, with the horizontal. If both bodies attain same vertical height, then the ratio of velocities with which these are thrown is

Ans) $\sqrt{\frac{3}{2}}$, sol: $H = \frac{u^2\sin^2\theta}{2g}$

According to problem $\frac{u_1^2\sin^2 45°}{2g} = \frac{u_2^2\sin^2 60°}{2g}$

ð $\frac{u_1^2}{u_2^2} = \frac{\sin^2 60°}{\sin^2 45°} => \frac{u_1}{u_2} = \frac{\sqrt{3}/2}{1/\sqrt{2}} = \sqrt{\frac{3}{2}}$

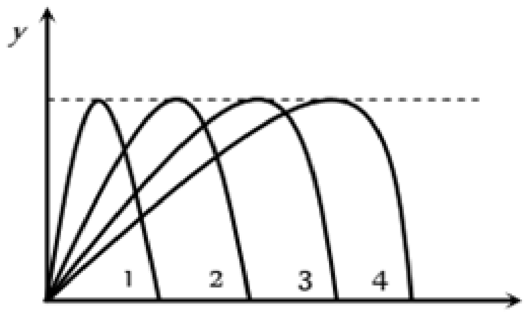
32) At what point of a projectile motion acceleration and velocity are perpendicular to each other
Ans) At the topmost point

33) The maximum horizontal range of a projectile is 400 m. the maximum value of height attained by it will be

Ans) $R_{max} = \frac{u^2}{g} = 400\ m$ (For $\theta = 45°$)

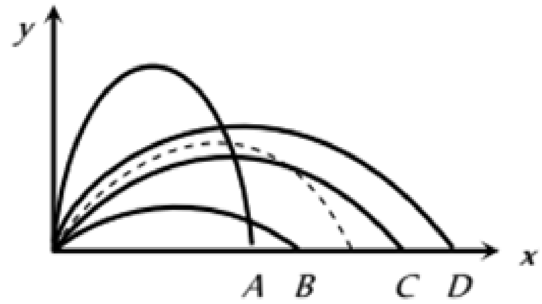
$H_{max} = \frac{u^2}{2g} = \frac{400}{2} = 200\ m$ (For $\theta = 90°$)

34) Figure shows four paths for a kicked football. Ignoring the effects of air on the flight, rank the paths according to initial horizontal velocity component, highest first



Ans) 4, 3, 2, 1, Range ∝ horizontal initial velocity (u)
In path 4 range is maximum so football possess maximum horizontal velocity in this path.

35) The path of the projectile in the absence of air drag is shown in the figure by dotted line. If the air resistance is not ignored then which one of the path shown in the figure is appropriate for the projectile.



Ans) B , If air resistance is taken into consideration then range and maximum height, both will decrease

Chap no.7 Oscillation

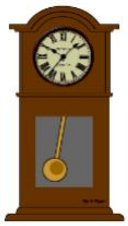
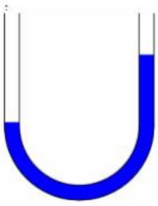
Periodic Motion

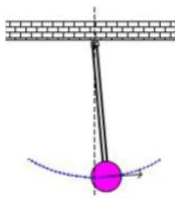
- Motion, which repeat itself over and over again after a regular interval of time.
- Example of periodic motion:
  - ✓ Revolution of earth around the sun (period one year),
  - ✓ Rotation of earth about its polar axis (period one day),
  - ✓ Motion of moon around the earth (period 30 days)
  - ✓ Motion of hour's hand of a clock (period 12-hour)
  - ✓ Motion of hour's hand of a clock (period 60 min)
  - ✓ Motion of hour's hand of a clock (period 60 sec)

Oscillatory or vibratory motion:

- To and fro or back and forth repeatedly about a fixed point in a definite interval of time.
- In such a motion, the body is confined with in well defined limits on either side of mean position.
- Oscillatory motion is also called as harmonic motion.

- Some typical vibrating bodies are :
  - ✓ Pendulum of a wall clock
  - ✓ Simple Pendulum
  - ✓ Mass spring system.
  - ✓ Liquid in U-Tube : The motion of liquid contained in U-tube when it is compressed once in one limb and left to itself.



Some Important Terms

Time period (T) :

- It is the least interval of time after which the periodic motion of a body repeats itself.
- S.I. unit of time period is second.
$\omega = 2\pi f \rightarrow \omega = 2\pi/T \rightarrow T = 2\pi/\omega$

- For mass spring system $\omega^2 = k/m$

  So $T = 2\pi\sqrt{\frac{m}{k}}$ and $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

ω for

- pendulum = $\sqrt{\frac{g}{l}}$
- mass spring system = $\sqrt{\frac{k}{m}}$

Frequency (n) :

- It is defined as the number of oscillations executed by body per second.
- S.I unit of frequency is hertz (Hz).
- $T = 2\pi\sqrt{\frac{m}{k}}$ and $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Angular Frequency (ω) :

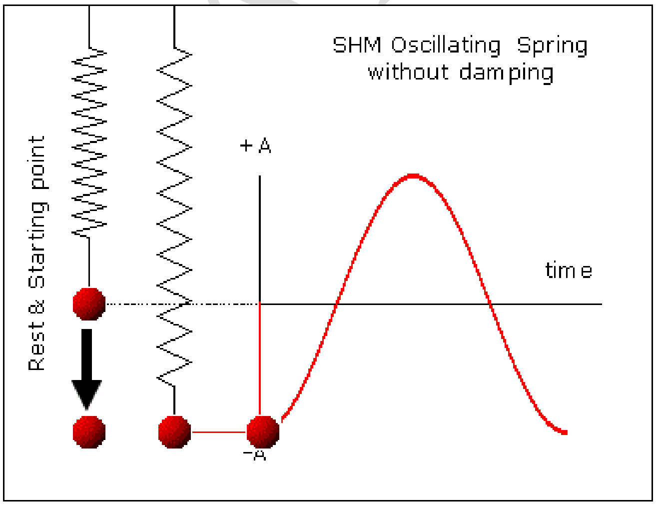
- Angular frequency of a body executing periodic motion is equal to product of frequency of the body with factor 2π.
- Angular frequency $\omega = 2\pi f$

Instantaneous displacement and amplitude of vibration

- The value of its distance from the mean position at any time is known as its instantaneous displacement.
- It is zero at the instant when the body is at the mean position
- It is maximum at the extreme positions.
- The maximum value of displacement is known as amplitude
- The curve showing the variation of displacement with tie is a sine curve.

Vibration

- A vibration means one complete round trip of the body in motion.



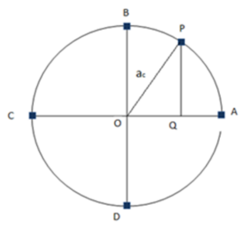
- $\omega = 2\pi f \rightarrow f = \omega/2\pi$ here ω is angular velocity and f is angular frequency.

Simple Hormonic Motion (SHM):

- Simple harmonic motion is a special type of periodic motion, in which a particle moves to and fro repeatedly about a mean position.
- In linear S.H.M. a restoring force which is always directed towards the mean position and whose magnitude at any instant is directly proportional to the displacement of the particle from the mean position at that instant i.e.
- Restoring force α Displacement of the particle from mean position.
- $F \propto -x$
- $F = -kx$
- Where k is known as force constant.
- Its S.I. unit is Newton/meter & dimension is $[MT^{-2}]$.
- The oscillatory motion taking place under the action of such a restoring force is known as simple harmonic (SHM).
- The acceleration a produced in the mass m due to restoring force can be calculated using second law of motion
- F= ma Then, -kx = ma Or $a = -\frac{h}{m}x$
- Or $a \propto -x$
- The acceleration at any instant of a body executing SHM is proportional to displacement and is always directed towards its means position

SHM AND UNIFORM CIRCULAR MOTION

- Lets we have Mass in circle and Light from one side , The shadow execute SHM.
- Amplitude is equal to radius of circle not diameter.



- $a_x = a_c \cos\theta = r\omega^2 \cos\theta = a_x = r\omega^2 \left(\frac{x}{r}\right)$ as $\cos\theta = x/r$

  $a_x = x\omega^2 \rightarrow a_x = -x\omega^2 \rightarrow a_x \propto -x$

Velocity:

- $v = \omega\sqrt{r^2 - x^2}$
- if x= r then

  $v = \omega\sqrt{r^2 - x^2} = \omega\sqrt{r^2 - r^2}$

  $= \omega\sqrt{0} = 0$
- if x= 0 then

  $v = \omega\sqrt{r^2 - 0^2} = \omega\sqrt{r^2}$

  $v = \omega r$ velocity is maximum

Simple Pendulum

- A simple pendulum consists of a small heavy mass m suspended by a light sting of length l fixed at its upper end.
- when such a pendulum is displaced from its mean position through a small angle θ to the position B and released, it starts oscillating to and or over the same path.
- The weight mg of the mass can be resolved into two components; mg sin θ and mg cos θ to balance the tension of the string.
- The restoring force will be

$$F = -mg\sin\theta \quad \text{or} \quad F = -mg\theta = -mg\frac{x}{l}$$

$$\left(\text{When } \theta \text{ is small } \sin\theta \simeq \theta = \frac{\text{Arc}}{\text{Length}} = \frac{OP}{l} = \frac{x}{l}\right)$$

$$\therefore \frac{F}{x} = \frac{-mg}{l} = k \quad (\text{Spring factor})$$

$$\text{So } T = 2\pi\sqrt{\frac{\text{Inertia factor}}{\text{Spring factor}}} = 2\pi\sqrt{\frac{m}{mg/l}} = 2\pi\sqrt{\frac{l}{g}}$$

- The displacement should be small because for small θ = → sin θ = θ
- The tension of the string cancelled with x-component of weight.
- The y-component of tension is force that cause simple harmonic motion.

Proof that simple pendulum is SHM

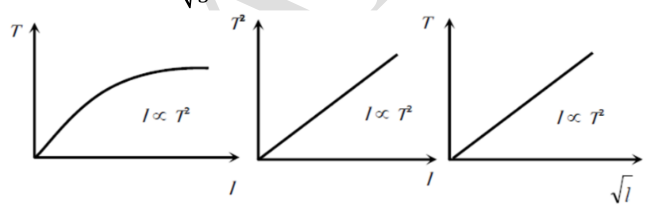
- $F_{applied} = -F_{restoring} \rightarrow ma- = w_y$
- ma = - mg sin θ
- a = -g sin θ for small angle sin θ=θ
- a= -g θ where θ= x/l
- a = -(g/l) x where g/ l = x^2 = constant
- a α -x

Time Period:

- T = 2π/ω putting ω= $\sqrt{g/l}$

$\rightarrow T = 2\pi/\sqrt{g/l}$

$\rightarrow T = 2\pi\sqrt{\frac{l}{g}}$



Factor Affecting Time Period of Simple Pendulum

Amplitude	Independent
Mass	Independent
Length	Directly
Gravity	Inversely
temperature	independent

1) Amplitude;

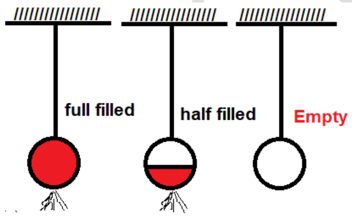
- The period of simple pendulum is independent of amplitude as long as its motion is simple harmonic.

(2) Mass of the bob :

- T is independent of mass of the bob.
- If the solid bob is replaced by a hollow sphere of same radius but different mass, time period remains unchanged.
- If a girl is swinging in a swing and another sits with her, the time period remains unchanged.

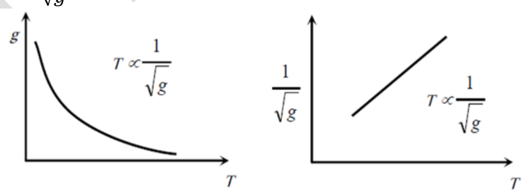
(3) Length of the pendulum :

- Time period T α $\sqrt{l}$ where l is the distance between point of suspension and center.
- When a sitting girl on a swinging swing stands up, her center of mass will go up and so l and hence T will decrease.
- If a hole is made at the bottom of a hollow sphere full of water and water comes out slowly through the hole and time period is recorded till the sphere is empty, T first increase, reaches a maximum and then decreases till it becomes equal to its initial value.



(4) Gravitational acceleration:

- $T\,\alpha\,\frac{1}{\sqrt{g}}$ i.e. as g increase T decreases.



- As we go high above the earth surface or we go deep inside the mines the value of g decrease, hence time period of pendulum (T) increases.
- What about Murree and Karachi now???
- If a clock, based on simple pendulum is taken to hill (or on any other planet), g will decrease so T will increases and clock will become slower.

(5) Temperature:

- If the bob of simple pendulum is suspended by a wire then effective length of pendulum will increase with the rise of temperature due to which the time period will increase.

Pendulum in a lift :

- If the lift is at rest or moving down ward /up ward with constant velocity.

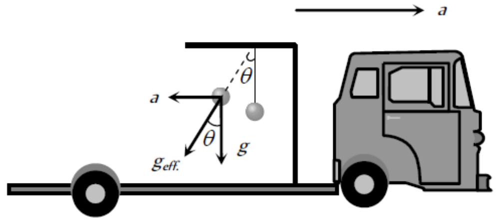
$T = 2\pi\sqrt{\frac{l}{g}}$

- If the lift is moving up ward with constant acceleration a

$T = 2\pi\sqrt{\frac{l}{g+a}}$

- Time period decreases and frequency increases

Pendulum in an accelerated vehicle :



In this case effective acceleration $g_{eff.} = \sqrt{g^2 + a^2}$

$$T = 2\pi\sqrt{\frac{l}{(g^2 + a^2)^{1/2}}} \quad \text{and} \quad \theta = \tan^{-1}(a/g)$$

1) What should be the length of a simple pendulum whose period is 1s? b) What is the frequency of such a pendulum?

Length:

$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow L = \frac{gT^2}{4\pi^2} = \frac{9.8\,ms^{-2} x\, 1s^2}{4\,x\,3.14\,x\,3.14} = 0.25$ m

$$f = \frac{1}{T} = \frac{1}{1s} = 1Hz$$

2) Second's Pendulum : It is that simple pendulum whose time period of vibrations is two seconds. Length = 0.993 m = 99.3 cm

3) The ratio of time period of mass one kg to that of mass 100 kG when length and g is constant ?

→→ Its is 1:1 or same because time period is independent to mass.

4) The ratio of time period of mass on earth to that of moon?

→→ on moon $g_{mon} = g_{earth}/6$ to time period will be

$T = 2\pi\sqrt{\frac{l}{\frac{g}{6}}} \rightarrow T = 2\pi\sqrt{\frac{6\,l}{g}} \rightarrow T = \sqrt{6}\,x\,2\pi\sqrt{\frac{l}{g}}$

$= \sqrt{6}\,T$, so on moon time period incrase because g value decrease.

5) As on Karachi and moon, where muree is on height and its value of g is less than Karachi so time period on muree mountains is more than as compare to Karachi.

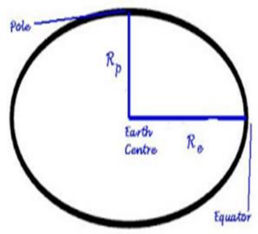
6) If length is increase 4 times then time period will be

$T = 2\pi\sqrt{\frac{4l}{g}} \rightarrow T = 2\,x\,2\pi\sqrt{\frac{l}{g}} = 2T$

If length is increases 4 time, the time period will becomes double like 1→2, 2→4, 3→6,4→8 and so on

7) At centre of earth as value of g is zero, so time period will be

$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow T = 2\pi\sqrt{\frac{l}{0}} \rightarrow T = 2\pi\,(0) = 0$

8) 

The time period will be greater for pendulum at pole or equator or same for both of these.

→→ The value of g is inversely proportional to the distance from the centre of the earth so $g_{pole} > g_{equator}$

So $T_{pole} < T_{equator}$

9) If the value of length and g both becomes double then the T will be ;

→ $T = 2\pi\sqrt{\frac{l}{g}} \rightarrow T = 2\pi\sqrt{\frac{2l}{2g}} \rightarrow T = 2\pi\sqrt{\frac{l}{g}} = T$, the time period will be same .

10) The ratio of time period of a pendulum of length ratio L_1 ; L_2,

→ $T = [2\pi\sqrt{\frac{L1}{g}}] / [2\pi\sqrt{\frac{L2}{g}}] \rightarrow \sqrt{\frac{L1}{g}}] / \sqrt{\frac{L2}{g}}$

$= L_1 / L_2$, the ratio of time period will be same as length because time period is directly proportional to the length.

Energy Conservation in SHM

- Law of conservation energy is totally conserved in case of S.H.M.

Kinetic Energy

- K.E = $\frac{1}{2}\boldsymbol{mv^2}$
- K.E = $\frac{1}{2}\boldsymbol{m}(\omega\sqrt{x_0^2 - x^2})^2$ → (v = $\omega\sqrt{\boldsymbol{r^2 - x^2}}$ = $\omega\sqrt{x_0^2 - x^2}$)

K.E = $\frac{1}{2}\boldsymbol{m\omega^2}\,(x_0^2 - x^2) = \frac{1}{2}\boldsymbol{k}\,(x_0^2 - x^2)$

K.E = $\frac{1}{2}\boldsymbol{k}\,(a^2 - x^2)$

- **At Extreme:**

X = x_0 → K. E= $\frac{1}{2}\,k\,({x_o}^2 - x^2)$

$= \frac{1}{2}\,k\,({x_o}^2 - {x_o}^2) = \frac{1}{2}\,k(0)$

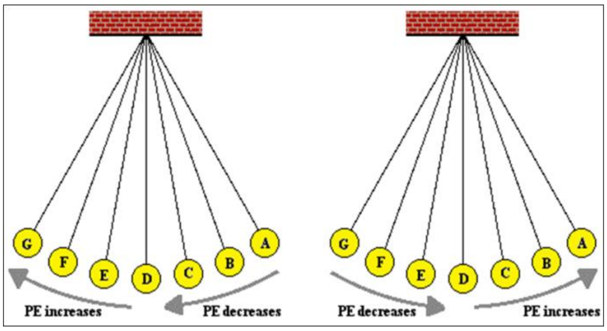
$K.E = 0$

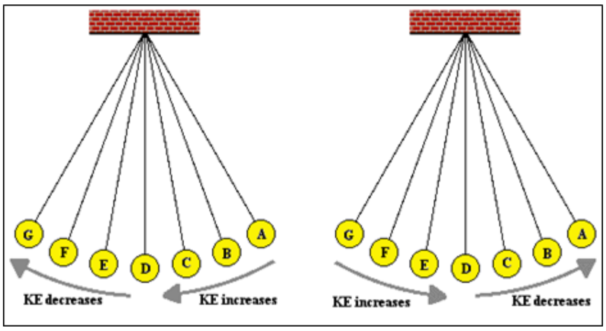
- **At Mean:**
- $K.E = \frac{1}{2}\,k\,({x_o}^2 - x^2)$
- $K.E = \frac{1}{2}\,k\,({x_o}^2)$ → maximum K.E

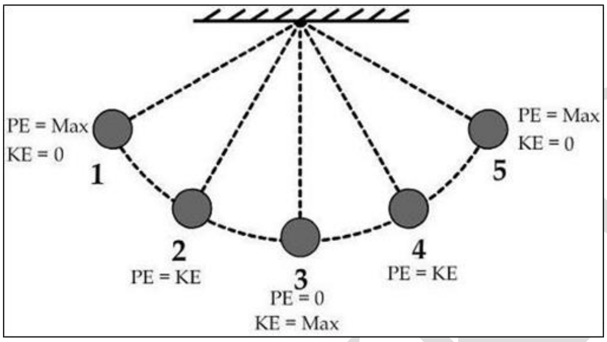
Potential energy:

- According to Hooke's law F = kx
- When displacement = 0 force = 0
- When displacement = x_0 force = kx_0
- Average force $F = \frac{0 + kx_0}{2} = \frac{1}{2}kx_0$
- $W = Fd = \frac{1}{2}k\,x_0 = \frac{1}{2}k\,x_0^2$
- $P.E._{max} = \frac{1}{2}k\,x_0^2$
- P.E. at any instant: P.E. = $\frac{1}{2}kx^2$
- P.E is minimum and maximum at
- As potential energy is directly proportional the distance from the mean position, so maximum the distance, as in case of amplitude, maximum will be the potential energy.

- at means x= 0 then $P.E = \frac{1}{2}kx^2 = \frac{1}{2}k(0)^2 = 0$
- at extreme $x = x_0$ = amplitude = $P.E = \frac{1}{2}kx_0^2$







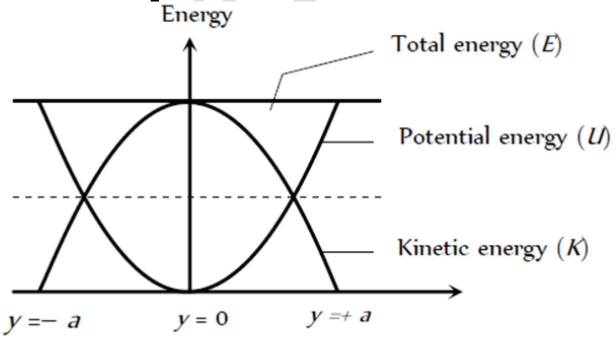
Total energy

- Total energy = K.E + P.E

$= [\frac{1}{2}\ k\ (r^2 - x^2)] + [\frac{1}{2}kx^2]$

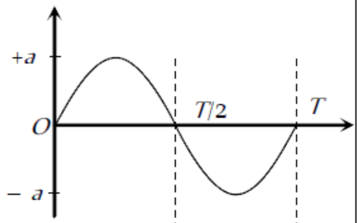
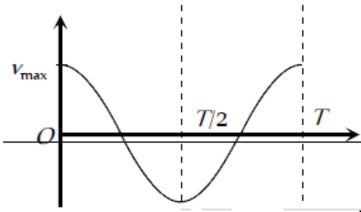
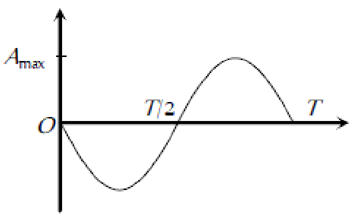
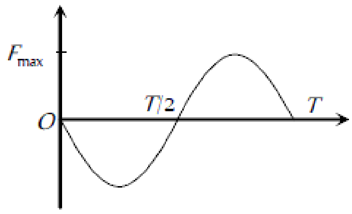
$\rightarrow \frac{1}{2}k[r^2 - x^2 + x^2] = \frac{1}{2}kr^2$

Total energy $= \frac{1}{2}kx_o^2$



Relation	Point
K.E = P.E	$x = \frac{a}{\sqrt{2}}$
K.E = 2P.E	$x = \frac{a}{\sqrt{3}}$
K.E = 3P.E	$x = \frac{a}{\sqrt{4}} = \frac{a}{2}$

Comparative study

Graph	At mean position	At extreme position
Displacement 	$y = 0$	$y = \pm a$
Velocity 	$v_{max} = a\omega$	$v_{min} = 0$
Acceleration 	$A_{min} = 0$	$\lvert A_{max} \rvert = \omega^2 a$
Force 	$F_{min} = 0$	$F_{max} = m\omega^2 a$

Value	Mean	Extreme
Velocity	Aω	0
Displacement	0	+-a
Acceleration	0	$\omega^2 a$
Force	0	$M\omega^2 a$
P.E	0	Max
K.E	Max	0

1)	The energy of pendulum is constant or variable? →The total energy depends upon the amplitude as the amplitude remains constant so the energy also remains constant.
2)	By doubling the amplitude the energy will increase, decrease or remains constant →Energy is directly proportional to the square of amplitude so doubling the amplitude will increase the energy times.
3)	The energy was 4 energy unit if amplitude is increase by 3 times, the new energy will be;

	$\to$T.E = $\frac{1}{2}kx_o^2 = \frac{1}{2}k(3x_o)^2 = 9\ x\ \frac{1}{2}kx_o^2$ = 9 T.E = 9 x 4 = 36 energy units.
4)	The total energy ratio if amplitude ratio is 1: 2 $\frac{1}{2}k1^2 / \frac{1}{2}k2^2 \to \frac{1}{2}k/4\ \frac{1}{2}k$= 1:4
5)	The total energy ratio if amplitude ratio is 1: 3 $\frac{1}{2}k1^2 / \frac{1}{2}k3^2 \to \frac{1}{2}k/9\ \frac{1}{2}k$= 1:9 The point where K.E is equal to Potential energy: $\to$ K.E = P.E $\to \frac{1}{2}\ k\ (r^2 - x^2) = \frac{1}{2}kx^2$ $\to (r^2 - x^2) = x^2 \ \to r^2 = x^2 + x^2$ $\to r^2 = 2x^2 \ \to x^2 = r^2/2 \ \to$ x = $\sqrt{r^2/2}$ $\to$ x=r/$\sqrt{2}$ x= a/$\sqrt{2}$
6)	The point where K.E is double of P.E $\to\to$ K.E = 2P.E $\to \frac{1}{2}\ k\ (r^2 - x^2) = 2\ \frac{1}{2}kx^2 \ \to (r^2 - x^2) = 2\ x^2$ $\to r^2 = x^2 + 2\ x^2 \ \to r^2 = 3x^2 \ \to x^2 = r^2/3 \ \to$ x = $\sqrt{r^2/3}$ $\to$ x=r/$\sqrt{3}$ = x= a/$\sqrt{3}$
7)	The point where K.E is triple of potential energy $\to\to$ K.E = 3 P.E $\to \frac{1}{2}\ k\ (r^2 - x^2) = 3\ \frac{1}{2}kx^2$ $\to (r^2 - x^2) = 3\ x^2 \ \to r^2 = 3\ x^2 + x^2$ $\to r^2 = 4\ x^2 \ \to x^2 = r^2/4 \ \to$ x = $\sqrt{\frac{r^2}{4}}$ $\to$ x=r/$\sqrt{4}$ = x= a/2
8)	The point where P.E is double of K.E $\to\to$ 2K.E = P.E $\to 2\ \frac{1}{2}\ k\ (r^2 - x^2) = \frac{1}{2}kx^2$ $\to\ (2r^2 - 2x^2) = x^2$ $\to 2r^2 = x^2 + 2x^2 \ \to 2r^2 = 3x^2$ $\to x^2 = 2r^2/3 \ \to$ x = $\sqrt{2r^2/3}$ $\to$ x=r/$\sqrt{2/3}$ = x= a/$\sqrt{\frac{2}{3}}$

Mass Spring System

- When a spring is stretched or compressed from its normal position (x = 0) by a small distance x, then a restoring force is produced in the spring because it obeys Hook's law i.e. F α x F = - k x where k is called spring constant.

Spring Constant

- K: It's S.I. unit Newton/metre, C.G.S unit Dyne/cm and dimension is [MT−2]
- Actually, k is a measure of the stiffness/softness of the spring.
- For massless spring constant restoring elastic force is same everywhere.
- When a spring compressed or stretched then work done is stored in the form of elastic potential energy in it.
- Spring constant depend upon radius and length of the wire used in spring.
- The spring constant k is inversely proportional to the spring length. K α 1/L
- That means if the length of spring is halved then its force constant becomes double.

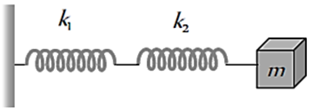
Time period

- T = $2\pi\sqrt{\frac{inertia\ factor}{spring\ factor}}$ $so\ T = 2\pi\sqrt{\frac{m}{k}}$
- Time period of a spring pendulum depends on the mass suspended
- $T\ \alpha\ \sqrt{m}$
- The time period depends on the force constant k of the spring i.e. $T\ \alpha\ \frac{1}{\sqrt{k}}$
- Time of a spring pendulum is independent of acceleration due to gravity. That is why a clock based on spring pendulum will keep proper time every where on a hill or moon.

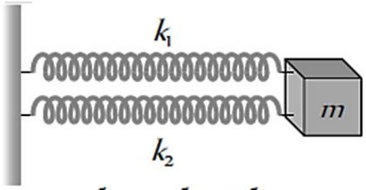
Massive spring :

- If the spring has a mass M and mass m is suspended from it, effective mass is given by
- $M_{eff} = m + \frac{M}{3}$ Hence $T = 2\pi\sqrt{\frac{m_{effective}}{k}}$

Oscillation of Spring Combination



- $$\frac{1}{k_s} = \frac{1}{k_1} + \frac{1}{k_2} \Rightarrow k_s = \frac{k_1 k_2}{k_1 + k_2}$$

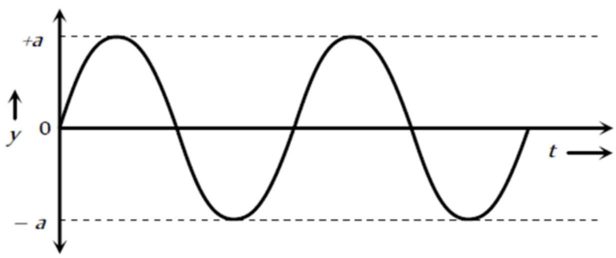


- $$k_P = k_1 + k_2$$

Free and force Oscillation

Free oscillation

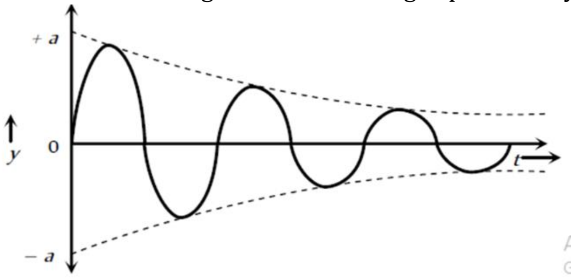
- The oscillation of a particle with fundamental frequency under the influence of restoring force are defined as free oscillations
- The amplitude, frequency and energy of oscillation remains constant
- Frequency of free oscillation is called natural frequency because it depends upon the nature and structure of the body.



(2) Damped oscillation

- The oscillation of a body whose amplitude goes on decreasing with time are defined as damped oscillation

- In these oscillation the amplitude of oscillation decreases exponentially due to damping forces like frictional force, viscous force, hysteresis etc.
- Due to decrease in amplitude the energy of the oscillator also goes on decreasing exponentially



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(3) Forced oscillation

- The oscillation in which a body oscillates under the influence of an external periodic force are known as forced oscillation
- The amplitude of oscillator decrease due to damping forces but on account of the energy gained from the external source it remains constant.
- While swinging in a swing if you apply a push periodically by pressing your feet against the ground, you find that not only the oscillations can now be maintained but the amplitude can also be increased. Under this condition the swing has forced or driven oscillation.

Resonance

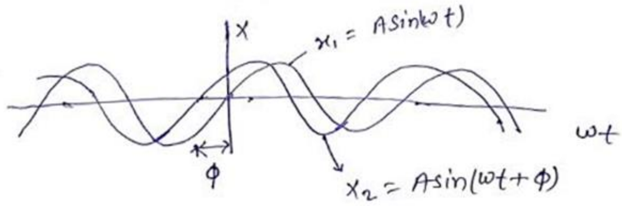
- A marked increase in amplitude of a vibration body when an external force having a time period equal to the natural timer period of a body is applied to it. This process is called resonance.
- When the frequency of external force is equal to the natural frequency of the oscillator. Then this state is known as the state of resonance. And this frequency is known as resonant frequency.

Examples of resonance

- Radio: when two frequecnies match, energy absorption is maximum. Its an example of electrical resonance.
- Magnetic Resonance image
- Microwave oven

Phase

- Phase simply means an angular term which represents situation of a particle in SHM at a certain instant
- Let one SHM is x_1=a sinωt and another SHM which is differ by first SHM of phase angle ϕ then other SHM is,x_2=a sin(ωt+ϕ)
- Clear that phase of oscillation is state of oscillation of particle performing SHM.
- $x = x_0 \cos(\omega t + \phi)$ where $\theta = \omega t + \phi$ is the phase angle ϕ gives information regarding initial or starting point.
- General equation of S.H.M $x = x_0 \cos \omega t$
- The θ=ωt which specifies the displacement as well as the direction of motion of the point oscillating



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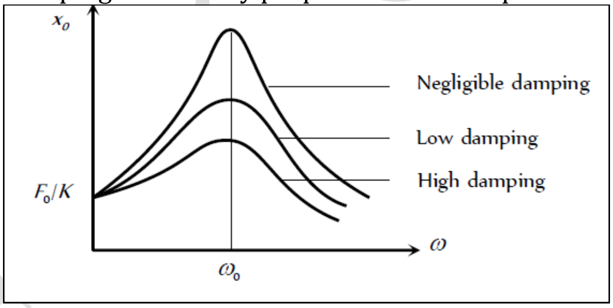
- S.H.M is called phase.

Sharpness of resonance

- At resonance, The amplitude of vibrations becomes very large when damping is small.
- Damping prevents the amplitude from becoming very large.
- Damping is inversely proportional the amplitude.



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MCQs

- When a particle execute repeated movement about a mean position, it is Harmonic motion
- If a motion is repeated at regular intervals, it is called Periodic motion
- The number of vibration completed by a body in one second is called Frequency
- The unit of frequency is Hertz / 1Hz / 1cs-1 / cps
- The number of revolution per second of a body is called Angular frequency
- (ω=2πf)
- In S.H.M the negative sign shows that both acceleration and displacement are Oppositely directed
- Length of string + length of radius of metallic bob = Length of simple pendulum
- The longer the pendulum the greater will be its Time period
- The time period of simple pendulum is independent to the Mass of the bob
- At extreme position K.E is Zero
- At mean position K.E is Maximum
- At extreme position the P.E is Maximum
- At mean position the P.E is Zero
- Law of conservation of energy is conserved in case of S.H.M

- The angle θ= ωt which specifies the displacement x as well as the direction of the motion of the point oscillating S.H.M is called Phase
- Oscillations where amplitude becomes smaller and smaller with time are called Damped oscillations
- If the length of simple pendulum becomes fore times, its time period will become Two times
- To find time period of simple pendulum we keep amplitude Small
- Time period of simple pendulum is one second its length is 0.25 m
- When the length of simple pendulum is increased four times, the frequency of its oscillation will Half
- If the length of simple pendulum is halved and mass is doubled then its time period Decreased by 4
- Elastic collision involves No gain no loss of energy
- If tunnel is bored through center of earth and stone is dropped it will Simple harmonic motion
- The SI unit of spring constant (k) is identical to Surface tension

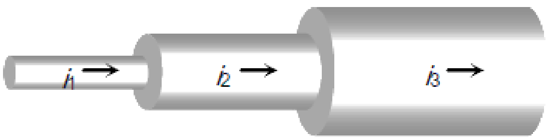
Chap No. 12 Current Electricity

- High voltage of power stations in Pakistan is 5 x 10^5 volts
- In Pakistan, in homes the electricity has been transformed to 220 volts
- The electric eel is an electric shock which generate electrical shocks of 600 volts

Current

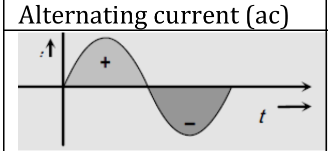
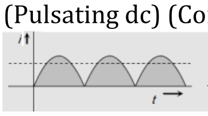
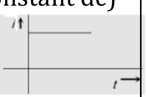
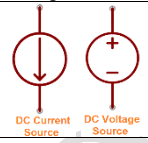
Steady current

- The time rate of flow of charge through any cross section is called current.
- $I = \frac{Q}{t} = \frac{ne}{t}$
- Current is a scalar quantity as it does not follow Vector law of addition
- The average speed of electron is 10^5 m/s
- S.I. unit:ampere (A) , 1A = 1C/s
- C.G.S. unit : emu and is called biot (Bi), or ab ampere.
- 1A = (1/10) Bi (ab amp.) or **1 Bi = 10A**
- **1e = 1.6 x 10^{-19}C** →1C = 0.625 x 10^{19} = 6.25 x10^{18} es
- Ampere of current means the flow of 6.25 x 10^{18} electrons/sec through any cross-section of the conductor.
- The conventional direction of current is taken to be the direction of flow of positive charge, i.e. field and is opposite to the direction of flow of negative charge .
- For a given conductor current does not change with change in cross-sectional area. In the following figure i1 = i2 = i3



- The continuous flow of electrons is called Steady current
- When electric field or voltage is applied to conductors the electrons moves Towards the positive terminals
- The directed flow of free electrons is called Electric current
- An electric current is Matter in motion
- The actual direction of current is from Negative terminal to positive.
- Flow of current from positive to negative terminal of the cell via the circuit Conventional current

Types of current

Types of current	
Alternating current (ac)	Direct current (dc)
	(Pulsating dc) (Constant dc)  
Magnitude and direction both varies with time	Constant direction, magnitude may vary.
ac → Rectifier → dc	dc → Inverter → ac
Shows heating effect only	Shows heating effect, chemical effect and magnetic effect of current
	

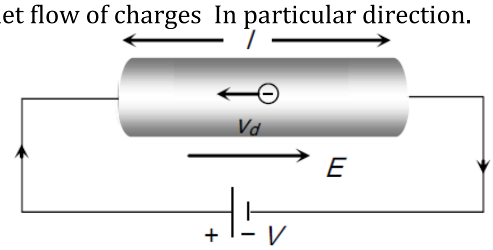
Current Carriers→

- The charged particles whose flow in a definite direction constitutes the electric current are called current carriers.

Current Carriers	
Solids	free electrons.
Liquids	positive and negative ions.
Gases	positive ions and free electrons.
Semi Conductors	holes and free electrons.

Drift velocity in a conductor

- The average velocity in which free electrons get drifted in a metallic conductor under the influence of electric field is called Drift velocity
- Drift velocity is the average uniform velocity acquired by free electrons inside a metal by the application of an electric field which is responsible for current through it.
- The drift velocity of the free electron is 10^{-5} m/s
- Due to random motion of all free electrons there is no net flow of charges In particular direction.

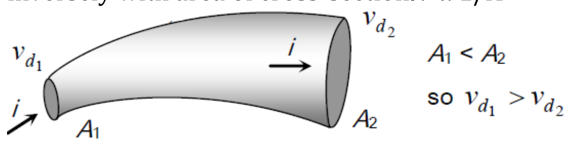


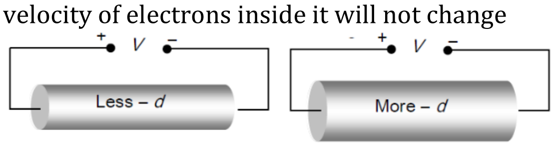
- The electrons experience a force in a direction Opposite to electric field.
- If suppose for a conductor

n = Number of electron per unit volume of the conductor
A = Area of cross-section
V = potential difference across the conductor
E = electric field inside the conductor
i = current, J = current density, □□= specific resistance,
□□= conductivity =(□□□□□□□)
then current relates with drift velocity as

$$v_d = \frac{i}{neA} = \frac{J}{ne} = \frac{\sigma E}{ne} = \frac{E}{\rho ne}$$

- The direction of drift velocity for electron in a metal is opposite to that of applied electric field (i.e. current density) $v \,\alpha\, E$ i.e. , greater the electric field, larger will be the drift velocity.

- When a steady current flows through a conductor of non-uniform cross-section drift velocity varies inversely with area of cross-section.V α 1/A
- 

- If diameter (d) of a conductor is doubled, then drift velocity of electrons inside it will not change
- 

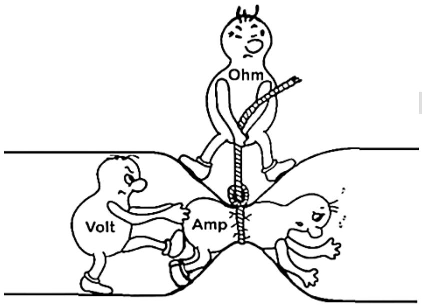
- Mobility : Drift velocity per unit electric field is called mobility of electron i.e. μ = v/E =(m/s)/(V/m) = m^2/Vs
- Propagation of electric field takes place with the Speed of light

Electroencephalogram

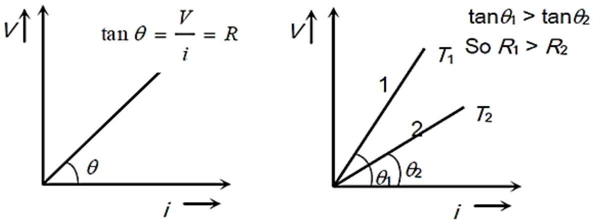
- Electroencephalography(EEG) is a neurological test for brain
- EEG measures the voltage fluctuation from ionic current flows through the Neurons of brain

Ohm's law

- If the physical conditions of the conductor (length, temperature, mechanical strain etc.) remains some, then the current flowing through the conductor is directly proportional to the potential difference across it's two ends i.e. ***i*** α ***V*** → ***V*** = ***iR*** where R is a proportionality constant, known as electric resistance



- Ohm's law is not a universal law, the substances, which obey ohm's law are known as ohmic substance.
- Graph between V and i for a metallic conductor is a straight line as shown. At different temperatures V-i curves are different.



- The device or substances which don't obey ohm's law e.g. gases, crystal rectifiers, thermoionic valve, transistors etc. are known as non-ohmic or non-linear conductors. For these V-I curve is not linear.
- Filament bulb, thermistor and semiconductor diode are non-ohmic materials

Electrical resistance (R)

- The property of substance by virtue of which it opposes the flow of current through it, is known as the resistance.
- V = IR → R = V/I
- The SI unit of resistance of resistance is ohm and represented by symbol Ω (omega) ● 1Ω = 1V/1A

Slope

- The slope decrease for increase of voltage for Filament bulb
- Resistance decrease sharply as temperature rises for Thermistor
- The I-v graph of semiconductor diode shows that it also Non-linear graph
- In semiconductor diode the current passes when the voltage is applied in one direction but when it act in opposite direction the current is almost Zero
- A given change V causes smaller change in I at larger value of V Filament bulb
- A given change V causes larger change in I at larger value of V Diode / Thermistor

Dependence of resistance:

- Resistance of a conductor depends upon Length, Area and Temperature.
- R = ρ L/A $\rightarrow R \propto L \rightarrow R \propto \frac{1}{A}$
- R = ρ L/πr² $\rightarrow R \propto \frac{1}{r^2}$
- R = 4ρ L/πd² $\rightarrow R \propto \frac{1}{d^2}$
- $\frac{R_1}{R_2} = \frac{L_1 A_2}{A_1 L_2} = \frac{L_1 r_2^2}{A_1 r_1^2} = \frac{L_1 d_2^2}{A_1 d_1^2}$
- **Resistance □□temperature .**
- If R_0 = resistance of conductor at 0°C R_t = resistance of conductor at t°C and α, β = temperature co-efficient of resistance then $R_t = R_0(1+\alpha t + \beta t^2)$ for t > 300°C and $R_t = R_0(1+\alpha t)$ for t ≤ 300°C
- $\alpha = \frac{R_t - R_0}{R_0 t}$
- If R_1 and R_2 are the resistances at t_1 °C and t_2 °C respectively then $\frac{R_1}{R_2} = \frac{R_0(1+\alpha t_1)}{R_0(1+\alpha t_1)} \rightarrow \frac{R_1}{R_2} = \frac{(1+\alpha t_1)}{(1+\alpha t_1)}$

Resistance is dimensionally represented as $M L^2 T^{-3} I^{-2}$.

Derivation

Resistance (R) = Voltage × Current^{-1} . . . . (1)

Since, voltage (V) = Electric Field × Distance = [Force × Charge^{-1}] × Distance

The dimensional formula of force = $M^1 L^1 T^{-2}$

The dimensional formula of charge = current × time = $I^1 T^1$

∴ The dimensional formula of voltage = [Force × Charge^{-1}] × Distance

= $[M^1 L^1 T^{-2}] \times [I^1 T^1]^{-1} \times [L^1] = [M^1 L^2 T^{-3} I^{-1}]$ . . . . (2)

On substituting equation (2) in equation (1) we get,

Resistance (R) = Voltage × Current^{-1}

Or, R = $[M^1 L^2 T^{-3} I^{-1}] \times [I]^{-1} = [M^1 L^2 T^{-3} I^{-2}]$

Stretching/Compressing of Wire

- **Stretch:** If a conducting wire stretches, it's length increases, area of cross-section decreases so resistance increases but volume remain constant.
- By Stretching, if length increase to double of its initial value the new resistance will be:
  $R = \rho\frac{L}{A} \rightarrow R' = \rho\frac{2L}{\frac{A}{2}} = 4R$
- **Compress:** If a conducting wire compresses, it's length decreases, area of cross-section increases so resistance increases but volume remain constant.
- By compressing, if length decrease to half of its initial value the new resistance will be:

$$R = \rho\frac{\frac{L}{2}}{2A} \rightarrow R' = \frac{R}{4}$$

If L is increases 'n' times, The R will increases n^2 times.

L' = nL → R' = n^2R

If L decreases 'n' times, The R will decreases n^2 times.

L' = n/2 → R' = R/n^2

MCQs

- A 50 resistance wire is stretched such that its length is doubled and its cross section area becomes half. The new resistance is:
  (a) 100 (b) 200
  Ans: B
  solution: We know that R=ρL/A
  making L → 2L and A → A/2 the R becomes
  =ρ 2L/A/2 =2 x 2 ρL/A =4ρL/A =4R = 4 x 50 = 200ohm

- Making the length and area double, the resistance becomes
  a. double b. increase four times
  ans; b
  solution: We know that R=ρL/A
  making L → 2L and A → A/2 the R becomes
  =ρ 2L/A/2 =2 x 2 ρL/A =4ρL/A =4R

- Making the length and radius double, what is the ratio of new resistance to old resistance
  a. 1:4 b. 4:1
  ans: a
  solution: R'/R = ρL'/A'/ρL/A
  $=\frac{\rho L'/\pi r_2^2}{\rho L/\pi r_1^2} = \frac{\frac{\rho 2L}{\pi}(\frac{r_1}{2})^2}{\frac{\rho L}{\pi r_1^2}} = \frac{r_1^2/4}{r_1^2} = 1/4 = 1;4$

Resistivity (ρ)

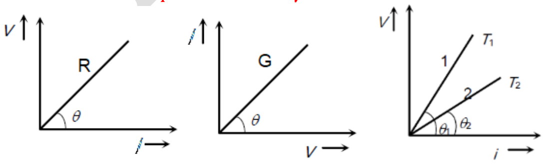
- R = ρ L/A → ρ = RA/L
- If l = 1m, A = 1 m^2 then $R = \rho$ i.e. resistivity is numerically equal to the resistance of a substance having unit area of cross-section and unit length.
- The unit of resistivity(ρ) is Ω.m
- The resistivity of metals and alloys are very Small, so these are Good conductors
- Resistivity is the intrinsic property of the substance. It is independent of shape and size of the body (i.e. l and A).
- For different substances their resistivity is also different

The resistivity of some metals			
Brass	0.06-0.09	Copper	0.178
Iron	0.1	Lead	0.219
Silver	0.163	Aluminium	0.285
Tin	0.114		

- $\rho_{nsulator} > \rho_{alloy} > \rho_{semi\text{-}conductor} > \rho_{conductor}$
- Resistivity depends on the temperature. For metals $\rho_t=\rho_o(1+\alpha t)$ i.e. resistivity increases with temperature.
- Resistivity increases with impurity and mechanical stress.
- Magnetic field increases the resistivity of all metals except iron, cobalt and nickel.
- Resistivity of certain substances like selenium, cadmium, sulphides is inversely proportional to intensity of light falling upon them.

Conductance

- The reciprocal of resistance of conductor is called Conductance (G) ● G=1/R
- G x R = 1
- The SI unit of conductance is mho and Simon(S)
- V = IR → $R = \frac{V}{I}$ and $G = \frac{I}{V}$



- Here $R_1 > R_2$ and ultimately $G_1 < G_2$

Conductivity

- The reciprocal of resistivity of conductor is called Conductivity (σ)
- If a conductor has resistivity (ρ = RA/L), then its conductivity is σ =1/ ρ → L/RA
- σ x ρ = 1
- The SI unit of conductivity is Mho m-1 or S.m-1
  ●σ=L/RA

Temperature co-efficient of resistance

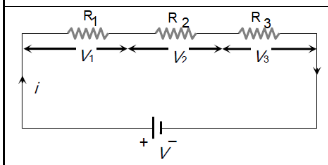
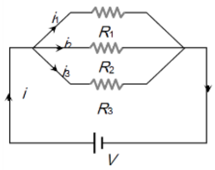
- The increase in resistance is directly proportional to the Initial resistance & temperature rise
- $R_T - R_o = \alpha R_o T$, Here α is constant and called Temperature co-efficient of resistance
- Temperature co-efficient of resistance depends upon nature of material & Temperature
- Increase in resistance per ohm original resistance per degree rise in temperature is called Temperature co-efficient of resistance which are as $\alpha = R_T - R_o / R_oT$
- The SI unit of Temperature co-efficient of resistance (α) is K^{-1} ●α=RT – Ro / Ro T
- Equation for Temperature co-efficient of resistivity is α = ρT – ρo / ρo T
- Frictional change in resistivity per kelvin is called Temperature co-efficient of resistivity (α)

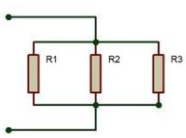
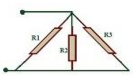
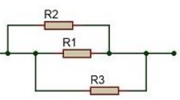
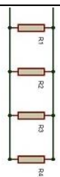
- The resistivity of metals rise with rise in temperature, they have Positive value of α
- The resistivity of semiconductors fall with rise in temperature, they have Negative value of α

Variation of resistance of some electrical material with temperature

Material	Temp. coefficient of resistance (α)	Variation of resistance with temperature rise
Metals	Positive	Increases
Solids non-metal	Zero	Independent
Electrolyte	Negative	Decreases
Ionised gases	Negative	Decreases
Alloys	Small positive value	Almost constant

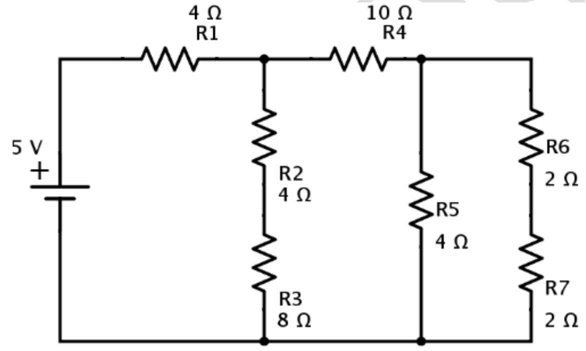
Resistance Combinations;

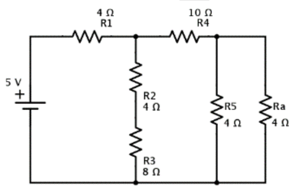
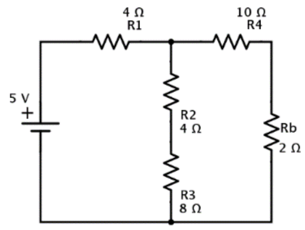
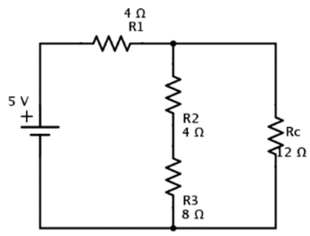
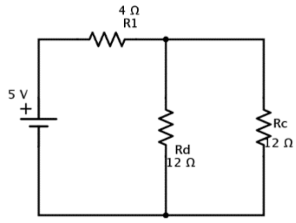
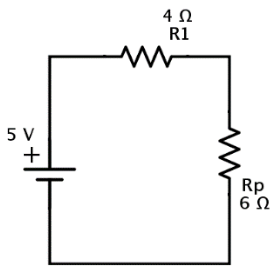
Series	Parallel
	
Current remains the same	current distributes in the reverse ratio of their resistance, I α 1/ R
Potential difference distributes in the ratio of resistance i.e. $V \alpha R$	Same potential difference appeared across each resistance
$R_{eq} = R_1 + R_2 + R_3$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $R_{eq} = \frac{R_1R_2R_3}{R_1R_2+R_2R_3+R_2R_1}$
equivalent resistance is greater than the maximum value of resistance in the combination.	Equivalent resistance is smaller than the minimum value of resistance in the combination.
If n identical resistance are connected in series $R=nR$ *and* potential difference across each resistance $V' = V/n$	In n identical resistance are connected in parallel $R_{eq}=n/R$ and current through each resistance $i'=i/n$
	If two resistances in parallel $R_{eq} = \frac{R_1R_2}{R_1+R_2} = \frac{Multliplication}{addition}$
If one burns, rests are inactive.	Of one burns, rest are ineffective

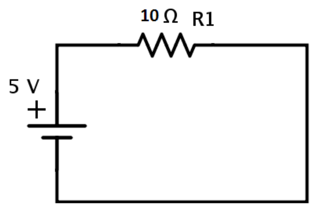





Elements Symbol	RESISTOR	CAPACITOR	INDUCTOR
Denoted by	R	C	L
Equation	$R = \frac{V}{I}$	$C = \frac{Q}{V}$	$L = \frac{V_L}{(di/dt)}$
Series	$R_T = R_1 + R_2$	$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$	$L_T = L_1 + L_2$
Parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$	$C_T = C_1 + C_2$	$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2}$

Steps for Complex System:





Assignment:

1) A wire of resistance R is divided in 10 equal parts. These parts are connected in parallel, the equivalent resistance of such connection will be 0.01 R.

Reason: Each part will have resistance r = R/10

Let equivalent resistance be r_R *then*

$\frac{1}{r_R} = \frac{1}{r} + \frac{1}{r} + \frac{1}{r}$ .... 10 times

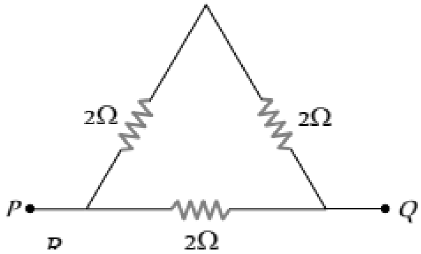
$\therefore \frac{1}{r_R} = \frac{10}{r} = \frac{10}{\frac{R}{10}} = \frac{100}{R} => r_R = \frac{R}{100} = 0.01\,R$

2) Three resistors each of 2 ohm are connected

together in a triangular shape. The resistance between any two vertices will be 4/3 ohm

Reason: Equivalent resistance of the combination

$= \frac{(2+2)x2}{2+2+2} = \frac{8}{6} = \frac{4}{3}\Omega$

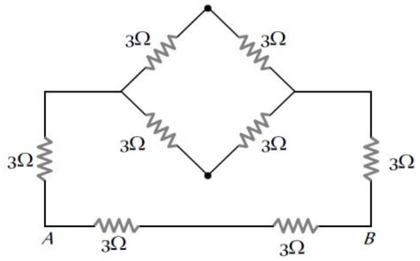


3) There are n similar conductors each of resistance R. The resultant resistance comes out to be x when connected in parallel. If they are connected in series, the resistance comes out to be n^2x

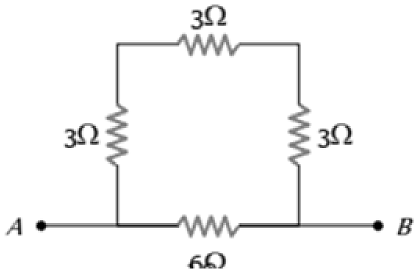
Reason: In parallel, x = $\frac{R}{n}$, R = nx

In series, R+R+R ... n times = nR = n(nx) = n^2 x

4) Equivalent resistance between A and B will be 3.6 ohm

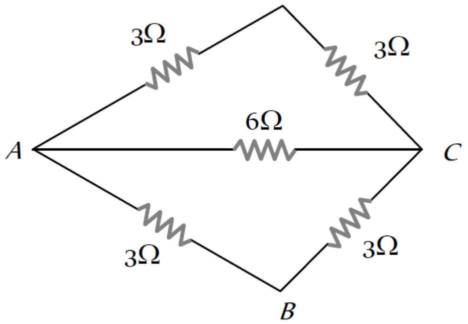


Reason: The circuit reduces to

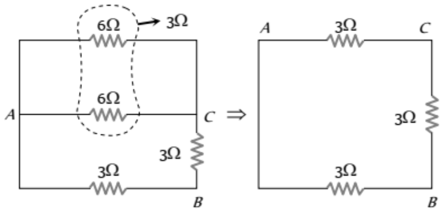


$$R_{AB} = \frac{9\,x\,6}{9+6} = \frac{9\,x\,6}{15} = \frac{16}{5} = 3.6\,\Omega$$

5) The effective resistance between the points A and B in the figure is 2 Ω



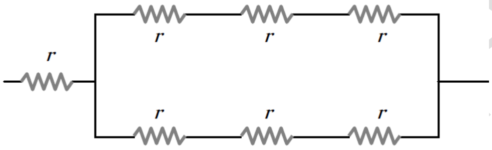
Reason: Given circuit is equivalent to



So the equivalent resistance between points A and B is equal to

$$R = \frac{6\,x\,3}{6+3} = 2\Omega$$

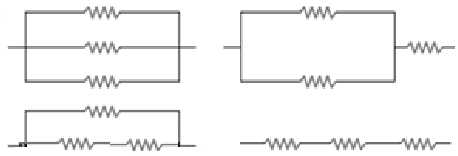
6) Referring to the figure below, the effective resistance of the network is 5r/2



Reason: $R = r + \frac{3r}{2} = \frac{5r}{2}$

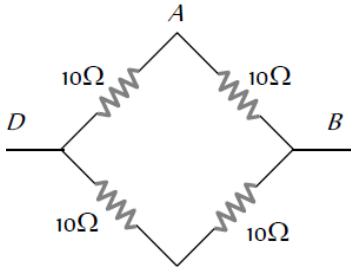
7) Given three equal resistors, how many different combinations of all the three resistors can be made Four

Reason: $2^{n-1} = 4$



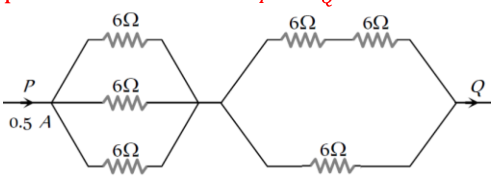
8) Four wires of equal length and of resistances 10 ohms each are connected in the form of a square. The equivalent resistance between two opposite corners of the square is 10 ohm

Reason: According to the problem, we arrange four resistance as follows



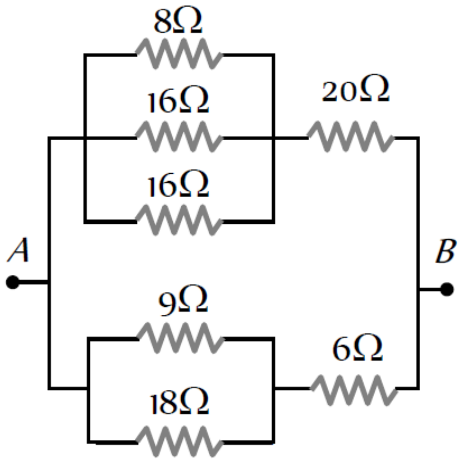
Equivalent resistance = $\frac{20\,x\,20}{40} = 10\Omega$

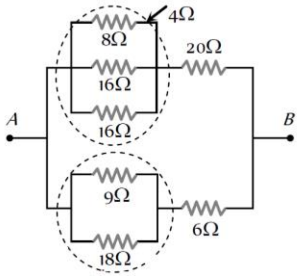
9) Resistances of 6 ohm each are connected in the manner shown in adjoining figure. With the current 0.5 ampere as shown in figure, the potential difference $V_P - V_Q$ is 3.0 v



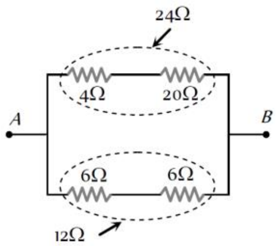
Reason: $V_P - V_q = \left(\frac{6}{3} + \frac{12\,x\,6}{12+6}\right)(0.5) =$
$(2+4)(0.5) = 3V$

10) The equivalent resistance of the arrangement of resistances shown in adjoining figure between the points A and B is 8 ohm



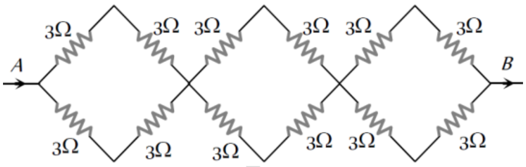


Reason:

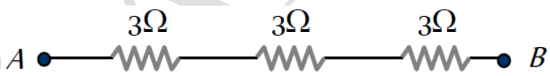


R_{AB} = 8 ohm

11) In the network of resistors shown in the adjoining figure the equivalent resistance between A and B is 9 ohm

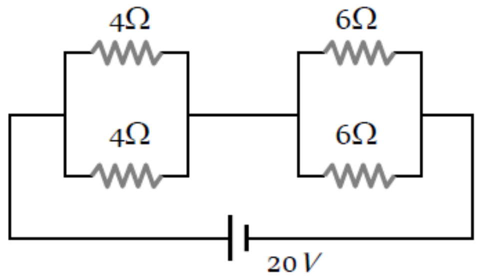


Reason: The network can be redrawn as follows



□ $R_{eq} = 9\Omega$

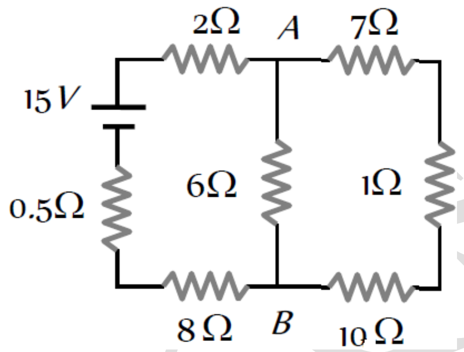
12) Four resistances are connected in a circuit in the given figure. The electric current flowing through 4 ohm and 6 ohm resistance is respectively 2 amp and 2 amp



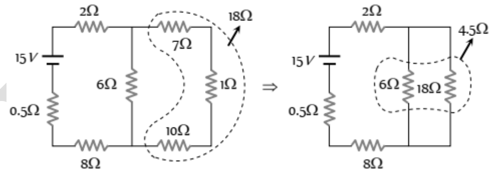
Reason: Equivalent resistance = $\frac{4\,x\,4}{4+4} + \frac{6\,x\,6}{6+6} =$ $5\,ohm$

the current in the circuit = $\frac{20}{5} =$ $4\ ampere$ hence the current flowing through each resistance = 2 ampere.

13) The current from the battery in circuit diagram shown is 1A



Reason: The given circuit can be simplified as follows



On further solving equivalent resistance R =15Ω

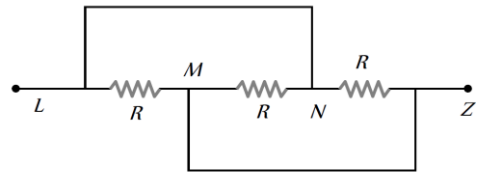
Hence current from the battery $i = \frac{15}{15} = 1A$

14) Three resistances, each of 1 ohm, are joined in parallel. Three such combinations are put in series, then the resultant resistance will be1 ohm

Reason: $\frac{1}{R} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1} = \frac{3}{1} => R = \frac{1}{3} ohm$

Now such three resistance are joined in series, hence total $R\ = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1\ ohm$

15) Three resistances each of value R are connected as shown in the figure the equivalent resistance between M and N is$\frac{R}{3}$



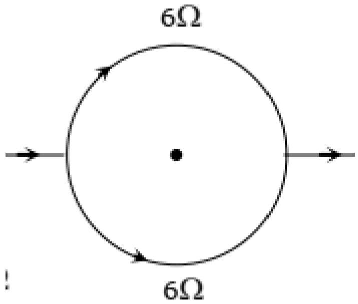
Reason: Three resistances are in parallel

$\therefore \frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$

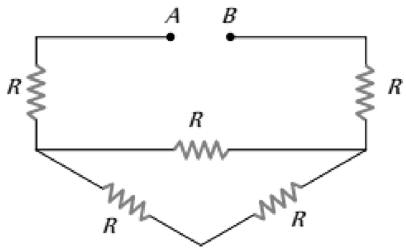
The equivalent resistance R' = $\frac{R}{3}$

16) A wire has resistance 12Ω. It is bent in the form of a circle. The effective resistance between the two points on any diameter is equal to 3 Ω

Reason: $R_{eq} = \frac{6}{2} = 3\Omega$

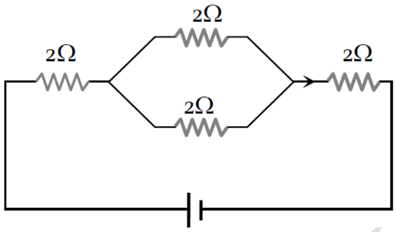


17) 8 Ω is the equivalent resistance between A and B in the figure below if R = 3Ω

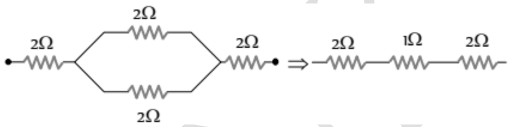


Reason: After simplifying the network, equivalent resistance obtained between A and B is 8Ω

18) The equivalent resistance of the circuit shown in the figure is 6 Ω

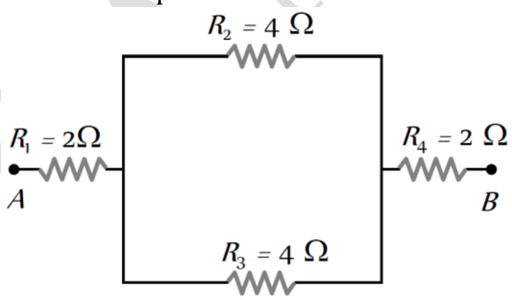


Reason: The given circuit can be redrawn as follows



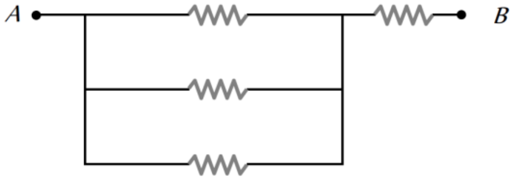
∴ $R_{eq} = 5\Omega$

19) In the given figure, the equivalent resistance between the point A and B is 6 Ω



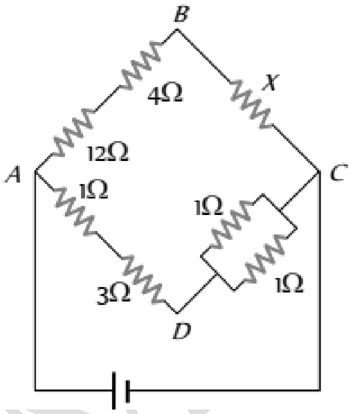
Reason: $R_{AB} = R_1 + \frac{R_2R_3}{R_2+R_3} + R_4 = 2 + \frac{4\,x\,4}{4+4} + 2 = 6\Omega.$

20) If all the resistors shown have the value 2 ohm each, the equivalent resistance over AB is $2\frac{2}{3}\,ohm$



Reason: $R_{AB} = \frac{R}{3} + R = \frac{2}{3} + 2 = \frac{8}{3} = 2\frac{2}{3}\Omega.$

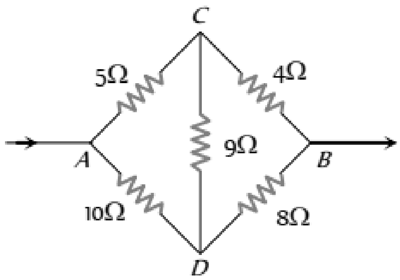
21) In the circuit shown in the adjoining figure, the current between B and D is zero, the unknown resistance is of2 Ω



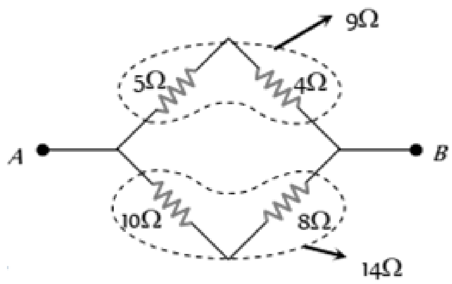
Reason: By balanced Wheatstone bridge condition $\frac{16}{X} = \frac{4}{0.5}$

∴ $X = \frac{8}{4} = 2\Omega$

22) Five resistors are connected as shown in the diagram. The equivalent resistance between A and B is 6 ohm

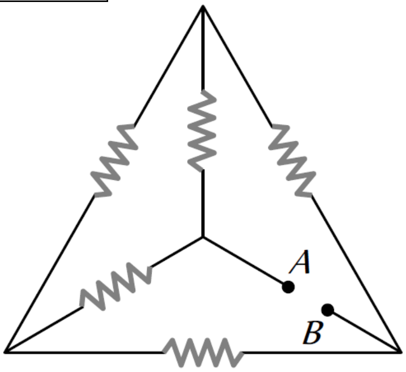


Reason: Since the given bridge is balanced, hence there will be no current through 9Ω resistance. This ressitance has no effect and must be ignored in the calculations.

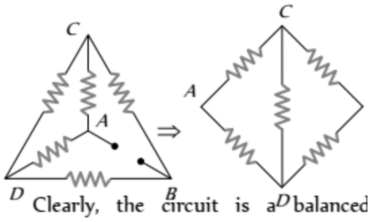


$R_{AB} = \frac{9\,x\,18}{27} = 6\Omega\,.$

23) In the network shown in the figure, each of the resistance is equal to 2Ω. The resistance between the points A and B is 2 Ω



Reason: The equivalent circuits are as shown below



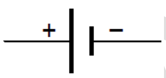
Clearly, the circuit is a balanced Wheatstone bridge. So effective resistance between A and B is 2Ω.

24) If a rod has resistance 4Ω and if rod is turned as half cycle then the reistance along diameter 4 Ω

Cell

- The device which converts chemical energy into electrical energy is known as electric cell. Cell is a source of constant emf but not constant current.

Symbol of cell:



Emf of cell (E) :

- The potential difference across the terminals of a cell when it is not supplying any current is called it's emf.

Potential difference (V) :

- The voltage across the terminals of a cell when it is supplying current to external resistance is called potential difference or terminal voltage.
- Potential difference is equal to the product of current and resistance of that given part i.e. V = iR.

Internal resistance (r):

- In case of a cell the opposition of electrolyte to the flow of current through it is called internal resistance of the cell.
- The internal resistance of a cell depends on nature and also on the distance between electrodes(d), area of electrodes , concentration and temperature.

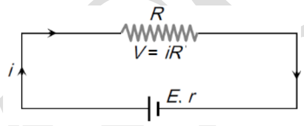
Factors affecting internal resisting of cell	
Factors	**Relation**
Distance b/w electrodes	r α d
Concentration	r α C
Area of electrodes	r α 1/A
Temperature of electrolyte	r α 1/ temp.

- A cell is said to be ideal, if it has zero internal resistance.

Cell in Various Positions

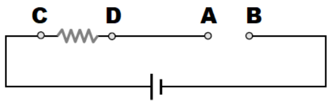
- 3 Positions:
  a) Close circuit
  b) Open circuit
  c) Short circuit

Close Circuit



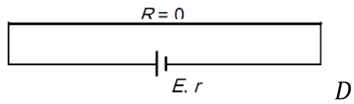
- Current given by the cell, I= $\frac{E}{R+r}$
- Potential difference across the resistance $V = iR$
- Potential drop inside the cell = ir
- Equation of cell $E = V + ir$, (E > V)
  (When the cell is being charged i.e. current is given to the cell then E = V – ir and E < V.)
- Internal resistance of the cell $r = (\frac{E}{V} - 1)R$
- Power dissipated in external resistance (load) , P = Vi = iRi = i²R = V²/R = $(\frac{E}{R+r})^2$ R
- Power delivered will be maximum when R ⍰ r so P = E2/4R, This statement in generalised from is called "maximum power transfer theorem".

Open Circuit;



- Current through the circuit i = 0
- Potential difference between A and B, VAB = E
- Potential difference between C and D, VCD = 0

Short circuit :



- If two terminals of cell are join together by a thick conducting wire
- Maximum current (called short circuit current) flows momentarily isc =E/r
- Potential difference V = 0

Wire wound variable resistance

- High stability and high accuracy resistors are always Wire wound
- Wire wound is enclosed in Insulator
- Nickel chromium is used in Wire wound because of its small value of Temperature co-efficient of resistance (α)

- Wire wound resistors can safely operate at higher temperature than Carbon type resistors
- In Rheostats, adjusting the resistance in the circuit control the Current in the circuit
- A potential divider provides a convenient way to getting a Variable P.D from fixed P.D
- vBC = RBC v/R, the value of friction RBC/R can be Varied from 0-1

thermistor

- A resistor made of semiconductors having resistance that varies rapidly and predictably with temperature is known as Thermistor
- A thermistor is short form of Thermal resistor
- The temperature co-efficient of a thermistor is Very high
- The resistance of thermistor changes very rapidly with change of Temperature
- The temperature co-efficient of thermistor can be Both positive and negative
- Thermistor are made from semiconductor oxides of Iron, nickel and cobalt
- Semiconductors in thermistor are in form of Disks or rods
- Platinum pairs leads are attached at the two ends for electrical connection In thermistors
- The arrangement of thermistor are enclosed by Glass bulb and sealed
- A thermistor with negative temperature co-efficient of resistance may be used as alarms and to safeguard against Current surges in a current
- If thermistor are used in series with heaters of the radio valves are Harmful

Electromotive force

- $V = \frac{W}{q} = \frac{Fd}{q} = \frac{K.E}{d} = \frac{P.E}{d}$
- Device which converts non-electrical energy to electrical energy Electromotive force (emf)
- emf of a source is equal to the work done in carrying one coulomb of charge through the source ε = W/q
- The potential at the ends of the battery when circuit is open is called Electromotive force (emf)
- the unit of the emf is the J/C or volt 1 ● ε =W/q
- The influence that makes current flow from lower to higher potential Emf
- If the cell is delivering no current then P.D across the terminal = e.m.f (ε)
- When some load resistance are connected the terminal voltage available will Less than emf ● Vt = ε – Ir

Battery	chemical energy is converted to electrical energy
Electrical generators	mechanical energy is converted to electrical energy
Thermocouples	heat energy is converted to electrical energy
Radiant or solar cell	sunlight energy is converted to electrical energy

Electric power

- The rate at which work is done is an electric circuit is called Electric power ● (p = w/t)
- The work done in moving the charge in unit time is also called Electric power
- p = w/t
- p=VQ/t (V=W/Q)
- p= VIt/t → p =VI
- The SI unit of power is watt
- 1 Watt = 1V x 1A ● P=VI
- One commercial unit of electrical energy is One kilowatt-hour
- 1kWh = 3.6 x 10^6 J ● 1J = 1W x 1s

Maximum power output

- If the load resistance is less or greater than the source resistance, then the power delivered to the load will be Minimum
- When internal resistance of a source of the emf = load resistance then power is Maximum
- When internal resistance of a source of the emf = load resistance then power is
- When internal resistance of a source of the emf = load resistance then power is maximum Maximum power transfer theorm
- The value of maximum power output is $(P_{out})max = ε^2/4r$ or $P= ε^2/4R$

Thermocouples

- Thomas Seebeck find relation between heat and electricity in 1821, is called Seebeck Effect
- The emf generated in thermocouples or Seebeck effect is called Thermoelectric emf
- The resulting emf in Seebeck effect is called Thermoelectric current
- The two junction circuit is called Thermocouple
- In thermocouple the heat is directly converted into Electricity
- Thermocouples are widely used as Temperature sensors
- The Seebeck effect is Reversible
- The thermo-emf in Seebeck effect s very small, of the order of mV per every degree of temperature difference
- The greater separation of the metals forming the couples in the series, the emf Produced is greater
- In thermocouples, when the cold junction is at 0 c the temperature dependence is given by ε=αT+1/2 βT^2
- The thermoelectric coefficient (α and β) depends on Nature of medium
- The thermo emf increase with temperature and become maximum at certain temperature called Neutral temperature (Tn)

- In thermoelectric emf, when both junction are at same temperature, there is No emf
- The value of neutral temperature is constant for a thermocouple, depends on nature Of material
- The value of neutral temperature is independent of the Temperature of cold junction
- The particular temperature at which the thermo emf becomes zero is called Inversion temperature

1)	The production of e.m.f. by maintaining a difference of temperature between the two junctions of two different metals is known as Seebeck effect
2)	When a current passes through the junction of two different metals, evolution or absorption of heat at the junction is known as Peltier effect
3)	The thermocouple is based on the principle of Seebeck effect
4)	Thermocouple is a device for the measurement of The temperature difference between two susbtances
5)	Thermo e.m.f. of a thermo couple depends on the nature of metals.
6)	The direction of current in an iron-coper thermocouple is From copper to iron at the hot junction
7)	For a thermocouple, the temperature of inversion is that temperature at which thermo e.m.f. is Zero
8)	For a given thermocouple, the thermo e.m.f. can be Zero , Positive or Negative
9)	In a thermocouple, the temperature that does not depend on the temperature of the cold junction is called Neutral temperature
10)	At neutral temperature, the thermoelectric power $\left(\frac{dE}{dT}\right)$ has the value Zero
11)	As the temperature of hot junction increases, the thermo e.m.f. May increase or decrease
12)	If the temrpature of cold junction of thermocouple is lowered, then the neutral temperature Remains the same because Neutral temperature is independent of temperature of cold junction.

Resistance thermometers

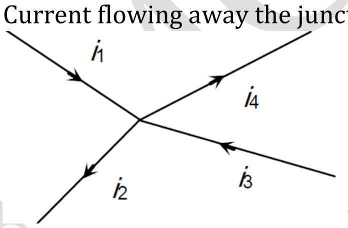
- Resistance thermometers are also called Resistance temperature detectors(RTDs)
- Common RTD has unique and repeatable and predictable Resistance vs temperature relationship
- Amount of resistance change of the sensor per degree of temperature change R vs T relationship
- The best metal for RTD is Platinum
- Platinum is best for RTD because of linear temperature resistance relationship & Highly repeatable manner
- The platinum is temperature standard for over range of -185o C to 630o C
- RTSs are slowly replacing thermocouples in industries below 600o C

Kirchoff's law

- When more than one emf and resistors are connected in complicated manner Complex circuits
- In order to solve complex circuits, German physics Gustar Robert Kirchoff's (1824-1887) gaves two laws known as Kirchoff's law

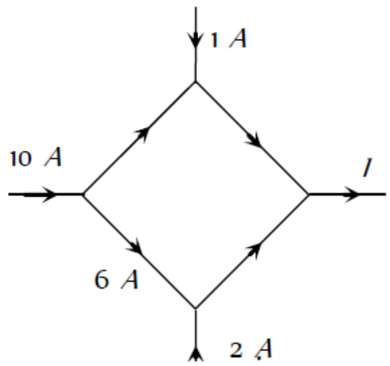
(1) Kirchoff's first law :

- This law is also known as junction rule or current law (KCL). According to it the algebraic sum of currents meeting at a junction is zero i.e. $\sum i = 0$
- In a circuit, at any junction the sum of the currents entering the junction must equal the sum of the currents leaving the junction.
- Current flowing toward the junction → Positive
- Current flowing away the junction → Negative



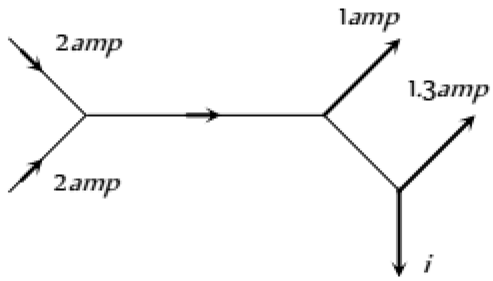
- $i_1 + i_3 = i_2 + i_4$
- This law is simply a statement of "conservation of charge".

The current I is



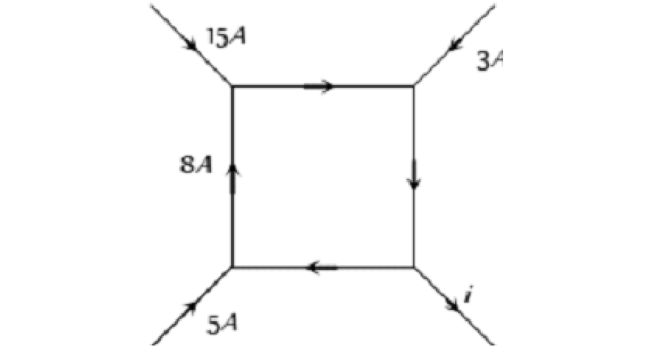
Ans: 13A

The current I is



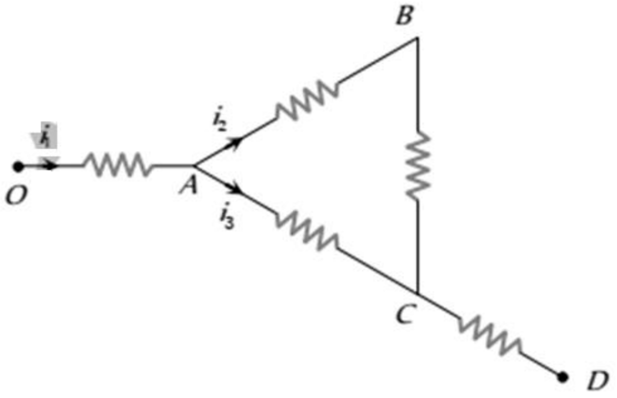
Ans: 1.7 amp

The current i will be



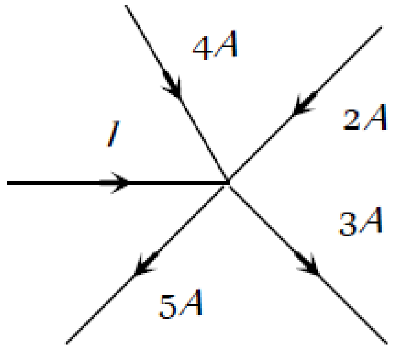
Ans; 23A

The current in the arm CD of the circuit will be



Ans: $i_2 + i_3$

In the given current distribution what is the value of I

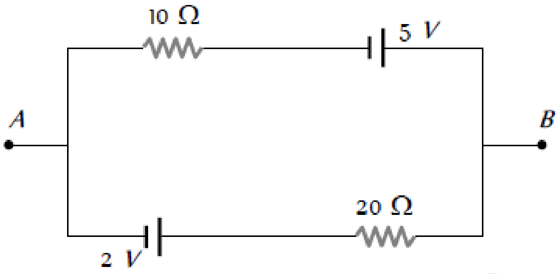


a. 2A

(2) Kirchoff's second law :

- This law is also known as loop rule or voltage law (KVL) and according to it "the algebraic sum of the changes in potential in complete traversal of a mesh (closed loop) is zero", i.e. $\sum V = 0$
- Algebraic sum of emf + algebraic sum of voltage drops = 0
- This law represents "conservation of energy".
- If there are n meshes in a circuit, the number of independent equations in accordance with loop rule will be (n – 1).
- In Kirchoff's voltage law (KVL)
    - A rise in potential is taken as Positive
    - A drop in potential is taken as Negative
    - For batteries, the positive end is always at Higher potential
    - Current flows from Higher to lower potential
    - Direction of current can be Clock or anti-clock
- In Kirchhoff's voltage law (KVL), if wrong direction is chosen, it will be indicated by Negative sign in result

The current in the given circuit is



a. 0.1 A

$-10i + 5 - 20i - 2 = 0 => i = 0.1A$

Wheatstone bridge

- An instrument used to measure an unknown resistance Wheatstone bridge
- In Wheatstone bridge, the point at which the bridge is balanced is called Null point
- In Wheatstone bridge the value of resistance is varied until galvanometer shows Zero result
- The principal of determining unknown resistance by Wheatstone bridge is X=RQ/P

potentiometer

- A potentiometer is null type resistance network for measuring Potential difference
- An unknown e.m.f or P.D is measured by balancing it , wholly or in part, against a known Potential difference
- For the accurate measurement of potential difference, current and resistance Potentiometer is useful instruments
- Small emf measurement, comparison, high emf measurement, resistance and current measurement, and calibration of ammeter and voltmeter Applications of potentiometer
- Potentiometer E2 = I2 / I1 x ε1
- Potentiometer measure small emf up to 2V
- Potentiometer measure high emf up to 250V

MCQs

1: A new battery is charged at the battery shop charging station using a current of 6.7 A for 5.0 h. How much charge passes through to the battery?

$$I = \frac{\Delta Q}{\Delta t}$$

$$\Delta Q = I\Delta T = (6.7 \times 18000)C = 120600C$$

2: While starting an engine of a truck, its battery set 720 C of charge in motion of 4.00 s. How much current is flowing

$$I = \frac{\Delta Q}{\Delta t} = \frac{720}{4} = 180A$$

3: A 30.0 V battery is connected to a 10.0Ω resistor. What is the current in the circuit?

$$I = \frac{V}{R} \rightarrow I = \frac{30}{10} = 3A$$

4 A heating element on a electric range operating on

240 V has a resistance of 30.0Ω.what current does it draw?

$V = IR \rightarrow 1 = \frac{V}{R} = \frac{240}{30} = 8A$

5 A small flashlight bulb draws 300mA from its battery. What is the resistance of the bulb?

$$V = IR \rightarrow R = \frac{V}{I}$$
$$R = \frac{1.5}{0.3} = 5\Omega$$

6 Calculate the resistance of wire when the current through it is 2.0 A and the voltage across its ends is 3.0V

$Re\,q\,uired: Current = I = 2A$

$V = IR \rightarrow R = \frac{V}{I} = \frac{3}{2} = 1.5\Omega$

7: Four Resistors R_1=5Ω, R_2=12Ω, R_3=13Ω and R_4=96Ω are connected in series across a 90 V battery. What is the current in the circuit?

$$R_{eq} = R_1 + R_2 + R_3 + R_4$$
$$R_{eq} = 5\Omega + 12\Omega + 13\Omega + 96\Omega$$
$$R_{eq} = 126\Omega$$
$$V = I\,R_{eq} \quad \rightarrow I = \frac{V}{R_{eq}} = \frac{90}{126}$$
$$A = 0.71A$$

8: Four resistors all having similar resistance of 15Ω are connected in series across a 30V battery. What is the current in the circuit?$Givendata: Re\,s\,istors = R_1 = 15$

$$R_{eq} = R_1 + R_2 + R_3 + R_4$$
$$R_{eq} = 15\Omega + 15\Omega + 15\Omega + 15\Omega$$
$$R_{eq} = 60\Omega$$
$$V = IR_{eq} \rightarrow I = \frac{V}{R_{eq}} = \frac{30}{60}$$
$$A = 0.5A$$

9.. Three Resistors R_1=5.0Ω, R_2=12Ω, R_2=10.0Ω and R_3=20.0Ω are connected in parallel across a 90.0 V battery. What is the total current in the circuit?

$\frac{1}{Req} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$

$\frac{1}{Req} = \frac{7}{20} = \frac{20}{7}\Omega = R_{eq}$=2.9Ω

Now the total circuit current is given by,

V =IR_{eq} = I = $\frac{V}{Req} = \left(\frac{90}{2.9}\right)$ A =I=31.0A

Answer: I=31.0A

10: Three Resistors of 60Ω, 30Ω, and 20Ω are connected in parallel across a 90 V battery. Calculate the current flowing through the circuit.

Required: Total current in circuit = I =?

$\frac{1}{Req} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$

$\frac{1}{Req} = \frac{6}{60} = R_{eq} = \frac{60}{6}\Omega$

= R_{eq}= 10Ω

V =IR_{eq} = I = $\frac{V}{Req} = \left(\frac{90}{10}\right)$ A =I=9.0A

Answer: I=9.0A

11: If a current of 10.0A take 5 minutes to boil a kettle of water required 3.6× 10^5J of energy, what is the potential difference [in voltage] across the kettle?

E = VIt = V =$\frac{E}{It}$

V=$\left(\frac{3.6\times10}{10\times3\times10}\right)$ V = 0.12×10^3V = V = 1.2×10^2V

Answer: V = 1.2×10^2V

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12 For how long a clothes dryer is operated, if it uses 32KJ energy to dry cloths at 220V, running 16a of current through it?

E = VIt = V =$\frac{E}{It}$

V=$\left(\frac{32\times10}{220\times16}\right)$ sec = 9.09 sec = t = 9.09 sec

Answer: t = 9.09 sec

13: In the flashlight the current is 0.40A, and the voltage of 3.0V is delivered by cell. Find the power delivered to the bulb.

P =IV

P =(0.40×3) watt = P = 1.2 watt

Answer: P = 1.2 watt

14: Calculate the resistance of a 40W automobile designed for 12V.

P = $\frac{V2}{R}$ = R = $\frac{V2}{P}$

R = $\frac{(12)2}{40} = \left(\frac{144}{40}\right)\Omega$ = R =3.6Ω

Answer: R =3.6Ω

15: You are arranging night cricket tournament, you have arranged five 1000W light bulbs. These bulbs will remain lit for 6 hours for 29 days. Estimate the cost of electricity consumption if the cost of electricity is 8.11Rs/kWh.

E = P×t

E = (5×174) kW.hr

E = 870 kW.hr

(ii) Cost of electricity = energy consumed ×tariff rate

= C = E×T.R = (870×8.11) Rs = 7055.7 Rs

Answer: C = 7055.7 Rs

16: A 100W bulb is left on, in an outdoor storage room to keep paint from freezing. The 100W rating refers to the power dissipated in the bulb's filament, which is a resistor. If electricity costs 8.11Rs/kWh, about how much does it cost to burn the light bulb for three months during winter?

= C = E× T.R

= C = P×t× T.R [E = P×t]

= C = (0.1×2160×8.11) Rs = C= 1751.76 Rs

Answer: Cost C= 1751.76 Rs

rce on charge moving within magnetic

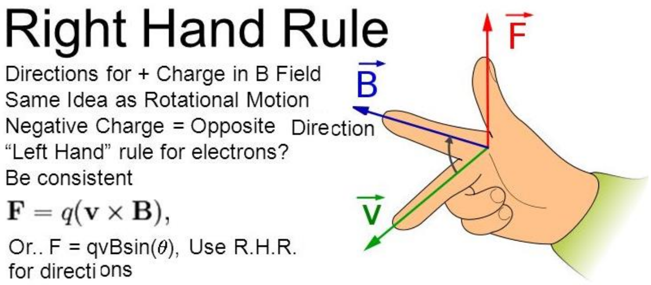
- For positive charge q moving with velocity v in magnetic field B, the force is F=q (v x B) or F = qv B sin θ
- For negative charge: F = - qv B sin θ
- V = 0 → F = q (0) B sin θ → F= 0

Particle	Force (v,B and θ = 90)
Proton	F = qv B
Electron	F = - qv B
Positron	F = qv B
Neutron	F = 0 v B = 0
Alpha particle	F = qv B = 4 qvB
Beta particle	F = qv B = qvB

Gamma particle	F = qv B = 0

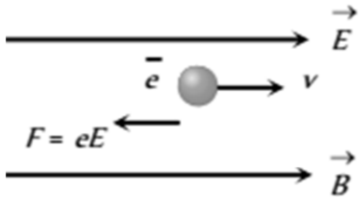
- $F_{alpha} = 4\ F_{Beta}$
- $F_{alpha} = F_{Beta} = F_{positron} = F_{electron} = F_{proton}$
- $F_{neutron} = F_{gamma} = 0$

Angle	Result
0^0	F= qv B sin 0= 0
90^0	F= qv B sin 90 = BIL
180^0	F= qv B sin 180 = 0
30^0	F= qv B sin30 = $\frac{F_{max}}{2}$ =50% of F_{max}
45^0	F= BIL sin45 = $\frac{F_{max}}{\sqrt{2}}$ =75% of F_{max}
60^0	F= BIL sin60 = $\frac{F_{max}}{\frac{\sqrt{2}}{3}}$ =80% of F_{max}



- Right hand rule → positive particles
- Left hand rule → negative particles
- Force is always perpendicular to direction of velocity Fleming's left hand rule
- When charge move along a magnetic field line then the charge move Spiral on spiral path ●θ =0-90
- Charged particle in magnetic field move along Circular path
- Frequency of electron in magnetic field or cyclotron frequency is F= q B/2πm
- T=2πm /q B

1) A uniform electric field and a uniform magnetic field are produced, pointed in the same direction. An electron is projected with its velocity pointing in the same direction
Ans) The electron will turn to its left
Since electron is moving parallel to the magnetic field, hence magnetic force on it



$F_m = 0$.
The only force acting on the electron is electric force which reduces it's speed.

2) If the direction of the initial velocity of the charged particle is perpendicular to the magnetic field, then the orbit will be
Ans) A circle

3) A charged particle moving in a magnetic field experiences a resultant force
Ans) In the direction perpendicular to both the field and its velocity, $F = qv\ x\ B$

4) The path executed by a charged particle whose motion is perpendicular to magnetic field is
Ans) A circle

5) A proton is moving along Z-axis in a magnetic field. The magnetic field is along X-axis. The proton will experience a force along
Ans) Y-axis, This is according to the cross product F = q(v x B) otherwise can be evaluated by the left-hand rule of Fleming.

6) A proton of (mass = $1.67\ x\ 10^{-27}$ kg and charge = $1.6\ x\ 10^{-19} C$) enters perpendicular to a magnetic field of intensity 2 weber / m² with a velocity $3.4\ x\ 10^7$ m/sec. The acceleration of the proton should be
Ans) $6.5\ x\ 10^{15}$ m/sec²
$F = ma = qvB => a = \frac{qvB}{m} =$
$\frac{1.6\ x\ 1^{-19} x\ 2\ x\ 3.4\ x\ 10^7}{1.67\ x\ 10^{-27}}$ = 6.5 x 10 m/sec

7) An α- particle travels in a circular path of radius 0.45 m in a magnetic field B = 1.2 Wb/m² with a speed of $2.6\ x\ 10^7$ m/sec. The period of revolution of the α – particle is
Ans) $T = \frac{2\pi m}{qB} = \frac{2\pi r}{v} = \frac{2\ x\ 3.14\ x\ 0.45}{2.6\ x\ 10^7} =$
$1.08\ x\ 10^{-7}$ sec

8) A strong magnetic field is applied on a stationary electron, then
Ans) The electron remains stationary

9) If a proton, deutron and $\alpha -$ particle on being accelerated by the same potential difference enters perpendicular to the magnetic field, then the ratio of their kinetic energies is
Ans) 1 : 1 : 2, Kinetic energy in magnetic field remains constant and it is K = q V => K ∝ q (V = constant)
$\therefore K_p : K_d : K_\alpha = q_p : q_d : q_a = 1 : 1 : 2$

10) There is no change in the energy of a charged particle moving in a magnetic field although a magnetic force is acting on it.
When charged particle enters perpendicularly in a magnetic field, it moves on a circular path with a constant speed. Hence it's kinetic energy also remains constant.

11) A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will
Ans) Move in a circular orbit with its speed unchanged because When particle enters perpendicularly in a magnetic field, it moves

along a circular path with constant speed.

12) A particle moving in a magnetic field increases its velocity, then its radius of the circle
Ans) Increases b/c For motion of a charged particle in a magnetic field, we have r = mv/qB i.e. r ∝ v

13) If an electron enters a magnetic field with its velocity pointing in the same direction as the magnetic field, then unchanged b/c Magnetic force on charge will be zero.

14) An electron and a proton with equal momentum enter perpendicularly into a uniform magnetic field, then
Ans) Both are equally curved.
r = mv/qB , Since both have same momentum, therefore the circular path of both will have the same radius

15) A charged particle of mass m and charge q describes circular motion of radius r in a uniform magnetic field of strength B. The frequency of revolution is
Ans) Time periods is given by T = $\frac{2\pi m}{qB}$
→ Frequency v = $\frac{1}{T} = \frac{qB}{2\pi m}$

16) An electron is moving on a circular path of radius r with speed v in a transverse magnetic field B. e/m for it will be
Ans) $r = \frac{mv}{eB} => \frac{e}{m} = \frac{v}{rB}$

17) A proton and an electron both moving with the same velocity v enter into a region of magnetic field directed perpendicular to the velocity of the particles. They will now move in circular orbits such that
Ans) The time period for proton will be higher.
We know that time period T = $\frac{2\pi m}{qB}$ $i.e. T \propto m$
(since q and B are same)
∵ Mass of proton > Mass of electron
∴ Time period of proton > Time period of electron

18) A proton and an α −particle enter a uniform magnetic field perpendicularly with the same speed. If proton takes 25 μ sec to make 5 revolutions, then the periodic time for the α − particle would be
Ans) $T_p = \frac{25}{5} = 5\mu$ sec
T = $\frac{2\pi m}{qB} => \frac{T_\alpha}{T_p} = \frac{m_\alpha}{m_p} x \frac{q_p}{q_\alpha} = \frac{4m_p}{m_p} x \frac{q_p}{2q_p}$
$\rightarrow T_\alpha = 2T_p = 10\mu$ sec.

19) Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describes circular path of radius R_1 and R_2 respectively. The ratio of mass of X to that of Y is
Ans) $r = \frac{\sqrt{2mk}}{qB} = \frac{1}{B}\sqrt{\frac{2mV}{q}} => r \propto \sqrt{m} =>$
$\frac{m_1}{m_2} = \left(\frac{R_1}{R_2}\right)^2$

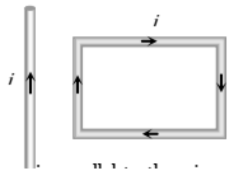
E/M RATIO FOR AN ELECTRON

- Radius of electron can be found by colliding with gas like hydrogen and helium Placed in uniform magnetic field and its de-excitation gives us Visible blue light
- e/m ratio of an electron is e/m=2V/B^2 r^2
- Mass of electron 9.109 x 10^{-31} kg
- Formula of velocity vector V = E/B

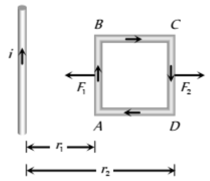
Force on coil in magnetic field

- The force on sides of coil in magnetic field F = NBIa
- The torque on coil produced by torque is τ = F (b cosθ) or τ = NBIa cosθ
- The maximum torque on current carrying coil BINA ●θ = 0
- When the plane of the coil is perpendicular to the magnetic field or normal to it is parallel to the field then Toque = 0
- Strong magnetic field and radio waves to produce an image of inside body Magnetic resonance imaging(MRI)
- By applying short radio frequency (RF) the protons in the slice spin Perpendicular to magnetic field

1) A rectangular loop carrying a current is situated near a long straight wire such that the wire is parallel to the one of the sides of the loop and is in the plane of the loop. If a steady current I is established in wire as shown in figure, the loop will



Ans) Move towards the wire
$\because r_1 < r_2$ So $F > F$
⇨ $F_{net} = (F_1 - F_2)$ Towards the wire.



2) A current carrying loop is placed in a uniform magnetic field. The torque acting on it does not depend upon

Ans) Shape of the loop Because $\tau = NiAB\ cos\theta$

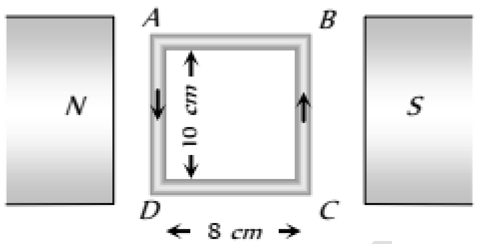
3) A current of 10 ampere is flowing in a wire of length 1.5 m. A force of 15 N acts on it when it is placed in a uniform magnetic field of 2 tesla. The angle between the magnetic field and the direction of the current is

Ans) $F = Bilsin\theta \Rightarrow sin\theta = \frac{F}{Bil} = \frac{15}{2\ x\ 10\ x\ 1.5} = \frac{1}{2} \Rightarrow \theta = 30°$

4) A current carrying rectangular coil is placed in a uniform magnetic field. In which orientation, the coil will not tend to rotate

Ans) The magnetic field is perpendicular to the plane of the coil

5) A 100 turns coil shown in figure carries a current of 2 amp in a magnetic field B = 0.2Wb/ m^2 . The torque acting on the coil is



Ans). $\tau = NBiA = 100\ x\ 0.2\ x\ 2\ x\ (0.08\ x\ 0.1) = 0.32\ N\ x\ m$

Direction can be found by Fleming's left hand rule. 0.32 Nm tending to rotate the side AD out of the page

6) A power line lies along the east-west direction and carries a current of 10 ampere. The force per metre due to the earth's magnetic field of 10^{-4} tesla is

Ans) Force on the wire = Bil

Force per unit length = bi = $10^{-4} x\ 10 = 10^{-3} N$

7) A straight wire of length 0.5 metre and carrying a current of 1.2 ampere placed in a uniform magnetic field of induction 2 Tesla. The magnetic field is perpendicular to the length of the wire. The force on the wire is

Ans) $F = bil = 2\ x\ 1.2\ x\ 0.5 = 1.2\ N$

Galvanometer, Voltmeter, Ammeter

Galvanometer

- An instrument uses for detection and measurement of small electric current Galvanometer
- Most modern galvanometer are of the moving-coil type called d'Arsonval galvanometer
- A cylinder of soft iron in galvanometer is used to Give more inertia to the coil
- The deflecting torque is equal to the restoring torque if coil is In equilibrium
- Galvanometer may be made more sensitive by making deflecting angle θ Large for certain value of current
- A sensitive galvanometer is that which show a large deflection for a Small value of current
- The angular displacement in galvanometer is being proportional to the current
- Lamp and scale arrangement galvanometer is More sensitive
- Pivoted coil galvanometer is Less sensitive
- In Pivoted coil galvanometer, the angle of the deflection of the coil is given By light aluminum pointer
- In less sensitive galvanometer the coil is pivoted between Two jeweled bearings

Ammeter

- The conversion of galvanometer to an ammeter is done by connecting a Low resistance in parallel
- The conversion of galvanometer to an volt meter is done by connecting a High resistance in series
- The low resistance connected with the galvanometer is called Shunt resistance
- When galvanometer are converted to ammeter the scale is marked in ampere
- The value of the shunt resistance depends upon the friction of the total current required to be passes through the Galvanometer
- An ideal ammeter has Zero resistance
- An ideal voltmeter has an Infinite resistance

Voltmeter

- The value of the resistance in voltmeter depends upon the Range of the voltmeter
- Voltmeter has high resister due to it must not draw Current from the circuit

Avometer

- An instrument used to measure current, voltage and resistance Avometer - Multimeter
- An Avometer – Multimeter is Amperemeter, voltmeter & ohmmeter (AVO)
- In current measurement on Avometer – Multimeter, circuit has series of shunt resistance called Universal shunt
- The added highly resistance converts the galvanometer to a voltmeter of A specific range
- Amount of the current through the galvanometer depends upon the External resistance
- The amount of the deflection on the ohms scale indicate directly the magnitude of the resistance
- Commercial AVO meter provides resistant measurement from less than One ohm to megaohms

- Modern multimeters are often digital due to accuracy, Durability & extra features
- In a digital multimeter the signal under test is converted to a voltage and an amplifier with electronically controlled gain Precondotions the signal
- A digital multimeters give result as a number which eliminate the Parallax error.

1) Two galvanometer s A and B require 3mA and 5mA respectively to produce the same deflection of 10 divisions. Then
Ans) Sensitivity (S) = $\frac{\theta}{i}$ => $\frac{S_A}{S_B} = \frac{i_B}{i_A} = \frac{5}{3}$ => $S_A > S_B$

2) A galvanometer can be used as a voltmeter by connecting a
Ans) High resistance in series . To convert a galvanometer into a voltmeter, a high value resistance is to be connected in series with it.

3) A galvanometer of 10 ohm resistance gives full scale deflection with 0.01 ampere of current. It is to be converted into an ammeter for measuring 10 ampere curent. The value of shunt resistance required will be
Ans) $S = \frac{i_g G}{i - i_g} = \frac{10 \, x \, 0.01}{10 - 0.01} = \frac{10}{999} \, ohm$

4) The resistance of a galvanometer is 25 ohm and it requires 50μA for full deflection. The value of the shunt resistance required to convert it into an ammeter of 5 amp is
Ans) $S = \frac{G}{\frac{i}{ig} - 1} = \frac{25}{\frac{5}{50 \, x \, 10^{-6}} - 1} = \frac{25}{10^5 - 1} = \frac{25}{10^5} =$
$2.5 \, x \, 10^{-4} \Omega$

5) We have a galvanometer of resistance 25Ω. It is shunted by a 2.5Ω wire. The part of total current that flows through the galvanometer is given as
Ans) $\frac{i}{i_g} + \frac{G+S}{S}$ => $\frac{i_g}{i} = \frac{S}{G+S} = \frac{2.5}{27.5} = \frac{1}{11}$

6) A galvanometer has resistance of 7Ω and gives a full scale deflection for a current of 1.0 A. how will you convert it into a voltmeter of range 10 V
Ans) By connecting a series resistance
$$R = \frac{V}{i_g} - G = \frac{10}{1} - 7 = 3\Omega$$

7) The potential gradient along the length of a uniform wire is 10 volt/meter. B and C are the two points at 30 cm and 60cm point on a meter scale fitted along the wire. The potential difference between B and C will be
Ans) potential gradient = Change in voltage per unit length
$\therefore 10 = \frac{V_2 - V_1}{30/100}$ => $V_2 - V_1 = 3 \, volt$

8) A potentiometer is used for the comparison of e.m.f of two cells E_1 and E_2. For cell E_1 the no deflection point is obtained at 20 cm and for E_2 the no deflection point is obtained at 30 cm. the ratio of their e.m.f.'s will be
Ans) Ratio will be equal to the ratio of no deflection lengths i.e. $\frac{E_1}{E_2} = \frac{l_1}{l_2} = \frac{2}{3}$

9) Potential gradient is defined as
Ans) Fall of potential per unit length of the wire

10) In an experiment of meter bridge, a null point is obtained at the centre of the bridge wire. When a resistance of 10 ohm is connected in one gap, the value of resistance in other gap is
Ans) 10Ω, Potential gradient = $\frac{Potential \, Difference}{Length}$

11) If the length of potentiometer wire is increased, then the length of the previously obtained balance point will
Ans) Increase, When the length of potentiometer wire is increased, the potential gradient decreases and the length of previous balance point is increased.

12) Which of the following is correct
Ans) Ammeter has low resistance and is connected in series

13) A potentiometer consists of a wire of length 4ma nd resistance 10Ω. It is connected to a cell of e.m.f. 2 V. the potential difference per unit length of the wire will be
Ans) Since potential difference for full length of wire = 2 V
$\therefore$ P.D. per unit length of wire = $\frac{2}{4}$ = 0.5 $\frac{V}{m}$

14) A potentiometer wire has length 10 m and resistance 20Ω. A 2.5 V battery of negligible resistance is connected across the wire with an 80Ω series resistance. The potential gradient on the wire will be
Ans) Potential gradient x = $\frac{e}{(R+R_h+r)} \cdot \frac{R}{L}$
$\rightarrow x = \frac{2.5}{(20+80+0)} x \frac{20}{10} = 5 \, x \, 10^{-5} \frac{V}{mm}$

15) There are three voltmeters of the same range but the resistances 10000Ω, 8000 Ω and 40000Ω respectively. the best voltmeter among these is the one whose resistance is
Ans) 10000Ω, Resistance of voltmeter should be high.

16) To convert a galvanometer into a voltmeter, one should connect a
Ans) High resistance in series with galvanometer

17) To convert a 800 mV range milli voltmeter of resistance 40Ω into a galvanometer of 100 mA range, the resistance to be connected as shunt is
Ans) $\frac{i}{i_g} = 1 + \frac{G}{S}$ => $i.\frac{G}{V_g} = 1 + \frac{G}{S}$ =>
$\frac{100 \, x \, 10^{-3} x \, 40}{800 \, x \, 10^{-3}} = 1 + \frac{40}{S}$ $\rightarrow$ S = 10Ω.

18) A 100 ohm galvanometer gives full scale deflection at 10 mA. How muchs hunt is require dto read 100 mA
Ans)
$i_g = i\frac{S}{G+S}$ => $10 \, x \, 10^{-3} = \frac{S}{100+S} x \, 100 \, x \, 10^{-3}$

$$90S = 1000 => S = \frac{1000}{90} = 11.11\Omega$$

19) The deflection in a moving coil galvanometer is
Ans) Directly proportional to the number of turns in the coil, $\theta = \frac{NiAB}{C} => \theta \propto N$

20) In a moving coil galvanometer , the deflection of the coil θ is related to the electrical current i by the relation
Ans), $i = \frac{C\theta}{NAB} => i \propto \theta$

21) A potentiometer is an ideal device of measuring potential different because
Ans) It does not disturb the potential difference it measures , In balance condition, potentiometer doesn't take the current from secondary circuit.

22) A moving coil galvanometer has a ressitance of 50**Ω** and gives full scale deflection for 1 mA. How could it be converted into an ammeter with a full scale deflection for 1A
Ans) 50/99 **Ω** in parallel
$S = \frac{i_g x\, G}{i - i_g} = \frac{10\ x\ 10^{-3} x\ 50}{1 - 10^{-3} x\ 10} = \frac{50}{99}\Omega$ in parallel.

23) A galvanometer having a resistance of 8 ohm is shunted by a wire of resistance 2 ohm. If the total current is 1 amp, the part of it passing through the shunt will be
Ans) $i_g S = (i - i_g)G => i_g(S + G) = iG$
$\rightarrow \frac{i_g}{i} = \frac{G}{S+G} = \frac{8}{2+8} = 0.8$

24) Sensitivity of potentiometer can be increased by
Ans) Increasing the length of the potentiometer wire. The sensitivity of potentiometer can be increased by decreasing the potential gradient i.e. by increasing the length of potentiometer wire.
(Sensitivity $\propto \frac{1}{P.G.} \propto$ ***Length***)

25) Which is a wrong statement
Ans) In a balanced Wheatstone bridge, interchanging the positions of galvanometer and cell affects the balance of the bridge
In balanced Wheatstone bridge, the arms of galvanometer and cell can be interchanged without affecting the balance of the bridge.

26) An ammeter with internal resistance **90Ω** reads 1.85 A when connected in a circuit containing a battery and two resistors 700**Ω** and 410**Ω** in series. Actual current will be
Ans) Greater than 1.85 A
In general, ammeter always reads less than the actual value because of its resistance

27) An ammeter whose resistance is **180Ω** gives full scale deflection when current is 2 mA. The shunt required to convert it into an ammeter reading 20 mA (in ohms) is
Ans) Given $i_g = 2mA, i = 20mA, G = 180\Omega$
$$\frac{i_g}{i} = \frac{S}{G+S} => 180 + S = 10S => S = \frac{180}{9} = 20\Omega$$

28) A galvanometer can be converted into an ammeter by connecting
Ans) High resistance in parallel
To convert a galvanometer into an ammeter a low value resistance is to be connected in parallel to it called shunt.

29) A galvanometer of 100**Ω** resistanec gives full scale deflection when 10 mA of current is passed. To convert it into 10 A range ammeter, the resistance of the shunt required will be
Ans) $S = \frac{i_g G}{i - i_g} = \frac{100\ x\ 0.01}{(10 - 0.01)} = \frac{1}{10} = 0.1\Omega$

30) In order to pass 10% of main current hrough a moving coil galvanometer of 99 ohm, the resistance of the required shunt is
Ans) Shunt resistances $S = \frac{i_g G}{(i - i_g)} = \frac{10\ x\ 99}{(100 - 10)} = 11\Omega$

31) 50**Ω** and 100**Ω** resistors are connected in series. This connection is connected with a battery of 2.4 volts. when a voltmeter of 100**Ω** resistance is connected across 100**Ω** resistor, then the reading of the voltmeter will be
Ans) 1.2 V
Equivalent resistance of the circuit $R_{eq} = 100\Omega$
Current through the circuit $i = \frac{2.4}{100} A$
P.D. across combination of voltmeter and 100**Ω** resistance = $\frac{2.4}{100} x\ 50 = 1.2\ V$
Since the voltmeter and 100**Ω** resistance are in parallel, so the voltmeter reads the same value i.e., 1.2V.

32) By ammeter, which of the following can be measured
Ans) Current , Ammeter is used to measure the current through the circuit.

33) The resistance of 1 A ammeter is 0.018**Ω**. to convert it into 10 A ammeter, the shunt ressitance required will be
Ans) $S = \frac{i_g G}{(i - i_g)} = \frac{1\ x\ 0.018}{10 - 1} = \frac{0.018}{9} = 0.002\Omega$

34) Ammeter is always connected in series with circuit.

35) A galvanometer whose resistance is 120**Ω** gives full scale deflection with a current 0.05 A so that it can read a maximum current of 10 A. A shunt resistance is added in parallel with it. The resistance of the ammeter so formed is
Ans) Resistance of shunted ammeter = $\frac{GS}{G+S}$
Also $\frac{i}{i_g} = 1 + \frac{G}{S} => \frac{GS}{G+S} = \frac{i_g.G}{i}$
$\rightarrow \frac{GS}{G+S} = \frac{0.05\ x\ 120}{10} = 0.6\Omega$

36) In a potentiometer experiment, the galvanometer shows no deflection when a cell is connected across 60 cm of the potentiometer wire. If the cell is shunted by a resistance of 6**Ω**, the balance is obtained across 50 cm of the wire. The internal resistance of the cell is
Ans) $r = \frac{(l_1 - l_2)}{l_2} X\ R' = \left(\frac{60-50}{50}\right) x6 = 1.2\ \Omega$

37) The resistance of 10 metre long potentiometer wire is 1ohm/meter. A cell of e.m.f. 2.2 volts and a high resistance box are connected in series to this wire. The value of resistance taken from resistance box for getting potential gradient of 2.2. milli volt/metre wire will be

Ans) Potential gradient x = $\frac{V}{L} = \frac{e}{(R+R_h+r)} \cdot \frac{R}{L}$

$\rightarrow \mathbf{2.2\ x\ 10^{-3}} = \frac{2.2}{(10++R_h)} \boldsymbol{x\ 1 = R' = 990\ \Omega}$

38) If an ammeter is to be used in place of a voltmeter then we must connect with the ammeter a

Ans) High resistance in series

If ammeter is used in place of voltmeter (i.e. in parallel) it may damage due to large current in circuit. Hence to control this large amount of current a high resistance must be connected in series.

39) The material of wire of potentiometer is

Ans) Manganin

Manganin or constantan are used for making the potentiometer wire.

40) 100mA current gives a full scale deflection in a galvanometer of 2**Ω** resistance. The resistance connected with the galvanometer to convert it into a voltmeter to measure 5V is

Ans) $\boldsymbol{R = \frac{V}{i_g} - G = \frac{5}{100/10^3} - 2 = \frac{5000}{100} - 2 =}$

$\mathbf{48\ \Omega}$

41) A galvanometer of resistance **25Ω** gives full scale deflection for a current of 10 milliampere, is to be changed into a voltmeter of range 100V by connecting a resistance of 'R' in serie with galvanometer . The value of resistance R in **Ω** is

Ans) $\boldsymbol{R = \frac{V}{i_g} - G = \frac{100}{10\ x\ 10^{-3}} - 25 = 9975\Omega}$

42) $\mathbf{10^{-3}}$ amp is flowing through a resistance of 1000**Ω**. To measure the correct potential difference, the voltmeter is to be used of which the resistance should be

Ans) >> 1000 **Ω**, Resistance of voltmeter should be greater than the external circuit resistance. An ideal voltmeter has infinite resistance.

43) An ammeter gives full scale deflection when current of 1.0 A is passed in it. To convert it into 10 A range ammeter, the ratio of its reistance and the shunt resistance will be

Ans) $\boldsymbol{S = \frac{i_g G}{(i-i_g)} => \frac{G}{S} = \frac{i-i_g}{i_g} = \frac{10-1}{1} = \frac{9}{1}}$

44) For measurement of potential difference, potentiometer is preferred in comparison to voltmeter because

Ans) Potentiometer does not take current form the circuit . Potentiometer works on null deflection method. In balance condition no current flows in secondary circuit.

45) An ammeter of 5 ohm resistance can read 5 mA. If it is to be used to read 100 volts, how much resistance is to be connected in series

Ans) By using $\boldsymbol{R = \frac{V}{i_g} - G => R = \frac{100}{5\ x\ 10^{-3}} -}$

$\mathbf{5 = 19,995\Omega}$

46) The net resistance of a voltmeter should be large to ensure that

Ans) It does not appreciably change the potential difference to be measured . The resistance of voltmeter is to high, so that is draws negligibles current from the circuit, hence potential drop in the external circuit is also negligible

47) In a meter bridge, the balancing length from the left end (standard resistance of one ohm is in the right gap) is found to be 20 cm. the value of the unknown resistance is

Ans) $\boldsymbol{\frac{X}{1} = \frac{20}{80} => X = \frac{1}{4}\Omega = 0.25\ \Omega}$

48) A voltmeter of resistance 1000**Ω** gives full scale deflection when a current of 100 mA flow through it. The shunt resistance requied across it to enable it to be used as an ammeter reading 1 A at full scale deflection is

Ans) By using $\boldsymbol{\frac{i}{i_g} = 1 + \frac{G}{S}}$

$\boldsymbol{\rightarrow \frac{i}{100\ x\ 10^{-3}} = 1 + \frac{1000}{S} => S = \frac{1000}{9} = 111\Omega}$

ALL PHYSICS FORMULAS

Measurements

Smallest unit of measurement by;
Measurement tape → 1 cm or 1mm
Meter rule or half meter rule → 0.1 cm or 1 mm
Vernier caliper → 0.01 cm or 0.1 mm
Screw gauge → 0.001 cm or 0.01 mm
$\theta = s/r$
2π rad = 360^0
360^0 = 1 revolution
1 radian = 57.3^0
1 degree = 60 minute
1 minute = 60 seconds
Angle at circle is 2π radian.
Angle at sphere is 4π steradian.
Volume of slid cylinder = $\pi r^2 l$
Area of sphere = $4\pi r^2$
Volume of sphere = $4/3\ \pi r^3$
Dimension of velocity = $[LT^{-1}]$
Dimension of acceleration= $[LT^{-2}]$
Energy of photon; E = hf
Time period of pendulum; $T = 2\pi\sqrt{\frac{l}{g}}$

Vectors and equilibrium

Commutative property of vector= A+B = B+A
$F_x = F\cos\theta$
$F_y = F\sin\theta$
$F = \sqrt{Fx^2 - Fy^2}$
A.B = AB cos θ
A x B = AB sin θ
Scalar product; work and power
Vector product; torque
τ = r x F
First condition of equilibrium; $\sum F = 0$
Second condition of equilibrium; $\sum \tau = 0$

Motion and Force

$v = s/t$
$a = v/t$
$v_f = v_i + at$
$s = v_it + \frac{1}{2}at^2$
$2as = v_f^2 - v_i^2$
$S = v_{ave} \times t$
$V_{ave} = (v_i + v_f)/2$
$g = 9.8\ ms^{-2} = 32\ ft^{-2}$
F = ma
a = v/t
P = mv
P = F t
Impulse; J = F x t = ΔP
J = ΔP
Law of conservation of momentum; Δp = 0
Elastic collision in one dimension; $[v_1 + v_2] = [v_1' + v_2']$

Magnitude of projectile velocity; $V_f = \sqrt{v_{fx}^2 + v_{fy}^2}$
Height of projectile; $H = v_i^2\sin^2\theta/2g$
Time of flight; $T = 2\ v_i\sin\theta/g$
Time of summit or time to reach to highest point; $T = v_i \sin\theta/g$
Range; $R = v_i^2 \sin 2\theta/g$
$R_{max} = v_i^2/g$
$R = R_{max}$ at 45^0

Work and Energy

W = Fd cosθ
Power; p=W/t or p =Fv
1 watt = Js^{-1}
1 hp = 746 watts
K.E = ½ mv^2
P.E = mgh
Efficiency = output/input = W x D/P x d
Circular motion
Absolute potential energy =Fr = - GM_m/R_e (- because work is done against gravity)
Gravitational potential = E/m = GM_e/R_e
For escape velocity compare K.E with Absolute potential energy; $v_{esc} = \sqrt{\frac{2GM_e}{r_e}} \rightarrow v_{esc} = \sqrt{2gr_e}$
$G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$
$R_e = 6.4 \times 10^6$ m
$M_e = 6 \times 10^{24}$ kg
$V_{esc} = 11.2 \times 10^3\ ms^{-1}$
Wh = K.E + fh → (Wh = loss in potential energy)
Loss in P.E = Gain inn K.E + work done against friction
$E = mc^2 \rightarrow (c = 3 \times 10^8\ ms^{-1})$

Rotational and circular motion

Angular velocity; ω = Δθ/Δt
Angular acceleration; α = Δω/Δt → a = α x r
v = r ω
$F_c = mv^2/r$
$a_c = -(v^2/r)$
Centrifugal force= mv^2/r
F sin θ = mv^2/r
F cos θ = mg
Tan θ = v^2/gr
Torque = r F = rma = rm (rα) =(r^2m)α = I α
Moment of inertia; I = mr^2
Ring or thin walled cylinder inertia(I) = MR^2
Disc or solid cylinder inertia = ½ MR^2
Disc inertia = ½ M $(R_2^2 + R_1^2)$
Solid sphere inertia = 2/5 MR^2
Solid rod or meter stick inertia = 1/12 Ml^2
Rectangular plate inertia = 1/12 M (a^2+b^2)

Angular momentum = L = r x p = r mv = rmrω =r^2mω = Iω
L = rmv → L/t = rmv/t = rma = rF = τ
L/t = τ
Linear kinetic energy = ½ mv^2
Rotational kinetic energy = ½ $I\omega^2$
Velocity of hoop = $v = \sqrt{gh}$
Velocity of disc = $v = \sqrt{\frac{4}{3}gh}$
Critical velocity = v = 7.9 km^2
The orbital velocity = $v = \sqrt{\frac{GM_e}{r}}$
Lift at rest → T =w
Lift moving downward → T = w – ma
Lift moving upward → T = w + ma
Lift falling freely = T mg-ma = 0
Frequency for artificial satellite → $f = \frac{1}{2\pi}\sqrt{\frac{g}{r}}$

Fluid dynamics

Drag force → $F_d = 6\ \pi\eta\ r\ v$
Terminal velocity → $v_t = \frac{2\rho g r^2}{9\eta}$
Continuity equation → $A_1 v_1 = A_2 v_2$
Av=ΔV/Δt = constant
Δm/Δt = ρ ΔV/Δt
Bernoulli's Equation = P + ½ ρv^2 + ρgh = constant
Torricelli's Theorem → $v = \sqrt{2gh}$
Flow meter or the venture meter → $v_1 = \sqrt{\frac{2gh}{\frac{A_1^2}{A_2^2} - 1}}$

Oscillation

Frequency → f=1/T
Angular frequency → ω = 2πf
Time period → T = 2π/ω
Velocity of projection → $v_y = \omega\sqrt{r^2 - x^2}$
Simple pendulum time period → $T = 2\pi\sqrt{\frac{L}{g}}$
Simple pendulum potential energy = ½ kx^2
Simple pendulum kinetic energy = ½ kx_0^2 -½ kx^2
Total energy of simple pendulum = ½ kx_0^2
Resonance frequency = $F_n = nf_1$
Phase → θ =ω t

Waves

Transverse wave speed → $v = \frac{\sqrt{T \times L}}{M}$ or $v = \frac{\sqrt{T}}{m}$
Longitudinal waves speed → $v = \frac{\sqrt{E}}{\rho}$
Phase change→ 2π = λ

Phase difference → δ = 2π/λ
Speed of sound by newton → $v = \sqrt{\frac{\rho_m gh}{\rho}} = 281\ ms^{-1}$
Laplace correction → $v = \sqrt{\frac{\gamma\rho_m gh}{\rho}} = 332\ ms^{-1}$

Chap No.11 ELECTROSTATICS

1 e = 1.602×10^{-19} C
Q = ne
Coulomb's Law; $F = k\frac{q1\ q2}{r2}$
$K = \frac{1}{4\pi\varepsilon o}$
$K = 9.0 \times 10^9\ N\ m^2\ C^{-2}$
$\varepsilon_o = 8.85 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$
$\varepsilon_r = \frac{\varepsilon}{\varepsilon 0}$
$F_{med} = \frac{F\ vac}{\varepsilon r}$
$E = \frac{F}{q} = \frac{V}{d} = K\frac{q}{r2}$
Φ = E A cos θ = N $m^2\ C^{-1}$
$\Phi = \frac{Q}{\varepsilon 0}$
E due to sheet of charge; $E = \frac{\sigma}{2\varepsilon}$
E due to charge palates; $E = \frac{\sigma}{\varepsilon}$
$V = \frac{W}{Q} = \frac{U}{Q}$ Volt = Joule / Coulomb
Electric potential energy; $U = K\frac{Qq}{r}$
Electric potential; $V = \frac{W}{Q} = \frac{Fr}{Q} = K\frac{Q}{r}$
Potential Gradient = $E = -\frac{\Delta V}{\Delta r}$
1 eV =1.602×10^{-19} C x 1V → (1 eV = 1.602×10^{-19} J)
$C = \frac{Q}{V}$ = C V^{-1} = farad
Charge density; $\sigma = \frac{Q}{A}$
$C_{vac} = \frac{Q}{V} = \frac{\varepsilon 0\ A}{d} = \frac{\varepsilon 0\ \varepsilon r\ A}{d}$
$\varepsilon_r = C_{med} / V_{vac}$
Capacitors In Series;
Q = Q1 = Q2 =Q3
V =V1 + V2 + V3
1/Ce = 1/C1 + 1/C2 + 1/C3
Capacitors In Parallel;
Q = Q1 = Q2 = Q3
V = V1 + V2 +V3,
Ce = C1 + C2 + C3
Electric dipole; P = q d
Energy = $U = \frac{UV}{2} = \frac{CV2}{2} = \frac{1}{2}\frac{A\ \varepsilon 0\ \varepsilon r}{d}(Ed)^2$
Energy density; $\mu = \frac{U}{Ad} = \frac{1}{2}\varepsilon o\ \varepsilon r\ E^2$
Maximum charge on capacitor = C x e.m.f
q/q_0 = 63.2 % →for charging
q/q_0 = 36.7 % →for discharging
$q = q_0(1-e^{-t/RC})$ →for charging

$q = q_0 e^{-t/RC}$ →for discharging

CURRENT ELECTRICITY

Current, $I = Q/t \rightarrow C s^{-1} = A$
Drift velocity order = 10^{-5} m/s.
V = IR
Tan θ = I/V = 1/R
Resistance, R = V/I → 1Ω = 1V/1A
R = ρ L/A → Ω.m
Conductance, G = 1/R → Siemen(S) or mho
Conductivity, σ = 1/ρ =L/RA →mho/m or S/m
Pure metals R inc with T inc.
Electrolytes and insulators, R dec with T inc.
$\Delta R = \alpha R_0 T \rightarrow R_T = R_0 (1+\alpha T)$
Temperature co-efficient of Resistance, $\alpha = R_T - R_0/R_0T \rightarrow K^{-1}$
Resistivity, $\rho_T = \rho_0 (1+\alpha T)$ OR $\alpha = \rho_T - \rho_0/ \rho_0 T \rightarrow K^{-1}$
Electromotive Force, ε = W/q → 1 volt = 1 joule/coulomb
Open circuit, I = 0 so V= ε
Terminal Voltage, $V_t = \varepsilon - Ir$
Power, P = W/t = VI → 1 Watt = 1V x 1A
1 kWh = 1 unit of electrical energy
1 J = 1W x 1s
Maximum output power, $(P_{out})_{max} = \varepsilon^2 /4r = \varepsilon^2 /4R$
Thermo emf, $\varepsilon = \alpha T + ½ \beta T^2$
KCL, ΣI = 0
KVL, Σε = ΣV = ΣIR
KCL based on L.O.C.O.CHARGE
KVL based on L.O.C.O.ENERGY
Wheatstone Bridge, X = PQ/R
Potentiometer, $\varepsilon_2 /\varepsilon_1 = I_2 /I_1$
Tan θ = I/V = 1/R

ELECTROMAGNETISM

Force on current carrying wire, F=BIL sin θ.
Magnetic field or magnetic induction, B = F/IL →1 tesla =1 $NA^{-1} m^{-1}$ = 1 Wb m^{-2}
1 T = 10^4 G
Magnetic Flux, Φ = B A cos θ → 1 Wb = 1 N m A^{-1}.
Ampere's Law, $B \propto I/r = \mu_0 (I/2\pi r)$ OR $\Sigma B.\Delta L = \mu_0 I$
$B_{net} = B_1 + B_2$
Magnetic field due to current carrying solenoid, $B = \mu_0 n I$ → n=N/L
Motion of charge particle in uniform magnetic field, F=q v B sin θ
Centripetal Force = Magnetic force → $mv^2/r = qvB$
Time period of charge particle in B, T = 2πm/qB
Frequency of charge particle in B, f = qB/2πm
Velocity selector, $F_E = F_M$ → qE = qvB → v = E/B
Torque on current carrying coil, τ = NBIA cos θ
Pestoring torque, τ = C θ
Galvanometer, NBIA cos θ = C θ → I = Cθ/NAB → I ∝ θ
Conversion of galvanometer into ammeter, small R connected in parallel
Conversion of galvanometer into voltmeter, large R in series are connected
Ammeter, $R_s = R_g I_g / (I - I_g)$ → Ideal ammeter → 0 R
Voltmeter, $R_h = (V/I_g) - R_g$ → Ideal voltmeter → infinite R

ELECTROMAGNETIC INDUCTION

Faraday's Law, ε ∝ N (ΔΦ/Δt) → ε = N (ΔΦ/Δt)
Lenz Law, ε = –N (ΔΦ/Δt)
Flux motional emf, ε = Blv sin θ
Rate of work done, W= Bilv
Rate of production of electrical energy, energy =ε I
W = energy → Bilv = εI → ε = Blv
Power, P = F v
ε = L ΔI/Δt or ε = N ΔΦ/Δt → LI = NΦ
Self-Inductance, L = NΦ /I
ε = M ΔI/Δt or ε = N ΔΦ/Δt → MI = NΦ
Mutually inductance, M = NΦ /I
F = 1/T
Induced emf, ε = NAB cosωt or NAB ω sinωt
$\varepsilon = \varepsilon_{max} \sin \omega t$
Back emf, V = ε + IR
$N_s / N_p = V_s / V_p = I_p /I_s$

PHYSICS OF SOLIDS

Elastic modulus = $\frac{Stress}{Strain}$
Tensile stress = $\frac{F}{A}$
Tensile strain = $\frac{\Delta L}{L}$
Young modulus = $\frac{\frac{F}{A}}{\frac{\Delta L}{L}}$ = Nm^{-2}
Shear stress = $\frac{F}{A}$
Shear strain = $\frac{\Delta x}{y}$ = tan θ
Shear modulus = rigidity modulus = $\frac{\frac{F}{A}}{\frac{\Delta x}{y}} = \frac{F}{A\theta}$
Bulk or volume stress = $\frac{F}{A}$
Bulk modulus (in fluids) = Δp = $\frac{F}{A}$
Volume strain =- $\frac{\Delta V}{V}$
Bulk modulus = $\frac{\frac{F}{A}}{-\frac{\Delta V}{V}} = \frac{\Delta p}{-\frac{\Delta V}{V}}$
Stress ∝ strain (Hook's law)
A = π r^2
W = ½Fe (work done on stretching wire).
Strain energy = ½ F e
Strain energy per unit volume = $\frac{1}{2}\frac{F\,x\,e}{A\,x\,l}$ = ½ (stress) (strain)

DAWN OF MODERN PHYSICS

$E = m_0 c^2$
L= $L_0 \sqrt{\frac{1=v2}{c2}}$
T = $t_0 \sqrt{\frac{1=v2}{c2}}$
M = $m_0 \sqrt{\frac{1=v2}{c2}}$
$\lambda_{max} T = 0.2898 \times 10^{-2}$ m k (Wein's displacement law)
E = σ T^4 (Steffan-Bolts Law)
σ = 5.67 x 10^{-8} $Wm^{-1} K^{-4}$
E = n h f
$K.E_{max} = e V_0$
$K.E_{max} = h f - \Phi$
H $f_0 = \Phi = \frac{hc}{\lambda}$
$K.E_{max} = hf - Hf_0$
Hf = K.E +hf
P= $\frac{E}{c}$
Δλ = $\frac{E}{m0\ c}$ 1-cos θ
$\frac{1}{f'} = \frac{1}{f} + \frac{E}{m0\ c}$ 1-cos θ
$E_{photon} = E_{electron} + E_{positron}$
Photon rest mass energy = $2m_0c^2$ = 1.02 MeV
$\frac{h}{fc} = mv_{e-} + mv_{e+}$
λ = $\frac{h}{p} = \frac{h}{mv}$
Δp = $\frac{h}{\lambda}$ and Δx = λ
(Δp)(Δx) = h
(ΔE)(Δt) = h

ATOMIC SPECTRA

$\frac{1}{\lambda} = R\,(\frac{1}{P2} - \frac{1}{n2})$
R =E_0 / hc
R == 1.097 x $10^7 m^{-1}$.
mvr = nh/2π.
h = planks constant = 6.6256 x 10^{-34} j s.
$E = hf = E_n - E_p$
$r_n = \frac{n2\ h2}{4\ \pi\ k\ m\ e2}$
$E_n = -\frac{2\ \pi 2\ \ 2\ k\ m\ e4}{n2\ h2}$
$E_n = -\frac{E0}{n2}$ = 2.17 x 10^{-18} j/ n^2 = +13.6 ev/ n^2
$r_n = n^2 r_1 \rightarrow r_1$ = 0.53 ^{0}A.
1 ^{0}A = 10^{-} m
2πr=nλ
$eV \rightarrow hf_{max} = hc/\lambda_{min}$
λ_{min} = hc/eV
excited state for 10^{-8} s.
metastable state for 10^{-3} s

NUCLEAR PHYSICS

Nuclear size is of the order of 10^{-14} m.
The mass of the nucleus is of the order of 10^{-27} kg.
½ mv^2 = Vq
Bqv = mv^2/r
Bqv = mv^2/r → m = Bqr/v
½ mv^2 = Vq → v^2 = 2Vq/m
So m = qr^2B^2/2V
$\Delta m = Zm_p + Nm_n - M_{(A,Z)}$
The binding energy in MeV is 931 x Δm.
The binding energy per nucleon = E_b/A.
${}_0n^1 \rightarrow {}_1H^1 + {}_{-1}\beta^0$ + antineutrino
12 MIN
ΔN/Δt =-λN
R =- ΔN/Δt =λN
N= $N_0e^{-\lambda t}$
1 Bq = 1 decay per second
1 Ci = 3.70 x 10^{10} decay/s
λT ½ = 0.693
The charge on u,t and c, in term of electron is +2/3e.
The charge on s,t and b in term of electron is -1/3e.
proton =2U→D.
neutron =U

Chapter 1 Measurments

1)	0.5 A=	500mA
2)	The dimension of plank constant(h) is	[M L^2 T^{-1}]
3)	Number of significant figures in 4.0030 are	5
4)	The angle subtended by the circumference of circle at center of circle is	2π radians or 1 rev or 360^0
5)	The angle subtended at the center of the sphere by its surface area =	4π steradian
6)	One atto =	10^{-18}
7)	The circumference of circle divided by diameter of the circle is called	π
8)	Plane angle subtended at center of circle by an arc of length equal to its radius	Radian
9)	Angle subtended at center of circle by an arc of length 1/360 of the circumference of the circle	Degree
10)	Carelessness, improper knowledge and incorrect reading causes	Personal error
11)	Faulty apparatus or poor calibration and zero error causes	Systematic error
12)	Change in temperature, voltage and humidity error causes	Random/accidental error
13)	Random error is also called	Statistical error
14)	The final result should contain as much significant figure as that contained by	Least significant figure
15)	Magnitude of frictional error or relative error	Accuracy
16)	Force, Energy and acceleration are	Dimensional variable
17)	Light speed in vacuum, plank's constant, gravitational constant and ideal gas constant are	Dimensional constant
18)	Plane angle, solid angle, strain and co-efficient of friction are	Dimensionless variable
19)	Pure numbers and π are	Dimensionless constant
20)	The uncertainty recorded in radius of sphere is 1.6% .uncertainty in area of sphere is	3.2% (Area=πr^2)
21)	10.00300 ,no of significant figures are	7
22)	A precise measurement is one which has	Absolute precision
23)	Particle physics concern with the particles of the	Matter
24)	Computer chips are made up of	Silicon
25)	SI unit of work is	N m
26)	The dimension of work is same to that of	Energy
27)	Steradian is	Supplementary unit

Chapter 3 Force and Motion

28)	When force is applied on body its mass remains	Constant
29)	Displacement-time graph is called	Velocity
30)	Displacement-time graph may be	Negative
31)	Distance-time graph can never be	Negative
32)	Slope or gradient of v-t graph is called	Acceleration
33)	Area under v-t graph is called	Distance traveled
34)	Free fall motion is	9.8 ms^{-2} or 32 ft s^{-2}
35)	Newton's first law of motion is also known as	Law of inertia
36)	Newton's second law of motion	F=ma
37)	Newton's third law of motion	$F_{AB} = -F_{BA}$
38)	Linear momentum was called quantity of motion by	Newton
39)	The rate of change of momentum is equal to	Force acting on body

40)	The product of F and t is called impulse of force, represented by	J
41)	In an elastic collision both kinetic energy and momentum is	Conserved
42)	In an inelastic collision momentum is conserved but kinetic energy is not	Conserved
43)	The type of collision in which before and after collision appear on singe line	Head-on collision
44)	The relative speed of approach is equal to relative speed of separating for two	Bodies colliding elastically
45)	Projectile motion is two dimensional under an action of	Gravity
46)	The vertical component of velocity in projectile in highest is	Zero
47)	The horizontal component of velocity of projectile remains	Constant
48)	In projectile motile motion the upward quantities are taken	Positive
49)	In projectile motile motion the downward quantities are taken	Negative
50)	Height of projectile	$V_i^2 \sin^2 \theta/2g$
51)	Range of projectile	$V_i^2 \sin 2\theta/g$
52)	Time of projectile	$2V_i \sin \theta/g$
53)	If kinetic energy of body is increased by 300%, the increase in momentum is	100%
54)	The vertical velocity of projectile at its maximum height is	Zero
55)	The velocity of projectile at its maximum height is	Minimum
56)	Two equal, anti parallel and non concurrent forces that produce only angular acceleration are	Couple
57)	The minimum number of equal forces that keep the body in equilibrium are	2
58)	The minimum number of unequal forces that keep the body in equilibrium are	2
59)	A ball of mass 5 kg is dropped from a height of 78.4m the time taken by the ball to hit the ground is	4 sec
60)	A ball is thrown from window of moving train, It hit the ground by	Parabolic path
61)	A man throws a ball vertically in accelerated train, he ball will fall in	His hand
62)	A jet drops a bomb when it is above the target but it miss it due to	Horizontal component of the velocity of bomber
63)	To jump long, a jumper should jump at	45^0
64)	The range of projectile is the same for two angles which are mutually	Complementary
65)	The path of projectile is parabolic in shape and is called	Trajectory
66)	Everything in the vastness of space is in state of	Rotatory motion
67)	The change in position of body is called	Displacement
68)	Inertia of body is measured in terms of	Mass
69)	If velocity is increasing, the acceleration is	Positive
70)	When bullet is fired by the gun, the gun moves backward with velocity	Less than bullet
71)	The three equations of motion are useful for	Linear motion
72)	Newton's laws are applicable in	Inertial frames only
73)	If two objects are moving with the same velocity, it's difficult to stop the	Massive of the two
74)	Acceleration of bodies of different masses are	The same
75)	Rate of change of momentum is called	Impulse
76)	The product of force and duration of impact is called	Impulse
77)	A system in which no external agency exerts any force is called	Isolated system
78)	A collision in which both K.E and momentum is conserved is called	Elastic collision
79)	a collision in which momentum is conserved but K.E is not, is called	Inelastic collision
80)	The laws of motion show the relation between	a and F
81)	Inertial mass and gravitational mass are	Identical

82)	A frame of reference stationed on earth is called	Inertial frame
83)	The relation between range and maximum range	$R=R_0\sin 2\theta$
84)	Newtonian physics does not hold true in case of	Atomic particles
85)	The conservation of linear momentum holds true in case of	Atomic physics
86)	The ballistics missiles are used only for	Short range
87)	The collisions between atomic particles, nuclear particles and fundamental particles are	Truly elastic collision
88)	A 5kg mass is falling freely, the force acting on, it will be	Zero
89)	Dimension of momentum is similar to that of	Impulse
90)	The vertical height and horizontal range will be equal, if angle of projection is	76^0
91)	If the line of action of force F passes through the origin. The torque is	Zero
92)	In rotational motion the analogue of force is	Torque

Chapter 7 Oscillation

93)	When a particle execute repeated movement about a mean position, it is	Harmonic motion
94)	If a motion is repeated at regular intervals, it is called	Periodic motion
95)	The number of vibration completed by a body in one second is called	Frequency
96)	The unit of frequency is	Hertz / 1Hz / $1cs^{-1}$ / cps
97)	The number of revolution per second of a body is called	Angular frequency ($\omega = 2\pi f$)
98)	In S.H.M the negative sign shows that both acceleration and displacement are	Oppositely directed
99)	Length of string + length of radius of metallic bob =	Length of simple pendulum
100)	The longer the pendulum the greater will be its	Time period
101)	The time period of simple pendulum is independent to the	Mass of the bob
102)	At extreme position K.E is	Zero
103)	At mean position K.E is	Maximum
104)	At extreme position the P.E is	Maximum
105)	At mean position the P.E is	Zero
106)	Law of conservation of energy is conserved in case of	S.H.M
107)	The angle θ= ωt which specifies the displacement x as well as the direction of the motion of the point oscillating S.H.M is called	Phase
108)	Oscillations where amplitude becomes smaller and smaller with time are called	Damped oscillations
109)	If the length of simple pendulum becomes fore times, its time period will become	Two times
110)	To find time period of simple pendulum we keep amplitude	Small
111)	Time period of simple pendulum is one second its length is	0.25 m
112)	When the length of simple pendulum is increased four times, the frequency of its oscillation will	Half
113)	If the length of simple pendulum is halved and mass is doubled then its time period	Decreased by 4
114)	Elastic collision involves	No gain no loss of energy
115)	If tunnel is bored through center of earth and stone is dropped it will	Simple harmonic motion
116)	The SI unit of spring constant (k) is identical to	Surface tension

Chapter 12 Current Electricity

117)	High voltage of power stations in Pakistan is	5 x 10^5 volts

118)	In Pakistan, in homes the electricity has been transformed to	220 volts
119)	The electric eel is an electric shock which generate electrical shocks of	600 volts
120)	The continuous flow of electrons is called	Steady current
121)	When electric field or voltage is applied to conductors the electrons moves	Towards the positive terminals
122)	The directed flow of free electrons is called	Electric current
123)	An electric current is	Matter in motion
124)	The actual direction of current is from	Negative terminal to positive
125)	Flow of current from positive to negative terminal of the cell via the circuit	Conventional current
126)	Those substances which have free electrons and permit current flow easily	Conductors
127)	In metals moving charges are always	Electrons
128)	In gases the moving charges are	Negative and positive ions
129)	In semiconductors the moving charges are	Electrons and vacancies or holes
130)	The net charge flowing through per unit area is called	Current ● I=Q/t
131)	The unit of current is Coulomb/second or	ampere(A)
132)	Current is scalar quantity as it does not follow	Vector law of addition
133)	The average speed of electron is	10^5 m s^{-1}
134)	The drift velocity of the free electron is	10^{-5} m s^{-1}
135)	Due to random motion of all free electrons there is no net flow of charges	In particular direction
136)	The electrons experience a force in a direction	Opposite to electric field
137)	The average velocity in which free electrons get drifted in a metallic conductor under the influence of electric field is called	Drift velocity
138)	Propagation of electric field takes place with the	Speed of light
139)	Electroencephalography(EEG) is a neurological test for	brain
140)	EEG measures the voltage fluctuation from ionic current flows through the	Neurons of brain
141)	The most important basic law of electricity is	Ohm's law
142)	The relation between V, I and R was first discovered by German scientist George Simon Ohm in 1826 in	D.C current
143)	The magnitude of the current in metals is proportional to the applied	Voltage ● T= constant
144)	Dimension depends upon nature, dimension and physical state of	Conductor
145)	For conductors that obey ohm's law, a graph of I and V is	Straight line passes through origin
146)	The slope of line for ohmic conductor is	Tan θ = I/V = I/R
147)	The ohm law is not valid for all	Conducting materials
148)	Those materials which do not follow ohm law are called	non-ohmic materials
149)	Filament bulb, thermistor and semiconductor diode are	non-ohmic materials
150)	The slope decrease for increase of voltage for	Filament bulb
151)	Resistance decrease sharply as temperature rises for	Thermistor
152)	The I-v graph of semiconductor diode shows that it also	Non-linear graph
153)	In semiconductor diode the current passes when the voltage is applied in one direction but when it act in opposite direction the current is almost	Zero
154)	A given change V causes smaller change in I at larger value of V	Filament bulb
155)	A given change V causes larger change in I at larger value of V	Diode / Thermistor
156)	Resistance is opposition offered by the substances to the flow of	Free electrons
157)	Resistance is electric friction to electron flow & with flow of current causes	Production of heat
158)	The SI unit of resistance of resistance is ohm and represented by symbol	**Ω** (omega) ● 1Ω =

		1V/1A
159)	Larger the length of wire, larger will be the	Resistance ● $R \propto L$
160)	Thicker wires have less resistance per meter and will cause	Less energy loss ● $R \propto 1/A$
161)	Resistance is directly proportional to the	Temperature
162)	Resistance is given by a formula as	$R = \rho L/A$
163)	The unit of resistivity(ρ) is	Ω.m ● $R = \rho L/A \rightarrow \rho = RA/L$
164)	The resistivity of some metals:	

Metals	Resistivity	Metals	Resistivity
Brass	0.06-0.09	**I**ron	0.1
Silver	0.163	**T**in	0.114
Copper	0.178	**L** ad	0.219
Aluminium	0.285		

165)	The resistivity of metals and alloys are very Small, so these are	Good conductors
166)	The reciprocal of resistance of conductor is called	Conductance (G) ● $G=1/R$
167)	The SI unit of conductance is	mho and Simon(S)
168)	The reciprocal of resistivity of conductor is called	Conductivity (σ)
169)	If a conductor has resistivity ($\rho = RA/L$), then its conductivity is	$\sigma = 1/\rho \rightarrow L/RA$
170)	The SI unit of conductivity is Mho m^{-1} or $S.m^{-1}$	●$\sigma = L/RA$
171)	With increase in temperature, the resistance of pure metal	Increases
172)	With increase in temperature, the resistance of electrolytes, insulators &	Semiconductor Decreases
173)	The increase in resistance is directly proportional to the	Initial resistance & temperature rise
174)	$R_T - R_o = \alpha R_o T$, Here α is constant and called	Temperature co-efficient of resistance
175)	Temperature co-efficient of resistance depends upon nature of material &	Temperature
176)	Increase in resistance per ohm original resistance per degree rise in temperature is called Temperature co-efficient of resistance which are as	$\alpha = R_T - R_o / R_o T$
177)	The SI unit of Temperature co-efficient of resistance(α) is	K^{-1} ●$\alpha = R_T - R_o / R_o T$
178)	The resistance of metals rise with rise in temperature, they have	Positive value of α
179)	The resistance of semiconductors fall with rise in temperature, they have	Negative value of α
180)	Equation for Temperature co-efficient of resistivity is	$\alpha = \rho_T - \rho_o / \rho_o T$
181)	Frictional change in resistivity per kelvin is called	Temperature co-efficient of resistivity (α)
182)	The resistivity of metals rise with rise in temperature, they have	Positive value of α
183)	The resistivity of semiconductors fall with rise in temperature, they have	Negative value of α
184)	High stability and high accuracy resistors are always	Wire wound
185)	Wire wound is enclosed in	Insulator
186)	Nickel chromium is used in Wire wound because of its small value of	Temperature co-efficient of resistance (α)
187)	Wire wound resistors can safely operate at higher temperature than	Carbon type resistors
188)	In Rheostats, adjusting the resistance in the circuit control the	Current in the circuit
189)	A potential divider provides a convenient way to getting a	Variable P.D from fixed P.D
190)	$v_{BC} = R_{BC}\, v/R$, the value of friction R_{BC}/R can be	Varied from 0-1
191)	A resistor made of semiconductors having resistance that varies rapidly and predictably with temperature is known as	Thermistor

192)	A thermistor is short form of	Thermal resistor
193)	The temperature co-efficient of a thermistor is	Very high
194)	The resistance of thermistor changes very rapidly with change of	Temperature
195)	The temperature co-efficient of thermistor can be	Both positive and negative
196)	Thermistor are made from semiconductor oxides of	Iron, nickel and cobalt
197)	Semiconductors in thermistor are in form of	Disks or rods
198)	Platinum pairs leads are attached at the two ends for electrical connection	In thermistors
199)	The arrangement of thermistor are enclosed by	Glass bulb and sealed
200)	A thermistor with negative temperature co-efficient of resistance may be used as alarms and to safeguard against	Current surges in a current
201)	If thermistor are used in series with heaters of the radio valves are	Harmful
202)	Device which converts non-electrical energy to electrical energy	Electromotive force (emf)
203)	emf of a source is equal to the work done in carrying one coulomb of charge through the source	$\varepsilon = W/q$
204)	The potential at the ends of the battery when circuit is open is called	Electromotive force (emf)
205)	the unit of the emf is the	J/C or volt [1] ● $\varepsilon = W/q$
206)	The influence that makes current flow from lower to higher potential	Emf
207)	The chemical energy is converted to electrical energy by	Batteries
208)	The mechanical energy is converted to electrical energy by	Electrical generators
209)	The heat energy is converted to electrical energy by	Thermocouples
210)	The sunlight energy is converted to electrical energy by	Radiant or solar cell
211)	If the cell is delivering no current then P.D across the terminal =	e.m.f (ε)
212)	When some load resistance are connected the terminal voltage available will	Less than emf ● $V_t = \varepsilon - Ir$
213)	The rate at which work is done is an electric circuit is called	Electric power ● ($p = w/t$)
214)	The work done in moving the charge in unit time is also called	Electric power
215)	$p = w/t \rightarrow p=VQ/t \rightarrow p= VIt/t \rightarrow p =VI$ <table><tr><td></td><td>p = w/t → W=pt</td><td></td></tr><tr><td>P = VI</td><td>W=VIt</td><td>I=P/V</td></tr><tr><td>P = I² R</td><td>W= I² R t</td><td>I=∫P/R</td></tr><tr><td>P = V² /R</td><td>W= V² t/R</td><td>V=∫PR</td></tr></table>	
216)	The SI unit of power is watt	1 Watt = 1V x 1A ● P=VI
217)	One commercial unit of electrical energy is	One kilowatt-hour
218)	1kWh =	3.6×10^6 J ● 1J = 1W x 1s
219)	If the load resistance is less or greater than the source resistance, then the power delivered to the load will be	Minimum
220)	When internal resistance of a source of the emf = load resistance then power is	Maximum
221)	When internal resistance of a source of the emf = load resistance then power is	
222)	When internal resistance of a source of the emf = load resistance then power is maximum	Maximum power transfer theorm
223)	The value of maximum power output is	$(P_{out})_{max} = \varepsilon^2/4r$ or $P= \varepsilon^2/4R$
224)	Thomas Seebeck find relation between heat and electricity in 1821, is called	Seebeck Effect
225)	The emf generated in thermocouples or Seebeck effect is called	Thermoelectric emf
226)	The resulting emf in Seebeck effect is called	Thermoelectric current
227)	The two junction circuit is called	Thermocouple

228)	In thermocouple the heat is directly converted into	Electricity
229)	Thermocouples are widely used as	Temperature sensors
230)	The Seebeck effect is	Reversible
231)	The thermo-emf in Seebeck effect s very small, of the order of	mV per every degree of temperature difference
232)	The greater separation of the metals forming the couples in the series, the emf	Produced is greater
233)	In thermocouples, when the cold junction is at 0 c the temperature dependence is given by	$\varepsilon = \alpha T + \frac{1}{2}\ \beta T^2$
234)	The thermoelectric coefficient (α and β) depends on	Nature of medium
235)	The thermo emf increase with temperature and become maximum at certain temperature called	Neutral temperature (T_n)
236)	In thermoelectric emf, when both junction are at same temperature, there is	No emf
237)	The value of neutral temperature is constant for a thermocouple, depends on nature	Of material
238)	The value of neutral temperature is independent of the	Temperature of cold junction
239)	The particular temperature at which the thermo emf becomes zero is called	Inversion temperature
240)	Resistance thermometers are also called	Resistance temperature detectors(RTDs)
241)	Common RTD has unique and repeatable and predictable Resistance vs	temperature relationship
242)	Amount of resistance change of the sensor per degree of temperature change	R vs T relationship
243)	The best metal for RTD is	Platinum
244)	Platinum is best for RTD because of linear temperature resistance relationship &	Highly repeatable manner
245)	The platinum is temperature standard for over range of	-185^{o} C to 630^{o} C
246)	RTSs are slowly replacing thermocouples in industries below	600^{o} C
247)	When more than one emf and resistors are connected in complicated manner	Complex circuits
248)	In order to solve complex circuits, German physics Gustar Robert Kirchoff's (1824-1887) gaves two laws known as	Kirchoff's law
249)	Algebraic sum of all currents meeting at a junction in an electrical circuit is zero	Kirchoff's current law (KCL)
250)	Signs of current flowing toward the junction are taken as	Positive
251)	Signs of current flowing away the junction are taken as	Negative
252)	Sum of incoming current= sum of outgoing current	Kirchoff's current law (KCL)
253)	Kirchoff's current law (KCL) is based on and according to	Law of conservation of charge
254)	In any closed electrical circuit, the algebraic sum of all electromotive forces and voltage drops is equal to zero	Kirchoff's voltage law (KVL)
255)	Algebraic sum of emf + algebraic sum of voltage drops = 0	Kirchoff's voltage law (KVL)
256)	In Kirchoff's voltage law (KVL),A rise in potential is taken as	Positive
257)	In Kirchoff's voltage law (KVL),A drop in potential is taken as	Negative
258)	In Kirchoff's voltage law (KVL),For batteries, the positive end is always at	Higher potential
259)	In Kirchoff's voltage law (KVL),Current flows from	Higher to lower potential
260)	In Kirchoff's voltage law (KVL),Direction of current can be	Clock or anti-clock
261)	Kirchoff's voltage law (KVL) is a statement of	Law of conservation of energy
262)	Sum of all emf = sum of all IR voltage drops	Kirchoff's voltage law (KVL)

263)	In Kirchoff's voltage law (KVL), if wrong direction is chosen, it will be indicated by	Negative sign in result
264)	An instrument used to measure an unknown resistance	Wheatstone bridge
265)	In Wheatstone bridge, the point at which the bridge is balanced is called	Null point
266)	In Wheatstone bridge the value of resistance is varied until galvanometer shows	Zero result
267)	The principal of determining unknown resistance by Wheatstone bridge is	X=RQ/P
268)	A potentiometer is null type resistance network for measuring	Potential difference
269)	An unknown e.m.f or P.D is measured by balancing it , wholly or in part, against a known	Potential difference
270)	For the accurate measurement of potential difference, current and resistance	Potentiometer is useful instruments
271)	Small emf measurement, comparison, high emf measurement, resistance and current measurement, and calibration of ammeter and voltmeter	Applications of potentiometer
272)	Potentiometer	$E_2 = I_2 / I_1 \times \varepsilon_1$
273)	Potentiometer measure small emf up to	2V
274)	Potentiometer measure high emf up to	250V

Chapter No.1 Measurements

Units System

1. The area of a book having length 1m and breadth 0.5m, in cm^3 is given by; **ETEA-2019**
a) 5000 b) 5
C) 500 d) 50

2. Which one of the following physical quantity does not have dimension of force per unit area?
a) Stress b) strain
c) young modulus d) pressure

3. Which expression using SI base units is equivalent to the volt; ETEA 2018-Med
a. kg m^2 s^{-1} A^{-1} b.kg m s^{-2} A
c. kg m^{-2} s^{-1} A d. kg m^2 s^{-3} A^{-1}

4. What is the circumfrence of the circle whos area is 100π ETEA 2018-Eng
a. 10π b. 20π
c. 10 d.290

5. The force of one Newton per meter square is equal to one. 2005 Med:
(a) Bar (b) Atm
(c) Pascal (d) Erg.

6. Which of following is unit of Pressure? ETEA ETEA 2013 Med:
(a) Kg m s^{-1} (b) Kg m^{-1} s^{-2}
(c) Kg m^2 s^{-2} (d) Kg m^{-2} s^{-1}

7. If p is a pressure and δ is a density then p/δha units of: ETEA 2016 Med
(a) m^2/s^2 (b) N/m^2
(c) Kg/m^2 (d) m^3/Kg

8. The unit of planks constant is same is that of: ETEA 2017-med
a. angular momentum b. work
c. force d. torque

9. An alternate unit to $kgms_{-1}$ is **NUMS-2017**
N
Nm_2
Nm
Ns

10. which quantity can be described in terms of only two base quantities? **FMDC 2012**
a. Current
b. Charge
c. force
d. temperature

11. **An alternate unit to kgms-1 is** **FMDC 2015**
a) N
b) Nm2
c) Nm
d) Ns

12. Force in terms of base units is expressed as? **MDCAT - 2018**
a. Kg ms^{-2}
b. Kg m^{-1} s^{-2}
c. Kg ms^{-1}
d. Kg^{-1} ms^{-2}

13. Light year is a measure of **MDCAT - 2018**
a. Velocity
b. Distance
c. Time
d. Speed

14. 1 radian is equal to: **MDCAT - 2020**
a. 57.1°
b. 57.2
C. 57.3"
d. 57.4°

15. One complete circle is equal to **NUMS-2020**
a) 2 radian
b) 3 radian
c) 5 radian
d) 6 radian

16. Radian is the SI unit of
A) plane angle
B) solid angle
C) both plane angle and solid angle
D) neither plane angle nor solid angle

17. Which expression using SI base units is equivalent to the volt;
a. kg m^2 s^{-1} A^{-1} b.kg m s^{-2} A
c. kg m^{-2} s^{-1} A d. kg m^2 s^{-3} A^{-1}

18. What is the circumfrence of the circle whose area is 100π :
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19. The force of one Newton per meter square is equal to one.
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20. Which of following is unit of Pressure?
a) Kg m s^{-1} b) Kg m^{-1} s^{-2}
c) Kg m^2 s^{-2} d) Kg m^{-2} s^{-1}

21. If p is a pressure and δ is a density then p/δha units of:
a) m^2/s^2 b) N/m^2 c) Kg/m^2 d) m^3/Kg

22. Which of the following is closest to a yard:
a) 0.01 m b) 0.1 m c) 1 m d) 100 m

23. A student measure current as 0.5A. which of the following correctly expresses the result:
a. 50Ma b. 50MA
c.500mA d. 500MA

24. The fundamental quantities which form the base MKS system?
a) Mass, energy, and time
b) mass, force, and time
c) mass, length, and time
d) Force, length, and time

25. The Set of supplementary units are:
a) Radian and kilometre
b) Radian and Steradian
c) Steradian and mole
d) Meter and kilometre

26. Three base units in S.I. units are:
a) Kilogram, Newton and second
b) Gram, centimeter and dyne
c) Kilogram, meter and second
d) Gram, Joule and second

27. The unit of force is________ and its symbol is _______ which is the correct pair?
a) Newton, n b) Newton, N
c) newton, n d) newton, N

28. Which of the following is a unit of pressure?
a. Kg ms^{-1} b. $Kgm^{-1}s^{-2}$
c. Kgm^2s^{-2} d. $Kgm^{-2}s^{-1}$

29. The energy of a photon of light of frequency is given by hf, where h is the Planck constant. what are the base units of h?
a. Kg ms^{-1} b. Kgm^2s^{-1}
c. Kgm^2s^{-2} d. $Kgm^{-2}s^{-3}$

30. Which of the following pairs of units are both Si base units?
a. Ampere, degree Celsius
b. Ampere , kelvin
c. Coulomb, degree Celsius
d. Coulomb, kelvin

31. Which of the following could be measured in the same units as force?
a. Energy/distance b. Energy x distance
c. Energy/time
d. Momentum x distance

32. Which one of the following shows only unit of length:
a) A°, kg, gm b) A°, km , m
c) m, m^3. s d) Gm, m^2, deci-m

33. Which of the following do not have the unit of energy?
a) force x distance
b) couple x angle turned through
c) impulse x time
d) moment of inertia x (angular velocity)"

34. The pair of physical quantities not having the same units is:
a) Planck's constant, Angular Momentum
b) spring constant, tension
c) Pressure, Young's Modulus
d) Frequency, decay constant

35. In SI system a set of supplementary units contains:
a) 7 units b) 2 units
C) many units d) 3 units

36. Light year is the unit of:
a) Light c) Time
b) Velocity d) Distance

37. Jm^{-1} is a possible unit for:
a) Momentum c) power
b) force d) work

38. If velocity (v), Force (F) and energy (E) are taken as fundamental units then formula for mass will be:
a) $v^{-2}F^{o}E$ b) V^0FE^2
c) $vF^{-2}E^0$ d) $v^{-2}F^0E^{-2}$

39. What are the S.1 units of "k" An that the equator,* velocity ••-• it x density is correct.
a) $kg^{-1}m^4s^{-1}$ b) kg m^4s^{-1}
c) kg ms d) kg ms^{-1}

40. Which of the following has not been expressed in suitable units?
a) Potential energy → kg ms^{-1}
b) Surface tension → N m^{-1}
c) Stress → N m^{-2}
d) Resistance → kg m^2 $A^{-2}s^3$

41. The base unit of Planck's constant are the same as:
a) electrostatic energy
b) angular Momentum
c) kinetic energy
d) linear Momentum

42. Which of the following quantities have same units:
a) Stress, strain b) Force, Momentum
c) Momentum, impulse d) Mass, weight

43. If L = inductance R = Resistance C = Capacitance and V = Potential difference then unit of RCV/L is same that of:
a) Current b) Charge
c) $(current)^{-1}$ d) $(charge)^{-1}$

44. All are the units of time except:
a) Light year b) Solar day
c) Decade d) Lunar year

45. The ratio of units of power and pressure give the measurement of:
a) Cross sectional area
b) Rate of change in Momentum
c) Volume flow per second
d) none of these

46. Which of the following is not the name of a

physical quantity?
a) Time b) Impulse
c) Mass d) Kilogram

47. Which of the following statements is wrong?
a) Unit of co-efficient of viscosity is poise
b) Work and energy have same units
c) Unit of kinetic energy is newton meter
d) Unit of surface tension is newton meter

48. Which of the following is a derived unit;
a) Unit of mass b) Unit of length
c) Unit of volume d) Unit of time

49. If u_1 and u_2 are the units selected in two systems of measurement and n_1 and n_2 are their numerical values, respectively, then
a) $N_1u_1 = n_2u_2$ b) $N_1u_1 + n_2u_2 = 0$
c) $N_1u_1 = u_1u_2$ d) $(n_1+u_1) = (n_2 + u_2)$

50. In the equation $v = at - \frac{b}{c^2+t}$, unit of "c" is:
a) S b) $S^{1/2}$
c) S^2 d) Ms^{-1}

51. In given equation $f = \frac{1}{2l}\sqrt{\frac{F}{m}}$, fundamental frequency of stretched string, the unit of 'm' is:
a) Kgm^{-1} b) $Kgm^{-1}s$
c) $Kgms^{-1}$ d) No units

52. Which of the following is not a unit of time:
a) Leap year b) Lunar month
c) Light year d) Micro-second

53. If $y = a + bt + ct^2$, where y is in meter and "t" is in second, the unit of 'b' is:
a) M b) Ms^{-1}
c) S^{-2} d) Ms^{-2}

54. In equation $\left(P + \frac{a}{v^2}\right)$(v- b) = RT the SI unit of "a":
a) Nm b) Nm^{-3}
c) $N\,m^{-4}$ d) $N\,m^{-2}$

55. A physical quantity 'X' is represented as velocity = $\sqrt{\frac{x}{density}}$, the units of "X are:
a) $Kgms^{-1}$ b) Kgm^2s^{-2}
c) $Kgm^{-1}s^{-2}$ d) Kgm^2s^{-1}

56. If "h" is the height and 'g' is the acceleration due to gravity, then the unit of $\sqrt{\frac{2h}{g}}$ is the same as that of:
a) Time b) Mass
c) Volume d) Velocity

57. Which of the following pairs of unit are both SI base units?
a) Ampere, degree Celsius
b) Coulomb, degree Celsius
c) Ampere, kelvin
d) Coulomb, kelvin

58. If "P" is the Momentum of an object and 'm' is the mass then expression $\frac{P^2}{2m}$ has base unit identical to:
a) Energy b) Power
c) Force d) Velocity

59. $N\,kg^{-1}$ is the unit of:
a) Velocity b) Acceleration
c) Momentum d) Angular Momentum

60. Which of the following relation is incorrect?
a) $T = \frac{x}{v}$ b) $V = \frac{a}{t}$
c) $A = \frac{v^2}{x}$ d) $T^2 = \frac{2x}{a}$

61. The unit of amphere-volt is equal to:
a) power b) energy
c) current d) quantity of electricity

62. Which of the following is unitless quantity?
a) $\frac{momentum}{acceleration}$ b) $\frac{volume}{area}$
C) $\frac{energy}{work}$ d) $\frac{power}{forec}$

63. Which of the following is not a unit of energy?
a) Kilo watt b) Election volt
c) Joule d) Kilo watt-hour

64. Which of the following quantity has been expressed in proper S.I base units?
a) $\frac{stress}{strain}$= newton meter^{-2}
b) Energy = g ms^{-2}
c) Force = $kgms^{-2}$
d) Pressure = newton meter $^{-1}$

65. What is the unit of gravitational constant?
a) $Nm^2\,kg^2$ b) $kg^{-1}m^3\,s^{-2}$
c) $kgm^{-1}\,s^{-3}$ d) $j\,kg^{-1}$

66. Which of the following is a unit of energy?
a) Pascal b) Watt x day
c) Newton d) Newton/meter

67. One thousand microns is equal to:
a) 10^{-3} m b) 10^{-6}m
c) 10^{-9}m d) 10^{-12}m

68. In the equation $x = x_o$ sin omega t the unit of 'w' is:
a) Rad b) Rad s^{-2}
c) Hz d) Rad s^{-1}

69. The base unit of $\sqrt{LC}$ will be:
a) Ms^{-1} b) M^{-1}
c) S d) S^{-1}

70. Unit of permittivity 'E_o' is:
a) Farad b) Farad m
c) $\frac{farad}{m}$ d) Amphere m^{-2}

71. $\frac{energy}{Massx\ Length}$ is equal to:
a) acceleration b) force
c) Power d) Work

72. Which of the following pair has same units.

a) Year and wavelength
b) Momentum and force
c) Energy density and young's modulus
d) Force and pressure

73. Which physical quantity is measured in meter
a) Light year b) Diameter
c) Breadth d) All of these

74. Which of the following quantity is not expressed in proper units
a) Young's modulus = Nm^{-2}
b) Surface tension = Nm^{-1}
c) Pressure = Nm^{-2}
d) Energy = kg m/s

75. A radio aerial of length "L", when the current "I", emits a signal of wavelength "λ" and power "P". these quantities are related by P = $kI^2\left[\frac{L}{\lambda}\right]$ where "k" is a constant. what unit if any, should be used for the constant 'k":
a) Volt b) Watt
c) Ohm d) No unit

76. How many femto seconds are there is one millisecond?
a) 10^9 b) 10^{15}
c) 10^{-15} d) 10^{12}

77. Which of the following is unit less? Letter have usual meanings:
a) $\frac{v^2}{rg}$ b) $\frac{v^2g}{r}$
c) $\frac{v^2r}{g}$ d) V^2rg

78. The unit of $\sqrt{\frac{energy}{mass}}$ is the same as that of
a) Mass b) Time
c) Length d) Velocity

79. An example of derived unit is
a) Candela b) Ampere
c) Coulomb d) Mole

80. Which is not equal to the time:
a) Frequency
b) Resistance x capacitance
c) Inductance ÷ resistance
d) All of these

81. Which of the following quantities have the same units
a) Frequency and decay constant
b) Force and mass
c) Acceleration and displacement
d) Impulse and force

82. The si unit of electric field strength is:
a) Newton $(coulomb)^{-1}$ b) Volt $(coulomb)^{-1}$
c) Newton $(amphere)^{-1}$ d) Joule $(coulomb)^{-1}$

83. A watt is defined as
a) volt x ampere b) Volt x $(ampere)^2$
c) Coulomb x volt d) Ampere x ohm

84. Density of liquid is 15.7 g cm^{-3}. Its value in the international system of Unit is:
a) $15.7kgm^{-3}$ b) $1570kgm^{-3}$
c) 157 kgm^{-3} d) 15700 kgm^{-3}

85. Let "L" denote the self inductance of a coil which is in series with a capacitor of capacitance "C" which of the following has the unit second
a) $\sqrt{LV}$ b) CL
c) C/L d) L^2/C^2

86. The SI unit of luminous intensity is
a) Watt b) Lux
c) Lumen d) Candela

87. In the equation $N = N_0e^{xt}$ the unit of 'λ" are same as unit of
a) Mass b) Angular frequency
c) Time period d) Torque

88. The Si units of $\frac{mg}{\eta r}$ is same as that of:
a) mass b) Length
c) Velocity d) Acceleration

89. 1 cm^3=
a) 0.01 m^3 b) 0.001 m^3
c) 1000 mm^3 d) 100 dm^3

90. Which of the following set contains base and derived units?
a) radian & kilogram b) mole & kilogram
c) kelvin & time d) ampere & coulomb

91. Out of the following pairs which one does not have same unit?
a) Angular Momentum, plank's constant
b) Impulse and Momentum
c) Work and energy
d) Pressure and kinetic energy

92. Which of the following does not have same units?
a) Electric field, electric flux
b) Pressure, young's modulus
c) Electromotive force, potential difference
d) Heat , potential energy

93. The unit of B2/1.to :
a) kgm^2s^{-2} b) $kgm^{-1}s^{-2}$
c) $kgm^{-I}s^{-1}$ d) $kgm^{-1}s^{-2}$

94. Which of the following is not a derived unit?
a) joule b) erg
c) dyne d) mole

95. Which of the writing units?
a) 25 μμ m b) 30 Kg
c) 5 Newton d) ION

96. What is the unit of "k" in the relation U = $\frac{ky}{y^2+a^2}$ where "U" represents the potential energy, "y" represents the displacement and "a" represents the maximum displacement i.e., amplitude?

a) m s^{-1} b) Nm^2C^{-2}
c) J m d) J s^{-1}

97. Unit of permittivity "E_o" is:
a) Nm^{-2} kg^2 b) Nm^2C^{-2}
c) $N^{-1}m^{-2}kg^2$ d) $N^{-1}m^{-2}C^2$

98. The velocity of a particle is given by $v = a + \frac{b}{t} + cr^2$. The unit of b will be:
a) m b) sr^{-1}
c) m s^2 d) m S^{-2}

99. The quantity X = m c^2 has the same units as that of:
a) Momentum b) work
c) Impulse d) moment of inertia

100. Slug is the unit of:
a) length b) time
c) mass d) foot

101. Which one of the following is not the name of physical quantity?
a) Density b) candela
c) Energy d) Impulse

102. Which one of the following is not a unit of length?
a) Angstrom b) Micron
c) Radian d) Light year

103. *Light year is a unit of*
a) Time
b. Mass
c. Distance
d. Energy

104. *The magnitude of any physical quantity*
a) Depends on the method of measurement
b. Does not depend on the method of measurement
c. Is more in SI system than in CGS system
d. Directly proportional to the fundamental units of mass, length and time

105. *One nanometer is equal to*
a) $10^9 mm$
b) 10^{-6} *cm*
c) 10^{-7} *cm*
d) 10^{-9} *cm*

106. *A micron is related to centimeter as*
a) $1\ micron = 10^{-8} cm$
b) $1\ micron = 10^{-6} cm$
c) $1\ micron = 10^{-5} cm$
d) $1\ micron = 10^{-4} cm$

107. *In S = a + bt + ct*^{2}. *S is measured in metres and t in seconds. The unit of c is*
a) None
b) M
c) Ms^{-1}
d) Ms^{-2}

108. *A cube has numerically equal volume and surface area. The volume of such a cube is*
a) 216 units
b) 1000 units
c) 2000 units
d) 3000 units

109. *Wavelength of ray of light is 0.00006m. it is equal to*
a) 6 microns
b) 60 microns
c) 600 microns
d) 0.6 microns

110. *Temperature can be expressed as a derived quantity in terms of any of the following.*
a) Length and mass
b) Mass and time
c) Length, mass and time
d) None of these

111. *The velocity of a particle depends upon a* $v = a + bt + ct^2$; *if the velocity is in m/ sec, the unit of a will be*
a) m / sec
b) m/sec^2
c) m^2/sec
d) m/sec^3

112. *If* u_1 *and* u_2 *are the units selected in two systems of measurement and* n_1 *and* n_2 *their numerical values, then*
a) $n_1u_1 = n_2u_2$
b) $n_1u_1 + n_2u_2 = 0$
c) $n_1n_2 = u_1u_2$
d) $(n_1 + u_1) = (n_2 + u_2)$

113. *If x = at +* bt^2, *where x is the distance travelled by the body in kilometres while t is the time in seconds, then the units of b are*
a) km/s
b) km-s
c) km/s^2
d) $km\text{-}s^2$

114. *The equation* $\left(P + \frac{a}{V^2}\right)(V - b)$ *constant. The unit of a are*
a) Dyne x cm^5
b) Dyne x cm^4
c) Dyne x cm^3
d) $Dyne/cm^2$

115. *Which of the following is not a unit of time*
a) Leap year
b) Micro second
c) Lunar month
d) Light year

Errors and uncertainity

116. An observer notes reading of scale from different angle (parallax) while measuring the length of wire, what type of error is possible: **MDCAT - 2017**
a. systematic error
b. zero error

c. précised error
d. random error

117. The measurement of physical quantity may be subject to random errors and to systematic errors. Which statement is correct? ETEA 2015 Eng:
(a) Random errors are always caused by the person taking the measurement.
(b) A systematic error cannot be reduced
(c) Random errors can be reduced by taking the average of several measurements
(d) A systematic error results in a different reading each time the measurement is taken.

118. The maximum error in measurement of mass and length of the sides of the cube are 3% and 2% respectively. The maximum error in the measurement of its density is ETEA 2017-Eng
a. 3% b. 5%
c. 6% d. 9%

119. In simple electrical circuit the current in a resistor is measured as 2.50+0.05mA. the resistor is marked as having a value of $4.7\pm2\%$. if these values where used to calculate the power dissipated in the percentage uncertainty in the value obtained ETEA 2017-Med
a. 2% b. 4% c. 6% d. 8%

120. The power loss in resistor is culates by formula $P=V^2/R$. the uncertaniuty in V s 3% and in R is 2%. Uncertainty in P is: ETEA 2018-MEd
a. 4% b. 7% c. 8% d. 11%

121. A quantity x is to be determined by the equation x=P-Q. P is measured as 1.27 ± 0.02 m and Q is measured as 0.83 ± 0.01m. what is percentage uncertainty in x to one significant figures; ETEA 2018-MEd
a. 0.04% b.2% c. 3% d. 7%

122. The quantity x is to be determined form the equation x = p-Q.nP is measured as (1.27+ 0.02)m and Q is measured as (0.03 + 0.01)m. What is the percentage uncertainty in x to one significant figure.
ETEA ETEA 2012-150 Eng:
(a) 4% (b) 2%
(c) 3% (d)7%

123. The density of the steel ball was determined by measuring the mass and diameter. The mass was measured with 1% and diameter 3% of the error. In the calculated density of the steel ball is at most.
ETEA 2009-61 Med:
(a) 2% (b) 4%
(c) 8% (d) 10%

124. The power loss, P in resistor is calculated using the formula $P = V^2/R$. The uncertainty in the potential difference V is 3% and the uncertainty in the resistance R is 2%, what is the uncertainty in P?
ETEA ETEA 2012-51 Eng:
(a) 4% (b) 7%
(c) 8% (d) 11%

125. The uncertainty recorded in the radius of a sphere is 1.6%. The uncertainty in the area of that sphere is;
ETEA ETEA 2012-61 Med:
(a) 4.8% (b) 3.2%
(c) 1.6% d) 0.8%

126. The percentage error in the measurement of mass and speed are 5% or 6% respectively the maximum error in the measurement of K.E is:
ETEA 2015-07 Med
A) 17% B) 30%
C) 15% D) 90%

127. Percentage un-certainly n length and width of a rectangle is 2% and 3%. The total un-certainly in area of the rectangle is? **MDCAT - 2019**
a. 1.5%
b. 5%
c. 6%
d. 1%

128. **The density of a steel ball was determined by measuring its mass and diameter. The mass was measured within 1% and the diameter with 3%. The error in the calculated density of the steel ball is at most:** **FMDC 2017**
a) 10%
b) 4%
c) 3%
d) 2%

129. Total uncertainty, in result obtained from the subtraction of two measurement, is equal to
A) sum of their absolute uncertainties
B) difference of their absolute uncertainties
C) product of their absolute uncertainties
D) division of their absolute uncertainties

130. The error in measurement may occur due to
A) inexperience of a person
B) the faulty apparatus
C) inappropriate method
D) due to all reasons in a, b and c

131. Which experimental technique reduces the systematic error of the quantity being investigated?
a) Adjusting an ammeter to remove its zero error before measuring a current
b) Measureing several intermodal distance on a standing wave to find the mean intermodal distance
c) Measureing the diameter of a wire repeatedly and calculating the average
d) Timing a large number of oscilations to find a period

132. Errors in measurement may be either systematic or random.
Which of the following involves random error?
a) Not allowing for zero error on a moving coil voltmeter
b) Not subtracting background count rate when determining the count rate from a radioactive source
c) Stopping a stopwatch at the end of a race
d) Using the value of g as 10 n kg^{-1} when calculating weight from mass.

133. The uncertainty in a measurement may occur due to
A) limitation of an instrument
B) natural variation of the object to be measured
C) inadequate of technique
D) all given in a , b and c

134. Random errors can be reduced by
A) taking zero correction
B) comparing the instrument with another more accurate one
C) taking mean of several measurement
D) all methods explained in a, b and c

135. Smaller the least count of the instrument more is the measurement
A) accurate B) precise
C) accurate and precise
D) none of these

136. Absolute uncertainty in a measurement depends upon
A) magnitude of the measurement
B) least count of the instrument
C) percentage error in the measurement
D) all of a, b and c

137. Zero error of the instrument is a type of
A) random error B) personal error
C)systematic error D)classified error

138. To reduce the uncertainty in the timing experiment
A) highly precise instrument
B) conduct at room temperature
C) count more number of vibration
D) both a and c

139. The measurement of physical quantity may be subject to random errors and to systematic errors. Which statement is correct?
a) Random errors are always caused by the person taking the measurement.
b) A systematic error cannot be reduced
c) Random errors can be reduced by taking the average of several measurements
d) A systematic error results in a different reading each time the measurement is taken.

140. The maximum error in measurement of mass and length of the sides of the cube are 3% and 2% respectively. The maximum error in the measurement of its density is;
a. 3% b. 5%
c. 6% d. 9%

141. In simple electrical circuit the current in a resistor is measured as 2.50+0.05mA. the resistor is marked as having a value of $4.7 \pm 2\%$. if these values where used to calculate the power dissipated in the percentage uncertainty in the value obtained
a. 2% b. 4%
c. 6% d. 8%

142. The power loss in resistor is culates by formula $P=V^2/R$. the uncertaniuty in V s 3% and in R is 2%. Uncertainty in P is:
a. 4% b. 7%
c. 8% d. 11%

143. A quantity x is to be determined by the equation x=P-Q. P is measured as 1.27 ± 0.02 m and Q is measured as 0.83 ± 0.01m. what is percentage uncertainty in x to one significant figures;
a. 0.04% b.2%
c. 3% d. 7%

144. The quantity x is to be determined form the equation x = p-Q.nP is measured as (1.27+ 0.02)m and Q is measured as (0.03 + 0.01)m. What is the percentage uncertainty in x to one significant figure.
a) 4% b) 2%
c) 3% (d)7%

145. The density of the steel ball was determined by measuring the mass and diameter. The mass was measured with 1% and diameter 3% of the error. In the calculated density of the steel ball is at most.
a) 2% b) 4%
c) 8% d) 10%

146. The power loss, P in resistor is calculated using the formula $P = V^2/R$. The uncertainty in the potential difference V is 3% and the uncertainty in the resistance R is 2%, what is the uncertainty in P?
a) 4% b) 7%
c) 8% d) 11%

147. The uncertainty recorded in the radius of a sphere is 1.6%. The uncertainty in the area of that sphere is;
a) 4.8% b) 3.2%
c) 1.6% d) 0.8%

148. The percentage error in the measurement of

mass and speed are 5% or 6% respectively the maximum error in the measurement of K.E is:
A) 17% B) 30%
C) 15% D) 90%

149. Two major types of errors are
a) significant error and random error
b) systematic error and random error
c) rounding error and significant error
(d)significant error and systematic error

150. Errors due incorrect design or caliberation of the measuring device are called
a) rounding error (b)systematic error
c) random error (d)significant error

151. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of kinetic energy obtained by measuring mass and speed
a) 11% b) 8%
c) 5% d) 1%

152. Given: resistance R_1 = (8 ± 0.4) Ω and resistance R_2 = (8 ± 0.6) Ω. What is the net resistance when R_1 and R_2 are connected in series?
a) (16 ± 0.4) Ω b) (16 ± 1.0) Ω
c) (16 ± 0.6) Ω d) (16 ± 0.2) Ω

153. The density of the material of a cube is measured by measuring its mass and length of the side. If the maximum errors in the measurement of mass and the length are 3% and 2% respectively, the maximum error in the measurement of density is:
a) 1% b) 7%
c) 5% d) 9%

154. Given: potential difference V = (8 ± 0.5) V and current, I = (2 ± 0.2) A. the value of resistance R is:
a) 4 ± 16.25% b) 4 ± 10%
c) 4 ± 6.25% d) 4 ± 8%

155. The lest count of a stop watch is 0.2 second. The time of 20 escillations of a pendulum is measured to be 25 second. The percentage error in the measurement of time will be.
a) 8% b) 1.8%
c) 0.8% d) 0.1%

156. In calculating the area of cross section 'A' of wire the total percentage uncertainly in the final result:
a) A = 2 x percentage uncertainly in radius
b) A = 2 x percentage uncertainly in diameter
c) A= 3 x percentage uncertainly in radius
d) Both a and b

157. In assessment of total uncertainty in the final result for timing experiment, uncertainty is inversely proportional to:
a) % uncertainty b) Least Count
c) No, of vibrations d) Stop watch

158. The initial temperature of a liquid is (80.0 ± 0.1)°C. After it has been cooled, its temperature is (10.0 ± 0.1)°C. The fall in temperature in degree centigrade is:
a) 70.0 ± 0.0 b) 70.0= 0.2
c) 70.0=0.3 d) 70.0 0.1

159. Which is correct record for the diameter of sure when measured by a screw gauge of least count 0.001 cm:
a) 2.3 cm b) 2.312 cm
c) 2.31 cm d) 2.3124 cm

160. Error in the measurement of radius of sphere is 2%. Then error in the measurement of volume is:
a) 1% b) 3%
c) 5% d) 6%

161. For total assessment of uncertainty in the final result obtained by multiplication and division:
a) Absolute uncertainties are added
b) Fractional uncertainties are added
c) %age uncertainties are added
d) both b) and c)

162. Two particles are located at x_1 = 10.5 ± 0.1 cm and x_2 = 26.8 ± 0.1 cm. the distance between them will be recorded as
a) 16.3 cm b) 16.3 ± 0.2 cm
c) 16.3 ± 0.1 cm d) 37.3 ± 0.01 cm

163. The mean time period of second's pendulum is 2.00 s and mean absolute error in the time period is 0.05s. the express maximum estimate of error, the time period should be written as:
a) (2.00 ± 0.01)s b) (2.00 + 0.025) s
c) (2.00 ± 0.05) s d) (2.00 ± 0.10) s

164. Depth of water in a bottle is 24.0 cm and uncertainty is 0.2 cm, percentage uncertainty in measurement of depth
a) 0.8% b) 1%
c) 9% d) 2%

165. The uncertainty record in the radius of a sphere is 1.6%. the uncertainty in the area of that sphere is:
a) 4.8% b) 3.2%
c) 1.6% d) 0.8%

166. For a well calibrated and standard instrument, which one of the following cannot occur during a measurement
a) Random error b) Systematic error
c) Personal error d) Unassigned error

167. If x = a^n. then relative error is (where n is power of "a")
a) $\frac{aa}{a} - N$ b) N $\frac{aa}{a}$
c) $\frac{aa}{a} + A$ d) $N^2 \frac{aa}{a}$

168. Poor calibration is the example of:

a) Personal error b) Systematic error
c) Random error d) Zero error

169. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. if the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value of resistance of the wire is:
a) 6% b) 0% c) 1% d) 3%

170. Error in the measurement of radius of a sphere is 1%. The error in the calculating the surface area of sphere is:
a) 2% b) 4% c) 3% d) 7%

171. The type of the systematic error is:
a) Personal error b) Instrumental error
c) Theoretical error d) All of these

172. If the pointer of the voltmeter is not exactly at the zero of the scale then the error in the voltmeter is said to be:
a) instrumental error b) systematic error
c) personal error d) random error

173. If radius of the sphere is (5.3 ± 0.1) cm. Then percentage error in its volume will be:
a) $3 + 6.01 \text{x} \frac{100}{5.3}$ b) $\frac{1}{3} \text{x } 100 \frac{100}{5.3}$
c) $\left(\frac{3x0.1}{5.3}\right) x\ 100$ d) $\frac{0.1}{5.3} \text{x } 100$

174. The error in a certain measurement occurs due to:
a) Faulty apparatus
b) In-appropriate method
c) negligence of person
d) All of these

175. The heat generated in a circuit is given by Q - Pm, where "I" is current. "R" is resistance and "t" is time. 111 the percentage error's in measuring I. R and t are 2%.1% and I% respectively then the maximum error in measuring heat will be:
a) 2% b) 4% c) 3% d) 6%

176. The pressure on a square plate is measured by measuring the force on the plate and the length of F the sides of the plate by using the formula P= $\frac{F}{L^{2-}}$. If the maximum errors in the measurement of force and length are 4% and 2% respectively, then the maximum errors in the measurement of pressure is:
a) 1% b) 8% c) 2% d) 10%

177. If the percentage errors of A, B and C are "a". "h" and "c" respectively then the total percentage error in the product ABC is:
a) abc b) $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$
c) a + b + c d) a + bc + ca

178. Choose the correct statement about base quantities:
a) All base quantities are independent of temperature
b) They are all scalar quantities
c) They can be measured by a single universal instrument
d) They are all immune to errors

179. The least count of a vernier calipers is 0.005 cm. the diameter of a wire is 0.020 cm as measured by it. the percentage error in measurement is
a) 25% b) 20%
c) 15% d) 5%

180. In an experiment four quantities a, b, c, and d are measured with percentage error 1%, 2%, 3% and 4% respectively. Quantity P is calculated as P = $\frac{a^3b^2}{cd}$% error in P is:
a) 14% b) 10%
c) 7% d) 4%

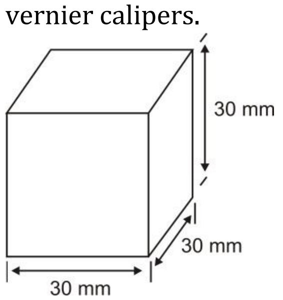
181. The resistance R = V/I where V = 100 $\pm$5 volts and I = 10 $\pm$0.2 amperes. What is the total number in R?
a) 5% b) 5.2%
c) 7% d) $\frac{5}{2}$%

182. Systematic errors can be removed by:
a) buying new instrument
b) Dusting the instrument
c) breaking the instrument
d) recalibrating the instrument

183. While measurement the acceleration due to gravity by a simple pendulum, a student makes a positive error of 1% in the length of the pendulum and a negative error of 3% in the value of time period. His percentage error in the measurement of g by the relation g = $4\pi^2$(t/T²) will be:
a) 2% b) 4%
c) 7% d) 10%

184. A body travels uniformly a distance of (10.0 $\pm$ 0.2) m in a time (4.0 $\pm$ 0.3) s. the percentage error in velocity of the body is:
a) 7.5% b) 5.7%
c) 12% d) 9.5%

185. The dimensions of a cube are measured with vernier calipers.



The measured length of each side is 30 mm. if the vernier calipers can be read with an uncertainly of $\pm$ 0.1 mm. what does this give for the approximate uncertainly in the value of its volume?

a) $\frac{1}{27}$% b) $\frac{3}{10}$%
c) $\frac{1}{3}$% d) 1%

186. The manufacturers of a digital voltmeter give, as its specification,
Accuracy $\pm$ 1% with an additional uncertainly of $\pm$ 10 mV. The meter reads 4.072 V.How should this reading be recorded, together with its uncertainly?

a) (4.07 + 0.01) V b) (4.07 + 0.04) V
c) (4.072 + 0.052) V d) (4.07 + 0.05) V

187. An instrument gives a numerical reading of 0.00160 $\pm$ 0.00005.
Which statement is correct?
a) The actual uncertainly is 5.
b) The fractional uncertainly is 5 x 10^{-5}
c) The fractional uncertainly is $\frac{5}{16}$
d) The percentage uncertainly is 3%

188. The resistance R of an unknown resistor is found by measuring the potential difference V across the resistor and the current / through it and using the equation R = $\frac{V}{I}$. The voltmeter reaching has a 3% uncertainly and the ammeter reading has a 2% uncertainly.
What is the uncertainly in the calculated resistance?

a) 1.5% b) 3%
c) 5% d) 6%

189. In an experiment to determine the acceleration of free fall g, the period of oscillation t and length l of a simple pendulum were measured. The uncertainly in the measurement of l was estimated to be 4% and that of T, 1%.
The value of g was determined using the formula
G = $\frac{4\pi^2 l}{T^2}$.
What is the uncertainly in the calculated value for g?

a) 2% b) 3%
c) 5% d) 6%

190. If the errors are uncertainties in the measurement of physical quantities due to instruments, mistakes made by the observer or faults in the surrounding conditions, then these errors are called as? **MDCAT - 2018**

a. Accuracy errors
b. Precession errors
c. Systematic errors
d. Random errors

191. The quantities which can be measured accurately are **MDCAT - 2017**

a. base quantities
b. physical quantities
c. derived quantities
d. supplementary quantities

Precision and Accuracy

192. A value for the acceleratiojn of free fall on earth is given (10+2) ms^2. Which statement is the most correct ETEA 2017-MEd

a. the value is accurate but not precise
b. the value is both accurate and precise
c. the value is neither precise nor accurate
d. the value is precise but not accurate

193. A student calculates the result of an experiment as 1.65, 1.72 and 1.89... But when he checks the answer, it comes out to be 2.35. What would it be called? **FMDC 2012**

A = No precision and no accuracy.
B = No precision but accurate.
C = No accuracy but precise.
D = Accurate and precise.

194. A precise measurement is one which has; ETEA ETEA 2010-85 Eng:

(a) Less uncertainty (b) Max precision
(c) Absolute precision (d) None of these

195. Three students measured length of a needle with meter rod and recorded as : (i) 0.2145m (ii) 0.21m (iii) 0.214m. Which one is correct record?

A)only (i) B)only (ii)
C)only (iii) D)both (i) and (ii)

196. A value for the acceleration of free fall on earth is given (10+2) ms². Which statement is the most correct

a. the value is accurate but not precise
b. the value is both accurate and precise
c. the value is neither precise nor accurate
d. the value is precise but not accurate

197. A precise measurement is one which has;

a) Less uncertainty b) Max precision
c) Absolute precision d) None of these

198. To reduce the uncertainly in the timing experiment:

a) Highly precise instrument
b) Count more number of vibration
c) Conduct at room temperature
d) Both A and C

199. Minimum length an instrument can measure is called its:

a) Accuracy b) Precision

c) Estimate d) Limitations

200. Measurement which is close to true value is
a) Accurate b) Precise
c) Average d) Error

201. Which of the following is most precise instruments?
a) meter rod b) screw guage
c) vernier calipers d) All of these

202. An accurate measurement is one which has less
a) precision
b) absolute uncertainty
c) fractional error
d) zero error

203. Smaller is the least count of the instrument more is the reading:
a) Accurate b) Accurate and Precise
c) Precise d) All of these

204. Precise measurement has:
a) No Uncertainty
b) Less absolute uncertainty
c) high absolute uncertainty
d) both a) & (B)

205. Precision is inversely related to:
a) % uncertainty b) Least Count
c) significant figures d) Fractional uncertainty

206. The time of 30 vibrations of a simple pendulum recorded by stopwatch accurate up to one tenth of a second is 60 seconds. The uncertainty in the time period may be:
a) 0.003s b) 0.03s
c) 0.3s d) 3.0s

207. Random errors can be reduced by
a) Taking zero correction
b) Comparing the instrument with another more accurate one
c) Taking mean of several measurement
d) All method explained in A, B and C

208. Accuracy is inversely related to:
a) % uncertainty b) Least Count
c) significant figures d) Absolute uncertainty

209. Instrumental error can be minimized by
a) taking large number of readings. b) using different accurate instrument for the same reading.
c) by zero correction of instrument.
d) Both b) and c)

210. A micrometer, reading to $\pm$ 0.01 mm, gives the following resuts when used to measure the diameter d of a uniform wire:
1.02 mm 1.02 mm 1.01 mm 1.02 mm 1.02 mm
When the wire is removed and the jaws are closed, a reading of -0.02 mm is obtained.
Which of the following gives the value of d with a precision appropriate to the micrometer?
a) 1.0 mm b) 1.00 mm
c) 1.038 mm d) 1.04 mm

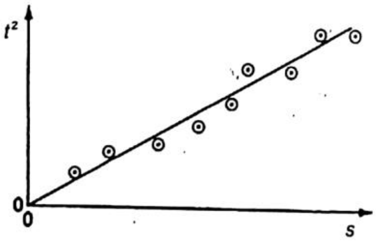
211. A student uses an analogue voltmeter to measure the potential difference across a lamp. The voltmeter is marked every 0.02 V but has a zero error of 0.08 V. the student is not aware of this zero error and writes down a reading of 2.16 V. is the reading accurate and is it precise?

	Accurate	Precise
A	No	No
B	No	Yes
C	Yes	No
D	Yes	Yes

212. Four students each made a series of measure-ments of the acceleration of free fall g. the table shows the results obtained.
Which student obtained a set of results that could be described as precise but not accurate?

Options	Student	Results	g/ms^{-2}
A	9.81	9.79	9.83
B	9.81	10.12	8.94
C	9.45	9.21	8.76
D	8.45	8.46	8.41

213. An object falls freely from rest and travels a distance s in time t. a graph of t^2 against s is plotted and used to determine the acceleration of free fall g.



The gradient of the graph is found to be 0.204 s^2 m^{-1}.
Which statement about the value obtained for g is correct?
a) It is accurate but not precise.
b) It is both precise and accurate
c) It is neither precise nor accurate
d) It is precise but not accurate.

214.

Prefixes

215. Which of the following is closest to a yard: ETEA 2016 Med
(a) 0.01 m (b) 0.1 m
(c) 1 m (d) 100 m

216. A student measure current as 0.5A. which of the following correctly expresses the result ETEA 2018-Eng

a. 50Ma b. 50MA
c.500mA d. 500MA

217. The prefix "tetra" stands for ETEA 2018-Eng
a. 10^6 b. 10^9
c. 10^{-9} d. 10^6

218. What is the ratio of 1 Gm/1μm? ETEA ETEA 2012 Eng:
(a) 10^{-3} (b) 10^{-7}
(c) 10^{-18} (d) 10^{15}

219. The prefix 'Pico' stands for: ETEA ETEA 2014 Med:
(a) 10^6 (b) 10^9
(c) 10^{-12} (d) 10^{12}

220. In prefix pico 'p' factor is **MDCAT - 2018**
a. 10^{+12}
b. 10^{-9}
c. 10^4
d. 10^{-12}

Significant numbers and Rounding off numbers

221. **A student makes measurements from which she calculated the speed of sound as 321 ms-1. She estimates that the result is accurate to +3% or -3%. Which of the following give result expressed to the appropriate number of significant figures.** **FMDC 2017**
a) **327 ms-1**
b) **328 ms-1**
c) **330 ms-1**
d) **300 ms-1**

222. **The length and width of a rectangular plate are measured to be 15.3mm and 12.50mm. Find the area of plate upto appropriate number of significant figure.** **FMDC 2015**
a) 195.84 mm^2
b) 195.8mm^2
c) 196mm^2
d) 200mm_2

223. The number of significant fiures in the measurement of 5.005x 10^{-5} s is; ETEA 2018-Eng
a. 2 b. 3
c. 4 d 5

224. The scientific notation of a number 0.0023 is expressed as: ETEA 2015 Eng
A) 2.3×10^{-3} B) 0.023×10^{-2}
C)2.3×10^{-4} D) 0.2×10^3

225. If 7.635 & 4.81 are two significant numbers, their multiplication in significant digit is ETEA ETEA 2011 Eng:
(a) 36.72435 (b) 36.724
(c) 36.72 (d) 36.7

226. The number of significan figures in 4.0030 is; ETEA 2009 Med:
(a) Four (b) Five
(c) Two (d) Three

227. The number of significant figures in the measurement x = 10.00300 ETEA ETEA 2012 Med:
(a) 7 (b) 8
(c) 5 (d) 3

228. The number of significant figures in the measurement of 5.05×10^{-3} m/s is; ETEA 2008 Med:
(a) 2 (b) 3
(c) 4 (d) 8

229. During the experiment one measured the mass of Mosquito and fount it 1.20×10^{-5} Kg. The numbers of significant figures in this case are: ETEA ETEA 2014 Med
(a) Five (b) One
(c) Two (d) Three

230. In a cricket match 500 spectators are counted one by one. How many significant figures will be there in the final result? ETEA 2016 Med
(a) 0 (b) 1
(c) 2 **(d) 3**

231. 9.5×10^{15}m when rounded off 40 is 10^{16} m which is equal to ETEA ETEA 2011 Eng:
(a) Tera meter (b) Atto meter
(c) Exa meter (d) Light year

232. In scientific notation numbers are expressed in
A) power of ten B) powers of two
C) reciprocal D) decimal

233. A student makes measurements from which she calculating the speed of sound as 327.66 ms^{-1}. She estimates that her result is accurate to $\pm$ 3%. Which of the following gives her result expressed to the appropriate number of significant figures?
a) 327.7 ms^{-1} b) 328 ms^{-1}
c) 330 ms^{-1} d) 300 ms^{-1}

234. 1024 can be written in scientific notation as
A) $1.024x10^3$ B) 10^2
C) 0.000976 D) 1/0.00097

235. In any measurement the significant figures are
A) all accurately known and all doubtful digits
B) only accurately known digits
C) only doubtful digits
D) all accurately known digits and the first doubuful digit

236. A digit zero in a measurement

A) may be significant may not significant
B) always significant
C) always insignificants
D) significant only if left to a significant figure

237. Number of significant figures in 0.0173 are
A) Three B) four
C) Five D) Two

238. The number of significant figures in the length of a bar 6200mm measured by meter rod are
A) Four B) three
C) Two D) none of these

239. The number of significant figures in the measurement of 5.005x 10^{-5} s is;
a. 2 b. 3 c. 4 d 5

240. The scientific notation of a number 0.0023 is expressed as:
A) 2.3×10^{-3} B) 0.023×10^{-2}
C) 2.3×10^{-4} D) 0.2×10^{3}

241. If 7.635 & 4.81 are two significant numbers, their multiplication in significant digit is:
a) 36.72435 b) 36.724
c) 36.72 d) 36.7

242. The number of significant figures in 4.0030 is;
a) Four b) Five c) Two d) Three

243. The number of significant figures in the measurement x = 10.00300;
a) 7 b) 8 c) 5 d) 3

244. The number of significant figures in the measurement of 5.05×10^{-3} m/s is;
a) 2 b) 3 c) 4 d) 8

245. During the experiment one measured the mass of Mosquito and fount it 1.20×10^{-5} Kg. The numbers of significant figures in this case are:
a) Five b) One
c) Two d) Three

246. In a cricket match 500 spectators are counted one by one. How many significant figures will be there in the final result?
a) 0 b) 1
c) 2 d) 3

247. In a cricket match 500 spectators are counted ten by ten.. How many significant figures will be there in the final result?
a) 0 b) 1
c) 2 d) 3

248. In a cricket match 500 spectators are counted 100 by 100. How many significant figures will be there in the final result?
a) 0 b) 1
c) 2 d) 3

Dimensions

249. The dimension of pressure is; **ETEA-2019**
a) $ML^{-1}T^{-2}$ b) $ML^{-2}T^{-2}$
c) $[MLT^{-2}$ d) $ML^{-1}T^{-1}$

250. The dimesnsional formula for change in momentum is same for: ETEA 2018-Med
a. force b. impulse
c. acceleration d. velocity

251. Suppose A=BC, where A has the dimesnsion L/M and C has the dimension L/T. then B has the dimension ETEA 2017-Med
a. T/M b. L^2 /TM
c. TM/L^2 d. L^2 T/M

252. Which one of the following is both unitless and dimentionless ETEA 2017-Eng
a. angle b. solid angle
c. mechanical equivalent of heat d. refractive index

253. The dimensions of Planck constant are;
ETEA ETEA 2010-Med
a. $[MLT^{-2}]$ b. $[ML^2T^{-1}]$
c. $[MLT^{-3}]$ d. $[ML^2T^{-2}]$

254. The Dimension of work are similar to the dimensions of; ETEA ETEA 2011 Eng:
(a) Impulse (b) Torque
(c) Power (d) Angular momentum.

255. $ML^{-1}T^{-1}$are dimensions of; ETEA ETEA 2011- Med:
(a) Augular Momentum (b) Power
(c) Impulse (d) Viscosity

256. The dimensions of energy are the same as those of ; ETEA 2007-Med
a . Momentum b. Acceleration
c. Force d. Work

257. The dimensions of the gravitational constant are:
ETEA ETEA 2010-Med:
a. $[M^2L^2T]$ b. $[M^{-1}L^3T^{-2}]$
c. $[M^2L^{-2}T^{-2}]$ d. $[ML^{-2}T^{-1}]$

258. The dimensions of torque are: ETEA 2008,Med, ETEA ETEA 2010-Eng:
a. $[MLT^{-2}]$ b. $[ML^2T^2]$
c. $[MLT^{-1}]$ d. $[ML^2T^{-2}]$

259. The dimensions of impulse are similar to the dimensions of: ETEA ETEA 2010-Eng
a. Torque b. Work
c. Momentum d. Force

260. The dimensions of angular acceleration are ; ETEA 2007-Med
a. $[L^{-1}T^{-1}]$ b. $[LT^{-2}]$
c. $[T^{-2}]$ d. $[L^2T^{-2}]$

261. Planck's constant has the dimension of: ETEA 2009-Med
a. Energy b. Work
c. Linear momentum d. Angular momentum

262. $M^0 L^0 T^0$are the dimension of

ETEA ETEA 2011- Med:
(a) Strain (b) Refractive Index
(c) Magnification (d) All

263. The time rate of change of magnetic flux has the same dimensions as that of: ETEA ETEA 2012-, Med:
A) Current B) Resistance
C) Magnetic induction D) Potential difference

264. Which of the following pairs have the same units and dimensions? ETEA ETEA 2012-Med:
A) Resistance and resistivity
B) Conductivity and resistivity
C) Electromotive force & potential difference
D) Resistivity & temperature coefficient of resistivity

265. Which one is correct formula for finding the speed, V of ocean waves in terms of the density p of sea water, the accelaration of free fall g, depth, h of the ocean & the wavelength λ?ETEA ETEA 2012-Eng:
(a) v = $\sqrt{g\lambda}$ (b) v = $\sqrt{g/4}$
c) v = $\sqrt{\rho g h}$ (d) v = $\sqrt{g/\rho}$

266. Suppose A = BC, where A has the dimension L/M and C has the dimension L/T. Then B has the dimension: ETEA 2016-Eng
(a) T/M (b) L^2/TM
(c) TM/L^2 (d) L^2T/M

267. Which of the following following is dimensionless quantity? **NUMS-2018**
Power
Frequency
Refractive index
Impulse

268. The dimension of Young's Modulus ¡s **NUMS-2017**
a) $M_2L_{+1}T_2$ b) $ML_{-1}T_{+1}$
c) $ML_{-1}T_{-2}$ d) $ML_{-2}T_{-2}$

269. Dimensional analysis is helpful for
A) deriving a possible formula
B) checking the homogeneity of a physical equation
C) verification of laws
D) only a and b are correct

270. Which equation is not dimensionally correct?
A) E=mc² B) Vf=Vi+at
C) S=Vt² D) S = $\frac{1}{2}$ at²

271. Which one is the dimensionally correct equation?
A) f=vt B) S=Vit+ $\frac{1}{2}$at²
C) V=St D) V=f/t

272. Suppose A=BC, where A has the dimesnsion L/M and C has the dimension L/T. then B has the dimension
a. T/M b. L^2 /TM
c. TM/L^2 d. L^2 T/M

273. The unit of planks constant is same is that of:
a. angular Momentum b. work
c. force d. torque

274. Which one of the following is both unitless and dimentionless
a. angle b. solid angle
c. mechanical equivalent of heat
d. refractive index

275. The dimensions of Planck constant are;
a. [MLT^{-2}] b. [ML^2T^{-1}]
c. [MLT^{-3}] d. [ML^2T^{-2}]

276. The Dimension of work are similar to the dimensions of;
a) Impulse b) Torque
c) Power d) Angular Momentum.

277. $ML^{-1}T^{-1}$are dimensions of;
a) Augular Momentum b) Power
c) Impulse d) Viscosity

278. The dimensions of energy are the same as those of ;
a . Momentum b. Acceleration
c. Force d. Work

279. The dimensions of the gravitational constant are:
a. [M^2L^2T] b. [$M^{-1}L^3T^{-2}$]
c. [$M^2L^{-2}T^{-2}$] d. [$ML^{-2}T^{-1}$]

280. The dimensions of torque are:
a. [MLT^{-2}] b. [ML^2T^2]
c. [MLT^{-1}] d. [ML^2T^{-2}]

281. The dimensions of impulse are similar to the dimensions of:
a. Torque b. Work
c. Momentum d. Force

282. The dimensions of angular acceleration are ;
a. [$L^{-1}T^{-1}$] b. [LT^{-2}]
c. [T^{-2}] d.[L^2T^{-2}]

283. Planck's constant has the dimension of:
a. Energy b. Work
c. Linear Momentum d. Angular Momentum

284. $M^0 L^0 T^0$are the dimension of
a) Strain
b) Refractive Index
c) Magnification d) All

285. Which one is correct formula for finding the speed, V of ocean waves in terms of the density p of sea water, the accelaration of free fall g, depth, h of the ocean & the wavelength λ?
a) v = $\sqrt{g\lambda}$ b) v = $\sqrt{g/4}$

c) $v = \sqrt{\rho g h}$ d) $v = \sqrt{g/\rho}$

286. Suppose A = BC, where A has the dimension L/M and C has the dimension L/T. Then B has the dimension:
a) T/M b) L^2/TM
c) TM/L^2 d) L^2T/M

287. The base unit which has the same power in the dimensional formula of surface tension and co-effcient of viscosity:
a) Mass b) Time
c) Length d) Temperature

288. Which of the following has no units?
a) Efficiency b) Refractive index
c) Strain d) All of these

289. Which of the following pair has same units?
a) Light year and wavelength
b) Momentum and force
c) Energy and young's modulus
d) Force and pressure

290. A quantity which has SI unit but no dimension is:
a) Solid angle
b) Radioactive decay constant
c) Frequency
d) Inertia

291. E, M, L and G denote energy, mass, angular Momentum, and gravitational constant. the dimension of $\frac{EL^2}{M^5G^2}$ *is that of*:
a) Time b) Length
c) Mass d) Angle

292. The unit of fractional uncertainty in length is:
a) Cm b) Dm
c) Mm d) No units

293. The dimensions of angular displacement are
a) $[L^2]$ b) $[L^0]$
c) $[LT^{-1}]$ d) $[L^{-1}T^{-1}]$

294. The dimensions of gravitational constant "G" are
a) $[M^{-1}L^3T^{-2}]$ b) $[M^2L^{-1}T^{-2}]$
c) $[ML^2T^{-2}]$ d) $[ML^{-2}T^{-1}]$

295. The dimensions of viscosity and pressure are:
a) $[ML^{-1}T$ & $MLT^{-2}]$ b) $[ML^{-2}T^{-1}$ & $M^{-1}LT^{-1}]$
c) $[ML^{-1}T^{-1}$ & $ML^{-1}T^{-2}]$ d) $[ML^2T^{-1}$ & $ML^{-1}T^{-2}]$

296. $|M^0L^0T^{-1}|$ refer to quantity
a) Velocity b) Frequency
c) Time period d) Force

297. Units of $\frac{1}{\mu_0 E_0}$ where symbols have their usual meaning are
a) ms^{-1} b) m^2s^2
c) $m^{-1}s$ d) $m^{-2}S^2$

298. Two physical quantities of which one is a vector and other is a scalar, having same dimensions are:
a) moment and Momentum
b) power and Momentum
c) impulse and Momentum
d) torque and work

299. Which pair of physical quantities given below has not the same units and dimensions?
a) torque and angular Momentum
b) Momentum and impulse
c) pressure and modulus of elasticity
d) acceleration and gravitational field strength

300. Of the following quantities, which one has units different from the remaining three:.
a) Energy per unit volume
b) Product of voltage and charge per unit volume
c) Force per unit area
d) Angular Momentum

301. The radioactive decay constant has the same dimensional formula as:
a) mole b) time
c) frequency d) mass

302. if C and R denotes the capacitance and resistance respectively, then the dimensional formula for CR is same as that of:
a) frequency b) time period
c) $(\text{frequency})^2$ d) $(\text{time period})^2$

303. The ratio of dimensions of angular Momentum to linear Momentum is:
a) [L] b) $[L^{-1}]$
c) $[LT^{-1}]$ d) $[L^{-1}T^{-1}]$

304. The dimension of product PV is same that of ("P" is presser and "V" is volume):
a) Energy b) Power
c) Temperature d) Momentum

305. Two physical quantities can be added only when they have same:
a) Kind b) Magnitudes
c) Directions d) All are correct

306. $\frac{B^2}{\mu_0}$ has the same dimensional formula as that of:
(B is magnetic field and μ_0 is absolute permeability of free space):
a) Energy density
b) Stress x strain
c) Magnetic energy per unit volume
d) All of these

307. *Select the pair whose dimensions are same*
a) Pressure and stress
b) Stress and strain
c) Pressure and force
d) Power and force

308. *Dimensional formula $ML^{-1}T^{-2}$ does not represent the physical quantity*
a) Young's modulus of elasticity
b) Stress

c) Strain
d) Pressure

309. Dimensional formula ML^2T^3 represents
a) Force
b) Power
c) Energy
d) Work

310. The dimensions of calorie are
a) ML^2T^{-2}
b) MLT^{-2}
c) ML^2T^{-1}
d) ML^2T^{-3}

311. Whose dimensions is ML^2T^{-1}
a) Torque
b) Angular momentum
c) Power
d) Work

312. If L and R are respectively the inductance are resistance, then the dimensions of $\frac{L}{R}$ will be
a) $M^0L^0T^{-1}$
b) M^0LT^0
c) M^0L^0T
d) Cannot be represented in terms of M, L and T

313. Which pair has the same dimensions
a) Work and power
b) Density and relative density
c) Momentum and impulse
d) Stress and strain

314. If C and R represent capacitance and resistance respectively, then the dimensions of RC are
a) $M^0L^0T^2$
b) M^0L^0T
c) ML^{-1}
d) None of the above

315. Dimensions of one or more pairs are same. Identify the pairs
a) Torque and work
b) Angular momentum and work
c) Energy and Young's modulus
d) Light year and wavelength

316. Dimensional formula for volume elasticity is
a) $M^1L^{-2}T^{-2}$
b) $M^1L^{-3}T^{-2}$
c) $M^1L^2T^{-2}$
d) $M^1L^{-1}T^{-2}$

317. The dimensions of universal gravitation constant are
a) $M^{-2}L^2T^{-2}$
b) $M^{-1}L^3T^{-2}$
c) $ML^{-1}T^{-2}$
d) ML^2T^{-2}

318. The dimensional formula of angular velocity is
a) $M^0L^0T^{-1}$
b) MLT^{-1}
c) $M^0L^0T^1$
d) ML^0T^{-2}

319. The dimensions of power are
a) $M^1L^2T^{-3}$
b) $M^2L^1T^{-2}$
c) $M^1L^2T^{-1}$
d) $M^1L^1T^{-2}$

320. The dimensions of couple are
a) ML^2T^{-2}
b) MLT^{-2}
c) $ML^{-1}T^{-3}$
d) $ML^{-2}T^{-2}$

321. Dimensional formula for angular momentum is
a) ML^2T^{-2}
b) ML^2T^{-1}
c) MLT^{-1}
d) $M^0L^2T^{-2}$

322. The dimensional formula for impulse is
a) MLT^{-2}
b) MLT^{-1}
c) ML^2T^{-1}
d) M^2LT^{-1}

323. The dimensional formula for the modulus of rigidity is
a) ML^2T^{-2}
b) $ML^{-1}T^{-3}$
c) $ML^{-2}T^{-2}$
d) $ML^{-1}T^{-2}$

324. The dimensional formula for Planck's constant (h) is
a) $ML^{-2}T^{-3}$
b) ML^2T^{-2}
c) ML^2T^{-1}
d) ML^2T^{-2}

325. Out of the following, the only pair that does not have identical dimensions is
a) Angular momentum and Planck's constant
b) Moment of inertia and moment of a force
c) Work and toruqe
d) Impulse and momentum

326. The dimensional formula for impulse is same as the dimensional formula is
a) Momentum
b) Force
c) Rate of change of momentum
d) Torque

327. Which of the following is dimensionally correct
a) Pressure = energy per unit area
b) Pressure = energy per unit volume
c) Pressure = force per unit volume
d) Pressure = momentum per unit volume per unit time

328. Plankc's constant has the dimensions (unit) of
a) Energy

b) Linear momentum
c) Work
d) Angular momentum

329. *The equation of state of some gases can be expressed as $\left(P+\frac{a}{V^2}\right)(V-b)=RT$. Here P is the pressure, V is the volume, T is the absolute temperature and a,b,R are constants. The dimensions of 'a' are*
a) ML^5T^{-2}
b) $ML^{-1}T^{-2}$
c) $M^0L^3T^0$
d) $M^0L^6T^0$

330. *If V denotes the potential difference across the plates of a capacitor of capacitance C, the dimensions of CV^2 are*
a) Not expressible in MLT
b) MLT^{-2}
c) M^2LT^1
d) ML^2T^{-2}

331. *If L denotes the inductance of an inductor through which a current i is flowing, the dimensions of Li^2 are*
a) ML^2T^{-2}
b) Not expressible in MLT
c) MLT^{-2}
d) $M^2L^2T^{-2}$

332. *Of the following quantities, which one has dimensions difference from the remaining three*
a) Energy per unit volume
b) Force per unit area
c) Product of voltage and charge per unit volume
d) Angular momentum per unit mass

333. *A spherical body of mass m and radius r is allowed to fall in medium of viscosity n. the time in which the velocity of the body increases from zero to 0.63 times the terminal velocity (v) is called time constant (τ). Dimensionally (τ) can be represented by*
a) $\frac{mr^2}{6\pi n}$
b) $\sqrt{\left(\frac{6\pi mrn}{g^2}\right)}$
c) $\frac{m}{6\pi nrv}$
d) None of the above

334. *The quantities A and B are related by the relation, m = A/B where m is the linear density and A is the force. The dimensions of B are of*
a) Pressure
b) Work
c) Latent heat
d) None of the above

335. *The velocity of water waves v may depend upon their wavelength λ, the density of water p and the acceleration due to gravity. The method of dimensions gives the relation between these quantities as*
a) $v^2 \propto \lambda g^{-1}p^{-1}$
b) $v^2 \propto g\lambda p$
c) $v^2 \propto g\lambda$
d) $v^2 \propto g^{-1}\lambda^{-3}$

336. *The dimensions of Farad are*
a) $M^{-1}L^{-2}T^2Q^2$
b) $M^{-1}L^{-2}TQ$
c) $M^{-1}L^{-2}T^{-2}Q$
d) $M^{-1}L^{-2}TQ^2$

337. *The dimensions of resistivity in terms of M, L, T and Q where Q stands for the dimensions of charge, is*
a) $ML^3T^{-1}Q^{-2}$
b) $ML^3T^{-2}Q^{-1}$
c) $ML^2T^{-1}Q^{-1}$
d) $MLT^{-1}Q^{-1}$

338. *The equation of a wave is given by*
$Y = A\, sin\omega\left(\frac{x}{v}-k\right)$
Where ω is the angular velocity and v is the linear velocity. The dimension of k is
a) LT
b) T
c) T^{-1}
d) T^2

339. *The dimensions of coefficient of thermal conductivity is*
a) $ML^2T^{-2}K^{-1}$
b) $MLT^{-3}K^{-1}$
c) $MLT^{-2}K^{-1}$
d) $MLT^{-3}K$

340. *Dimensional formula of stress is*
a) M^0LT^{-2}
b) $M^0L^{-1}T^{-2}$
c) $ML^{-1}T^{-2}$
d) ML^2T^{-2}

341. *Dimensional formula of capacitance is*
a) $M^{-1}L^{-2}T^4A^2$
b) $ML^2T^4A^2$
c) $MLT^{-4}A^2$
d) $M^{-1}L^{-2}T^{-4}A^{-2}$

342. *MLT^1 represents the dimensional formula of*
a) Power
b) Momentum
c) Force
d) Couple

343. *Dimensional formula of heat energy is*
a) ML^2T^{-2}
b) MLT^{-1}
c) $M^0L^0T^{-2}$
d) None of these

344. *If C and L denote capacitance and inductance respectively, then the dimensions of LC are*
a) $M^0L^0T^0$
b) $M^0L^0T^2$
c) $M^2L^0T^2$
d) MLT^2

345. *Which of the following quantities has the same dimensions as that of energy*
a) Power
b) Force
c) Momentum
d) Work

346. *The dimensions of "time constant" $\frac{L}{R}$ during growth and decay of current in all inductive circuit is same as that of*
a) Constant
b) Resistance
c) Current
d) Time

347. *Which one of the following does not have the same dimensions*
a) Work and energy
b) Angle and strain
c) Relative density and refractive index
d) Planck constant and energy

348. *Dimensions of frequency are*
a) $M^0L^{-1}T^0$
b) $M^0L^0T^{-1}$
c) M^0L^0T
d) MT^{-2}

349. *Which one has the dimensions from the remaining three*
a) Power
b) Work
c) Torque
d) Energy

350. *The dimensional formula of wave number is*
a) $M^0L^0T^{-1}$
b) $M^0L^{-1}T^0$
c) $M^{-1}L^{-1}T^0$
d) $M^0L^0T^0$

351. *The dimensions of stress are equal to*
a) Force
b) Pressure
c) Work
d) $\frac{1}{Pressure}$

352. *Dimensions of permeability are*
a) $A^{-2}M^1L^1T^{-2}$
b) MLT^{-2}
c) ML^0T^{-1}
d) $A^{-1}MLT^2$

353. *Dimensional formula of magnetic flux is*
a) $ML^2T^{-2}A^{-1}$
b) $ML^0T^{-2}A^{-2}$
c) $M^0L^{-2}T^{-2}A^{-3}$
d) $ML^2T^{-2}A^3$

354. *If P represents radiation pressure, c represents speed of light and Q represents radiation energy striking a unit area per second, the non-zero integers x,y and z such that $P^xQ^yc^z$ is dimensionless, are*
a) $x = 1, y = 1\ z = -1$
b) $x = 1, y = -1, z = 1$
c) $x = -1, y = 1, z = 1$
d) $x = 1, y = 1\ , z = 1$

355. *Dimensions of strain are*
a) MLT^{-1}
b) ML^2T^{-1}
c) MLT^{-2}
d) $M^0L^0T^0$

356. *Dimensions of time is power are*
a) T^{-1}
b) T^{-2}
c) T^{-3}
d) T^0

357. *Dimensions of kinetic energy are*
a) ML^2T^{-2}
b) M^2LT^{-1}
c) ML^2T^{-1}
d) ML^3T^{-1}

358. *Dimensional formula for torque is*
a) L^2MT^{-2}
b) $L^{-1}MT^{-2}$
c) L^2MT^{-3}
d) LMT^{-2}

359. *Dimensions of coefficient of viscosity are*
a) ML^2T^{-2}
b) ML^2T^{-1}
c) $ML^{-1}T^{-1}$
d) MLT

360. *The dimension of quantity (L / RCV) is*
a) [A]
b) [A^2]
c) [A^{-1}]
d) None of these

361. *The dimension of the ratio of angular to linear momentum is*
a) $M^0L^1T^0$
b) $M^1L^1T^{-1}$
c) $M^1L^2T^{-1}$
d) $M^{-1}L^{-1}T^{-1}$

362. *The pair having the same dimensions is*
a) Angular momentum, work
b) Work, torque
c) Potential energy, linear momentum
d) Kinetic energy, velocity

363. *The dimensions of surface tension are*
a) $ML^{-1}T^{-2}$ b) MLT^{-2}
c) $ML^{-1}T^{-1}$ d) MT^{-2}

364. *In the following list, the only pair which have different dimensions, is*
a) Linear momentum and moment of a force
b) Planck's constant and angular momentum
c) Pressure and modulus of elasticity

d) Torque and potential energy

365. *The dimensions of permittivity ε_0 are*
a) $A^2T^2M^{-1}L^3$
b) $A^2T^4M^{-1}L^{-3}$
c) $A^{-2}T^{-4}ML^3$
d) $A^2T^{-4}M^{-1}L^{-3}$

366. *Dimensions of the following three quantities are the same*
a) Work, energy, force
b) Velocity, momentum, impulse
c) Potential energy, kinetic energy, momentum
d) Pressure, stress, coefficient of elasticity

367. *Dimensions of CR are those of*
a) Frequency
b) Energy
c) Time period
d) Current

368. *The physical quantity that has no dimensions*
a) Angular velocity
b) Linear momentum
c) Angular momentum
d) Strain

369. *Dimensions of magnetic field intensity is*
a) $[M^0L^{-1}T^0A^1]$
b) $[MLT^{-1}A^{-1}]$
c) $[ML^0T^{-2}A^{-1}]$
d) $[MLT^{-2}A]$

370. *The force F on a sphere of radius 'a' moving in a medium with velocity 'v' is given by F =* $6\ \pi n a v$*. The dimensions of n are*
a) $ML^{-1}T^{-1}$
b) MT^{-1}
c) MLT^{-2}
d) ML^{-3}

371. *Which physical quantity have the same dimension*
a) Couple of force and work
b) Force and power
c) Latent heat and specific heat
d) Work and power

372. *Two quantities A and B have different dimensions. Which mathematical operation given below is physically meaningful*
a) A / B
b) A + B
c) A – B
d) None

373. *A force F is given by F = at + bt*^{2}*, where t is time, what are the dimensions of a and b*
a) MLT^{-3} *and* ML^2T^{-4}
b) MLT^{-3} *and* MLT^{-4}
c) MLT^{-1}*and* MLT^0
d) MLT^{-4}*and* MLT^1

374. *The dimensions of inter atomic force constant are*
a) MT^{-2}
b) MLT^{-1}
c) MLT^{-2}
d) $ML^{-1}T^{-1}$

375. *If the speed of light (c), acceleration due to gravity (g) and pressure (p) are taken as the fundamental quantities, then the dimension of gravitational constant is*
a) $c^2g^0p^{-2}$
b) $c^0g^2p^{-1}$
c) cg^3p^{-2}
d) $c^{-1}g^0p^{-1}$

376. *If the time period (T) of vibration of a liquid drop depends on surface tension (S), radius (r) of the drop and density (p) of the liquid, then the expression of T is*
a) $T = k\ \sqrt{pr^3/S}$
b) $T = k\ \sqrt{p^{1/2}\,r^3/S}$
c) $T = k\ \sqrt{pr^3/S^{1/2}}$
d) None of these

377. $ML^3T^{-1}Q^{-2}$ *is dimension of*
a) Resistivity
b) Conductivity
c) Resistance
d) None of these

378. *Dimension of electric current is*
a) $M^0L^0T^{-1}Q]$
b) $[ML^2T^{-1}Q]$
c) $[M^2LT^{-1}Q]$
d) $[M^2L^2T^{-1}Q]$

379. *The fundamental physical quantities that have same dimensions in the dimensional formulae of torque and angular momentum are*
a) Mass, time
b) Time, length
c) Mass, length
d) Time, mole

380. *If pressure P , velocity V and time T are taken as fundamental physical quantities, the dimensional formula of force is*
a) PV^2T^2
b) $P^{-1}V^2T^{-2}$
c) PVT^2
d) $P^{-1}VT^2$

381. *The physical quantity which has dimensional formula as that of* $\frac{Energy}{Mass x length}$ *is*
a) Force
b) Power
c) Pressure
d) Acceleration

382. *If energy (E) , velocity (v) and force (F) be taken as fundamental quantity, then what are the dimensions of mass*
a) Ev^2
b) Ev^{-2}

c) Fv^{-1}
d) Fv^{-2}

383. *Which of the following pair does not have similar dimensions*
a) Stress and pressure
b) Angle and strain
c) Tension and surface tension
d) Planck's constant and angular momentum

384. *Out of the following which pair of quantities do not have same dimensions*
a) Planck's constant and angular momentum
b) Work and energy
c) Pressure and Young's modulus
d) Torque & moment of inertia

385. *Identify the pair which has different dimensions*
a) Planck's constant and angular momentum
b) Impulse and linear momentum
c) Angular momentum and frequency
d) Pressure and Young's modulus

386. *The dimensional formula $M^0L^2T^{-2}$ stands for*
a) Torque
b) Angular momentum
c) Latent heat
d) Coefficient of thermal conductivity

387. *Which of the following represents the dimensions of Farad*
a) $M^{-1}L^{-2}T^4A^2$
b) $ML^2T^2A^{-2}$
c) $ML^2T^2A^{-1}$
d) $MT^{-2}A^{-1}$

388. *Dimensions of charge are*
a) $M^0L^0T^{-1}A^{-1}$
b) $MLTA^{-1}$
c) $T^{-1}A$
d) TA

389. *According to Newton, the viscous force acting between liquid layers of area A and velocity gradient Δv / Δz is given by $F = -nA\frac{\Delta v}{\Delta z}$ where n is constant called coefficient of viscosity. The dimension of n are*
a) $[ML^2T^{-2}]$ b) $[ML^{-1}T^{-1}]$
c) $[ML^{-2}T^{-2}]$ d) $[M^0L^0T^0]$

390. *The dimensions of pressure is equal to*
a) Force per unit volume
b) Energy per unit volume
c) Force
d) Energy

391. *Which of the two have same dimensions*
a) Force and strain
b) Force and stress
c) Angular velocity and frequency
d) Energy and strain

392. *An object is moving through the liquid. The viscous damping force acting on it is proportional to the velocity. Then dimensions of constant of proportionality is*
a) $ML^{-1}T^{-1}$
b) MLT^{-1}
c) M^0LT^{-1}
d) ML^0T^{-1}

393. *Which of the following quantities is dimensionless*
a) Gravitational constant
b) Planck's constant
c) Power of a convex lens
d) None

Key

1.	A	A = lxb = 1 x 0.5 = 0.5m^2 = 0.5 c^{2}m^2/c^2 =0.5 cm^2/10^{-2x2} = 0.5 cm^2/10^{-4} = 0.5 x 10^4 cm^2 = 5000
2.	B	Stress = F/A Young modulus = stress/strain , strain is no unit. P = F/A
3.	D	V=W/q=fd/q=mad/It=mvd/tIt=msd/ttIt= kgmm/ssAs= kg m^2 /s^3 A^1= kg m^2 s^{-3} A^{-1}
4.	B	Circumfrnce of circle(c)= 2πr and area of circle(a) =πr^2 NOW a=πr^2=100π→r^2=100→r=10 to find C=2πr = 2π10=20π
5.	C	P=F/A
6.	B	Kg m^{-1} s^{-2}Hints: $P = \frac{F}{A} = \frac{Kg^m/S^2}{m^2} = Kgm^{-1}S^{-2}$
7.	A	P = F/A=ma/A= kg. ms^{-2}/m^2 = kg/m s and δha=(m/V)ha= kg. m.m^2/m^3 = kg now p/δha= kg/ms /kg =m s
8.	A	L=rp=rmv=rms/t= m kg m/s= kg m^2 /s E=hf→h=E/f=ET=wt=Fdt=madt=mdvt/t=mdv =mds/t=kg m m /s = kg m^2 /s
9.	**D**	
10.	B	
11.	D	
12.	A	Kg ms^{-2}
13.	A	Velocity
14.	c	**360^0 = 2π radian→ 1 radian = 360/2π= 57.3^0.**

15.	**D)**	
16.	A	Radian is the SI unit of plane angle
17.	D	V=W/q=fd/q=mad/It=mvd/tIt=msd/ttIt= kgmm/ssAs= kg m^2 /s^3 A^1= kg m^2 s^{-3} A^{-1}
18.	B	Circumfrnce of circle(c)= 2πr and area of circlea) =πr^2 NOW a=πr^2=100π→πr^2=100→r=10 to find C=2πr = 2π10=20π
19.	C	P=F/A
20.	B	Kg m^{-1} s^{-2}Hints: $P = \frac{F}{A} = \frac{Kg^m/S^2}{m^2} = Kgm^{-1}S^{-2}$
21.	A	P = F/A=ma/A= kg. ms^{-2}/m^2 = kg/m s and δha=(m/V)ha= kg. m.m^2/m^3 = kg now p/δha= kg/ms /kg =m s
22.	C	1 m is closed to year
23.	<u>C</u>	0.5 A= 0.5 mA/m = 0.5/10^{-3} mA= 0.5 x 10^3 mA= 5x 1000 mA=500 mA
24.	C	The fundamental quantities which form the base MKS system mass, length, and time
25.	B	The Set of supplementary units are Radian and Steradian
26.	C	Three base units in S.I. units are: Kilogram, meter and second
27.	B	The unit of force is Newton and its symbol is N
28.	B	Unit of pressure = N m^{-2} = (kg ms^{-2})m^{-2} = kg $m^{-1}s^{-2}$
29.	B	Energy of a photon = *hf* Base unit of energy = kgm^2s^{-2} Base unit of frequency = s^{-1} Base units of Planck constant = kg m^2s^{-1}
30.	B	SI base units are ampere, kelvin , mole, metre, sec-ond, kilogram and candela.
31.	A	Work done = force x distance Force = $\frac{work\ done}{distance} = \frac{energy}{distance}$
32.	B	1A° = 10^{-10} m, 1km = 10^3m
33.	C	Unit of energy is joule = kgm^2s^{-2} But the unit of (impulse x time) = $kgms^{-1}s$ = kgm
34.	B	Unit of spring constant, k = Nm^{-1} Unit of tension (force), F=N
35.	B	There are only two supplementary units. Radian and steradian.
36.	D	Light year is the distance that light travels in one year (S = ct)
37.	B	W = Fd => $\frac{W}{d}$ = F
38.	A	[$v^{-2}F^0E$] = [$L^{-2}T^2$][1][ML^2T^{-2}]=[M]
39.	B	K= $\frac{velocity}{density} = \frac{ms^{-1}}{kgm^{-3}}$ = $kg^{-1}m^4s^{-1}$
40.	A	Unit of P.E = J = kgm^2s^{-2}

41.	B	L = mvr = $\frac{nh}{2\pi}$ = Js
42.	C	Impulse = ΔP = $kgms^{-1}$ = N s
43.	A	$\frac{RCV}{L} = \frac{(RC)V}{L} = \frac{TV}{V\Delta T\Delta I} = \Delta I = current$:V = L $\frac{\Delta I}{\Delta T}$ => L = $\frac{V\Delta T}{\Delta I}$ and :RC = T
44.	A	Light year is the unit of distance
45.	C	$\frac{power}{pressure} = \frac{[ML^2T^{-3}]}{[ML^{-1}T^{-2}]}$ = [L^3T^{-1}] = m^3s^{-1} = volume flow per second
46.	D	Kilogram is the base unit not base quantity
47.	D	Unit of surface tension = Nm^{-1}
48.	C	Volume is a derived quantity. So, its unit is derived unit.
49.	A	For example: $N_1u_1 = n_2u_2$ => 1m = 100 cm => (1)(m) = (100)(cm)
50.	B	By principle of homogeneity C^2 =s => c = $s^{1/2}$
51.	A	The speed of wave in stretched string is given by: V = $\sqrt{\frac{F}{m}}$ F = tension in the string M = mass per unit length of string F = $\frac{v}{2l} = \frac{I}{2l}\sqrt{\frac{F}{m}}$ Unit of "m" = kgm^{-1}
52.	C	Light year the unit of distance
53.	B	By the principle of homogeneity Unit of "y" = unit of term "bt" M = bs => b = ms^{-1}
54.	C	By the principle of homogeneity Unit of term "a/V^2" = unit of "P" a/m^6 = Nm^{-2} => a = Nm^{-2} m^6 = Nm^4
55.	C	The speed of wave in any medium is given by: V = $\sqrt{\frac{Elastic\ modulus}{density}} = \sqrt{\frac{E}{P}} => x = E =$ $kgm^{-1}s^{-2}$
56.	A	H = $\frac{1}{2}gt^2$ => $t^2 = \frac{2h}{g}$ => t = $\sqrt{\frac{2h}{g}}$
57.	C	The only pair of SI base units is "ampere" and "kelvin".
58.	A	K.E = $\frac{1}{2}mv^2 = \frac{m^2v^2}{2m} = \frac{P^2}{2m}$
59.	B	F = ma => a = $\frac{F}{m}$(N kg^{-1})
60.	C	V = $\frac{a}{t}$ m/s = m/s^3 the only equation exist that have same units on both sides of equality.
61.	A	P = VI => watt = ampere x volt
62.	B	Both energy and work have same units. So,

		their ratio will be unit less.
63.	A	All are the units of energy except kilo watt (kW). Kilo watt (kW) is the unit of power.
64.	B	F = ma Units of "F" = $kgms^{-2}$
65.	B	$F = G\frac{m_1m_2}{r^2}$ ➔ $G = \frac{Fr^2}{m_1m_2}$ Unit of "G" = Nm^2kg^{-2} = $(kgms^{-2})(m^2kg^{-2}) = kg^{-1}m^3s^{-2}$
66.	B	$P = \frac{w}{t}$ => w = (P)(t) => Energy = (energy)(time) Unit of energy = (watt)(day)
67.	A	1000 microns = 1000 x 10^{-6} m = 10^{-3} m
68.	D	$W = \frac{0}{t}$ Unit of "w" = rad s^{-1}
69.	C	$F = \frac{1}{2\pi\sqrt{LC}} => \sqrt{LC} = \frac{1}{2\pi f} = \frac{T}{2\pi}$ Unit of $\sqrt{LC} = s$
70.	C	$C = \frac{Ae0}{d}$ => $E_o = \frac{Cd}{A}$ Unit of "E_o" = $\frac{Fm}{m^2} = \frac{F}{m}$
71.	A	$\frac{energy}{mass\ x\ length} = \frac{fd}{m\ x\ d} = \frac{(ma)d}{m\ x\ d}$ = a (acceleration)
72.	c.	Energy density = $\frac{energy}{volume}$ = Jm^{-3} = Nm m^{-3} = Nm^{-2} = Young's modulus
73.	D	All represent length. So, all have unit in meters.
74.	D	Units of energy is kgm^2s^{-2}
75.	B	$P = kI^2\left[\frac{l}{\lambda}\right]^2 = I^2R$ $\left[\frac{l}{\lambda}\right]^2$ = unit less K = R = ohm
76.	B	$\frac{1ms}{1fs} = \frac{10^{-13}}{10^{-15}} = 10^{12}$ => 1ms = 10^{12} fs
77.	A	$\frac{v^2}{rg} = \frac{m^2s^{-2}}{m.ms^{-2}}$ = no unit or unit less
78.	D	$\sqrt{\frac{energy}{mass}} = \left(\frac{energy}{mass}\right)^{1/2}$ $=\left(\frac{kgm^2s^{-2}}{kg}\right)^{1/2} = (m^2s^{-2})^{1/2} = ms^{-1}$ = velocity
79.	C	Coulomb = ampere x second
80.	A	RC = t, L/R = T while f 1/T
81.	A	F = 1/T = s^{-1} $\lambda = \frac{\Delta N/N}{\Delta t} = s^{-1}$
82.	A	$E = \frac{F}{q} = Fq^{-1}$ = newton $(coulomb)^{-1}$
83.	A	P = VI = (volt)x(ampere)
84.	D	As 1gcm^{-3} = 1000 kgm^{-3} 15.7 gcm^{-3} = 15.7 x 1000 kgm^{-3} = 15700 kgm^{-3}
85.	A	As $f_r = \frac{1}{2\pi\sqrt{LC}} => \sqrt{LC} = \frac{1}{2\pi f_r} = \frac{T}{2\pi} = second$
86.	D	Candela is the SI unit of luminous intensity
87.	B	Unit of term "λt" = 1

		$\lambda = 1/t = s^{-1}$ = unit of angular frequency
88.	C	F_D = w => $6\pi\eta r = mg => v = \frac{mg}{6\pi\eta r}$
89.	C	$1cm^3 = 1000\ mm^3$
90.	D	Ampere is a base unit while coulomb is a derived unit.
91.	D	Unit of pressure – Nm^{-2} Unit of K.E = Nm = J
92.	A	Unit of electric field intensity = NC^{-1} Unit of electric flux = Nm^2C^{-1}
93.	B	$\frac{B^2}{2u0}$ = energy density = Jm^{-3} = $kgm^{-1}s^{-2}$
94.	D	Mole is a base unit
95.	D	The symbol of unit named after a scientist has initial capital letter such as "N" for newton
96.	B	$U = \frac{ky}{y^2+a^2} => k = \frac{U(y^2+a^2)}{y} = \frac{jm^2}{m} = Jm$
97.	D	$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2} => \varepsilon_0 = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2} = \frac{C^2}{Nm^2} = N^{-1}m^{-2}C^2$
98.	A	$V = a + \frac{b}{t} + c^2$ By the principle of homogeneity $\frac{b}{t} = ms^{-1}$ => $bs^{-1} = ms^{-1}$ => b = m
99.	B	Mc^2 = x = energy = work
100.	C	Slug is he unit of mass in FPS system (British engineering system) 1 slug = 14.6 kg
101.	B	Candela is the base unit not physical quantity
102.	C	Radian is the supplementary unit. It is the unit of plane angle.
103.	***C***	*Light year is a distance which light travels in one year.*
104.	***B***	*Because magnitude is absolute.*
105.	***C***	*1 nm = 10^{-9} m = 10^{-7} cm*
106.	***D***	*1 micron* $= 10^{-6}m = 10^{-4}cm$
107.	***D***	ct^2 *must have dimensions of L* ⇨ *C must have dimensions of l/T^2 i.e. LT^{-2}*
108.	***A***	*Volume of cube* $= a^3$ *Surface area of cube* $= 6a^2$ *According to problem a = 6a => a = 6* $V = a^3 = 216\ units.$
109.	***B***	$6\ x\ 10^{-5} = 60\ x\ 10^{-6} = 60\ microns$
110.	***D***	*Because temperature is a fundamental quantity.*
111.	***A***	*Quantities of similar dimensions can be added or subtracted so unit of a will be same as that of velocity.*
112.	***A***	*Physical quantity (P) = Numerical value (n) x unit (u) if physical quantity remains constant then n ∝1/u* *Nu = nu.*
113.	***C***	$[x] = [bt^2] = [b] = [x/t^2]$ = *km / s^2*

114.	***B***	*Unit of a and PV are same and equal to dyne x cm.*
115.	***D***	*1 light year = 9.46 x 10^{15} meter*
116.	D	random error
117.	**<u>C</u>**	**Random errors can be reduced by taking average of several measurements**
118.	d	D=m/V=m/LLL=3/2222=3+2+2+2=9%
119.	c	P=VI=IRI=I2%I=2+2+2=6% Uncertainty in I=0.05/2.50 x100=2%
120.		P=V^2/R=VV/R=3%3%/2%=3+3+2=8%
121.	D	
122.	B	Hints; x=P-Q=1.27-0.03=1.24 , Error = 0.02+0.01=0.03 Percentage uncertainty= $\frac{\text{Error}}{\text{Measured quantity}}\times 100=\frac{0.03}{1.24}\times 100=2.4\approx 2$
123.	D	By formula of density D=m/V ,the error is 1%+3% = 4%
124.	C	$P=\frac{V^2}{R}=\frac{(3\%)^2}{2\%}=\frac{3\%\times 2}{2\%}$ $= 6\% + 2\% = 8\%$ Note; power is multliped to the error
125.	B	Area of sphere = $4\pi r^2$ => Thus uncertainty in area = $(1.6\%)^2$ = 1.6% × 2 = 3.2% (In uncertainty power is multiplied)
126.	A	Maximum Error in K.E = $\frac{1}{2}$ mv^2 = (5%)($6\%)^2$= (5%) + (6%x2) = 17%
127.		
128.		
129.	A	Total uncertainty, in result obtained from the subtraction of two measurement, is equal to sum of their absolute uncertainties
130.	D	The error in measurement may occur due to A) inexperience of a person B) the faulty apparatus C) inappropriate method
131.	A	A zero error is a systematic error.
132.	C	Random error arises when measured value is higher or lower than its true value.
133.	D	The uncertainty in a measurement may occur due to A) limitation of an instrument B) natural variation of the object to be measured C) inadequate of technique
134.	C	Random errors can be reduced by taking mean of several measurement
135.	B	Smaller the least count of the instrument more is the measurement precise

136.	B	Absolute uncertainty in a measurement depends upon least count of the instrument
137.	C	Zero error of the instrument is a type of systematic error
138.	D	
139.	<u>C</u>	Random errors can be reduced by taking average of several measurements
140.	d	D=m/V=m/LLL=3/2222=3+2+2+2=9%
141.	c	P=VI=IRI=I2%I=2+2+2=6% Uncertainty in I=0.05/2.50 x100=2%
142.		P=V^2/R=VV/R=3%3%/2%=3+3+2=8%
143.	D	
144.	B	Hints; x=P-Q=1.27-0.03=1.24 , Error = 0.02+0.01=0.03 Percentage uncertainty= $\frac{\text{Error}}{\text{Measured quantity}}\times 100=\frac{0.03}{1.24}\times 100=2.4\approx 2$
145.	D	By formula of density D=m/V ,the error is 1%+3% = 4%
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147.	B	Area of sphere = $4\pi r^2$ => Thus uncertainty in area = $(1.6\%)^2$ = 1.6% × 2 = 3.2% (In uncertainty power is multiplied)
148.	A	Maximum Error in K.E = $\frac{1}{2}$ mv^2 = (5%)($6\%)^2$= (5%) + (6%x2) = 17%
149.	B	Two major types of errors are systematic error and random error
150.	B	Errors due incorrect design or caliberation of the measuring device are called systematic error
151.	C	K.E = $\frac{1}{m}$ mv^2 Uncertainity in K.E = %age uncertainty in mass + 2(%age uncertainty in velocity) = 2% + 2(3%) = 8%
152.	B	$R_e = R_1 + R_2$ In addition and subtraction absolute uncertainties are added.
153.	D	$P=\frac{m}{V}=\frac{m}{L^3}$ Uncertainty in p = %age uncertainty in mass + 3(%age uncertainity in length) = 3% + 3(2%) = 9%
154.	A	%age uncertainty in V = $\frac{0.5}{8}$ x 100% = 6.25% %age uncertainty in I = $\frac{0.2}{2}$ x 100% = 10% Uncertainty in R = %age uncertainty in V + %age uncertainty in 1 = 6.25% + 10% = 16.25%
155.	C	%age uncertainty in time = $\frac{least\ count}{measured\ value}\ x$ 100%

		$= \frac{0.2}{25} x\ 100\% = 0.8\%$
156.	D	Area of wire $\pi r^2 = \pi\left(\frac{d}{2}\right)^2$ %age uncertainty in are of wire = 2x (%age uncertainty in radius or diameter)
157.	C	Uncertainty in the time period = $\frac{absolute\ uncertainly\ of\ stop\ watch}{total\ number\ of\ vibration}$
158.	B	In addition and subtraction absolute uncertainities are added
159.	B	As the absolute uncertainty (least count) of screw gauge is 0.001 cm so, it recorded up-to three decimal places.
160.	D	V = $\frac{4}{3}\pi r^3$ Uncertainty in V = 3(%age uncertainty in radius) = 3(2%) = 6%
161.	D	In multiplication and division percentage or fractional uncertainties are added.
162.	B	Δx = $x_2 - x_1$ = (26.8 – 10.5) $\pm$ (0.1 + 0.1) = 16.3 $\pm$ 0.2 cm In addition and subtraction absolute uncertainties are added
163.	C	Maximum error in any measurement – Least count of instrument being used (absolute uncertainty) so, T = (2.00 $\pm$ 0.05) s
164.	A	%age uncertainty in depth = $\frac{0.2}{24}$ x 100 = 0.8%
165.	B	A = 4 πr^2 Uncertainty in area = 2(%age uncertainty in radius) Uncertainty in area = 2(1.6%) = 3.2%
166.	C	By definition of systematic error
167.	C	Fractional or relative error in "a" = $\frac{\Delta a}{a}$ Fractional or relative error in "x" = n $\left(\frac{\Delta a}{a}\right)$
168.	B	By definition of systematic error.
169.	A	Error in R = %age error in 'V" = %age error in "I" = 3% + 3% = 6%
170.	A	Area of sphere = $4\pi r^2$ Error in area = 2(%age error in radius) Error in area = 2(%1) = 2%
171.	B	Error refers to an effect that influences all measurements of a particular quantity equal is called systematic error. It produces a consistent difference in reading. It occurs to some definite rule. It may occur due to the zero error, poor calibration of instruments of incorrect marking etc.
172.	B	Error refers to an effect that influences all measurements of a particular quantity equally is called systematic error. It produces a consistent difference in reading. It occurs to some definite rule. It may occur due to the zero error, poor calibration of instruments or incorrect marking etc.
173.	C	Error in volume of sphere = 3(%age error in radius) $=3\left(\frac{least}{measured\ value}\ x\ 100\right) = 3\left(\frac{0.1}{5.3} x\ 100\right)$
174.	D	The error in a measurement may occur due to i. Negligence or inexperience of a person ii. The fault apparatus iii. Inappropriate method or technique
175.	D	Error in Q = 2 (error in current) + error in Resistance + error in Time Error in Q = 2(2%) + 1% + 1% = 6
176.	B	Error in pressure = error in force +2(Error in length) Error in pressure = 4% + 2(2%) = 8%
177.	C	Because errors are always be added
178.	B	All the seven base quantities are scalar in nature.
179.	A	Error in diameter of wire = $\frac{Least\ Count}{Measured\ Value}\ x\ 100\%$ = $\frac{0.005}{0.020}$ x 100% = 25%
180.	A	Error in P = 3(%age error in "a") + 2(%age error in "b") + (%age error in "c") + (%age error in "d") Error in P = 3(1%) + 2(2%) + (3%) + (4%) = 14%
181.	C	%age error in V = $\frac{5}{100} x\ 100 = 5\%$ %age error in I = $\frac{0.2}{10} x\ 100 = 2\%$ Total error in R = 5% + 2% - 7% (errors always be added)
182.	D	Systematic error in the instrumental error that may occur due to poor calibration. So, to remove this recalibrating the instrument.
183.	C	%age error in L = $\frac{5}{100} x\ 100 = 5\%$ %age error in I = $\frac{0.2}{10}$ x 100 = 2% Total error in g = %age error in L + 2(%age error in T) (error always be added)
184.	D	%age error in distance = $\frac{0.2}{10} x\ 100 = 2\%$ %age error in time = $\frac{0.3}{4} x\ 100 = 7.5\%$ Total error in velocity = 2% + 7.5% = 9.5% (errors always be added)
185.	D	Since volume V = r^3, the fractional uncertainly in the value of volume is given by

		$\frac{\Delta V}{V} = 3\left(\frac{\Delta t}{t}\right) = +3\left(\frac{0.1}{30}\right) = +0.01 = +1\%$
186.	d	Uncertainly, ΔV = (4.072 x 1% + 10 mV) = 0.0572 = 0.05 V (1 S.F.) V $\pm$ ΔV = (4.07 $\pm$ 0.05) V Where decimal places of V and λV are the same, in the hundredth decimal place in this case.
187.	D	Fractional uncertainly = $\frac{0.00005}{0.00160} = \frac{5}{160}$ = 0.03125 Percentage uncertainly = fractional uncertainly x 100% = 3.125% = 3%
188.	c	$R = \frac{V}{I}$ Given $\frac{\Delta V}{V} x\ 100\% = 3\%$ $\frac{\Delta A}{A} x\ 100\% = 2\%$ $\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$ => $\frac{\Delta R}{R} x\ 100\% = \frac{\Delta V}{V} x\ 100\% + \frac{\Delta I}{I} x\ 100\%$ = 3% + 2% = 5%
189.	D	$g \propto \frac{l}{T^2}$ => uncertainly in calculated value for g = uncertainly in measurement of l + (2 x uncertainly in measurement of T) = 4% + 2(1%) =6%
190.	D	Random errors
191.	B	physical quantities
192.	A	Accurate because value is near to 9.8 but not precise because least count is little more.
193.	C	
194.	A	Smaller L.C——>More precise measurement. Relative Erro——>More Accurate
195.	C	
196.	A	Accurate because value is near to 9.8 but not precise because least count is little more.
197.	A	Smaller L.C––––>More precise measurement. Relative Erro–––>More Accurate
198.	B	Uncertainty in time period = $\frac{Least\ count}{No.of\ vibration}$
199.	B	Precision relates to the least count of instrument. Smaller the least count, more precise will be the instrument. The minimum reading (length) that can be measured by any instrument (L.C) is the precision of that instrument.
200.	A	Accurate measurement is the one which is near to true value.
201.	B	As the least count of screw gauge is smallest then meter rod and vernier calipers. So, it is most precise among them.
202.	C	A precise measurement is the one which has less absolute uncertainty and accurate measurement is the one which has less fractional or percentage uncertainty or error.
203.	C	A precise measurement is the one which has less absolute uncertainty or least count.
204.	B	The precision of a measurement is determined by the instrument being used. A precise measurement is that which has less absolute uncertainty.
205.	B	A precise measurement is that which has less absolute uncertainty.
206.	A	Uncertainty in time period = $\frac{least\ count}{no\ of\ vibrations}$ = $\frac{0.1}{30}$s = 0.003 s
207.	C	When repeated measurements of the quantity give different values under the same conditions, such type of error is called random error. It is due to some unknown causes. This error can be reduced by repeating the measurements several times and taking an average.
208.	A	An accurate measurement is that which has less fractional or percentage uncertainty
209.	D	This error can be reduced by comparing the instrument with another which is known to be more accurate or applying a correction factor.
210.	D	Mean measurement = $\frac{1.02\ x\ 4+1.01}{5}$ = 1.02 mm Value of d = 1.02 – (-0.02) = 1.04 mm
211.	D	% systematic error is $\frac{0.08}{2.16} x\ 100\% = 3.7\%$ It is accurate as the systematic error is small (i.e. close to the true value). It is precise as the random error is small (i.e. 0.02 V).
212.	d	A small spread of the measurements in an experiment is said to be precise. On the other hand, the set of results is not accurate if the measured mean value deviates too far from the true value, for example, if the systematic error associated with the

		experiment is too large. Acceleration of free fall, g = 9.81 ms^{-2}

Student	Max. deviation = max. value – min. value	Mean of the set of value
A	9.84 – 9.79 = 0.05	9.85
B	10.12 – 8.94 = 1.18	9.69
C	9.45 – 8.76 = 0.69	9.10
D	8.50 – 8.41 = 0.09	8.46

		Hence, set of values measured by student D can say to be precise but not accurate.
213.	a	$S = ut + \frac{1}{2}at^2$ As u = 0 (falls freely from rest), $S = \frac{1}{2}gt^2 => t^2 = \left(\frac{2}{g}\right)s$ $\frac{2}{g} = 0.204 => gradient, g =$ $9.80\ ms^{-2}, which\ is\ close\ to\ true$ value of 9.80 ms^{-2}. The value of calculated g is accurate. As the plotted points are distributed about best fit line, it is not precise.
214.		
215.	C	1 m is closed to year
216.	**C**	0.5 A= 0.5 mA/m = 0.5/10^{-3} mA= 0.5 x 10^3 mA= 5x 1000 mA=500 mA
217.		
218.	**D**	1Gm =Gaga meter = 10^9,1μm = micro meter = 10^{-6} Thus; 1Gm/1μm = $\frac{10^9}{10^{-6}}$ = $10^9 \times 10^6$ = 10^{15})
219.	**C**	Pice = 10^{-12}
220.	D	10^{-12}
221.	C	
222.	C	
223.	c	The zero between two significant figure is also significant and power is not counted in significant figures.
224.	**A**	2.3 × 10^{-3}. Decimal moved to right after first non zero digit and sign of power will be negative while moving to right
225.	B	Answer should be carried to least significant figure operation i.e. 4.81 which are to be multiplied.
226.	B	Zero after decimal to the right are also significant
227.	A	Zero after decimal to the right are also significant because it sow least count of measuring instrument
228.	b	Number in powers are in included in significant figures
229.	D	Number in powers are in included in significant figures
230.	D	If L.C is 100 than 1 significant figure. If L.C is 10 than 2 significant figure. As there are 500 spectators and are counted one by one means L.C is 1 So there will be 3 significant figure
231.	**D**	as Peta = 10^{15} so Light year = 9.5 × 10^{15} m = peta meter
232.	A	
233.	C	Value of error = 327.66 x 3% = 9.83 ms^{-1}= 10 ms^{-1} (1 sig. fig.) Speed of sound = 330 ms^{-1} (rounded to the same tens place as the error).
234.	a	1024 can be written in scientific notation as 1.024x10^3
235.	D	In any measurement the significant figures are all accurately known digits and the first doubtful digit
236.	A	A digit zero in a measurement may be significant may not significant
237.	A	Number of significant figures in 0.0173 are Three. Zero on left is not significant.
238.	A	Least count of meter rod is mm. so 6200/1 = 6200 = 4 significant fingures
239.	c	The zero between two significant figures is also significant and power is not counted in significant figures.
240.	A	2.3 × 10^{-3}. Decimal moved to right after first non zero digit and sign of power will be negative while moving to right
241.	B	Answer should be carried to least significant figure operation i.e. 4.81 which are to be multiplied.
242.	B	Zero after decimal to the right are also significant
243.	A	Zero after decimal to the right are also significant because it sow least count of measuring instrument
244.	b	Number in powers are in included in significant figures
245.	D	Number in powers are in included in significant figures
246.	D	If L.C is 100 than 1 significant figure. If L.C is 10 than 2 significant figure. As there are 500 spectators and are counted one by one means L.C is 1 So there will be 3 significant figure
247.	C	If L.C is 100 than 1 significant figure. If L.C is 10 than 2 significant figure. As there are 500 spectators and are counted one by one means L.C is 1 So there will be 3 significant figure
248.	B	500/100 = 5 = 1 significant figure.
249.	A	P = F/A = ma/A = kg m/s^2m^2 = M/LT^2 =

		$ML^{-1}T^{-2}$
250.	A	$\Delta P/t=\Delta mv/t=\Delta ma=\Delta F$
251.	A	A=BC thus B=A/C (putting dimesnsion of both A and C) we get B= $\frac{L/M}{L/T}$ = T/M
252.	A	Angle is ration between two length so it has no unit and no dimension.
253.	b	E=hf →h=E/f=ET=k.E t= M (L^2/T^2) T= ML^2T^{-1}. Not dimesntion for all types of energy are same
254.	B	W= Fd and torque = Fr as r and d have same dimensionso work and torwue have also same dimension.
255.	D	F=6πηrv →η=F/6πrv=F/rv=ma/rv=$\frac{mv/t}{rv}$ = $ML^{-1}T^{-1}$
256.	D	Work is ability to do work and its type of energy so it has same dimension.
257.	B	F=gM1M2/R^2→ g = FR^2/M1M2→$MLT^{-2}L^2M^{-2}$ → $M^{-1}L^3T^{-2}$
258.	D	Torque = rf = L MLT^{-2} = ML^2T^{-2}
259.	C	Impulse = Ft=mv/t xt= mv and momentum =mv
260.	C	Angular acceleration = a/r=s/ttr=1/tt= T^{-2}
261.	D	E=hf→h=E/f=Et=Wt =Frt=mart=mvrt/t=mvr = pr = Angular momentum
262.	D	All of these are rarion of same wuantity so all are dimensionless.
263.	D	
264.	C	Electromotive force & potential differenc both have same dimension
265.	A	For valid formula dimension of both sides are same; v = $\sqrt{g\lambda}$ = $\sqrt{\frac{m}{S2}\times m}$ = $\sqrt{\frac{m^2}{S^2}}$ = m/s = Velocity.
266.	A	A=BC→ B=$\frac{A}{C}=\frac{L/M}{L/T}=\frac{LT}{ML}=\frac{T}{M}=$
267.	C	
268.	**C**	
269.	D	Dimensional analysis is helpful for A) deriving a possible formula B) checking the homogeneity of a physical equation C) verification of laws
270.	C	Only equation c is incorret
271.	B	Correct: S=Vit+ $\frac{1}{2}$at²
272.	A	A=BC thus B=A/C (putting dimesnsion of both A and C) we get B= $\frac{L/M}{L/T}$ = T/M
273.	A	L=rp=rmv=rms/t= m kg m/s= kg m² /s E=hf→h=E/f=ET=wt=Fdt=madt=mdvt/t=m dv=mds/t=kg m m /s = kg m² /s
274.	A	Angle is ration between two length so it has no unit and no dimension.

275.	b	E=hf →h=E/f=ET=k.E t= M (L^2/T^2) T= ML^2T^{-1}. Not dimesntion for all types of energy are same
276.	B	W= Fd and torque = Fr as r and d have same dimensionso work and torwue have also same dimension.
277.	D	F=6πηrv →η=F/6πrv=F/rv=ma/rv=$\frac{mv/t}{rv}$ = $ML^{-1}T^{-1}$
278.	D	Work is ability to do work and its type of energy so it has same dimension.
279.	B	F=gM1M2/R^2→ g = FR^2/M1M2→$MLT^{-2}L^2M^{-2}$ → $M^{-1}L^3T^{-2}$
280.	D	Torque = rf = L MLT^{-2} = ML^2T^{-2}
281.	C	Impulse = Ft=mv/t xt= mv and Momentum =mv
282.	C	Angular acceleration = a/r=s/ttr=1/tt= T^{-2}
283.	D	E=hf→h=E/f=Et=Wt =Frt=mart=mvrt/t=mvr = pr = Angular Momentum
284.	D	All of these are rarion of same wuantity so all are dimensionless.
285.	A	For valid formula dimension of both sides are same; v = $\sqrt{g\lambda}$ = $\sqrt{\frac{m}{S2}\times m}$ = $\sqrt{\frac{m^2}{S^2}}$ = m/s = Velocity.
286.	A	A=BC→ B=$\frac{A}{C}=\frac{\frac{L}{M}}{\frac{L}{T}}=\frac{LT}{ML}=\frac{T}{M}$
287.	A	Dimensions of surface tension = [MT^{-2}] Dimensions of co-efficient of viscosity = [$ML^{-1}T^{-1}$] In both cases the power of "M" is same i.e. , "I"
288.	D	All given quantities are the ratios of same physical quantities. So, these are the unit less and dimensionless.
289.	A	Light year and wavelength both have the dimensions of distance [L]
290.	A	Steradian (sr) is the SI unit of solid angle. By definition of Sr 1sr = $\frac{Area\ of\ circular\ patch\ on\ sphere}{square\ of\ radius\ of\ sphere}$ = $\left[\frac{L^2}{L^2}\right]$ = dimension less
291.	D	$\frac{EL^2}{M^5G^2}=\frac{[ML^2][ML^2T^{-1}]^2}{[M]^5[M^{-1}L^3T^{-2}]^2}=\frac{[M^3L^6T^{-4}]}{[M^3L^6T^{-4}]}$ = dimension less
292.	D	Fractional uncertainty = $\frac{absolute\ uncertainity\ of\ leaset\ count}{measured\ value}$ As it the ratio of same dimensional quantities. So, it has no unit or unit less.
293.	B	0 = $\frac{arc\ length}{radius}$ => [0] = $\frac{[l]}{[r]}=\frac{[L]}{[L]}$ = [L^o]
294.	A	[G] = $\frac{[F][r^2]}{[m1][m2]}=\frac{[MLT^{-2}][L^2]}{[M][M]}$ = [$M^{-1}L^3T^{-2}$]

295.	C	N = $\frac{F}{6\pi v r}$ => [n] = $\frac{[F]}{[V][r]}$ = [$ML^{-1}T^{-1}$] P = $\frac{F}{A}$ => [P] = $\frac{[F]}{[A\}}$ = [$ML^{-1}T^{-2}$]
296.	B	F = $\frac{1}{T}$ => [f] = [T^{-1}] = [$M^oL^oT^{-1}$]
297.	D	As speed of light, e = $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$ => $C^2 = \frac{1}{\mu_0\varepsilon_0}$ By the principle of homogeneity both sides have same SI unit and dimensions.
298.	D	By definition T = r x F (vector) and W = F.D (scalar)
299.	A	Unit of torque = Nm = kgm^{2}s^{-2} Unit of angular Momentum = J s = kgm^{2}s^{-1}
300.	D	Energy density and pressure have same SI unit kg m^{-1}s^{-2} while angular Momentum have dimension kg m^{2}s^{-1}
301.	C	$\lambda = \frac{\Delta N/N}{\Delta t}$ = s^{-1} = frequency
302.	B	RC = t = capacitive time constant
303.	A	L = rP => r = $\frac{L}{P} = [L]$
304.	A	In thermodynamic process W = PΔV = energy = joule
305.	A	Quantities of same kind (dimensions) are added or subtracted according to principle of homogeneity
306.	D	As energy density = $\frac{1B^2}{2\mu_0}$ = Jm^{-3} = kgm^{-1}s^{-2} As "A" , "B" and "C" options have same dimensional units as that of energy density.
307.	***A***	*Pressure* = $\frac{Force}{Area} = ML^{-1}T^{-2}$ *Stress* = $\frac{Restoring\ force}{Area} = ML^{-1}T^{-2}$
308.	***C***	$Strain = \frac{\Delta L}{L}$ = *dimensionless quantity*
309.	***B***	$Power = \frac{Work}{Time} = \frac{ML^2T^{-2}}{T} = ML^2T^{-3}$
310.	***A***	*Calorie is the unit of heat i.e., energy.* *So dimensions of energy* = ML^2T^{-2}.
311.	***B***	*Angular momentum = mvr* = $MLT^{-1}x\ L = ML^2T^{-1}$
312.	***C***	$\frac{L}{R} = Time\ constant$
313.	***C***	*Impulse = change in momentum so dimensions of both quantities will be same and equal to MLT*
314.	***B***	*RC = T* *[R]* = $[ML^2T^{-3}I^{-2}]$*and* $[C] = [M^{-1}L^{-2}T^4I^2]$
315.	***Ad***	*[Torque] = [work] = [MLT]* *[Light year] = [Wavelength] = [L]*
316.	***D***	*Volume elasticity* = $\frac{Force/Area}{VOlume\ Strain}$ *Strain is dimensionless, so* $= \frac{Force}{Area} = \frac{MLT^{-2}}{L^2} = [ML^{-1}T^{-2}]$
317.	***B***	$F = \frac{Gm_1m_2}{d^2} => G = \frac{Fd^2}{m_1m_2}$ $[G] = \frac{[MLT^{-2}][L^2]}{[M^2]} = [M^{-1}L^3T^{-2}]$
318.	***A***	*Angular velocity* = $\frac{\theta}{t}, [\omega] = \frac{[M^0L^0T^0]}{[T]} = [T^{-1}]$
319.	***A***	$Power = \frac{Work\ done}{Time} = \left[\frac{ML^2T^{-2}}{T}\right] = [ML^2T^{-3}]$
320.	***A***	*Couple = Force x Arm length = [MLT^{-2}][L] = [ML^{2}T^{-2}]*
321.	***B***	*Angular momentum = mvr* $= [MLT^{-1}][L] = [ML^2T^{-1}]$
322.	***B***	*Impoulse = force x time* = $[MLT^{-2}][T] = [MLT^{-1}]$
323.	***D***	*Modulus of rigidity* = $\frac{Shear\ stress}{Shear\ strain} = [ML^{-1}T^{-2}]$
324.	***C***	*E = hv* => $[ML^2T^{-2}] = [h][T^{-1}] => [h] = [ML^2T^{-1}]$
325.	***B***	*Moment of inertia = mr^2 = [M][L^2]* *Moment of Force = Force x Perpendicular distance* $=[MLT^{-2}][L] = [ML^2T^{-2}]$
326.	***A***	*Momentum = mv* = $[MLT^{-1}]$ *Impulse = Force x Time* = $[MLT^{-2}]x\ [T] = [MLT^{-1}]$
327.	***B***	*Pressure* = $\frac{Force}{Area} = \frac{Energy}{Volume} = ML^{-1}T^{-2}$
328.	***D***	*[h] = [Angularmomentum]* = $[ML^2T^{-1}]$
329.	***A***	*By principle of dimensional homogeneity* $\left[\frac{a}{V^2}\right] = [P]$ *[a] = [P] [V^2]* = $[ML^{-1}T^{-2}]x\ [L^6] = [ML^5T^{-2}]$
330.	***D***	$\frac{1}{2}CV^2$ = *stored energy in a capacity* = $[ML^2T^{-2}]$
331.	***A***	$\frac{1}{2}Li^2$ = *Stored energy in an inductor* = $[ML^2T^{-2}]$
332.	***D***	*Energy per unit volume* = $\frac{[ML^2T^{-2}]}{[L^3]} = [ML^{-1}T^{-2}]$ *Force per unit area* = $\frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$ *Product of voltage and charge per unit volume* $= \frac{V\ x\ Q}{Volume} = \frac{VIt}{Volume} = \frac{Power\ x\ Time}{Volume}$ $= \frac{[ML^2T^{-3}][T]}{[L^3]} = [ML^{-1}T^{-2}]$ *Angular momentum per unit mass* = $\frac{[ML^2T^{-1}]}{[M]} = [L^2T^{-1}]$ *So angular momentum per unit mass has different dimension.*

333.	***D***	*Time constant* $\tau = [T]$ *and Viscosity* $n = [ML^{-1}T^{-1}]$ *For options (a), (b) and (c) dimensions are not matching with time constant.*
334.	***C***	*M = linear density = mass per unit length =* $\left[\frac{M}{L}\right]$ *A = force =* $[MLT^{-2}]$ $[B] = \frac{[A]}{[m]} = \frac{[MLT^{-2}]}{[ML^{-1}]} = [L^2T^{-2}]$ *This is same dimension as that of latent heat.*
335.	***C***	*Let* $v^x = kg^y\lambda^z p^\delta$. *Now by substituting the dimensions of each quantities and equating the powers of M, L and T we get* $\delta = 0$ *and* $x = 2, y = 1, z = 1$.
336.	***A***	*Farad is the unit of capacitance and* $C = \frac{Q}{V} = \frac{[Q]}{[ML^2T^{-2}Q^{-1}]} = M^{-1}L^{-2}T^2Q^2$
337.	***A***	$P = \frac{RA}{l}$ *i.e. dimension of resistivity is* $[ML^3T^{-1}Q^{-2}]$
338.	***B***	*From the principle of homogeneity* $\left(\frac{x}{v}\right)$ *has dimensions of T.*
339.	***B***	$\frac{dQ}{dt} = -KA\left(\frac{d\theta}{dx}\right)$ $= [K] = \frac{[ML^2T^{-2}]}{[T]} x \frac{[L]}{[L^2][K]} = MLT^{-3}K^{-1}$
340.	***C***	$Stress = \frac{Force}{Area} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$
341.	***A***	$[C] = \left(\frac{Q}{V}\right) = \left(\frac{Q^2}{W}\right) = \left[\frac{A^2T^2}{ML^2T^{-2}}\right] = [M^{-1}L^{-2}T^4A^2]$
342.	***B***	*Momentum = mv =* $[MLT^{-1}]$
343.	***A***	$Q = [ML^2T^{-2}]$ *(All energies have same dimension)*
344.	***B***	$f = \frac{1}{2\pi\sqrt{LC}} = LC = \frac{1}{f^2} = [M^0L^0T^2]$
345.	***D***	*Energy = Work done [Dimensionally]*
346.	***D***	$\frac{L}{R}$ *= Time constant.*
347.	***D***	*[Planck constant] =* $[ML^2T^{-1}]$ *and [Energy] =* $[ML^2T^{-2}]$
348.	***B***	*Frequency =* $\frac{1}{T} = [M^0L^0T^{-1}]$
349.	***A***	*Power =* $\frac{Energy}{Time}$
350.	***B***	*Wave number =* $\frac{1}{\lambda}$ *Dimension is* $[M^0L^{-1}T^0]$
351.	***B***	$[Pressure] = [stress] = [ML^{-1}T^{-2}]$
352.	***A***	$F = \frac{\mu_0}{4\pi}\frac{2I_1I_2l}{r} = \mu_0 = [F][A]^{-2} = [MLT^{-2}A^{-2}]$
353.	***A***	$\Phi = BA = \frac{F}{IxL}A = \frac{[MLT^{-2}][L^2]}{[A][L]} = [ML^2T^{-2}A^{-1}]$
354.	***B***	*By substituting the dimension of given quantities* $[ML^{-1}T^{-2}]^x[MT^{-3}]^y[LT^{-1}]^z = [MLT]^0$ *By comparing the power of M, L, T in both sides* *x + y = 0* *-x + z = 0* *-2x – 3y – z = 0* *The only values of x,y,z satisfying (i), (ii) and (iii) corresponds to (b)*
355.	***D***	*Strain is dimensionless.*
356.	***C***	*Dimensions of power is* $[ML^2T^{-3}]$
357.	***A***	*Kinetic energy =* $\frac{1}{2}mv^2 = M[LT^{-1}]^2 = [ML^2T^{-2}]$
358.	***A***	*Torque = force x distance =* $[ML^2T^{-2}]$
359.	***C***	*F = -n, A* $\frac{dv}{dx} = [n] = [ML^{-1}T^{-1}]$
360.	***C***	$\frac{L}{RCV} = \left[\frac{L}{R}\right]\frac{1}{CV} = \frac{T}{Q} = [A^{-1}]$
361.	***A***	$\frac{Angularmomentum}{Linearmomentum} = \frac{mvr}{mv} = r = [M^0L^1T^0]$
362.	***B***	*Dimension of work and torque =* $[ML^2T^{-2}]$
363.	***D***	*Surface tension =* $\frac{Force}{Length} = \frac{[MLT^{-2}]}{L} = [MT^{-2}]$
364.	***A***	*Linear momentum = Mass x Velocity =* $[MLT^{-1}]$ *Moment of a force = force x distance =* $[MLT^2\ T^2]$
365.	***B***	$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2}$ = $\varepsilon_0 = \frac{\lvert q_1\rvert\lvert q_2\rvert}{[F][r^2]} = \frac{[A^2T^2]}{[MLT^{-2}][L^2]} = [A^2T^4M^{-1}L^{-23}]$
366.	***D***	*[Pressure] = [Stress] = [coefficient of elasticity] =* $[ML^{-1}T^{-2}]$
367.	***C***	*Capacity x Resistance =* $\frac{Charge}{Potential} x \frac{Volt}{amp}$ $= \frac{amp\ x\ second\ x\ Volt}{Volt\ x\ amp}$ *= second*
368.	***D***	*Strain has no dimensions.*
369.	***C***	$B = \frac{F}{IL} = \frac{[MLT^{-2}]}{[A][L]} = [ML^{-2}A^{-1}]$
370.	***A***	$n = \frac{F}{av} = \frac{[MLT^{-2}]}{[L][LT^{-1}]} = [ML^{-1}T^{-1}]$
371.	***A***	*Couple of force = |r x F| =* $[ML^2T^{-2}]$ *Work = [F.d] =* $[ML^2T^{-2}]$
372.	***A***	*Quantities having different dimensions can only be divided or multiplied but they cannot be added or subtracted.*
373.	***B***	*From the principle of dimensional homogeneity* $[a] = \left[\frac{F}{t}\right] = [MLT^{-3}] and\ [b] = \left[\frac{F}{t^2}\right] = [MLT^{-4}]$
374.	***A***	$K = Y = r_o = [ML^{-1}T^{-2}]x[L] = [MT^{-2}]$ *Y = Young's modulus and* r_0 *= interatomic*

distance

375. **B** Let $[G] \propto c^x g^y p^z$
By substituting the following dimensions:
$[G] = [M^{-1}L^3T^{-2}], [C] = [LT^{-1}], [g] = [LT^{-2}]$
$[P] = [ML^{-1}T^{-2}]$
And by comparing the powers of both sides we can get x = 0, y = 2, z = -1
$[G] \propto c^0 g^2 p^{-1}$

376. **A** Let $T \propto S^x r^y p^z$
By substituting the dimensions of [T] = [T]
$[S] = [MT^{-2}], [r] = [L], [p] = [ML^{-3}]$
And by comparing the power of both the sides
X = -1 /2, y = 3 /2 , z = 1 / 2
So $T \propto \sqrt{pr^3/S}$ => $T = k\sqrt{\frac{pr^3}{S}}$

377. **A** Resistivity $[p] = \frac{[R].[A]}{[l]}$. where $[R] = [ML^2T^{-1}Q^{-2}]$
$[p] = [ML^3T^{-1}Q^{-2}]$

378. **A** $I = \frac{Q}{t} = \frac{[Q]}{[T]} = [M^0L^0T^{-1}Q]$

379. **C** Torque = $[ML^2T^{-2}]$, Angular momentum = $[ML^2T^{-1}]$ So mass and length have the same dimensions

380. **A** Let $F \propto P^x V^y T^z$
By substituting the following dimensions:
$[P] = [ML^{-1}T^{-2}][V] = [LT^{-1}], [T] = [T]$
And comparing the dimensions of both sides
$x = 1, x = 2, z = 2, so\ F = PV^2T^2$

381. **D** $\frac{Energy}{mass\ x\ length} = \frac{[ML^2T^{-2}]}{[M][L]} = [LT^2]$

382. **B** Let $m \propto E^x v^y F^z$
By substituting the following dimensions:
$[E] = [ML^2T^{-2}], [v] = [LT^{-1}], [F] = [MLT^{-2}]$
And by equating the both sides
$x = 1, y = -2, z = 0, So\ [m] = [Ev^{-2}]$

383. **C** Tension = $[MLT^{-2}]$, surface Tension = $[MT^{-2}]$

384. **D** Torque = $[ML^2T^{-2}]$, moment of inertia = $[ML^2]$

385. **C** Angular momentum = $[ML^2T^{-1}]$, Frequency = $[T^{-1}]$

386. **C** Latent Heat $L = \frac{Q}{m} = \frac{Energy}{mass} = \frac{[ML^2T^{-2}]}{[M]} = [L^2T^{-2}]$

387. **A** $C = \frac{Q}{V} = \frac{[AT]}{[ML^2T^{-3}A^{-1}]} = [M^{-1}L^{-2}T^4A^2]$

388. **D** Charge = current x time = [AT]

389. **B** $F = -nA\frac{\Delta v}{\Delta z}$ => $[n] = [ML^{-1}T^{-1}]$
As $F = [MLT^{-2}], A = [L^2], \frac{\Delta v}{\Delta z} = [T^{-1}]$

390. **B** $\frac{Energy}{Volume} = \frac{ML^2T^{-2}}{L^3} = [ML^{-1}T^{-2}]$= Pressure

391. **C** $\omega = \frac{d\theta}{dt} = [T^{-1}]$ and frequency [n] = $[T^{-1}]$

392. **D** $F \propto v$ => $F = kv$ => $[k] = \left[\frac{F}{v}\right] = \left[\frac{MLT^{-2}}{L^{-1}}\right] = [MT^{-1}]$

393. **D** $[G] = [M^{-1}L^3T^{-2}]; [h] = [ML^2T^{-1}]$
Power = $\frac{1}{focal\ length} = [L^{-1}]$
All quantities have dimensions

Chapter 03 Force and Motion

Distance , displacement , speed ,velocity and acceleration.

1) A ball thrown vertically upwards will have constant _____ and a varying _____. **ETEA-2023**
a) Velocity and acceleration
b) Kinetic energy, velocity
c) Acceleration, velocity
d) Kinetic energy and acceleration

2) if a moving object has no force acting on it: **ETEA-2023**
a) it will decelerate and eventually stop
b) continue to move in a straight line at constant velocity
c) it will stop immediately
d) its velocity will increase while moving in a straight line

3) Measure of displacement covered with passage of time is called: **ETEA-2023**
a) Acceleration
b) Speed
c) Velocity
d) Deceleration

4) A body covers displacement of 10m towards north and returns back to initial point by covering 10 towards south, its total displacement is : **ETEA-2022**
a) 20m north
b) 10m south
c) 0m along north-south
d) 0m

5) The net displacement divided by the total time (t) is

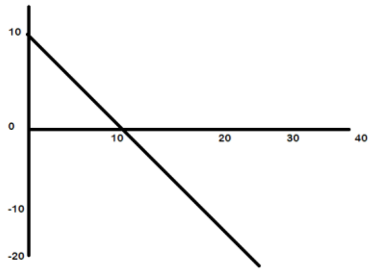
known as: **ETEA-2022**
a) Instantaneous velocity
b) Uniform velocity
c) Average velocity
d) Variable velocity

6) The velocity time graph of a motion starting from rest with uniform acceleration is a straight line: **ETEA-2022**
a) Not passing through origin
b) Parallel to time axis
c) Parallel to velocity axis
d) Passing through origin

7) Under what condition an object will have zero displacement but non zero Distance? : **NMDCAT-2020**
a. Linear motion. b. Circular motion.
c. Random motion. d. Oscillation

8) The slope of distance -time graph will always be: **NMDCAT-2020**
a. Negative. b. Positive.
c. Zero. d. Maximum.

9) The velocity time plot for a particular moving on a straight line is shown in the figure



; **ETEA-2019**
a) The particle has a constant acceleration
b) The particle has never turned around
c) The particle has zero displacement
d) The data is insufficient

10) The time rate of change of velocity is called: **NUMS -2022-2021**
a. Force
b. Acceleration
c. Power
d. Energy

11) ...ravels at 20m/s for 2 seconds, 40m/s for 3 ...ls, 30m/s for 4 seconds. Its average Velocity will ... **UMS -2021**
...rage Velocity= = $\frac{20+40+30}{9}$ m/s
...erage Velocity= $\frac{20x40\ x30}{9}$ m/s
...rage Velocity= $\frac{20+40+30}{6}$ m/s
D) Average Velocity= $\frac{20+40+30}{4}$ m/s

12) The slope of a displacement-time graph is: **NUMS -2021**
A) Velocity
B) Displacement
C) Acceleration
D) Distance

13) A man walk for some time with velocity v due east, then he walks for same time with velocity v due north . the average velocity of the man is **ETEA 2017-med**
a. 2v b. $\sqrt{2v}$
c. v d. v/$\sqrt{2}$

14) A car travels a distance Son a straight road in 2 hours and then returns to the starting point n the next 3 hours. Its average velocity is **ETEA 2017-Eng**
a. S/5 b. 2S/5
c. S/2+S/3 d. zero

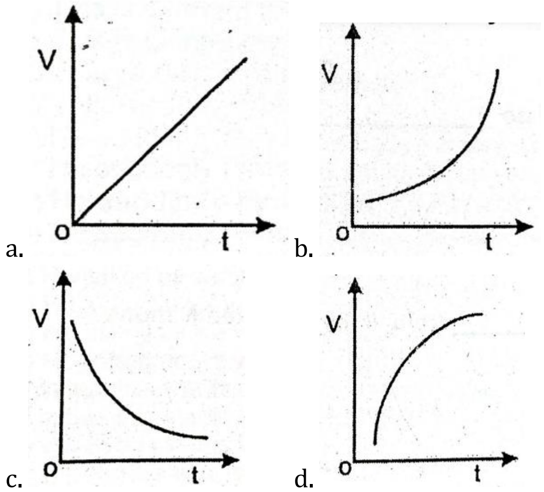
15) The numerical value of displacement to distance is **ETEA 2017-Eng**
a. always less than one b. always equal to one
c. always more than one d. equal to or less than one

16) A man walk for sometime with velocity v due to east. Then he walks for same time with velocity v due north. The average velocity of the man. **ETEA 2017-medical**
a. 2v b. $\sqrt{2v}$C c. v d. v/$\sqrt{2}$

17) The area under acceleration time graph represents. **ETEA 2017-eng**
a. displacement b. velocity
c. change in velocity d. distance travelled

18) The numerical ratio of displacement to distance is : **ETEA 2017-eng**
a. always less than one b. always equal to one
c. always more than one d. equal or less than one

19) When a car moves with constant acceleration, the velocity-time graph is a: **MDCAT - 2018**



20) The area under force displacement graph gives us **NUMS-2020**

a) Displacement b) power
c) work d) acceleration

21) A body covering equal displacement in equal interval of time possesses:
a) Variable velocity b) Uniform acceleration
c) Uniform velocity d) None of above

22) Instantaneous and average velocities become equal when body:
a) Has zero acceleration
b) Has uniform velocity
c) Has variable velocity
d) Moves in a circle

23) When velocity time graph is a straight line parallel to time axis then:
a) Acceleration is constant
b) Acceleration is variable
c) Acceleration is zero
d) Velocity is zero

24) The area between the velocity-time graph and the time axis is numerically equal to:
a) Velocity b) Distance
c) Time d) Acceleration

25) The numerical ratio of displacement to distance is
a. always less than one
b). always equal to one
c. always more than one
d).equal or less than one

26) Two blocks of masses 1.0 kg and 3.0 kg placed in contact are acted upon by a forces of 40 N. the acceleration of 1.0 Kg mass will be;
a) 40 m/sec^2 b) 10 m/sec^2
c) 30 m/sec^2 d) 50 m/sec^2

27) The shortest distance between two points is called:
a) speed b) acceleration
c) distance d) displacement

28) When average velocity becomes equal to instantaneous then the body is moving with:
a) instantaneous acceleration
b) constant acceleration
c) constant velocity
d) variable velocity

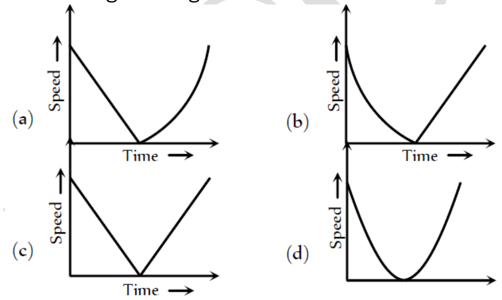
29) An athlete complete one round of a circular track of radius R in 40 sec. what will be his displacement at the end of 2 min. 20 sec
a) Zero b) 2R
c) 2πR d) 7πR

30) A wheel of radius 1 meter rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of the wheel initially in contact with the ground is
a) 2π b) $\sqrt{2}\,\pi$
c) $\sqrt{\pi^2+4}$ d) π

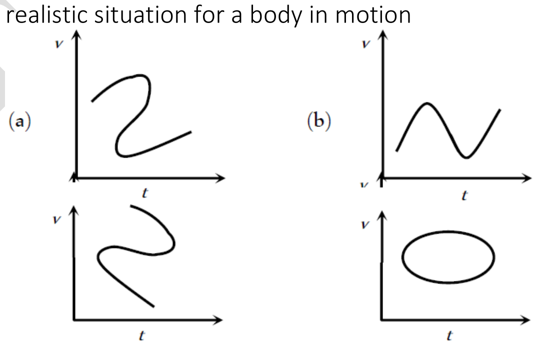
31) Velocity-time curve for a body projected vertically upwards is
a) Parabola b) Ellipse
c) Hyperbola d) Straight line

32) The area under acceleration-time graph gives
a) Distance travelled
b) Change in acceleration
c) Force acting
d) Change in velocity

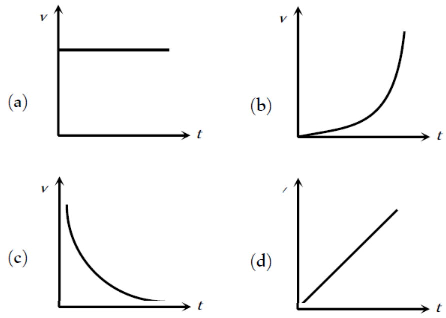
33) A ball is thrown vertically upwards. Which of the following plots represents the speed-time graph of the ball during its height if the air resistance is not ignored



34) Which of the following velocity-time graph shows a realistic situation for a body in motion



35) Which of the following velocity-time graph represent uniform motion



36) **Relative Velocity**
[**Note:** This topic is not included in book but important for test.]
A 150 m long train is moving to north at a speed of 10 m/s. a parrot flying towards south with a speed of 5 m/s crosses the train. The time __________ the parrot the cross to train would be:
a) 30 s b) 15 s

c) 8 s d) 10 s

37) A moves with 65 km/h while B is coming bank of A with 80 km/h. The relative velocity of B with respect to A is
a) 80 km/h b) 60 km/h
c) 15 km/h d) 145 km/h

38) A thief is running away on a straight road on a jeep moving with a speed of 9 m/s. a police man chases him on a motor cycle moving at a speed of 10 m/s. If the instantaneous separation of jeep from the motor cycle is 100 m, how long will it take for the policemen to catch the thief
a) 1 second b) 19 second
c) 90 second d) 100 second

39) A 120 m long train is moving towards west with a speed of 10 m/s. a bird flying towards east with a speed of 5 m/s crosses the train. The time taken by the bird to cross the train will be
a) 16 sec b) 12 sec
c) 10 sec d) 8 sec

40) A boat cross a river with a velocity of 8 km/h. if the resulting velocity of boat is 10 km/h then the velocity of river water is
a) 4 km/h b) 6 km/h
c) 8 km/h d) 10 km/h

41) **Uniform Motion**
A person travels along a straight road for half the distance with velocity v_1 and the remaining half distance with velocity v_2 The average velocity is given by
a) $v_1 v_2$ b) $\frac{v_2^2}{v_1^2}$
c) $\frac{v_1+v_2}{2}$ d) $\frac{2v_1 v_2}{v_1+v_2}$

42) The displacement time graph for two particles A and B are straight lines inclined at angle of 30°and 60° with the time axis. The ratio of velocities of $V_A : V_B$ is
a) 1 : 2 b) 1 : $\sqrt{3}$
c) $\sqrt{3}$: 1 d) 1 : 3

43) A car travels from A to B at a speed of 20 km / hr and returns at a speed of 30 km / hr. The average speed of the car for the whole journey is
a) 25 km/hr b) 24 km/hr
c) 50 km/hr d) 5 km/hr

44) A boy walks to his school at a distance of 6 km with constant speed of 2.5 km/hour and walks back with a constant sped of 4 km/hr. his average speed for round trip expressed in km/hour, is
a) 24/13 b) 40/13
c) 3 d) 1/2

45) A car travels the first half of a distance between two places at a speed of 30 km/hr and the second half of the distance at 50 km/hr. The average speed of the car for the whole journey is
a) 42.5 km/hr b) 40.0 km/hr
c) 37.5 km/hr d) 35.0 km/hr

46) One car moving on a straight road covers one third of the distance with 20 km/hr and the rest with 60 km/hr. the average speed is
a) 40 km/hr b) 80 km/hr
c) $46\frac{2}{3}$km/hr d) 36 km/hr

47) A car moves for half of its time at 80 km/h and for rest half of time at 40 km/h. Total distance covered is 60 km. what is the average speed of the car
a) 60 km/h b) 80 km/h
c) 120 km/h d) 180 km/h

48) A train has a speed of 60 km/h. for the first one hour and 40 km/h for the next half hour. Its average speed in km/h is
a) 50 b) 53.33
c) 48 d) 70

49) Which of the following is a one dimensional motion
a) Landing of a aircraft
b) Earth revolving a round the sun
c) Motion of wheels of a moving trains
d) Train running on a straight track

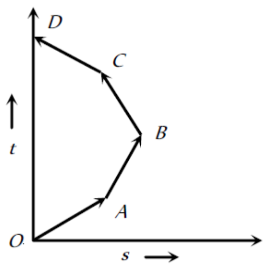
50) A 150 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 850 meters is
a) 56 sec
b) 68 sec
c) 80 sec
d) 92 sec

51) A particle is constrained to move on a straight line path. It returns to the starting point after 10 sec. the total distance covered by the particle during this time is 30 m. which of the following statements about the motion of the particle is false.
a) Displacement of the particle is zero
b) Average speed of the particle is 3 m/s
c) Displacement of the particle is 30 m
d) Both (a) and (b)

52) A particle moves along a semicircle of radius 10 m in 5 seconds. The average velocity of the particle is
a) $2\pi\ ms^{-1}$ b) $4\pi ms^{-1}$
c) $2ms^{-1}$ d) $4ms^{-1}$

53) The ratio of the numerical values of the average velocity and average speed of a body is always
a) Unity b) Unity or less
c) Unity or more d) Less than unity

54) Which of the following option is correct for the object having a straight line motion represented by the following graph



a) The object moves with constantly increasing velocity from O to A and then it moves with constant velocity.
b) Velocity of the object increases uniformly
c) Average velocity is zero
d) The graph shown is impossible

55) The numerical ratio of displacement to the distance covered is always
a) Less than one
b) Equal to one
c) Equal to or less than one
d) Equal to or greater than one

56) A 100 m long train is moving with a uniform velocity of 45 km/hr. The time taken by the train to cross a bridge of length 1 km is
a) 58 s b) 68 s
c) 78 s d) 88 s

57) A particle moves for 20 seconds with velocity 3 m/s and then velocity 4 m/s for another 20 seconds and finally moves with velocity 5 m/s for next 20 seconds. What is the average velocity of the particle
a) 3 m/s b) 4 m/s
c) 5 m/s d) Zero

58) The correct statement from the following is
a) A body having zero velocity with not necessarily have zero acceleration
b) A body having zero velocity will necessarily have zero acceleration
c) A body having uniform speed can have only uniform acceleration
d) A body having non-uniform velocity will have zero acceleration

59) A car travels half the distance with constant velocity of 40 km/ph and the remaining half with a constant velocity of 60 kmph. The average velocity of the car in kmph is
a) 40 b) 45
c) 48 d) 50

Newton Laws:

60) A body is moving with momentum of 100 kg m/s. What is the magnitude of force required to stop this body in 25 sec? : **ETEA-2023**
A. 4 N B. 25 N
C. 100 N D. 2500 N

61) Newton's 3rd law of motion is correlated with: **ETEA-2023**
a) Law of conservation of energy
b) Law of conservation of momentum
c) Law of conservation of velocity
d) All of these

62) Which of the following best describes inertia? : **ETEA-2023**
a) The force of gravity acting on an object
b) The resistance of an object to a change in its state of motion
c) The weight of an object
d) The acceleration of an object due to applied force

63) Equal forces F act on isolated bodies A and B. The mass of B is 1/5 times that of A. The magnitude of the acceleration of A is: **ETEA-2023**
A. 1/5 times that of B
B. 1/3 times that of B
C. the same as B
D. nine times that of B

64) Which of the following is NOT TRUE? : **NUMS - 2022**
a. Action and reaction have same nature
b. Action and reaction have same line of action
c. Action and reaction never act on same body
d. Action and reaction can cancel each other

65) In newton's first law of motion which quantity remains constant: **ETEA-2022**
a) Velocity b) Angular displacement
c) Amplitude d) Amount of work

66) Law of inertia satisfies: **ETEA-2022**
a) Condition of equilibrium
b) Condition of variable force
c) Condition of force in contact
d) Condition of conservation of mass

67) When we kick a stone, we get hurt, it happens due to ETEA 2017-Eng
a. inertia b. velocity
c. reaction d. momentum

68) Newton second law of motion establishes relationship between. ETEA 2010 Med
a. Force and acceleration b. Mass and force
c. Mass and velocity d. Acceleration and mass

69) Two blocks of masses 1.0 kg and 3.0 kg placed in contact are acted upon by a forces of 40 N. the acceleration of 1.0 Kg mass will be; ETEA 2012-Med

(a) 40 m/sec^2 (b) 10 m/sec^2
(c) 30 m/sec^2 (d) 50 m/sec^2

70) The property of moving object by virtue of which it exerts force on the object that tries to slop it is: ETEA 2011- Med
(a) Inertia of the body (b) quantity of motion of body
(c) Acceleration of body (d) All of these

71) A mass accelerates uniformly when the resultant force acting on it is: ETEA 2016- Med
(a)Zero
(b) Constant but not zero
(c) Increases uniformly with respect to time
(d) Both (a) & (c)

72) Newton second law of motion establishes relationship between. ETEA 2010- Med
a. Force and acceleration b. Mass and force
c. Mass and velocity d. Acceleration and mass

73) Two blocks of masses 1.0 kg and 3.0 kg placed in contact are acted upon by a forces of 40 N. the acceleration of 1.0 Kg mass will be; ETEA 2012- Med
(a) 40 m/sec^2 (b) 10 m/sec^2
(c) 30 m/sec^2 (d) 50 m/sec^2

74) The property of moving object by virtue of which it exerts force on the object that tries to slop it is: ETEA 2011- Med
(a) Inertia of the body (b) quantity of motion of body
(c) Acceleration of body (d) All of these

75) A mass accelerates uniformly when the resultant force acting on it is: ETEA 2016-Med
(a)Zero
(b) Constant but not zero
(c) Increases uniformly with respect to time
(d) Both (a) & (c)

76) If the 100 gram masshaving 32 ft/sec^2, then its force is ETEA 2017-Eng
a. 320 lb b. 9.8N
c. 320 dyne d. non of these

77) ball is thrown vertically upward with a velocity of 98 m/s. If it takes 10 seconds to reach the highest point, then the acceleration of the ball is; ETEA 2011- Med
(a) 9.8 m/s^2 (b) 98 0 m/s^2
(c) 98 m/s^2 (d) -9.8 m/s^2

78) A cricketer hits 4 runs, When middle of the bat hits the ball. This is an example of Newton's:
a) 2nd law of motion b) 3rd law of motion
c) 1st of motion d) Law of gravity

79) Third law of Newton is also called NUMS-2016
a. Law of inertia b. Equilibrium
c. Both a and b d. None

80) Newton second is the unit of: ETEA 2015-Eng
A) Work B) Angular Momentum
C) Power D) Linear momentum

81) Conservation of linear momentum is equivalent to: ETEA 2015-Med
A) Newton's 1st law of motion
B) Newton's 2nd law of motion
C) Newton's 3rd law of motion
D) None of the above

82) When we kick a stone, we get hurt. It happens due to : ETEA 2017- eng
a. inertia b. velocity
c. reaction d. momentum

83) If the 100g mass having 32 ft/sec^2 , then its force is : ETEA 2017-eng
a. 320 lb b. 9.8 N
c. 320 Dynes d. none of the above

84) The symbol "g" represents the acceleration of free fall. Which of these – statements is correct? ETEA 2012- Eng
(a) g is gravity
(b) g is the ratio weight/mass
(c) g is the weight of an object
(d) g is reduced by air resistance.

85) All statements are correct about third law of motion except: NUMS-2016
a. Forces have equal magnitude
b. Both of them have opposite direction
c. Both are applied on different bodies
d. Both are applied on same body maintaining equilibirium.

86) A mass has constant acceleration, what is true about force applied on it? NUMS-2016
a. Constantly increasing
b. Constant but not zero
c. Is directly proportional to square of displacement
d. Is directly proportional to velocity

87) **Newton Laws of motion**
NEWTON's laws do not hold good for particles
A) at rest
B) moving slowly
C) move with high velocity
D) move with velocity comparable to velocity of light

88) The property of moving object by virtue of which it exerts force on the object that tries to slop it is:
a) Inertia of the body
b) quantity of motion of body
c) Acceleration of body
d) All of these

89) A mass accelerates uniformly when the resultant force acting on it is:
(a)Zero
b) Constant but not zero

c) Increases uniformly with respect to time
d) Both a) & (c)

90) A man throws a ball vertically upward in a compartment of an "accelerated" train. The ball will fall:
a) In font of him b) In his land
c) Behind him d) beside him

91) When we kick a stone, we get hurt, it happens due to:
a. inertia b. velocity
c. reaction d. **MOMENTUM**

92) **NEWTON** second law of motion establishes relationship between.
a. Force and acceleration
b. Mass and force
c. Mass and velocity
d. Acceleration and mass

93) Which **LAW** of motion is also called **LAW** of inertia?
A) 1st **LAW** B) 2nd **LAW**
C) 3rd **LAW**
D) all 1st, 2nd and 3rd **LAW**s

94) Inertia of an object is quantitative measure of its
A) volume B) density
C) mass D) temperature

95) 3rd **LAW** of motion explains
A) effect of force
B) existence of a force
C) existence of two forces
D) existence of pair of forces in nature

96) The dimension of force is
A) MLT^{-2} B) $ML2T^{-2}$ C) ML^2T^2 D) $ML^{-2}T^{-2}$

97) Flight of a rocket in the space is an example of
A) **SECOND LAW** of motion
B) third **LAW** of motion
C) **FIRST LAW** of motion
D) **LAW** of gravitation

98) Newton's 2^{nd} gives the measurement of:
a) Acceleration b) Momentum
c) Force d) Inertia

99) **Newton 1^{st} Law**
A rider on horse back falls when horse starts running all of a sudden because
a) Rider is taken back
b) Rider is suddenly afraid of falling
c) Inertia of rest keeps the upper part of body at rest whereas lower part of the body moves forward with the horse
d) None of the above

100) When a train stops suddenly, passengers in the running train feel an instant jerk in the forward direction because
a) The back of seat suddenly pushes the passengers forward
b) Inertia of res stops the train and takes the body forward
c) Upper part of the body continues to be in the state of motion whereas the lower part of the body in contact with seat remains at rest
d) Nothing can be said due to insufficient data

101) Inertia is that property of a body by virtue of which the body is
a) Unable to change by itself the state of rest
b) Unable to change by itself the state of uniform motion
c) Unable to change by itself the direction of motion
d) Unable to change by itself the state of rest and of uniform linear motion

102) A man getting down a running bus falls forward because
a) Due to inertia of rest, road is left behind and man reaches forward
b) Due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road
c) He leans forward as a matter of habit
d) Of the combined effect of all the three factors stated in (a), (b) and (c).

103) Newton's first law of motion describes the following
a) Energy
b) Work
c) Inertia
d) Moment of inertia

104) A person sitting in an open car moving at constant velocity throws a ball vertically up into air. The ball falls.
a) Outside the car
b) In the car ahead of the person
c) In the car to the side of the person
d) Exactly in the hand which threw it up

105) A particle is moving away with a constant speed along a straight line path. a force is not required to
a) Increase its speed
b) Decrease the momentum
c) Change the direction
d) Keep it moving with uniform velocity

106) When a bus suddenly takes a turn, the passengers are thrown outward because of
a) Inertia of motion
b) Acceleration of motion
c) Speed of motion
d) Both (b) and (c)

107) **Newton 2^{nd} Law**
Newton's second law gives the measure of
a) Acceleration

b) Force
c) Momentum
d) Angular momentum

108) A bullet of mass 5 gm moving with velocity 100 m/sec, penetrates the wooden block upto 6 cm. then the average force imposed by the bullet on the block is
a) 8300 N
b) 417 N
c) 830 N
d) Zero

109) Newton's second law gives the measure of
a) Acceleration
b) Force
c) Momentum
d) Angular momentum

110) A force of 100 dynes acts on mass of 5 gm for 10 sec. the velocity produced by
a) 2 cm/sec
b) 20 cm/sec
c) 200 cm/sec
d) 2000 cm/sec

111) An object will continue moving uniformly until
a) The resultant force acting on it begins to decrease
b) The resultant force on it is zero
c) The resultant force is a right angle to its rotation
d) The resultant force on it is increased continuously

112) A rocket is ejecting 0.05 kg of gases per second at a velocity of 400 m/sec. the accelerating force on the rocket is
a) 20 dynes
b) 20 N
c) 22 dynes
d) 1000 N

113) If the tension in the cable of 1000 kg elevator is 1000 kg weight, the elevator
a) Is accelerating upwards
b) Is accelerating downwards
c) May be at rest or accelerating
d) May be at rest or in uniform motion

114) A man weighing 80 kg is standing in a trolley weighing 320 kg. the trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley with a speed of 1 m/s, then after 4 sec his displacement relative to the ground will be
a) 5 m
b) 4.8m
c) 3.2m
d) 3.0m

115) In doubling the mass and acceleration of the mass, the force acting on the mass with respect to the previous value
a) Decreases to half
b) Remains unchanged
c) Increase two times
d) Increases four times

116) A force of 5 N acts on a body of weight 9.8 N. What is the acceleration produced in m/sec^2
a) 49.00
b) 5.00
c) 4.46
d) 0.51

117) A body of mass 40 gm is moving with a constant velocity of 2 cm/sec on a horizontal frictionless table. The force on the table is
a) 39200 dyne
b) 160 dyne
c) 80 dyne
d) Zero dyne

118) When 1 N force acts on 1 kg body that is able to move freely, the body receives
a) A speed of 1 m/sec
b) An acceleration of 1 m/sec^2
c) An acceleration of 980 cm/sec^2
d) An acceleration of 1 cm/sec^2

119) An object with a mass 10 kg moves at a constant velocity of 10 m/sec. a constant force then acts for 4 second on the object and gives it a speed of 2 m/sec in opposite direction. The acceleration produced in it, is
a) 3 m/sec^2
b) -3 m/sec^2
c) 0.3 m/sec^2
d) -0.3 m/sec^2

120) In a rocket of mass 1000 kg fuel is consumed at a rate of 40 kg/s. the velocity of the gases ejected from the rocket is 5 x 10^4 m/s. the thrust on the rocket is
a) 2 x 10^3 N
b) 5 x 10^4 N
c) 2 x 10^6 N
d) 2 x 10^9 N

121) A ball of mass 0.2 kg moves with a velocity of 20 m/sec and it stops in 0.1 sec, then the force on the ball is
a) 40 N
b) 20 N
c) 4 N
d) 2 N

122) A vehicle of 100 kg is moving with a velocity of 5 m/sec. to stop it in $\frac{1}{10}$ sec, the required force in opposite direction is
a) 5000 N
b) 500 N
c) 50 N
d) 1000 N

123) If force on a rocket having exhaust velocity of 300 m/sec is 210 N, then rate of combustion of the fuel is
a) 0.7 kg/s
b) 1.4 kg/s
c) 0.07 kg/s
d) 10.7 kg/s

124) The average resisting force that must act on a 5 kg mass to reduce its speed from 65 cm/s to 15 cm/s in 0.2 s is
a) 12.5 N
b) 25 N
c) 50 N
d) 100 N

125) A body of mass 2 kg is moving with a velocity 8 m/s on a smooth surface. If it is to be brought to rest in 4 seconds, then the force to be applied is
a) 8 N
b) 4 N
c) 2 N
d) 1 N

126) A force of 10 Newton acts on a body of mass 20 kg for 10 seconds. change in its momentum is
a) 5 kg m/s
b) 100 kg m/s
c) 200 kg m/s
d) 1000 kg m/s

127) A player caught a cricket ball of mass 150 gm moving at the rate of 20 m/sec, if the catching process be completed in 0.1 sec the force of the blow exerted by the ball on the hands of player is
a) 0.3 N
b) 30 N
c) 300 N
d) 3000 N

128) **Newton's 3rd Law**
Swimming is possible on account of
a) First law of motion
b) Second law of motion
c) Third law of motion
d) Newton's law of gravitation

129) When we jump out of a boat standing in water it moves
a) Forward
b) Backward
c) Sideways
d) None of the above

130) You are a frictionless plane. How can you get off if no horizontal force is exerted be pushing against the surface
a) By jumping
b) By spitting or sneezing
c) By rolling your body on the surface
d) By running on the plane

131) A cannon after firing recoils due to
a) Conservation of energy
b) Backward thrust of gases produced
c) Newton's third law of motion
d) Newton's first law of motion

132) Newton's third law of motion leads to the law of conservation of
a) Angular momentum
b) Energy
c) Mass
d) Momentum

133) A cold soft drink is kept on the balance. When the cap is open, then the weight
a) Increase
b) Decrease
c) First increase then decrease
d) Remains same

Momentum

134) Newton-second is the unit of; **ETEA-2019**
a) work
b) angular momentum
c) power
d) linear momentum

135) The Newton-second is unit of: **NMDCAT-2020**
A Work. B. Power.
C. Impulse. D Momentum.

136) A body is moving with momentum of 100 kg m/s. What is the magnitude of force required to stop this body in 25 sec? : **ETEA-2023**
A. 4 N B. 25 N
C. 100 N D. 2500 N

137) Unit of linear momentum is: : **NUMS -2021**
A) Nm
B) N/s
c) Ns
D) Ns ^{2}

138) Which of the following is NOT TRUE? : **NUMS -2021**
A) Momentum is quantity of motion
B) Unit of momentum is N.s
C) Momentum is not a vector quantity
D) Momentum is product of mass and velocity

139) The explosion of explosive material is application of: **NUMS -2022**
a. Law of conservation of energy
b. Law of conservation of mass
c. Law of conservation of momentum
d. Newton's third law of motion

140) The time rate of change of linear momentum is; **ETEA-2019**
a) Force b) tension
c) inertia d) impulse

141) Two railway trucks of masses m and 5m move towards each other in opposite direction with speed 3v and v respectively. These trucks collide and stuck together. What is the speed of the truck after collision? ; **ETEA-2019**
a) v/3 b) v/2
c) v d) 5v/4

142) A shell of mass m moving with velocity v suddenly breaks into two pieces. The part having mass m/4 remains stationary. The velocity of the other shell will be; **ETEA-2019**
a) v b) 2v c) 3v/4 d) 4v/3

143) Two objects and Q have the same momentum, Q has more kinetic energy than P if it: ETEA 2016
A) weight more than P B)is moving faster than P
C) weight same as P D) is moving slower than P

144) A 5 kg stone is released from rest and falls towards the earth after 4 sec. The magnitude of its momentum is;
A)98kgm/s B)78 kgm/s
C)39 kgm/s D) non of these

145) Two bodies of unequal mass, placed at rest on a frictionless surface, are acted on by equal horizontal forces for equal times. Just after these forces are removed, the body of greater mass will have:
A) greater acceleration
B) smaller momentum
C)greater momentum
D)same momentum as other body

146) Two bodies of mass 1 and 4 m are moving with equal kinetic energies. The ratio of their linear momentum will be:
ETEA 2017- Eng
A.1:4 B.4:1
C.1.2 D.2:1

147) The kinetic energy of a body of mass 1 kg and momentum 2 Ns is equal to: ETEA 2017- Eng
A.1J B.10J
C.5J D.2J

148) Which is a statement of the principle of conservation of momentum?
ETEA 2014- Med
(a) Momentum is the product of mass and velocity.
(b) Momentum is conserved only in elastic collisions
(c) Momentum is conserved by all bodies in a collision.
(d) Momentum is conserved providing no external forces act.

149) Light and heavy bodies have equal kinetic energies. Which one has the greater momentum? ETEA 2009- Med
a. Heavy body b. Light body
c. Both have same momentum d. None of these

150) In order to change the momentum of an objective there must be; ETEA 2005- Med
a. A force applied
b. A change in time
c . A change in distance
d. A change in temperature

151) The rate of change of momentum of a body falling freely under gravity is equal to its: ETEA 2013-Med
A) Impulse B) Kinetic energy
C) Power D) weight

152) A 2N force acts on a mass. If the momentum of the mass changes by 120 Kg m/sec then the force acts for a time of; ETEA 2005- Med
(a) 8 Sec (b) 30 Sec
(c) 60 sec (d) 120 sec

153) The change in momentum of the body is equal to; ETEA 2011-Eng
(a) Force (b) Torque
(c) Impulse (d) Pressure

154) The motion of the rocket in space in according to law of conservation of;
(a) Energy (b) Charge
(c) Mass (d) Momentum

155) A constant force, F is applied on a body of mass m for time interval, t b/c of this force, the velocity of body changes from Vi to Vg. Then the changes in momentum during the interval Δt will be; ETA 2005- Med
(a) $-m(sq^2 - Vi^2)$ (b) $\Delta t/ma$
(c) $\frac{m(vf - vi)}{\Delta t}$; $\frac{\Delta p}{t}$ (d) m a/t

156) If P is momentum of an object of mass m, than expression P^2/m has same unit as; ETEA 2015-Med
A) Acceleration B) Energy
C) Force D) Impulse

157) A particle of mass m has momentum P, its K.E will be: ETEA 2015- Med
A) mP B) P^2m
C) P^2/m D) $P^2/2m$

158) A rifle of mass M is initially at rest but free to recoil. It fires a bullet of mass am and velocity v (relative to the ground). After firing, the velocity of the rifle (relative to the ground) is: ETEA 2015- Eng
A) –mv B) –Mv/m
C) –mv/ M D) –v

159) Two objects, P and Q have the same momentum. Q

has more kinetic energy than P if it: ETEA 2016-Med
(a) Weighs more than P
(b) Is moving faster than P
(c) Weighs same as P
(d) Is moving slower than P

160) A 2.5kg stone is released from rest and falls towards Earth after 4.0s, the magnitude of its momentum is: ETEA 2016- Eng
(a) 98 kg .m/s (b) 78 kg . m/s
(c) 39 kg .m/s D) All of these

161) Two bodies of unequal mass, placed at rest on a frictionless surface, are acted on by equal horizontal forces for equal times. Just after these forces are removed, the body of greater mass will have: ETEA 2016-161 Eng
(a)Greater acceleration
(b) Smaller momentum
(c) Greater momentum
(d)Same momentum as other body (d) (0)

162) The Newton-second is unit of: **MDCAT - 2020**
A Work. B. Power.
C. Impulse. D Momentum.

163) The product of force and time is equal to **NUMS-2020**
a) Angular momentum b) force
c) change in momentum d) velocity

164) The time rate of change of linear momentum of a body is equal to **NUMS-2020**
a) Force b) momentum
c) power d) acceleration

165) **"If there is no external force applied to a system, then the total momentum of that systems remains constant". This known as: FMDC 2013**
A) Law of conversation of mass
B) Elastic collision
C) Law of conversation of momentum
D) Momentum of body

166) **A force of 50N acts on a body for 10 seconds. What will be the change in momentum FMDC 2013**
A) 200N/s B) 500N/s
C) 800N/s D) 5N/s

167) A bullets of mass m moving with a velocity v is fired into a large wooden block of mass M. If bullet remains embedded in wooden block, the velocity of the system will be: ETEA 2017136 Med
A) $\frac{M}{M+m}$ B) $\frac{m}{M-m}$
C) $\frac{M}{M+m}$ D) $\frac{m}{M-m}$

168) MOMENTUM depends upon
A) force acts on the body
B) mass of the body
C) velocity of the body
D) both mass and velocity of the body

169) Which of the following pair has same direction always?
A) force, displacement B) force, velocity
C) force, acceleration D) force, MOMENTUM

170) During long jump, athlete runs before taking the jump. By doing so he
A) provide him a larger inertia
B) decreases his inertia
C) decreases his MOMENTUM
D) increases his MOMENTUM

171) Two bodies of mass 1 and 4 m are moving with equal kinetic energies. The ratio of their linear MOMENTUM will be:
A.1:4 B.4:1 C.1.2 D.2:1

172) The kinetic energy of a body of mass 1 kg and MOMENTUM 2 Ns is equal to:
A.1J B.10J C.5J D.2J

173) Two objectives of different masses falling freely from the same heights above the earth's surface will experience the same
A) Change in MOMENTUM per unit time.
B) Change in velocity per unit time.
C) Decrease in gravitational potential energy per unit time.
D) Increase in kinetic energy per unit time.

174) Light and heavy bodies have equal kinetic energies. Which one has the greater MOMENTUM?
a. Heavy body b. Light body
c. Both have same MOMENTUM
d. None of these

175) A 2N force acts on a mass. If the MOMENTUM of the mass changes by 120 Kg m/sec then the force acts for a time of;
a) 8 Sec b) 30 Sec
c) 60 sec d) 120 sec

176) Newton second is the unit of:
A) Work B) Angular MOMENTUM
C) Power D) Linear MOMENTUM

177) If P is MOMENTUM of an object of mass m, than expression P^2/m has same unit as;
A) Acceleration B) Energy
C) Force D) Impulse

178) A particle of mass m has MOMENTUM P, its K.E will be:
A) mP B) P^2m
C) P^2/m D) $P^2/2m$

179) Flight of a rocket in the space is an example of:
a) Second law of motion

b) Third law of motion
c) First law of motion
d) Law of conservation of linear Momentum

180) Time rate of change of Momentum is equal to:
a) Force b) Velocity
c) Impulse d) Both "a" and "c"

181) The unit of Momentum is SI unit is:
a) $Kgms^{-2}$ or N m b) Kgm^2s or N^2 m
c) $Kg^2\ ms^{-1}$ or N m^2 d) $Kgms^{-1}$ or N s

182) A 1.0 kg ball moving at 2.9 m/s perpendicular to a wall rebounds from the wall at 1.5 m/s. the change in the Momentum of the ball is.
a) Zero
b) 0.5 N s toward wall
c) 0.5 n s away from wall
d) 3.5 N s away from wall

183) If the total Momentum of a system is changing:
a) Particles of the system must be exerting forces on each other
b) The system must be under the influence of gravity
c) The center of mass unit have constant velocity
d) A net external force must be acting on the system

184) Bullets from two revolvers are fired with the same velocity. The bullet from gun # 1 is twice as heavy as the bullet from gun # 2. Gun # 1 weighs three times as much as gun # 2. The ratio of the Momentum imparted to gun # 1 to that imparted to gun # 2 is:
a) 2:3 b) 2:1
c) 3:2 d) 3:1

185) For a rocket, the change in Momentum per second of the ejecting gases is equal
a) Acceleration of the rocket
b) Velocity of the rocket
c) Momentum of the rocket
d) Thrust acting on rocket

186) A student's life was saved in an automobile accident because an airbag expanded in front of his head. If the car had not been equipped with an airbag, the windshield would have stopped the motion of his head in a much shorter time. Compared to the windshield, the airbag.
a) Cause a much smaller change in Momentum
b) Exert a much smaller impulse
c) Causes a much smaller change in kinetic energy
d) Exerts a much smaller force

187) The rate of change of Momentum for a freely falling object is always:
a) = mg b) > mg
c) < mg d) Zero

188) Two bodies of unequal mass, placed at rest on a frictionless surface, are acted on by equal horizontal forces for equal times. Just after these forces are removed, the body of greater mass will have:
a) The smaller acceleration
b) The greater acceleration
c) The smaller Momentum
d) The greater Momentum

189) A 10 kg block of ice is at rest on a frictionless horizontal surface. A 1.0 N force is applied in East direction for 1.0 s. during the time interval, the block
a) Acquires a speed of 1m/s
b) Acquires a Momentum of 1.0 kg m/s
c) Moves 10 cm
d) Acquires a kinetic energy of 0.1 J

190) If the body of mass 2 kg dropped from the height of 5 m find its Momentum ($g = 10ms^{-2}$)
a) 15 N s b) 20 N s
c) 30 N s d) 40 N s

191) A 2.5 kg stone is released from rest and falls toward Earth. After 4.0 s, the magnitude of its Momentum is ($g = 10ms^{-2}$):
a) 100 kgm/s b) 50 kgm/s
c) 98 kgm/s d) 49 kgm/s

192) The Momentum of an object is increased from 10 N s to 20 N s by the application of the force is 1s. what is the magnitude of applied force?
a) 10 N b) 20 N
c) 30N d) 40N

193) A bear can be knocked down by hitting one of the following bullets of same Momentum
a) Lead b) Steel
c) Gold d) Rubber

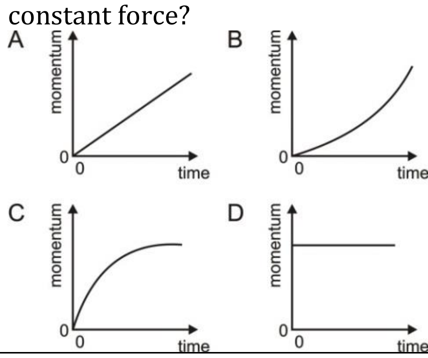
194) If a shell explodes in mid air, its fragments fly off in different directions. Total Momentum of the fragments:
a) Decreases b) Remain constant
c) Increases d) Becomes zero

195) A force of 10 N acts on a body of mass 5kg for one second, then its time rate of change of Momentum will be:
a) 10 $kgms^{-2}$ b) 5 $kgms^{-2}$
c) 50 $kgms^{-2}$ d) 2 $kgms^{-2}$

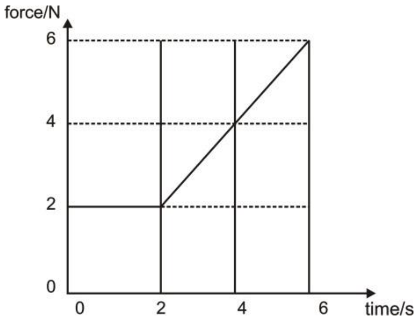
196) If a force is 12 N is applied on a body and its Momentum is changed from 60 $kgms^{-1}$ to 36 kg ms^{-1}, then find the timing during, which this force acts:
a) 1 second b) 2 seconds
c) 12 seconds d) 24 seconds

197) Which graph best shows the variation with time of the Momentum of a body accelerated by a

constant force?



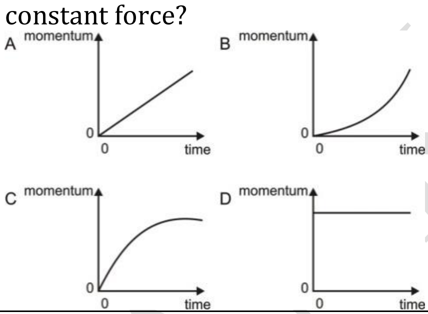
198) The graphs shows how the force acting on a body varies with time.



Assuming that the body is moving in the straight line, by how much does its Momentum change?

a) 40 kg ms^{-1} b) 36 kg ms^{-1}
c) 20 kg ms^{-1} d) 16 kg ms^{-1}

199) Which graph bets shows the variation with time of the Momentum of a body accelerated by a constant force?



200) In which of the following cases forces may not be required to keep the
a) Particle going in a circle
b) Particle going along a straight line
c) The momentum of the particle constant
d) Acceleration of the particle constant

201) A wagon weighing 1000 kg is moving with a velocity 50 km/h on smooth horizontal rails. A mass of 250 kg is dropped into it. The velocity with which it moves now is
a) 2.5 km/hour
b) 20 km/hour
c) 40 km/hour
d) 50 km/hour

202) If a force of 250 N act on body, the momentum acquired is 125 kg m/s. what is the period for which force acts on the body
a) 0.5 sec
b) 0.2 sec
c) 0.4 sec
d) 0.25 sec

203) A ball of mass 150g starts moving with an acceleration of 20 m/s^2. When hit by a force, which acts on it 0.1 sec. the impulsive force is
a) 0.5 N-s
b) 0.1 N-s
c) 0.3 N-s
d) 1.2 N-s

204) A body, whose momentum is constant, must have constant
a) Force
b) Velocity
c) Acceleration
d) All of these

205) A rocket of mass 1000 kg exhausts gases at a rate of 4 kg/sec with a velocity 3000 m/s. the thrust developed on the rocket is
a) 12000 N
b) 120 N
c) 800 N
d) 200 N

206) The momentum is most closely related to
a) Force
b) Impulse
c) Power
d) K.E

207) Rocket engines lift a rocket from the earth surface because hot gas with high velocity
a) Push against the earth
b) Push against in air
c) React against the rocket and push it up
d) Heat up the air which lifts the rocket

208) A force of 50 dynes is acted on a body of mass 5 g which is at rest for an interval of 3 seconds, then impulse is
a) 0.15×10^{-3}Ns
b) 0.98×10^{-3} Ns
c) 1.5×10^{-3}Ns
d) 2.5×10^{-3}Ns

209) A body of mass M at rest explodes into three pieces, two of which of mass M/4 each are thrown off in perpendicular directions with velocities of 3 m/s and 4 m/s respectively. the third piece will be thrown off with a velocity of
a) 1.5 m/s
b) 2.0 m/s
c) 2.5 m/s
d) 3.0 m/s

210) The momentum of a system is conserved

a) Always
b) Never
c) In the absence of an external force on the system
d) None of the above

211) A bullet of mass 0.1 kg is fired with a speed of 100 m/sec, the mass of gun is 50 kg. the velocity of recoil is
a) 0.2 m/sec
b) 0.1 m/sec
c) 0.5 m/sec
d) 0.05 m/sec

212) A bullet mass 10 gm is fired from a gun of mass 1 kg. if the recoil velocity is 5 m/s, the velocity of the muzzle is
a) 0.05 m/s
b) 5 m/s
c) 50 m/s
d) 500 m/s

213) A shell initially at rest explodes into two pieces of equal mass, then the two pieces will
a) Be at rest
b) Move with different velocities in different directions
c) Move with the same velocity in opposite directions
d) Move with the same velocity in same direction

Equations of motions

214) A train travels on a straight track passing signal A at 20 m/s. it accelerates uniformly at 2 m/s^2 and reaches signal 100m further than A, at B the velocity of the train in m/s is: **ETEA-2023**
a) 10 b) 20 c) 28 d) 56

215) Neglecting the effect of air resistance how long a stone takes to dropped off a 125m high building lands on the ground, take g=10m/s2: : **ETEA-2023**
A. 3 sec B. 4 sec
C. 18 sec D. 5 sec

216) A 200N force acts on 8 kg crate that starts from rest. At the instant the object has gone 2m, the rate at which the force is doing work is: : **ETEA-2023**
A.2.5 W B. 25 W
C. 75 W D. 2000 W

217) If we drop an object, its initial velocity is zero. How far will it fall in time 't'? **NMDCAT-2020**
a. $9.8t^2$ b. $4.9t^2$ c. $0.49t^2$ d. $98t^2$

218) A train is 200 m long and is moving with uniform velocity of 36 km/hr, the time it will take to cross a; bridge of 1km is **ETEA-2019**
a) 100 sec b) 120 sec c) 60 sec d) 50 sec

219) Two buses moving at 100 km/h and 80 km/h respectively cross each other while moving in opposite direction. Velocity of one bus relative to other bus is: **NUMS -2022**
a. 100 km/h
b. 20 km/h
c. 80 km/h
d. 180 km/h

220) Two stones, 10Kg and 50 kg fall through 80 cm high cliff. Which stone has greater velocity at bottom? ($g=10ms^2$) (ignoring air resistance) : **NUMS -2021**
A) 10 Kg
B) 50 Kg
C) Both have same velocity
D) Cannot be calculated

221) A stone is thrown upward from the top CA = 59.4m high cliff with an upward velocity component of 19.6m/s. How long is stone in the air? ETEA 2016-Eng
(a) 4.00 s (b) 5.00 s (c) 6.00 s (d) 7.00 s

222) A ball of iron of mass 2 kg is droped from the top of the building. The ball reaches the ground in 10 s. twhat is te velocity in m/s wjem it strikes the ground ETEA 2018-Eng
a. 150 b. 99 c. 49 d. 27

223) A ball of mass 5kg is dropped from height of 78.4m. the time takeen by the ball to hit the ground is: ETEA 2012- Med
(a) 2 sec (b) 4 sec (c) 8 sec (d) 16 sec

224) On a railway track a driver applies the brakes of the train at a yellow signal, a distance 1 km from red signal, where it stops. The max deceleration of the train is 0.2 m/s^2. Assuming uniform deceleration, what is the maximum safe speed of the train at the yellow signal? ETEA 2012- Eng
(a) 20 m/s (b) 40 m/s
(c) 200 m/s (d) 400 m/s

225) A racing car accelerates uniformly through their gear changes with the following average speeds: $20ms^{-1}$ for 2.0s, $40ms^{-1}$ for 2.0s and $60ms^{-1}$ for 6.0s. What is the overall average speed of the car?
a) $12ms^{-1}$ b) $13.3ms^{-1}$ c) $48ms^{-1}$ d) $40ms^{-1}$

226) A mass accelerates uniformly when the resultant force acting on it: ETEA 2014 Med
(a) Is zero
(b) Is constant but not zero
(c) Increases uniformly with respect to time.
(d) Is proportional to the displacement of the mass from a fixed point.

227) A ball is dropped from the roof of a very tall building. What is its velocity after falling for 5.0s? ETEA 2014-Med

a) 1.96 m/s b) 9.80m/s
c) 49.0m/s d) 98.0m/s

228) The acceleration of free fall on a planet, P is 1/6th of the acceleration of free fall on earth. The mass of a body on planet P is 30 Kg, what is the weight on planet? ETEA 2012- Eng
(a) 4.9N (b) 100N (c) 290N (d) 49N

229) The acceleration of free fal on the moon is one-sixth of that of earth. On earth it takes time 't' for a stone to fall from rest at distance of 2m. what is the time taken for a stone to fall from rest at 2m distance starting from rest. ETEA 2017-med
a. 6t b. T/6 c. t$\sqrt{6}$ d. t$\sqrt{2}$

230) A ball of iron, mass 1kg, is dropped from the top of the building. The ball reaches the ground in 5s. what is the velocity, in m/s, of the ball when it strikes the ground. ETEA 2018-eng
a. 150 m/s b. 99m/s c. 49 m/s d. 27 m/s

231) Bodies which fall freely under the action of gravity is an example of: ETEA 2011- Eng
(a) uniform acceleration (b) variable acceleration
(c) uniform velocity (d) average acceleration

232) A science museum designs an experiment to show the fall of a feather in a vertical glass vacuum tube. The time of fall from rest is too close to 0.5 s. What length of tube is required? ETEA 2016 Eng
(a) 1.3 m (b) 2.5 m (c) 5.0 m (d) 10.0 m

233) An object is thrown vertically upward with a velocity of 20m/s. How much time it will take to reach the highest point? FMDC 2015
a) 2 sec
b) 4 sec
c) 1 sec
d) Insufficient information

234) Suppose you drop an object from the roof of your house. It takes 2 sec. to reach the ground. What is the height of your house? FMDC 2015
a) 10 m
b) 20 m
c) 5 m
d) Insufficient information

235) Consider an object is placed on a frictionless inclined plane at a height of 5m, if it is released, what will be its velocity at the bottom of the inclined plane? FMDC 2015
a) Insufficient information
b) 10m/s
c) 100m/s
d) 20m/s

236) Two bodies are dropped from different heights h1 and h2. There ratio of the times taken by them to reach the ground will be:
A. $h_2^2 : h_1^2$ B. $h_2 : h_1^2$
C. $\sqrt{h1} = \sqrt{h2}$ D. Non of the above
Hints; $t^2=2h/g$

237) Two objectives of different masses falling freely from the same heights above the earth's surface will experience the same
A) Change in momentum per unit time.
B) Change in velocity per unit time.
C) Decrease in gravitational potential energy per unit time.
D) Increase in kinetic energy per unit time.

238) The symbol "g" represents the acceleration of free fall. Which of these – statements is correct? ETEA 2012- 156 Eng:
(a) g is gravity
(b) g is the ratio weight/mass
(c) g is the weight of an object
(d) g is reduced by air resistance.

239) Bodies which fall freely under the action of gravity is an example of: ETEA 2011- 26 Eng:
(a) uniform acceleration (b) variable acceleration
(c) uniform velocity (d) average acceleration

240) A stone is thrown upward from the top CA = 59.4m high cliff with an upward velocity component of 19.6m/s. How long is stone in the air? ETEA 2016-93 Eng
(a) 4.00 s (b) 5.00 s
(c) 6.00 s (d) 7.00 s

241) A science museum designs an experiment to show the fall of a feather in a vertical glass vacuum tube. The time of fall from rest is too close to 0.5 s. What length of tube is required? ETEA 2016-71 Eng
(a) 1.3 m (b) 2.5 m
(c) 5.0 m (d) 10.0 m

242) A cone is 9 cm high and has a vertical angle of 60°, then the diameter of its base is: ETEA 2017-Eng
A) 3$\sqrt{3}$ B)6$\sqrt{3}$3
C)9$\sqrt{3}$ D)18$\sqrt{3}$

243) A helicopter of mass 3.0×10^3 Kg rises vertically with a constant speed of 2m/s, what resultant force acts on the helicopter? ETEA 2015-37 Eng
A) Zero B) 3×10^4 N downwards
C) 4.5N upwards D) 7.5×10^4 N upwards

244) Arshad is driving down 7th street, he drives 150 m in 18s.. Assume he does not speed up or slow down, what is his speed: MDCAT - 2017

a. 0.38 m/s
b. 126 m/s
c. 8.33 m/s
d. A 58.33 m/s

245) The distance travelled by a moving car with velocity 15 m/s in 2s, decelerates at 2 m/s is MDCAT - 2017
a. 30 m
b. 34m
c. 16 m
d. 26 m

246) A mass is dropped from rest position from aheight of 30 m. if g is taken as 10 m/s then its velocity at a height of 25 m above the ground is? MDCAT - 2018
a. 4.9 ms^{-1}
b. 10 ms^{-1}
c. 100 ms^{-1}
d. 9.8 ms^{-1}

247) A toy train travels around a circular track of radius 2.5 m in a time of 40 s. What is the speed?
a. 0.39 ms^{-1}
b. 0.49 ms^{-1}
c. 15.9 ms^{-1}
d. 0.0625 ms^{-1}

248) A bullet train is lifted above the rails due to magnetic effect, thus friction is reduced to minimum and speed can be enhanced up to: MDCAT - 2018
a. 500 Km min^{-1}
b. 1000 Km h^{-1}
c. 500 Km sec^{-1}
d. 500 Km h^{-1}

249) An automobile is moving forwards with uniform velocity due to the force exerted by its engine. If that force is double with the velocity remaining constant what happens to its total power? MDCAT - 2019
a. It does not change
b. It is squared
c. It is halved
d. It is doubled

250) If we drop an object, its initial velocity is zero. How far will it fall in time 't'? MDCAT - 2020
a. $9.8t^2$
b. $4.9t^2$
c. $0.49t^2$
d. $98t^2$

251) 3kg stone falls from 20m high platform. Find its falling speed at 10m height. NUMS-2020
a) 196m/s
b) 14m/s
c) 10m/s
d) 100m/s

252) A car at rest starts moving with linear uniformly increasing velocity. After 20 seconds it attains the maximum velocity of 80 m/s. what is the distance covered during this time interval? NUMS-2019
200m
400 m
800 m
1600 m

253) An aircraft is moving along a straight path with constant velocity, its acceleration will be NUMS-2019
Constant
Zero
Maximum
Uniform

254) A body moves with a constant velocity and covers X metres in 1st second and Y metres in next 4 second then what will be relation between X and Y. NUMS-2019
X = 4Y
Y = 4X
Y = 16X
X = 2Y

255) An object is thrown vertically upward with a velocity of 20m/s. How much time ¡t will take to reach the highest point? NUMS-2017
a) 2 sec
b) 4 sec
c) 1 sec
d) Insufficient information

256) Suppose you drop an object from the roof of your house. It takes 2 sec. to reach the ground. What is the height of your house? NUMS-2017
a) 10m
b) 20m
c) 5m
d) Insufficient information

257) A body will be in translational equilibrium if the vector sum of all the forces acting on it is NUMS-2017
a) O
b) Min.
c) Max.
d) Equal

258) Consider an object is placed on a frictionless inclined plane at a height of 5m, if it is released, what will be its velocity at the bottom of the inclined plane? NUMS-2017
a) Insufficient information
b) 10 m/s
c) 100 m/s
d) 20 m/s

259) A cricketer hits 4 runs, When middle of the bat hits the ball. This is an example of Newton's: NUMS-2017

a) 2nd la w of motion
b) 3rd law of motion
c) lt of motion
d) Law of gravity

260) A body moving with velocity V can be stopped by a force F in direction of It. Same body moving with velocity 5V can be stopped by a force 5F in distance equal to: NUMS-2017
a) X
b) 5x
c) 10x
d) x/2

261) A ball is thrown vertically upward with a velocity of 98 m/s, how high does the ball rise? (g = 9.8 m/s) FMDC 2012
a.360 meters
b.380 meters
c.490 meters
d.510 meters
e.320 meters

262) a freely falling object is an example of? FMDC 2012
A. newt0ns first law
B. newt0ns 2nd law
C. Archimedes principle

263) A ball is thrown vertically upward with velocity of 196 m/s. how high does the ball rise? FMDC 2013
A) 1960 meters
B) 2960 meters
C) 1000 meters
D) 1100 meters

264) An elevator, in which a man is standing is moving upward with a constant speed of 10 m/s2. If the man drops a coin from a height of 2.5 m, find the time taken by it to reach the floor of the elevation (g=9.8 m/s2) FMDC 2013
A) 0.707 s
B) 1.9 s
C) 3.1 s
D) 6.17 s
E) 7.15 s

265) If an object is released 19.6 meter above the ground, how long does it take the object to reach the ground? (g=9.8 m/s2) FMDC 2013
A) 1 seconds
B) 2 seconds
C) 6 seconds
D) 8 seconds
E) 10 seconds

266) A rock is dropped from a high bridge at the end of 3 seconds of free fall the speed of the rock in cm/s: FMDC 2013
A) 30
B) 100
C) 500
D) 1000
E) 2940

267) A body rolling freely on the surface of the earth eventually comes to rest because FMDC 2013
A) It has mass
B) It suffers friction
C) It has inertia of rest
D) It has a momentum
E) It is gravitation less because it is already on the surface.

268) A body of mass 2 kg is suspended in an elevator by means of a spring balance. The balance reads its weight when the elevator moves up with an acceleration of 5ms-2 as FMDC 2013
A) 30.5N
B) 29.6N
C) 26.5N
D) 9.8N
E) 30.9N

269) The resultant of two forces of magnitude f and 2F can be: FMDC 2017
a) Less than F
b) More than 3F
c) C perpendicular to F
d) Perpendicular to 2F

270) If the resultant of two vectors each of magnitude F is also of magnitude F, the angle between them is: FMDC 2017
a) 60°
b) 90°
c) 120°
d) 130°

271) A motorist travelling a t 10 ms-1 can bring his car to rest in a breaking distance of 10 m. In what distance could he bring the car to rest from the period of 30 ms-1 using the same breaking force? FMDC 2017
a) 17 m
b) 30 m
c) 52 m
d) 90 m

272) A guy is standing in a lift falling freely under gravity releases a ball from hand. As seen by the ball, the boy FMDC 2015
a) falls down
b) remains stationary
c) goes up
d) none of above

273) A body moving with velocity V can be stopped by a force F in direction of it. Same body moving with velocity 5V can be stopped by a force 5F in distance equal to: FMDC 2015

a) X
b) 5x
c) 10x
d) x/2

274) **Equations of Motions**
A body is falling freely under gravity. How much distance it falls during an interval of time between 1st and 2nd **SECOND**s of its motion, taking $g=10m/s^2$
A) 14 m B) 20 m C) 5 m D) 25 m

275) Distance covered by a freely falling body in 2 **SECOND**s will be
A) 4.9 m B) 19.6 m C) 39.2 m D) 44.1 m

276) The distance covered by a body in time t starting from rest is
A) $\frac{at^2}{2}$ B) Vt C) $\frac{a^2t}{2}$ D) at^2

277) A car travels a distance Son a straight road in 2 hours and then returns to the starting point n the next 3 hours. Its average velocity is :
a. S/5 b. 2S/5
c. S/2+S/3 d. zero

278) If the 100 gram masshaving 32 ft/sec^2, then its force is
a. 320 lb b. 9.8N
c. 320 dyne d. non of these

279) ball is thrown vertically upward with a velocity of 98 m/s. If it takes 10 **SECOND**s to reach the highest point, then the acceleration of the ball is;
a) 9.8 m/s^2 b) 98 0 m/s^2
c) 98 m/s^2 d) -9.8 m/s^2

280) A ball of mass 5000 kg is dropped from height of 500 m. the time taken by the ball to hit the ground is, take g=10 m/ :
a) 2 sec b) 4 sec c) 8 sec d) 16 sec

281) A ball of mass 5kg is dropped from height of 78.4m. the time taken by the ball to hit the ground is :
a) 2 sec b) 4 sec c) 8 sec d) 16 sec

282) On a railway track a driver applies the brakes of the train at a yellow signal, a distance 1 km from red signal, where it stops. The max deceleration of the train is 0.2 m/s^2. Assuming uniform deceleration, what is the maximum safe speed of the train at the yellow signal?
a) 20 m/s b) 40 m/s
c) 200 m/s d) 400 m/s

283) A racing car accelerates uniformly through their gear changes with the following average speeds: $20ms^{-1}$ for 2.0s, $40ms^{-1}$ for 2.0s and $60ms^{-1}$ for 6.0s. What is the overall average speed of the car?
a) 12m/s b) 13.3m/s c) 48m/s d) 40m/s

284) A ball is dropped from the roof of a very tall building. What is its velocity after falling for 5.0s?
a) 1.96 m/s b) 9.80m/s
c) 49.0m/s d) 98.0m/s

285) The symbol "g" represents the acceleration of free fall. Which of these – statements is correct?
a) g is gravity
b) g is the ratio weight/mass
c) g is the weight of an object
d) g is reduced by air resistance.

286) Bodies which fall freely under the action of gravity is an example of:
a) uniform acceleration b) variable acceleration
c) uniform velocity d) average acceleration

287) Which one of the following statements is correct for an object released from rest?
a) The average velocity during the first second of time is 4.9 m/s
b) During each second the object falls 9.8 m
c) The acceleration changes by 9.8 m/s^2 every second
d) The object falls 9.8 m during the first second of time

288) For a freely falling body, the vertical velocity at the fifth second in m/s is:
a) 39.2 b) 49 c) 19.6 d) 94.9

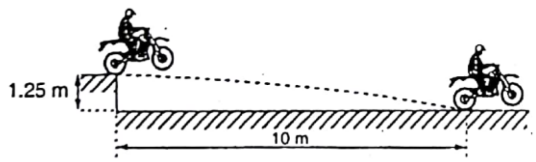
289) When a certain force is applied to the standard kilogram its acceleration is 5.0 m/s^2. When the same force is applied to another object its acceleration is one-fifth as much. The mass of the object is:
a) 0.2 kg b) 1.0 kg c) 0.5 kg d) 5.0 kg

290) A ball is allowed to fall freely from certain height. It covers a distance in first second equal to:
a) 2g b) g/2 c) g d) 3g

291) A body throws a ball vertically upwards. It rises to a maximum height, where it is momentarily at rest, and falls back to his hands.
Which of the following gives the acceleration of the ball at various stages in its motion? Take vertically upwards as positive. Neglect air resistance.

	Rising	At max. height	Faling
A	$-9.81\ ms^{-2}$	0	$+9.81\ ms^{-2}$
B	$-9.81\ ms^{-2}$	$-9.81\ ms^{-2}$	$-9.81\ ms^{-2}$
C	$+9.81\ ms^{-2}$	$+9.81\ ms^{-2}$	$+9.81\ ms^{-2}$
D	$+9.81\ ms^{-2}$	0	$-9.81\ ms^{-2}$

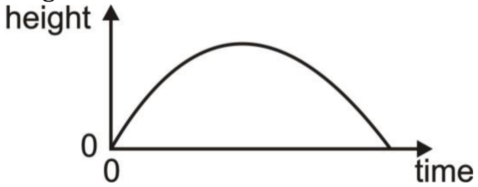
292) A motorcycle stunt-rider moving horizontal takes off from a point 1.25 m above the ground, landing 10 m away as shown.



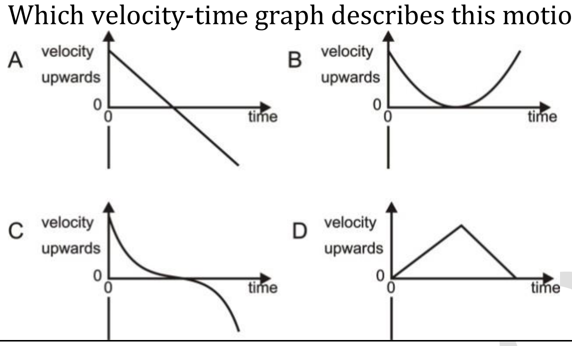
What was the speed at take-off?

a) 5 ms^{-1} b) 10 ms^{-1}
c) 15 ms^{-1} d) 20 ms^{-1}

293) A ball is thrown vertically upwards and returns along the same path. The graph shows how its height varies with time.



Which velocity-time graph describes this motion?



294) **Non-Uniform Motion**
A motor car moving with a uniform speed of 20 m / sec comes to stop on the application of brakes after travelling a distance of 10 m its acceleration is

a) 20 m/sec^2 b) -20 m/sec^2
c) -40 m/sec^2 d) +2 m/sec^2

295) A particle experiences a constant acceleration for 20 sec after starting from rest. If it travels a distance S_1 in the first 10 sec and a distance S_2 in the next 10 sec, then

a) $S_1 = S_2$ b) $S_1 = S_2 / 3$
c) $S_1 = S_2 / 2$ d) $S_1 = S_2 / 4$

296) The velocity of a body moving with a uniform acceleration of 2 m/sec^2 is 10 m/sec. its velocity after an interval of 4 sec is

a) 12 m/ sec b) 14 m/sec
c) 16 m/sec d) 18 m/sec

297) A particle starting from rest travels a distance x in first 2 seconds and a distance y in next two seconds, then

a) Y = x b) Y = 2x
c) Y = 3x d) Y = 4x

298) The initial velocity of a body moving along a straight line is 7 m/s. it has a uniform acceleration of 4 m/s^2. The distance covered by the body in the 5 second of its motion is

a) 25 m b) 35 m
c) 50 m d) 85 m

299) If body having initial velocity zero is moving with uniform acceleration 8 m/sec^2 the distance travelled by it in fifth second will be

a) 36 metres b) 40 metres
c) 100 metres d) Zero

300) Acceleration of a particle changes when

a) Direction of velocity changes
b) Magnitude of velocity changes
c) Both of above
d) Speed changes

301) The position of a particle moving along the x-axis at certain times is given below:

T(s)	0		2	3
X(m)	-2	0	6	16

Which of the following describe the motion correctly

a) Uniform, accelerated
b) Uniform, decelerated
c) Non-uniform accelerated
d) There is not enough data for generalization

302) Consider the acceleration, velocity and displacement of a tennis ball as it falls to the ground and bounces back. Directions of which of these changes in the process.

a) Velocity only
b) Displacement and velocity
c) Acceleration, velocity and displacement
d) Displacement and acceleration

303) The velocity of a bullet is reduced from 200 m/s to 100 m/s while travelling through a wooden block of thickness 10 cm. the retardation, assuming it to be uniform, will be

a) 10×10^4 m/s b) 12×10^4 m/s
c) 13.5×10^4 m/s d) 15×10^4 m/s

304) A body of 5 kg is moving with a velocity of 20 m/s. if a force of 100 N is applied on it for 10 s in the same direction as its velocity what will now be the velocity of the body

a) 200 m/s b) 220 m/s
c) 240 m/s d) 260 m/s

305) **Motion Under Gravity**
Two bodies of different mass m_a and m_b are dropped from two different heights a and b. the ratio of the time taken by the two to cover these distance are

a) A : b b) B : a
c) $\sqrt{a} : \sqrt{b}$ d) $a^2 : b^2$

306) A stone is dropped into water from a bridge 44.1 m above the water. Another stone is thrown vertically downward 1 sec later. Both strike the water simultaneously. What was the intial speed of the second stone.

a) 12.25 m/s
b) 14.75 m/s

c) 16.23 m/s

d) 17.15 m/s

307) An iron ball and wooden ball of the same radius are released from the same height in vacuum. They take the same time to reach the ground. The reason for this is

a) Acceleration due to gravity in vacuum is same irrespective of the size and mass of the body

b) Acceleration due to gravity in vacuum depends upon the mass of the body

c) There is no acceleration due to gravity in vacuum

d) In vacuum there is a resistance offered to the motion of the body and this resistance depends upon the mass of the body

308) A body is released from a great height and falls freely towards the earth. Another body is released from the same height exactly one second later. The separation between the two bodies, two seconds after the release of the second body is

a) 4.9m b) 9.8m

c) 19.6m d) 24.5m

309) A stone dropped from the top of the tower touches the ground in 4 sec. the height of the tower is about

a) 80 m b) 40 m

c) 20 m d) 160 m

310) A body is released from the top of a tower of height h. it takes t second to reach the ground. Where will be the ball after time t/2 sec

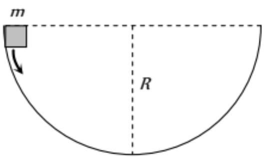
(a) At h/ 2 from the ground

(b) At h/2 from the ground

(c) Depends upon mass and volume of the body

(d) At 3h / 4 from the ground

311) A mass m slips along the wall of a seispherical surface of radius R. the velocity at the bottom of the surface is



a) $\sqrt{Rg}$ b) $\sqrt{2Rg}$

c) $2\sqrt{\pi Rg}$ d) $\sqrt{\pi Rg}$

312) A body falls from rest, its velocity at the end of first second is (g = 32 ft / sec)

a) 16 ft/sec b) 32 ft/sec

c) 64 ft/sec d) 24 ft/sec

313) A stone thrown upward with a speed u from the top of the tower reaches the ground with a velocity 3u. The height of the tower is

a) $3u^2/g$ b) $4u^2/g$

c) $6u^2/g$ d) $9u^2/g$

314) Two stones of different masses are dropped simultaneously from the top of a building.

a) Smaller stone hit the ground earlier

b) Larger stone hit the ground earlier

c) Both stones reach the ground simultaneously

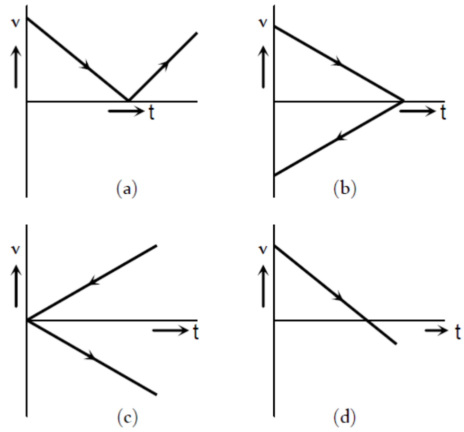
d) Which of the stone reaches the ground earlier depends on the composition of the stone

315) A balloon is at a height of 81 m and is ascending upwards with a velocity of 12 m/s. a body of 2 kg weight is dropped from it. If $g = 10\ m/s^2$, the body will reach the surface of the earth in

a) 1.5 s b) 4.025 s

c) 5.4 s d) 6.75 s

316) A ball is thrown vertically upwards. Which of the following graph/graphs represent velocity-time graph of the ball during its flight (air resistance is neglected)



a) A b) B c) C d) D

Collision

317) In perfect elastic Collision: : **NUMS -2021**

A) Only momentum is conserved

B) Only total energy is conserved

C) Only kinetic energy is conserved

D) Momentum kinetic energy and total kinetic energy is conserved

318) An elastic collision is the one in which: : **NUMS - 2022**

a. Kinetic energy and momentum is conserved

b. Kinetic energy is conserved but total energy is not conserved

c. Momentum is conserved but kinetic energy is not conserved

d. Both kinetic energy and momentum are not conserved

319) A car in motion hits and gets embedded in a tree trunk. What is conserved? ; **ETEA-2019**

a) Momentum and K.E

b) Kinetic energy alone

c) neither K.E nor momentum

d) Momentum alone

320) A particle of mass moving with a velocity, makes head on elastic collision with another particle of mass same with that, and initially at rest. The velocity of the first particle after collision. ETEA 2009-Med
(a) 2V (b) –V (c) +V (d) Zero

321) In elastic collision, when a massive body collides with light body at conditions m1 >> m2 and v2 = 0 ms^{-1}, then the change in velocity will be written as: MDCAT - 2018
a. $V_1' \approx -v_1; v_2' \approx v_1$ b. $v_1' \approx v_1; v2' \approx 0$
c. $v_1' \approx v_1; v_2' \approx 2v_1$ d. $v_1' \approx -v_1; V_2' \approx 0$

322) Two railway trucks of masses m and 3m move towards each other in opposite directions with speeds 2v and v respectively. These trucks collide and stick together. what is the speed of the trucks after the collision?
A)v/4 B)v/2 C)v D)5v/4

323) If two objects of equal masses 'm' are moving towards each other with the same speeds 'v' then what will be the total final momentum after elastic head-on collision? **MDCAT - 2019**
a. -mg kg/s b. Mv kg m/s
c. 2 mv kg/s d. 0 kg m/s

324) Elastic collision involves ETEA 2010-Eng:
(a) Loss of Energy
(b) Gain of Energy
(c) No relation b/w energy & elastic collision
(d) No gain, no loss of energy

325) A snooker ball moving with velocity v collides head on with another snooker ball of same mass at rest. If the collision is **ELASTIC**, the velocity of the **SECOND** snooker ball is:
a) Zero b) Infinity
c) V d) 2V

326) If a body of mass 2 kg moving with 15m/s collides with stationary body of same mass, then after elastic collision Second body will move with velocity of:
a) 15 m/s b) 30 m/s
c) Zero m/s d) None of these

327) ELASTIC collision involves:
a) Loss of Energy
b) Gain of Energy
c) No relation b/w energy & ELASTIC collision
d) No gain, no loss of energy

328) Which is a statement of the principle of conservation of Momentum?
a) Momentum is the product of mass and velocity.
b) Momentum is conserved only in ELASTIC collisions
c) Momentum is conserved by all bodies in a collision.
d) Momentum is conserved providing no external forces act.

329) The collision between two bodies be ELASTIC if bodies are
A) solid and soft B) soft and ELASTIC
C) solid and hard D) hard and ELASTIC

330) When there is no loss of K.E and Momentum then collisions is called:
a) ELASTIC collision b) in-ELASTIC collision
c) inertial collision d) none of these

331) When two bodies stick together after the collision, the collision is said to be?
a) perfectly ELASTIC
b) partially ELASTIC
c) completely inELASTIC
d) none of these

332) If a body of mass 2 kg moves with 15 m/s collides with stationary body of same mass, then after elastic collision second body will move with velocity of:
a) 15 m/s b) 2 m/s
c) 30 m/s d) 0 m/s

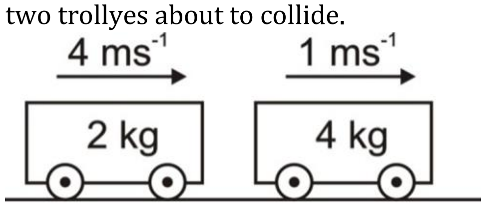
333) When a heavy particle collides with a light particle at rest, then after collision the target particle moves with:
a) The same speed
b) Double the velocity of incident particle
c) Zero velocity
d) Bounce back with same velocity

334) Sphere "A" has mass m and is moving with velocity "v". it makes a head-on elastic collision with a stationary sphere "B" of mass 2m. after the collision their speeds (v_A and v_B) are:
a) 0, v/2 b) – v, v
c) –v/3, 2v/3 d) -2v/3, v/3

335) Two satellites in space collide inelastically. What happens to the kinetic energy and Momentum turn?

	Kinetic energy	Momentum
A	Conserved	Conserved
B	Conserved	Reduced
C	Reduced	Conserved
D	Reduced	Reduced

336) The diagram shows the masses and velocities of two trollyes about to collide.

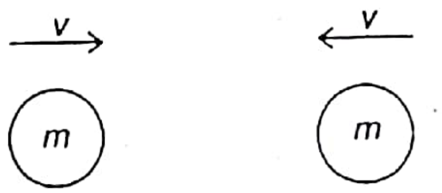


After the impact they move off together.

What is the total kinetic energy of the trollyes after the collision?
a) 1.3 J b) 12 J
c) 18 J d) 19 J

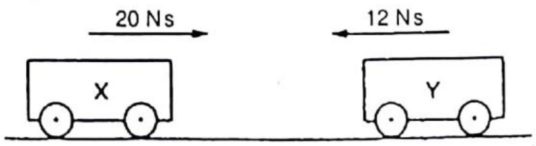
337) In perfectly elastic collisions between two atoms, it is always true to say that
a) The initial speed of one atom will be the same as the final speed of the other atom.
b) The relative speed of approach between the two atoms equals their relative speed of separation
c) The total Momentum must be conserved, but a small amount of the total kinetic energy may be lost in the collision.
d) Whatever their initial statement of motion, neither atom can be stationary after the collision.

338) Two similar spehres, each of mass m and travelling with speed v, are moving towards each other.



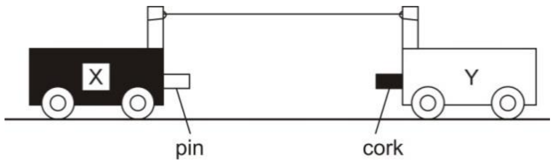
The spheres have a head-on elastic collision. Which statement is correct?
a) The spheres stick together on impact.
b) The total kinetic energy after impact is mv^2.
c) The total kinetic energy before impact is zero
d) The total Momentum before impact is 2 mv.

339) The diagram shows two trollyes, X and Y, about to collide and gives the Momentum of each trolley before the collision.



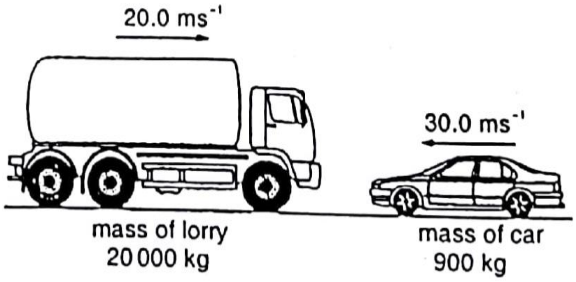
After the collision, the directions of motion of both trolleys are reversed and the magnitude of the Momentum of X is then 2 Ns.
What is the magnitude of the corresponding Momentum of Y?
a) 6 Ns b) 8 Ns c) 10 Ns d) 30 Ns

340) The diagram shows two rollyes X and Y held stationary and connected by an extended eleastic cord. The mass of X is twice that of Y.



The trollyes are released at the same instant. They move towards each other and stick together on impact. Just before the collision, the speed of X is 20 cm s^{-1}.
What is the speed of Y after the collision?
a) Zero b) 5 cm s^{-1}
c) 7 cm s^{-1} d) 10 cm s^{-1}

341) The diagram shows a situation just before a head-on collision. A lorry of mass 20000 kg is travelling at 20.0 ms^{-1} towards a car of mass 900 kg travelling at 30.0 ms^{-1} towards the lorry.



What is the magnitude of the total Momentum?
a) 373 kNs b) 427 kNs
c) 3600 kNs d) 4410 kNs

342) A ball of mass 80 g collides with a vertical wall. The ball has a velocity of 23 ms^{-1} in a horizontal direction. After hitting the wall the ball moves with a velocity of 18 ms^{-1} in the opposite direction.
What is the impulse provided by the wall?
a) 0.40 Ns in direction away from the wall
b) 3.3 Ns in a direction away from the wall
c) 33 Ns in a direction towards the wall
d) 3300 Ns in a direction towards the wall

343) Two solid rubber balls A and B having masses 200 and 400 gm respectively are moving in opposite directions with velocity of A equal to 0.3 m/s. after collision the two balls come to rest, then the velocity of B is
a) 0.15 m/sec
b) 1.5 m/sec
c) -0.15 m/sec
d) None of the above

344) Two perfectly elastic particles P and Q of equal mass traveling along the line joining them with velocities 15 m/sec and 10 m/sec. after collision, their velocities respectively (in m/sec) will be
a) 0, 25
b) 5, 20
c) 10, 15
d) 20, 5

345) When two bodies collide elastically, then
a) Kinetic energy of the system alone is conserved
b) Only momentum is conserved
c) Both energy and momentum are conserved

d) Neither energy nor momentum is conserved

346) Two balls at same temperature collide. What is conserved
a) Temperature
b) Velocity
c) Kinetic energy
d) Momentum

347) A heavy steel ball of mass greater than 1 kg moving with a speed of 2 m/s collides head on with a stationary ping-pong ball of mass less than 0.1 gm. The collision is elastic. After the collision the ping-pong moves approximately with speed
a) 2 m sec-1
b) 4 m sec-1
c) 2 x 104 m sec-1
d) 2 x 103 m sec-1

348) A body of mass 'M' collides against a wall with a velocity v and retraces its path with the same speed. The change in momentum is (take initial direction of velocity as positive)
a) Zero
b) 2Mv
c) Mv
d) -2 Mv

349) A smooth sphere of mass M moving with velocity u directly collides elastically with another sphere of mass m at rest. After collision their final velocities are V and v respectively. the value of v is
a) $\frac{2uM}{m}$
b) $\frac{2um}{M}$
c) $\frac{2m}{1+\frac{m}{M}}$
d) $\frac{2u}{1+\frac{M}{m}}$

350) A body of mass m having an initial velocity v, makes head on collision with a stationary body of mass M. after the collision, the body of mass m comes to rest and only the body having mass M moves. This will happen only when
a) m>>M
b) m << M
c) m = M
d) m = $\frac{1}{2}$M

351) A particle of mass m moving with a velocity V makes a head on elastic collision with another particle of same mass initially at rest. The velocity of the first particle after the collision will be
a) V
b) –V
c) -2V
d) Zero

352) A body of mass 2 kg collides with a wall with speed 100 m/s and rebounds with same speed. If the time of contact was 1/50 second, the force exerted on the wall is
a) 8 N
b) 2 x 104 N
c) 4 N
d) 104 N

353) A ball of weight 0.1 kg coming with speed 30 m/s strikes with a bat and returns in opposite direction with speed 40 m/s, then the impulse is
a) – 0.1 x (40) – 0.1 x (30)
b) 0.1 x (40) – 0.1 x (-30)
c) 0.1 x (40) + 0.1 x (-30)
d) 0.1 x (40) – 0.1 x (20)

354) A billiard ball moving with speed of 5 m/s collides with an identical ball originally at rest. If the first ball stops after collision hen the second ball will move forward with a speed of
a) 10 ms-1
b) 5 ms-1
c) 2.5 ms-1
d) 1.0 ms-1

Projectile Motion

355) Doubling the initial velocity of a projectile while keeping all other parameters the same, the height reached by the projectile increases by: : **ETEA-2023**
A. two times B. Three times
C. four times D. remains the same

356) When the range of a projectile is equal to one fourth of the height then which one is true: : **ETEA-2023**
A. Tanθ = 10 B. Tanθ = 12
C. Tanθ = 16 D. Tanθ = 1

357) A projectile is thrown at an angle of 45° with horizontal and its range is R_2. Another projectile is thrown at an angle of 45^0 with vertical and its range is R_2. The relation between $R_1 and\ R_2$ is: **ETEA-2022**
a) $R_2 = 2R_1$ b) $R_1 = 2R_2$
c) $R_1 = R_2$ d) $3R = R_2$

358) Projectile is launched, its velocity is maximum at: **ETEA-2022**
a) Point of projection
b) Highest point
c) Between launching and highest point
d) All points

359) Projectile is thrown in such a way that its maximum height equals to its range, the angle of projection is; **ETEA-2019**
a) Tan-1 45 b) Tan-1 60

c) Tan-1 30 d) None

360) At what angle of projection of a projectile the range becomes half of its Maximum value? **NMDCAT-2020**

a. 15° b.20° c. 30° d. 40°

361) In projectile motion, the rage of projectile will be maximum at an angle of: **NUMS -2022**

a. 30 degrees
b. 45 degrees
c. 60 degrees
d. 90 degrees

362) Which of the following pair of angles have same rang for a projectile? : **NUMS -2022**

a. 10° and 20°
b. 75° and 15°
c. 45° and 60°
d. 0° and 30°

363) In projectile motion, the range of projectile will be maximum at an Angle of: **NUMS -2021**

A) 30
B) 45
C) 80
D) 90

364) In projectile motion, at maximum height: **NUMS -2021**

A) Vx = 0, Vy = Constant
B) Vx= constant, Vy= Constant
c) V x =0,V y=0
D) Vx= constant, Vy = 0

365) The angle of projection of a projectile for which its maximum height and horizontal range are equal is: **NUMS -2022**

a. 45°
b. 90°
c. 0°
d. 70°

366) Time required by the projectile to reach the summit point is ; **ETEA-2019**

a) $T = \sqrt{\frac{2H}{g}}$ b) $T = \sqrt{\frac{3H}{g}}$

c) $T = \sqrt{\frac{4H}{g}}$ d) $T = \sqrt{\frac{H}{g}}$

367) The range of projectile when launched at an angle of 15° with the horizontal is 15 m. Its range, when launched at 45° with the same speed is: FMDC 2017

a) 3.0 m b) 1.5 m c) 6.0 km d) 0.752 km

368) The range of projectile is the same for two angles which are mutually; ETEA 2017-med

A) Perpendicular B) Supplementary
C) Complementary D) 270^0

369) A ball is projected upwards. Its acceleration at the highest point is: ETEA 2017-Eng

A. Zero
B. Directed upwards
C. Directed downward
D. Can't be predicted

370) On a planet, a vertically-launched projectile takes 12.5 s to return to its starting position. The projectile gains a maximum height of 170 m. The planet does not have an atmosphere.What is the acceleration of free fall on this planet? ETEA 2017-Eng

a)2.2 m s^{-2} 2 b)8.7 m s^{-2}
c)27 m s^{-2} d)54 m s^{-2}

371) A stone is projected vertically upwards from ground at an initial speed of 15 m/s. Air resistance is negligible. What is maximum height reached by stone? ETEA 2018-Med

A) 0.76 m B) 11 m
C) 23 m D) 110 m

372) A basketball is thrown upward along a parabolic path. What is the ball's acceleration while movingupward? ETEA 2018-Med

A)g, upward B)1/2 g, upward
C) g, downward D) g, upward.

373) A ball is just allowed to fall from the window of a moving train, it will hit the gund following. 2005- 67 Med:

a) Circular path (b) Hyperbolic
(c) Straight line path (d) Parabolic path

374) At maximum height the velocity of projectile is; ETEA 2012-78Med

(a) Zero (b) Minimum
(c) Maximum (d) In b/w min & max

375) A projectile is launched at 45^0 to the horizontal with initial K. Energy, E. Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point? ETEA 2012- 193 Eng: ETEA 2014-136; Med

(a) 0.71E (b) 0.50 E
(c) 0.87E (d) E

376) A projectile is throw horizontally from a 490m high diff with velocity of 10m/s, the time taken by projectile to reach to reach the ground is….. ETEA 2007-41 Med

(a) 2.5 sec (b) 7.5 sec
(c) 5.0 sec (d) 10 sec

377) The maximum height, H attained by a projectile

projected with initial velocity $v = v_0$ is given by; ETEA 2008-88 Med:

(a) $H = V^2 \cos^2\theta/2g$ (b) $H = V^2 \sin^2\theta/2g$

(c) $H = V^2 \cos^2\theta/g$ (d) $H = V^{2\ \cos 2}\theta/g$

378) The horizontal range of the projector is; ETEA 2009-30 Med:

(a) $R = \frac{Vo^2}{g} \sin\theta \cos\theta$ (b) $R = \frac{V_1{}^2}{2g} \sin\theta$

(c) $R = \frac{V^2}{g} \cos\theta\,(2\theta)$ (d) $R = \frac{V_1{}^2}{g} \sin 2\theta$

379) The range of proejctile is the same for two angles which are mutually

(a) Orthogonal (b) Supplementary

(c) Complementary (d) Sum is 45^0

380) A bomber drops a bomb, when it is vertically above the target. It misses the target b/c of: ETEA 2011- 32 Med:

(a) Vertical component of the velocity of bomber

(b) force of gravity

(c) Acceleration of bomber

(d) Horizontal component of the velocity of bomber

381) To improve the jumping record a long jumper should jump at an angle; ETEA 2010- 22 Med

(a) 30^0 (b) 45^0

(c) 60^0 (d) 90^0

382) The span of broad jump depends upon; ETEA 2010-49 Eng:

(a) Mass of jumper

(b) vision of jumper

(c) Angle of projection of jumper

(d) Height of jumped

383) A hunter aiming a bird in tree should aim; ETEA 2012-65Med

(a) A little above the bird

(b) A little belo

(c) Exactly at the bird

(d) Very high

384) A person throws a ball vertically upward while standing in a train moving with uniform velocity. The ball will fall. ETEA 2007- 148, ETEA 2011-29 Eng:

(a) In his hand (b) Behind him

(c) In from of him (d) Beside him

385) A man throws a ball vertically upward in a compartment of an "accelerated" train. The ball will fall ETEA 2011-28 Med

(a) In font of him (b) In his land

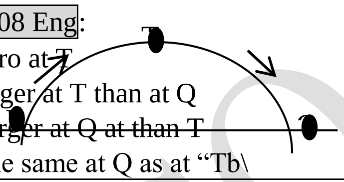
(c) Behind him (d) beside him

386) A missile is fired with a speed of 98 m/see at 300 with horizontal. The missile is airborne for ETEA 2011-33 Med

(a) 10 sec (b) 20 sec

(c) 30 sec (d) 40sec

387) In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is "T". The point reaches point Q just before landing. The vertical component of acceleration of stone is ETEA 2013-08 Eng:



(a) Zero at T

(b) larger at T than at Q

(c) Larger at Q at than T

(d) The same at Q as at "Tb\

388) At what angle should a projectile be fired in order for its range to be at maximum? ETEA 2014-199;Eng;

(a) 30^o (b) 45^o

(c) 90^o (d) 60^o

389) A shot is fired at an angle of 60^o to the horizontal with kinetic energy E. if air resistance is ignored, the kinetic energy at the top of the trajectory is: ETEA 2014-194;Med

a) Zero b) E/8

c) E/4 d) E/2

390) A basketball is thrown upward along a parabollic path. What is the ball's acceleratio0n at its highest point? ETEA 2014-43;Med

(a) 0 (b) 1/2g, horizontally

(c) g, upward (d) g, downward

391) The velocity of projectile equal to its initial velocity added to: ETEA 2015-37 Eng

A) A constant horizontal velocity

B) A constant vertical velocity

C)A constantly increasing horizontally

D) A constantly increasing downward vertically

392) Two projectiles are in flight at the same time. The acceleration of one relative to othe ETEA 2015-28 Med

A) Always 9.8 m-s^{-2}

B) Can be horizontal

C) Can be as large as 19.8 m-s^{-2}

D) Is zero

393) A stone thrown horizontally from the top of a tall building follows a path that is: ETEA 2015-119 Eng

A) Circular

B) Made of two straight line segments

C) Hyperbolic

D) Parabolic

394) Two projectiles are in flight at the same time. The acceleration of one relative to the other: ETEA 2016-11 Med

(a) Is always 9.8 m/s^2

(b) Can be as large as 19.8 m/s^2
(c) Can be horizontal
(d) Is zero

395) For projectile motion in the absence of air resistance MDCAT - 2019
a. Vertical speed is constant
b. Horizontal force is constant
c. Horizontal acceleration is zero
d. Vertical acceleration is zero

396) The range of the projectile depends upon the velocity of the projection and the angle of the projection i.e. 45°C. for a fix velocity, when the angle of projection is large than 45°. What of the following is correct? MDCAT - 2019
a. Both the height and the range attained by the projectile will be less
b. Both the height and the range attained by the projectile will be more
c. The height attained by the projectile will be less but the range is more
d. The height attained by the projectile will be more but the range is less

397) At what angle of projection of a projectile the range becomes half of its Maximum value? MDCAT - 2020
a. 15°
b.20°
c. 30°
d. 40°

398) Which one of the following is the angle of projection of a projectile if its range is equal to its height? NUMS-2020
a) 48^0 b) 60^0 c) 90^0 d) 76^0

399) The kinetic energy of a projectile at the highest point is half of its kinetic energy. The angle of projection is FMDC 2013
A) 0° B) 30° C) 60° D) 45° E) 90°

400) Which of the following is not an example of projectile motion?
a) A gas-filled balloon
b) Bullet fired from a gun
c) A football kicked
d) A baseball shot

401) The range of the projectile at 30° is R30 and at 60° is R60 then?
a) $R_{30} = R_{60}$ b) $R_{30} = 2R_{60}$
c) $2R_{30} = R_{60}$ d) $R_{30} = R_{60}$

402) time taken by the projectile to reach its maximum height
a) $\frac{Vi\, sin\theta}{g}$ (b) $\frac{Vi \cos\theta}{g}$
c) $\frac{2Vi\cos\theta}{g}$ d) $2V_i\,g$

403) The football kicked in the air is an example of
a) rotational motion b) circular motion
c) linear motion d) projectile motion

404) Motion of projectile is
a) one dimensional b) two dimensional
c) three dimensional d) four dimensional

405) the magnitude of the velocity of the projectile is
a) v= $\sqrt{vi\ sin\theta - gt}$
b) v= $\sqrt{ax - bx}$
c) v= $\sqrt{vi^2 + 2gtvi\ sin\theta + g^2 t^2}$
d) v= $\sqrt{vi^2 - 2gtvi\ sin\theta + g^2 t^2}$

406) The range of the projectile at 30^0 and 60^0 are
A) equal to 45^0 B) equal to 90^0
C) equal to each other D) none of the above

407) At which angle the range of the projectile is maximum
A) 45^0 B) 60^0 C) 30^0 D) none

408) The trajectory (or path) of a projectile is.
a) Straight line b) Parabola
c) Hyperbola d) Circle

409) A football player will throw a football at maximum distance if the angle of projection is:
a) 30^0 b) 45^0 c) 60^0 d) 90^0

410) The velocity of projectile at its maximum height is:
a) vi sin θ b) vi cos θ
c) Maximum d) Zero

411) During projectile motion, the horizontal component of velocity:
a) Changes with time
b) Becomes zero
c) Remains constant
d) Increases with time

412) The range of projectile is the same for two angles which are mutually;
A) Perpendicular B) Supplementary
C) Complementary D) 270^0

413) On a planet, a vertically-launched projectile takes 12.5 s to return to its starting position. The projectile gains a maximum height of 170 m. The planet does not have an atmosphere.What is the acceleration of free fall on this planet?
a)2.2 m s^{-2} b)8.7 m s^{-2}
c)27 m s^{-2} d)54 m s^{-2}

414) At maximum height the velocity of projectile is;
a) Zero b) Minimum
c) Maximum d) In b/w min & max

415) A projectile is launched at 45^0 to the horizontal with initial K. Energy, E. Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?
a) 0.75E b) 0.50 E c) 0.90E d) E

416) A projectile is launched at 30^0 to the horizontal

with initial K. Energy, E. Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?
a) 0.75E b) 0.50 E c) 0.90E d) E

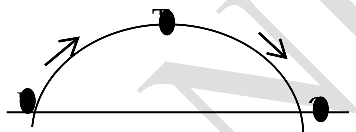
417) A projectile is launched at 60^0 to the horizontal with initial K. Energy, 100J. Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?
a) 25J b) 50J c) 75J d) E

418) A projectile is launched at 60^0 to the horizontal with initial K. Energy, 10J. Assuming air resistance to be negligible, what will be the potential energy of the projectile when it reaches its highest point?
a) 2.5J b) 5.0J c) 7.5J d) E

419) A projectile is throw horizontally from a 490m high diff with velocity of 10m/s, the time taken by projectile to reach to reach the ground is…..
a) 2.5 sec b) 7.5 sec
c) 5.0 sec d) 10 sec

420) The maximum height, H attained by a projectile projected with initial velocity $v = v_0$ is given by;
a) $H = V^2 \cos^2\theta/2g$ b) $H = V^2 \sin^2\theta/2g$
c) $H = V^2 \cos^2\theta/g$ d) $H = V^{2\ \cos 2}\theta/g$

421) In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is "T". The point reaches point Q just before landing. The vertical component of acceleration of stone is



a) Zero at T
b) larger at T than at Q
c) Larger at Q at than T
d) The same at Q as at "Tb\

422) Two projectiles are in flight at the same time. The acceleration of one relative to other
A) Always 9.8 $m\text{-}s^{-2}$
B) Can be horizontal
C) Can be as large as 19.8 $m\text{-}s^{-2}$
D) Is zero

423) A stone thrown horizontally from the top of a tall building follows a path that is:
A) Circular
B) Made of two straight line segments
C) Hyperbolic
D) Parabolic

424) The ballistic missiles are useful for:
a) Long range b) Short range
c) Intermediate range
d) Zero range

425) The Velocity of projectile is maximum:
a) At the highest point
b) At point of launching and just before striking the ground
c) At half of the height
d) After striking the ground

426) The range of projectile is same for:
a) 0^0 b) $35^0, 55^0$
c) $15^0, 60^0$ d) $30^0, 75^0$

427) If the time of flight of a projectile is doubled, what happens to the maximum height attained?
a) halved
b) remains unchanged
c) doubled
d) becomes four times

428) If R is the maximum horizontal range of a particle, then the greatest height attained by it is:
a) R b) 2R c) R/2 d) R/4

429) What is the angle of projection for which its maximum height and horizontal range are equal?
a) 46^0 b) 56^0 (c)66^0 d) 76^0

430) The span of broad jump depends upon;
a) Mass of jumper
b) vision of jumper
c) Angle of projection of jumper
d) Height of jumped

431) A hunter aiming a bird in tree should aim;
a) A little above the bird
b) A little below
c) Exactly at the bird
d) Very high

432) What is the angle of projection for which the range and maximum height become equal?
A) $\tan^{-1} 1/4$ B) $\tan^{-1} 4$
C) $\tan^{-1} 1/2$ D) $\tan^{-1} 2$

433) The range of proejctile is the same for two angles which are mutually
a) Orthogonal
b) Supplementary
c) Complementary d) Sum is 45^0

434) Which shows the correct relation between time of flight T and maximum height H?
A) $H=gT^2/8$ B) $H=8T^2/g$
C) $H=8g/T^2$ D) $H=gT^2$

435) Why Ballistic missile fails in some circumstances of precision.
A) due to their shape
B) due to air resistance

C) due to angle of projection
D) all of these

436) When the object is moving towards earth, the value of "g" is taken as:
a) Positive b) Negative
c) Zero d) None

437) A ball is projected upwards. Its acceleration at the highest point is:
A. Zero B. Directed upwards
C. Directed downward D. Can't be predicted

438) A stone is projected vertically upwards from ground at an initial speed of 15 m/s. Air resistance is negligible. What is maximum height reached by stone?
A) 0.76 m B) 11 m C) 23 m D) 110 m

439) A basketball is thrown upward along a parabolic path. What is the ball's acceleration while moving upward?
A)g, upward B)1/2 g, upward
C) g, downward D) g, upward.

440) A ball is just allowed to fall from the window of a moving train, it will hit the ground following.
a) Circular path b) Hyperbolic
c) Straight line path d) Parabolic path

441) A bomber drops a bomb, when it is vertically above the target. It misses the target b/c of:
a) Vertical component of the velocity of bomber
b) force of gravity
c) Acceleration of bomber
d) Horizontal component of the velocity of bomber

442) To improve the jumping record a long jumper should jump at an angle;
a) 30^0 b) 45^0
c) 60^0 d) 90^0

443) A missile is fired with a speed of 98 m/see at 300 with horizontal. The missile is airborne for
a) 10 sec b) 20 sec
c) 30 sec d) 40sec

444) What is the angle of projection for which the range and maximum height becomes equal?
a) $\tan^{-1}\left(\frac{1}{4}\right)$ b) $\tan^{-1}(4)$
c) $\cos^{-1}\left(\frac{1}{4}\right)$ d) $\sin^{-1}\left(\frac{1}{4}\right)$

445) A projectile is fired from ground with an initial velocity that has a vertical component of 20 m/s and a horizontal component of 30 m/s. using g = 10 m/s², the distance from launching to landing points is:
a) 40 m b) 80 m c) 60m d) 120 m

446) Two stones are projected from the same point with same speed making angles 45° + 0 and 45° - 0 with the horizontal respectively. If 0 ≤ 45°, then the horizontal range of the two stones are in the ratio of:
a) 1 : 1 b) 1 : 3 c) 1 : 2 d) 1 : 4

447) Two projectiles "P" and "Q" are thrown with the same speed up at angles of 40° and 50° with the horizontal. Range of "P" will be
a) Equal to that of Q
b) Less than that of Q
c) Greater than that of Q
d) 3/7 times that of Q

448) The range of projectiles is directly proportional to:
a) Sin θ b) Sin 30
c) Sin 2 θ d) Sin θ and sin 2 θ

449) Horizontal range of a projectile is related with maximum range according to relation
a) $R = R_{max} \sin 2\theta$ b) $R_{max} = \frac{R}{\sin 2\theta}$
c) $R_{max} = R \sin 2\theta$ d) $R = R_{max} \sin 2\theta$

450) In the projectile motion the vertical component of velocity:
a) Remains constant b) Become zero
c) Varies point to point d) Increases with time

451) An object is thrown along a direction inclined at an angle of 45° with the horizontal direction. The horizontal range of the particle is:
a) Four times the vertical height
b) Twice the vertical height
c) Thrice the vertical height
d) Equal to vertical height

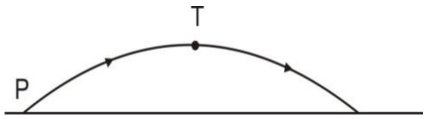
452) What is the acceleration of a projectile at its highest point:
a) Max b) zero c) min d) g

453) What is the angle of projection of a projectile for which its height and horizontal range are equal:
a) 46° b) 66° c) 56° d) 76°

454) Time of projectile's flight is:
a) $\frac{v_1^2 sin^2 0}{g}$ b) $\frac{2v_1 sin0}{g}$
c) $\frac{v_1^2 sin0}{g}$ d) $\frac{v_1^2}{g}$ sin20

455) One object is thrown vertically upward with an initial velocity of 100 m/s and another object with an initial velocity of 10 m/s. the maximum height reached by the first object will be that of the other:
a) 10 times b) 1000 times
c) 100 times d) 10000 times

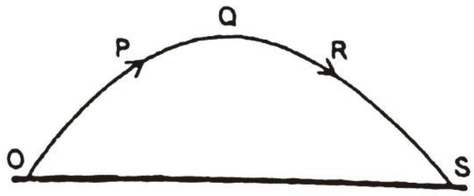
456) In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is T.



The vertical component of acceleration of the stone is

a) Zero at T. b) Greatest at T.
c) Greatest at P. d) The same at P as at T.

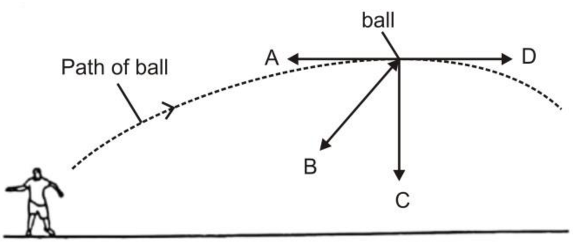
457) A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highest point Q of its path?

a) The horizontal component of the projectile's acceleration is zero.
b) The horizontal component of the projectile's velocity is zero.
c) The kinetic energy of the projectile is zero.
d) The Momentum of the projectile is zero.

458) The diagram shows a ball which a ball has been thrown and is being acted on by air resistance. Which labeled arrow shows the direction of the resultant force on the ball when it is at the position shown?



459) The maximum angle of a gun on horizontal terrain is 16 km. if g = 10 m/s^2. What must be the muzzle velocity of the shell

a) 200 mm/s
b) 400 m/s
c) 100 m/s
d) 50 m/s

460) A stone is just released from the window of a train moving along a horizontal straight tack. The stone will hit the ground following.

a) Straight path
b) Circular path
c) Parabolic path
d) Hyperbolic path

461) A bullet is dropped from the same height when another bullet is fired horizontally. They will hit the ground

a) One after the other
b) Simultaneously
c) Depends on the observer
d) None of the above

462) An aeroplane is flying at a constant horizontal velocity of 600 km/hr at an elevation of 6 km towards a point directly above the target on the earth's surface. At an appropriate time, the pilot released a ball so that it strikes the target at the earth. The ball will appear to be falling

a) On a parabolic path as seen by pilot in the plane
b) Vertically along a straight path as seen by an observer on the ground near the target
c) On a parabolic path as seen by an observer on the ground near the target
d) On a zig-zag path as seen by pilot in the plane

463) A bomb is dropped from an aeroplane moving horizontally at constant speed. When air resistance is taken into consideration, the bomb

a) Falls to earth exactly below the aeroplane
b) Fall to earth behind the aeroplane
c) Falls to earth ahead of the aeropalne
d) Flies with the aeroplane

464) A man projects a coin upwards from the gate of a uniformly moving train. The path of coin for the man will be

a) Parabolic
b) Inclined straight line
c) Vertical straight line
d) Horizontal straight line

465) A particle (A) is dropped from a height and another particle (B) is thrown in horizontal direction with speed of 5 m/sec from the same height. The correct statement is

a.A both particles will reach at ground simultaneously
b) Both particles will reach at ground with same speed
c) Particle (A) will reach at ground with respect to particle (B)
d) Particle (B) will reach at ground first with respect to particle (A)

466) A projectile fired with initial velocity u at some angle θ has a range R. if the initial velocity be doubled at the same angle of projection, thent he range will be

a) 2R
b) R/2
c) R
d) 4R

467) If the initial velocity of a projectile be doubled, keeping the angle of projection same, the maximum height reached by it will

a) Remain the same

b) Be doubled
c) Be quardrupled
d) Be halved

468) In the motion of a projectile freely under gravity, its
a) Total energy is conserved
b) Momentum is conserved
c) Energy and momentum both are conserved
d) None is conserved

469) The range of a projectile for a given initial velocity is maximum when the angle of projection is 45°. The range will be minimum, if the angle of projection is
a) 90°
b) 180°
c) 60°
d) 75°

470) A ball is thrown upwards and it returns to ground describeing a parabolic path. which of the following remains constant
a) Kinetic energy of the ball
b) Speed of the ball
c) Horizontal components of velocity
d) Vertical component of velocity

471) At the top of the trajectory of a projectile, the directions of its velocity and acceleration are
a) Perpendicular to each other
b) Parallel to each other
c) Inclined to each other at an angle of 45°
d) Antiparallel to each other

472) The range of a particle when launched at an angle of 15° with the horizontal is 1.5 km. what is the range of the projectile when launched at an angle of 45° to the horizontal
a) 1.5 km
b) 3.0 km
c) 6.0 km
d) 0.75 km

473) A stone is projected from the ground with velocity 25 m/s. two seconds later, it just clears a wall 5 m high. The angle of projection of the stone is (g = 10 m/sec^2)
a) 30°
b) 45°
c) 50.2°
d) 60°

474) A projectile thrown with a speed v at an angle θ has a range R on the surface of earth. For same v and θ, its range on the surface of moon will be
a) R / 6
b) 6R
c) R / 36
d) 36R

475) At the top of the trajectory of a projectile, the acceleration is
a) Maximum
b) Minimum
c) Zero
d) G

476) A football player throws a ball with a velocity of 50 metre/sec at an angle 30 degrees from he horizontal. The ball remains in the air for (g = 10 m/s^2)
a) 2.5 sec
b) 1.25 sec
c) 5 sec
d) 0.625 sec

477) A body of mass 0.5 kg is projected under gravity with a speed of 98 m/s at an angle of 30° with the horizontal. The change in momentum (in magnitude) of the body is
a) 24.5 N – s
b) 49.0 N –s
c) 98.0 N –s
d) 50.0 N –s

478) Two bodies are projected with the same velocity. If one is projected at an angle of 30° and the other at an angle of 60° to the horizontal, the ratio of the maximum heights reached is
a) 3 : 1
b) 1 : 3
c) 1 : 2
d) 2 : 1

479) If time of flight of projectile is 10 seconds. Range is 500 meters. The maximum height attained by it will be
a) 125 m
b) 50 m
c) 100 m
d) 150 m

480) If a body A of mass M thrown with velocity V at an angle of 30° to the horizontal and another body B of the same mass is thrown with the same speed at an angle of 60° to the horizontal. The ratio of horizontal range of A to B will be
a) 1 : 3
b) 1 : 1
c) 1 : $\sqrt{3}$
d) $\sqrt{3}: 1$

481) A bullet is fired from a cannon with velocity 500 m/s. if the angle of projection is 15° and g = 10 m/s^2. Then the range is
a) 25 x 10^3 m
b) 12.5 x 10^3 m
c) 50 x 10^2 m
d) 25 x 10^2 m

482) A ball thrown by a body is caught by another after 2 sec. some distance away in the same level. If the angle of projection is 30, the velocity of projection is
a) 19.6 m/s

b) 9.8 m/s
c) 14.7 m/s
d) None of these

483) A particle covers 50 m distance when projected with an initial speed. On the same surface it will cover a distance, when projected with double the initial speed.
a) 100 m
b) 150 m
c) 200 m
d) 250 m

484) A ball is thrown upwards at an angle of 60° the horizontal. It falls on the ground at a distance of 90 m. if the ball is thrown with the same initial velocity at an angle 30°, it will fall on the ground at a distance of
a) 30 m
b) 60m
c) 90m
d) 120m

485) Four bodies P, Q, R and S are projected with equal velocities having angle of projection 15, 30, 45 and 60 with the horizontal respectively. the body having shortest range is
a. P
b) Q
c) R
d) S

486) For a projectile, the ratio of maximum height reached to the square of flight time is (g = 10 ms)
a) 5 : 4
b) 5 : 2
c) 5 : 1
d) 10 : 1

487) Which of the following sets of factors will affect the horizontal distance covered by an athlete in a long-jump even
a) Speed before he jumps and his weight
b) The direction in which he leaps and the initial speed
c) The force with which he pushes the ground and his speed
d) None of these

488) A ball thrown by one player reaches the other in 2 sec. the maximum height attained by the ball above the point of projection will be about
a) 10 m
b) 7.5 m
c) 5 m
d) 2.5 m

489) In a projectile motion, velocity at maximum height is
a) $\frac{u\cos\theta}{2}$
b) $u\cos\theta$
c) $\frac{u\sin\theta}{2}$
d) None of these

490) If two bodies are projected at 30 and 60 respectively, with the same velocity, then
a) Their ranges are same
b) Their heights are same
c) Their times of flight are same
d) All of these

491) A body is thrown with a velocity of 9.8 m/s making an angle of 30 with the horizontal. It will hit the ground after a time
a) 1.5 s
b) 1 s
c) 3 s
d) 2 s

492) For a given velocity , a projectile has the same range R for two angles of projection if t and t are the times of flight in the two cases then
a) $t_1t_2 \propto R^2$
b) $t_1t_2 \propto R$
c) $t_1t_2 \propto \frac{1}{R}$
d) $t_1t_2 \propto \frac{1}{R^2}$

493) A cricketer can throw a ball to a maximum horizontal distance of 100 m. with the same effort, he throws the ball vertically upward. The maximum height attained by the ball is
a) 100 m
b) 80 m
c) 60 m
d) 50 m

494) A cricketer can throw a ball to a maximum horizontal distance of 100 m. the speed with which he throw the ball is (to the nearest integer)
a) 30 ms
b) 42 ms
c) 23 ms
d) 35 ms

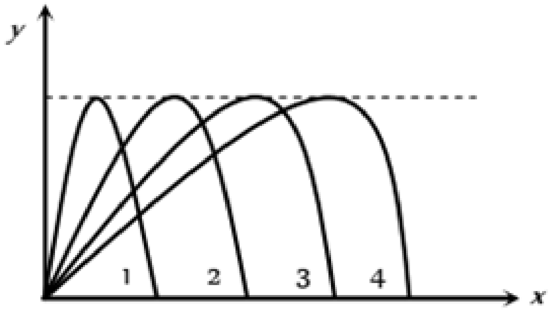
495) A ball is projected with velocity V_0 at an angle of elevation 30°. Mark the correct statement
a) Kinetic energy will be zero at the highest point of the trajectory
b) Vertical component of momentum will be conserved
c) Horizontal component of momentum will be conserved
d) Gravitational protential energy will be minimum at the highest point of the trajectory

496) Two bodies are thrown up at angle of 45 and 60, respectively, with the horizontal. If both bodies attain same vertical height, then the ratio of velocities with which these are thrown is
a) $\sqrt{\frac{2}{3}}$

b) $\frac{2}{\sqrt{3}}$
c) $\sqrt{\frac{3}{2}}$
d) $\frac{\sqrt{3}}{2}$

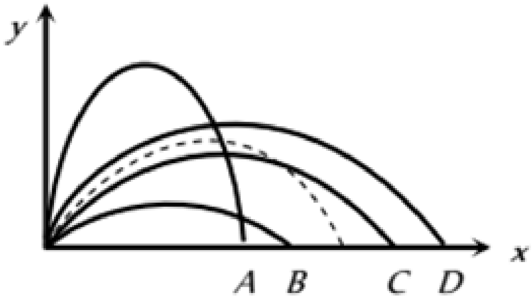
497) At what point of a projectile motion acceleration and velocity are perpendicular to each other
a) At the point of projection
b) At the point of drop
c) At the topmost point
d) Any where in between the point of projection and topmost point

498) Figure shows four paths for a kicked football. Ignoring the effects of air on the flight, rank the paths according to initial horizontal velocity component, highest first



a) 1, 2, 3, 4
b) 2, 3, 4, 1
c) 3, 4, 1, 2
d) 4, 3, 2, 1

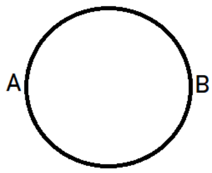
499) The path of the projectile in the absence of air drag is shown in the figure by dotted line. If the air resistance is not ignored then which one of the path shown in the figure is appropriate for the projectile.



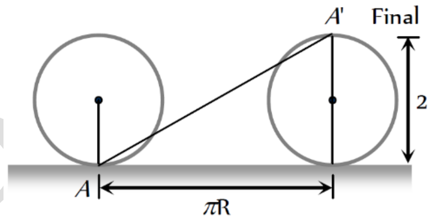
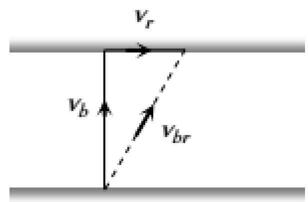
a) B
b) A
c) D
d) C

Key

1)	C	A ball thrown vertically upwards will have constant Acceleration of 9.8 m/s^2 and a varying velocity with changing direction.
2)	B	if a moving object has no force acting on it continue to move in a straight line at constant velocity and the body will be an equilibrium.
3)	C	Measure of displacement covered with passage of time is called Velocity.
4)	C	it's displacement will be zero as initial and final point is same.
5)	C	Average velocity = $\frac{total\ displacement}{total\ time}$
6)	D	The velocity time graph of a motion starting from rest with uniform acceleration is a straight line Passing through origin because it origin velocity value is zero and motion is started from velocity.
7)	B	**Sol: when body moves in a circle, after one complete revolution, as the body returns to its original position so displacement becomes zero while the distance has been covered by the body.**



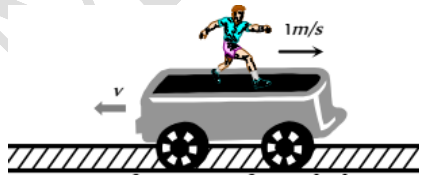
8)	B	**Sol : The slope of distance -time graph will always be positive because distance can never be negative.**
9)	A	The particle has constant acceleration. Sam diagram far object thrown in upward direction.
10)	B	the rate of change in velocity is called acceleration.
11)	A	Average Velocity= = $\frac{20+40+30}{9}$ m/s
12)	C	Slope or gradient of v-t graph is called Acceleration
13)	C	
14)	D	Car returns to its original place so displacement is zero and also velocity becomes zero.
15)	D	Displacement in most cases is less than displacement so displacemtn/distance <1 but displacemt may also equal to distance so

		displacement/distance = 1
16)	C	
17)	C	A=Δv/t → Δv = at
18)	D	
19)		
20)	C)	W = Fd
21)	C	A body covering equal displacement in equal interval of time possesses Uniform velocity
22)	B	Instantaneous and average velocities become equal when body Has uniform velocity
23)	C	When velocity time graph is a straight line parallel to time axis then Acceleration is zero it means time is passing and velocity is not changing. if velocity is not changing then there is no acceleration.
24)	B	V = s/t → s = vt
25)	D	The numerical ratio of displacement to distance is equal or less than one
26)	B	$a = \frac{F}{m_1+m_2} = \frac{40}{1+3} = \frac{40}{4} = 10\ m/s^2$
27)	D	The shortest distance between two points is called displacement and the actual is called distance.
28)	C	When average velocity becomes equal to instantaneous then the body is moving with constant acceleration
29)	B	Total time of motion is 2 min 20 sec = 140 sec. As time period of circular motion is 40 sec so in 140 sec. athlete will complete 3.5 revolution i.e., He will be at diametrically opposite point i.e., displacement = 2R.
30)	c	 Horizontal distance covered by the wheel in half revolution = πR So the displacement of the point which was initially in contact with ground = AA' = $\sqrt{(\pi R)^2 + (2R)^2}$ $= R\sqrt{\pi^2+4} = \sqrt{\pi^2+4}$ (as R = 1m)
31)	d	Because acceleration due to gravity is constant so the slope of line will be constant i.e. velocity time curve for a body projected vertically upwards in straight line.
32)	d	
33)	c	For upward motion Effective acceleration = -(g+a) And for downward motion Effective acceleration = (g – a) But both are constant. So the slope of speed-time graph will be constant.
34)	b	Other graph shows more than one velocity of the particle at single instant of time which is not practically possible.
35)	a	Sloe of velocity-time graph measure acceleration. For graph (a) slope is zero. Hence a = 0 i.e. motion is uniform
36)	D	Relative velocity of parrot with respect to train = 5 – (-10) = 5 + 10 = 15 m/sec. Time taken by the parrot = $\frac{d}{v_{rel}} = \frac{150}{15}$ = 10 sec.
37)	C	$v_B + v_A = v_B + v_A = 80 + 65 = 145$ km/hr.
38)	D	Relative speed of police with respect to the thief. = 10-9=1 m/s Instantaneous separation = 100 m Time = $\frac{\text{distance}}{\text{velocity}} = \frac{100}{1} = 100$ sec.
39)	D	Relative velocity = 10 + 5 = 15 m/s. Time taken by the bird to cross the train = $\frac{12}{15}$ = 8 sec
40)	B	$v_{br} = v_b + v_r$ $v_{br} = \sqrt{v_b^2 + v_r^2}$ $10 = \sqrt{8^2 + v_r^2}$ $v_r = 6$km/hr. 
41)	d	As the total distance is divided into two equal parts therefore distance averaged speed = $\frac{2v_1v_2}{v_1+v_2}$
42)	D	$\frac{V_A}{V_B} = \frac{\tan\theta_A}{\tan\theta_B} = \frac{\tan 30°}{\tan 60°} = \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$
43)	b	Distance average speed = $\frac{2v_1v_2}{v_1+v_2} = \frac{2x20x30}{20+30}$ $= \frac{120}{5} = 24$ km/hr

44)	b	Distance average speed = $\frac{2v_1v_2}{v_1+v_2} = \frac{2x2.5x4}{2.5+4}$ $= \frac{200}{65} = \frac{40}{13}$km/hr
45)	c	Distance average speed = $\frac{2v_1v_2}{v_1+v_2} = \frac{2x2.5x4}{30+50}$ $= \frac{75}{2} = 37.5$ km/hr
46)	d	Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{x}{t_1+t_2}$ $= \frac{x}{\frac{\frac{x}{3}}{v_1}+\frac{\frac{2x}{3}}{v_2}} = \frac{1}{\frac{1}{3x20}+\frac{2}{3x60}} = 36$ km/hr
47)	a	Time average speed = $\frac{v_1+v_2}{2} = \frac{80+40}{2} =$ 60 km/hr
48)	b	Distance travelled by train in first 1 hour is 60 km and distance in next 1/2 hour is 20 km/ So average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{60+20}{3/2}$ = 53.33 km/hour
49)	d	
50)	c	Total distance to be covered for crossing the bridge = length of train + length of bridge = 150m + 850 m = 1000 m Time $= \frac{\text{Distance}}{\text{Velocity}} = \frac{1000}{45x\frac{5}{18}}$= 80 sec
51)	c	Displacement of the particle will be zero becaust it comes balck to its starting point Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{30m}{10sec}$= 3 m/s
52)	d	Velocity of particle = $\frac{\text{Total displacment}}{\text{Total time}}$ $= \frac{\text{Diameter of circle}}{5} = \frac{2x10}{5} = 4$ m/s
53)	b	$\frac{\text{\|Average velocity\|}}{\text{\|Average speed\|}} = \frac{\text{\|Displacement\|}}{\text{\|distance\|}} < 1$ Because displacement will either be equal or less than distance. It can never be greater than distance.
54)	c	From given figure, it is clear that the net displacement is zero. So average velocity will be zero
55)	c	Since displacement is always less than or equal to distance, but never greater than distance. Hence numerical ratio of displacement to the distance covered is always equal to or less that one.
56)	d	Length of train = 100 m Velocity of train = 45 km/hr = 45 x $\frac{5}{18}$ = 12.5 m/s Length of bridge = 1 km = 1000 m Total length covered by train = 1100 m Time taken by train to cross the bridge = $\frac{1100}{12.5} = 88$ sec.

57)	b	Time average velocity = $\frac{v_1+v_2+v_3}{3} = \frac{3+4+5}{3}$= 4 m/s
58)	a	When the body is projected vertically upward then at the highest point its velocity is zero but acceleration is not equal to zero (g = 9.8 m/s^2)
59)	c	$v_{ac} = \frac{2v_1v_2}{v_1+v_2} = \frac{2x40x60}{100} = 48$ kmph.
60)	A	F = P/t = 100/25 = 4N
61)	B	Newton's 3rd law of motion is correlated with Law of conservation of momentum
62)	B	Inertia: The resistance of an object to a change in its state of motion
63)	A	$a = \frac{1}{m} \rightarrow \frac{a_1}{a_2} = \frac{m_2}{m_1}$ $\frac{a_1}{a_2} = \frac{\frac{1}{5}m_1}{m_1} = \frac{1}{5}$
64)		Every action has an equal and opposite reaction. As soon as we apply a force on a body, there is a resultant opposite force generated.
65)	A	In newton's first law of motion which quantity remains constant velocity.
66)	A	Law of inertia satisfies Condition of equilibrium.
67)	**C**	Newton third law, to every action there is equal and opposite reaction.
68)	**A**	
69)	**B**	a = $\frac{F}{m_1+m_2} = \frac{40}{1+3} = \frac{40}{4} = 10\ m/s^2$
70)	**A**	
71)	**B**	
72)	**A**	
73)	**B**	a = $\frac{F}{m_1+m_2} = \frac{40}{1+3} = \frac{40}{4} = 10\ m/s^2$
74)	**A**	
75)	**B**	
76)	**D**	M=100g=0.1 kg and a= 32 ft/sec^2=9.8 m/sec^2 so F =9.8x0.1=0.98 N As 1N =10^5 dyne so F = 0.98 x10^5 dyne and lb isunit of mass called pound.
77)	**D**	a = $\frac{vf-vi}{t} = \frac{0-9.8}{10} = \frac{-98}{10}$ = -9.8
78)	B	
79)	A	
80)	**D**	
81)		
82)	**C**	
83)	**D**	
84)	**B**	

85)	D	
86)	D	
87)	D	**NEWTON**'s laws do not hold good for particles move with velocity comparable to velocity of light
88)	A	The property of moving object by virtue of which it exerts force on the object that tries to slop it is Inertia of the body
89)	B	A mass accelerates uniformly when the resultant force acting on it is Increases uniformly with respect to time
90)	C	A man throws a ball vertically upward in a compartment of an "accelerated" train. The ball will fall Behind him. a) decelerated train → In font of him b) zero accelerating → In his land c) accelerated train → Behind him
91)	C	**NEWTON** third law, to every action there is equal and opposite reaction.
92)	A	**NEWTON** second law of motion establishes relationship between Force and acceleration
93)	a	1st **LAW** of motion is also called **LAW** of inertia
94)	C	Inertia of an object is quantitative measure of its mass
95)	D	3rd **LAW** of motion explains existence of pair of forces in nature
96)	A	F = ma = mv/t
97)	B	Flight of a rocket in the space is an example of third **LAW** of motion
98)	C	Newton's 2nd law of motion gives the measurement of force. F = ma = $\frac{p_f - P_1}{t}$
99)	C	
100)	C	
101)	D	
102)	B	
103)	C	Newton's first law of motion defines the inertia of body. It state that every body has a tendency to remain in its state (either rest or motion) due to its inertia.
104)	D	Horizontal velocity of ball and person are same so both will cover equal horizontal distance in a given interval of time and after following the parabolic path the ball falls exactly in the hand which threw it up.
105)	d	Particle will move with uniform velocity due to inertia.
106)	a	

107)	B	F = ma
108)	b	u = 100 m / s, v = 0, s = 0.06 m Retardation = a = $\frac{u^2}{2s} = \frac{(100)^2}{2x0.06} = \frac{1x10^6}{12}$ Force = ma = $\frac{5 \times 10^{-3} x\, 1 \times 10^6}{12} = \frac{5000}{12} =$ 417 N
109)	B	F = ma
110)	C	Acceleration = $\frac{F}{m} = \frac{100}{5} = 20$ cm/s^2 Now v = at = 20 x 10 = 200 cm/s
111)	B	
112)	b	$F = ma = m\left(\frac{v}{t}\right) = v\left(\frac{m}{t}\right)$ $F = u\left(\frac{dm}{dt}\right) = 400 \times 0.05 = 20$ N
113)	d	Since T = mg, it implies that elevator may be at rest or in uniform motion.
114)	c	If the man starts walking on the trolley in the forward direction, then whole system will move in backward direction with same momentum.  Momentum of man in forward direction = Momentum of system (man + trolley) in backward direction □ 80 x 1 = (80 + 320) x v □ V = 0.2 m/s So the velocity of man w.r.t. ground 1.0 – 0.2 = 0.8 m/s Displacement of man w.r.t. ground = 0.8 x 4 = 3.2 m
115)	d	Force = mass x acceleration. If mass and acceleration both are doubled then force will become four times.
116)	B	As weight = 9.8 N Mass = 1 kg Acceleration = $\frac{Force}{Mass} = \frac{5}{1}$ = 5 m/s^2
117)	A	Force on the table = mg = 40 x 980 = 39200 dyne
118)	B	$a = \frac{F}{m} = \frac{1N}{1kg} = 1$ m/s^2
119)	b	$a = \frac{v_2 - v_1}{t} = \frac{(-2)-(+10)}{4} = \frac{-12}{4}$ = -3 m/s^2
120)	c	Thrust F = u $\left(\frac{dm}{dt}\right)$ = 5 x 10^4 x 40 = 2 x 10^6 N
121)	a	$F = ma = \frac{m\Delta v}{\Delta t} = \frac{0.2x20}{0.1} = 40$ N
122)	a	$F = m\left(\frac{dv}{dt}\right) = \frac{100x5}{0.1} = 5000$ N
123)	A	$F = u\left(\frac{dm}{dt}\right) \Rightarrow \frac{dm}{dt} = \frac{F}{u} = \frac{210}{300} = 0.7$ kg/s

124)	A	$F = m\left(\frac{v-u}{t}\right) = \frac{5(65-15)x10^{-2}}{0.2} = 12.5\ N$
125)	B	$F = ma = \frac{m(u-v)}{t} = \frac{2x(8-0)}{4} = 4N$
126)	B	$dp = F\ x\ dt = 10\ x\ 10 = 100\ kg\ m/s$
127)	B	Force exerted by the ball $F = m\left(\frac{dv}{dt}\right) = 0.15\ x\frac{20}{0.1} = 30\ N$
128)	C	Swimming is a result of pushing water in the opposite direction of the motion.
129)	B	Because for every action there is an equal and opposite reaction takes place.
130)	B	
131)	C	
132)	d	
133)	C	Gas will come out with sufficient speed in forward direction, so reaction of this forward force will change the reading of the spring balance.
134)	D	p = mv p = m at = Ft = N s
135)	C	**Hint; impulse = J =Ft** **J = Newton second**
136)	A	F = P/t = 100/25 = 4N
137)	C	Linear momentum was called quantity of motion by Newton •The product of mass and velocity is called momentum. •Linear momentum is vector quanitity. •Units: kg m s-1 or Ns •F= ma = mv/t=p/t → P=Ft= Ns
138)		•Linear momentum was called quantity of motion by Newton •The product of mass and velocity is called momentum. •Linear momentum is vector quanitity. •Units: kg m s-1 or Ns •F= ma = mv/t=p/t → P=Ft= Ns
139)	C	The law of momentum conservation can be used as a model for *predicting the after-explosion velocities of one of the objects in an exploding system*
140)	A	$F = \frac{\Delta P}{\Delta t}$
141)	A	This is a problem of conservation of momentum. The total momentum before the collision must equal the total momentum after the collision. Before the collision, the total momentum p =m3v+ 5m-v = 3mv -5mv After the collision, the two trucks stick together, so their combined mass is 6m, P (after) = $6mv_f$ Equating the momenta: 3mv -5mv = $6mv_f$ The speed of the trucks after the collision is approximately v/3.
142)	D	Pi = Pf mv = m/4(0) + 3m/4(V) mv = 3m/4(V) V = 4v/3
143)	**B**	
144)	**A**	
145)	**C**	
146)	**C**	$\frac{K.E1}{K.E\ 2} = \frac{m1}{m2}$ and $\frac{p1}{p2} = \sqrt{\frac{m1}{m2}}$
147)	**D**	
148)	**D**	
149)	**A**	
150)	**A**	
151)	**D**	$\Delta P/t = F\ (mg = \Delta P/t)\left\{w = \frac{\Delta P}{t}\right\}$
152)	**C**	$F = \Delta p/t,\quad T = \frac{\Delta p}{F} = \frac{120}{2} = 60\ Sec$
153)	**C**	
154)	**D**	
155)	**C**	
156)	**B**	
157)	**D**	
158)	**C**	According to the law of conservation of momentum; Initial momentum is equal to the final Momentum.i.e Pi= Pf. Thus; if Initial momentum is equal to zero than final momentum must be equal to zero; So, Pf= mv+Mv=0, V=–**mv/ MS**
159)	**B**	**P= √2mK.E**
160)	**A**	
161)	**B**	
162)	c	**impulse = J =Ft** **J = Newton second**
163)	**C)**	
164)	**A)**	
165)	C	
166)	B	
167)	**B**	Firstly wooden block of mass, M has zero initial momentum (Pi) because it is at rest but after fired(strike),bullet moves block along its velocity .Momentum of system(pf) i.e (bullet+wooden block) is conserved as Pi = Pf
168)	D	P = mv
169)	C	Force and acceleration have same direction.

170)	D	During long jump, athlete runs before taking the jump. By doing so he increases his MOMENTUM
171)	C	$\frac{K.E1}{K.E\ 2} = \frac{m1}{m2}$ and $\frac{p1}{p2} = \sqrt{\frac{m1}{m2}}$
172)	D	$P = \sqrt{2mK} \rightarrow K = P^2/2m = 2^2/2 = 2$
173)	B	Two objectives of different masses falling freely from the same heights above the earth's surface will experience the same Change in velocity per unit time because both have same acceleration.
174)	A	$K = P^2/2m$
175)	C	$F = \Delta p/t$, $T = \frac{\Delta p}{F} = \frac{120}{2} = 60\ Sec$
176)	D	F = ma = mv/t = p/t or P = Ft
177)	B	$P = \sqrt{2mK} \rightarrow K = P^2/2m$
178)	D	$P = \sqrt{2mK} \rightarrow K = P^2/2m$
179)	D	The motion of rocket is an application of law of conservation of Momentum. Rocket movies upward by ejecting hot gases at the tail of the rocket with very high velocity in downward direction. The rocket gain Momentum equal to the Momentum of gas ejected from the tail of the rocket, but in opposite direction.
180)	A	$F = \frac{P_r - P_1}{t} = \frac{\Delta P}{t}$ F = time rate of change of Momentum time rate of change of Momentum of a body is equal to the applied force.
181)	D	$P = mv = kgms^{-1} = N\ s$
182)	D	$P_i = mv_i = (1)(2) = 2$ Ns $P_f = mv_r = (1)(-1.5) = -1.5$ Ns $\Delta P = mv_r - mv_i = -1.5 - 2 = -3.5$ Ns
183)	D	In an isolated system (no external force) the total lienar Momentum of system remains constant
184)	B	For Gun#1 By law of conservation of Momentum Momentum of Gun = Momentum of bullet $P_t = m_i v$ For Gun#2 By law of conservation of Momentum Momentum of Gun = Momentum of bullet $P_2 = m_2 v$ $\frac{p_1}{p_2} = \frac{m_1 v}{m_2 v} = \frac{m_1}{m_2} = \frac{2m_2}{m_2} = 2$
185)	C	Rocket moves upward by ejecting hot gases at the tail of the rocket with very high velocity in downward direction. The rocket gain Momentum equal to the Momentum of gas ejected from the tail of the rocket, but in oppsite direction.
186)	D	The average force generated in a collision is equal to the Momentum change during the collision divided by the time interval in which collision is taken place. $F = \frac{\Delta P}{\Delta t}$ The air bag extends the time interval over which the collision occurs and reduces the force experienced by the student.
187)	A	Time rate of change of Momentum = applied force $\frac{P_t - P_1}{t} = \frac{AP}{t} = F$ In freely falling motion Force = Weight => F = W = mg $\frac{Ap}{T}$ = W = mg
188)	A	F = ma , $a = \frac{F}{m}$ For same force the body of greater mass has lesser acceleration.
189)	B	$\Delta P = Ft = (1)(1) = 1$ kgm/s
190)	B	$2gh = v_f^2 - v_1^2 - 0$ $Vf^2 = 2gh$ $V_f = \sqrt{2gh}$ $P = mv = m\sqrt{2gh} = 2\sqrt{[2(10)(5)]} = 2(10) = 20$ Ns
191)	A	$V_f = v_1 + gt = 0 + (10)(4) = 40\ ms^{-1}$ $P = mv = (2.5)(40) = 100\ kgms^{-1}$
192)	A	$F = \frac{p_f - p_i}{t} = \frac{20 - 10}{1}\ 10\ N$
193)	D	The rubber bullet will be more effective as it will boune back after hitting the bear. If initial the bullet was moving to the right with a velocity v. after bouncing off the bear it will move the left with a velocity = 0v. if m is the mass of the bullet iss initial Momentum is mv while the final Momentum is – mv. So change in Momentum is mv – (-mv) = 2mv. Since the force on the bear is proportional to the change in Momentum. The rubber bullet will exert more force. The lead bullet will pass through, as its direction is the same as before, it only slows down so the change in Momentum is always less, even if it gets stuck in the bear in which case it has the max value of mv – 0 = mv. However if we are looking at which can cause more damage it is obviously the lead bullet.
194)	B	When a shell explodes in mid air. Its parts fly off in different directions. The total Momentum of all of its parts is equal to the initial Momentum of the shell.

195)	A	$\frac{\Delta P}{\Delta t}$ = F = 10 kgms^{-2}
196)	B	F = $f = \frac{\Delta p}{\Delta t} \Rightarrow \Delta t = \frac{P_f - P_1}{F} = \frac{36-60}{12} = \frac{-24}{12} = -2\ s$ Time can never be negative
197)	a	A body accelerated by a constant force has constant acceleration. Its velocity increases linearly. With time. Hence, its Momentum also increases linearly with time.
198)	C	Change in Momentum = $F\ dt$ = area under the curve = (2)(2) + $\frac{1}{2}$(2 + 6)(4) = 20 kg ms^{-1}
199)	a	Net force is the rate of change of Momentum, which is the gradient of Momentum vs time graph. Since net force is constant, gradient is also constant and not equal to zero.
200)	C	If momentum remains constant then force will be zero because F = $\frac{dP}{dt}$
201)	C	According to principle of conservation of linear momentum 1000 x 50 = 1250 x v V = 40 km/hr
202)	A	Change in momentum = impulse $\Delta p = F \times \Delta t$ $\Delta t = \frac{\Delta p}{F} = \frac{125}{250} = 0.5$ sec
203)	C	Impulse = Force x time = m a t = 0.15 x 20 x 0.1 = 0.3 N-s
204)	B	For a given mass P ∝ v. If the momentum is constant then it's velocity must have constant.
205)	A	$F = u\left(\frac{dm}{dt}\right) = 3000 \times 3 = 12000$ N
206)	B	
207)	C	It worked on the principle of conservation of momentum.
208)	C	Impulse, I = F x $\Delta t = 50 \times 10^{-5} \times 3 = 1.5 \times 10^{-3}$ N-s
209)	C	Momentum of one piece = $\frac{M}{4}$ x 3 Momentum of the other piece = $\frac{m}{4}$ x 4 Resultant momentum = $\sqrt{\frac{9M^2}{16} + M^2} = \frac{5M}{4}$ The third piece should also have the same momentum. Let its velocity be v, then $\frac{5M}{4} = \frac{M}{2} \times v$ or $v = \frac{5}{2}$ =2.5 m/sec
210)	C	
211)	A	According to principle of conservation of linear momentum $m_G v_G = m_B v_B$ $v_G = \frac{m_B v_B}{m_G} = \frac{0.1 \times 10^2}{50}$ = 0.2 m/s
212)	D	$m_G v_G = m_B v_B$ $v_B = \frac{m_G v_G}{m_B} = \frac{1 \times 5}{10 \times 10^{-3}}$ = 500 m/s
213)	C	According to law of conservation of linear momentum both pieces should possess equal momentum after explosion. As their masses are equal therefore they will possess equal speed in opposite direction.
214)	C	2as = $v_f^2 - v_i^2$ 2 x 2 x 100 = $v_f^2 - 20^2$ 400 = v_f^2 -400 $V_f = \sqrt{800}$ = 28 m/s
215)	D	S = vit + ½ at^2 → s = ½ at^2 125 = ½ 10 t^2 → 25 = t^2 T = 5 sec
216)	D	2 as = $v_f^2 - v_i^2$ 2(F/m) s = v_f^2 – 0 2 x (200/8) 2 = v_f^2 v_f^2 = 2 x 25 x 2 =100 v_f = 10. P = W/t = Fd/t = Fv = 200x10 =2000W
217)	C	**we know that s = vit + $\frac{1}{2}$at^2 if initial velocity as zero** **S = 0 + $\frac{1}{2}$(9.8) t^2** **S = 0.49 t^2**
218)	B	V =36 km/h =36x1000/3600 = 10m/s S =1km+200m =1200m V = s/t → t = s/v = 1200/10 = 120
219)		Here the two buses are moving in the opposite directions Their speeds are u=100 km/hr and v=80 km/hr ∴ Relative speed =(u+v) km/hr =(100+80)=180 km/hr Hence, the buses have their relative speeds as 180 km/hr.
220)	C	Vf= Vi + at Final velocity does not depend on mass.
221)	<u>C</u>	
222)	<u>b</u>	Vf=vi +at→vf=0+9.8 x 10 = 98
223)	<u>B</u>	: t = $\sqrt{2h/g} = \sqrt{2(78.4)/9.8} = \sqrt{16}$ =4
224)	<u>A</u>	
225)	<u>C</u>	First we will find S_1, S_2, S_3…..Since $S_1 = v_1 x t_1 =$ 20x2=40m,& $S_2 =$ 40x2=60m, & $S_3 =$60x6=360m Thus; Total distance=40+60+360=480m So,

		Average speed=480/10=**48ms^{-1}**
226)	**C**	
227)	**C**	Vf =Vi+gt=0+9.8(5)=49
228)	**D**	g on planet = $\frac{9.8}{6}$, m = 30 Kg, W = m×$\frac{9.8}{6}$ = 30×$\frac{9.8}{6}$ = 30×1.63 = 48.9 = 49N
229)	**C**	S = vit+1/2 at^2 S = 1/2 a t^2 T = $\sqrt{2s}$/g
230)	**C**	
231)	**A**	
232)	**A**	
233)	A	
234)	B	
235)	B	
236)	**C**	
237)	**B**	
238)	**B**	
239)	**A**	
240)	**C**	
241)	**A**	
242)	**D**	if you are given the height and the vertical angle formed at the cone apex,then multiply the height of the cone with the tangent of angle to get radius and multiply it with 2 to get diameter.
243)	**A**	As the magnitude and direction of velocity is constant hence n et force is equal to zero.
244)	C	8.33 m/s
245)	D	26 m
246)	B	10 ms^{-1}
247)	A	0.39 ms^{-1}
248)	D	500 Km h^{-1}
249)		
250)	c	**we know that s = vit + $\frac{1}{2}$at^2 if initial velocity as zero** **S = 0 + $\frac{1}{2}$ (9.8) t^2** **S = 0.49 t^2**
251)	**B)**	
252)	**C**	Explanation Intial velocity – 0 Using 1st equation of motion V_1=V_1 + at Gives A = 4m/s^2 Then using 2aS = $V_f^2 - V_1^2$ We can calculate S = 800 m
253)	**B**	Explanation

		If there is no change in velocity acceleration will zero
254)	**B**	Explanation If the body is moving with constant velocity then the acceleration will be 0. The body will be moving equal distances in equal proportions of time. Hence, if the body covers Xm in 1 second it. Would be covering 4Xm in 4 seconds so the relation will be Y = 4X
255)	**A**	
256)	**B**	
257)	**A**	
258)	**B**	
259)	**B**	
260)	**B**	
261)	C	
262)	A	
263)	**A**	
264)	A	
265)	B	
266)	E	
267)	**B**	
268)	**B**	
269)	C	
270)	C	
271)	**D**	
272)	B	
273)	B	
274)	A	S_n = 5(2n-1) N = 2 → S = 15
275)	A	S = vit +1/2 at^2 = at^2 /2 = 40/2 =20 m or S = 5t^2 → 5 (2)^2 = 20m
276)	B	S = vit +at^2/2 → s = at^2/2
277)	d	Car rerurns to its original place so displacement is zero and also velocity becomes zero
278)	D	M=100g=0.1 kg and a= 32 ft/sec^2=9.8 m/sec^2 so F =9.8x0.1=0.98 N As 1N =10^5 dyne so F = 0.98 x10^5 dyne and lb isunit of mass called pound.
279)	D	a = $\frac{vf-vi}{t}$ = $\frac{0-9.8}{10}$ = $\frac{-98}{10}$ = -9.8
280)	B	: t = $\sqrt{2h/g}$ = $\sqrt{2(78.4)/9.8}$ = $\sqrt{16}$ =4
281)	B	: t = $\sqrt{2h/g}$ = $\sqrt{2(78.4)/9.8}$ = $\sqrt{16}$ =4
282)	A	S = 1 km, v_f = 0 v_i = ?, a = 0.2 2as = $v_f^2 - v_i^2 = - v_i^2$ v_i^2 = 2as = 2 x 0.2 x 1000 = 400 v_i = 20

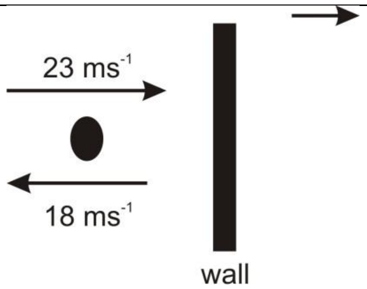
283)	C	**FIRST** we will find S_1, S_2, S_3.....Since $S_1=v_1 x t_1$ = 20x2=40m,& S_2= 40x2=60m, & S_3=60x6=360m Thus; Total distance=40+60+360=480m So, Average speed=480/10=48ms^{-1}
284)	C	Vf =Vi+gt=0+9.8(5)=49 m/s
285)	B	W = mg → g = W/m
286)	A	Bodies which fall freely under the action of gravity is an example of uniform acceleration
287)	A	$V_f = v_1 + gt = 0 + (9.8)(1) = 9.8$ m/s $V_{as} = \frac{v_1 + v_f}{2} = \frac{0+9.8}{2} = 4.9\frac{m}{s}$
288)	B	$V_r = v_t + gt = 0 + (9.8)(5) = 49$ ms^{-1}
289)	D	$A = \frac{F}{m} => a \propto \frac{1}{m}$
290)	B	$s = vit + \frac{1}{2}gt^2 = \frac{1}{2}gt^2 = \frac{1}{2}g(1)^2 = \frac{g}{2}$
291)	B	Acceleration is constant at value of 9.81 ms^{-2} for free fall without air resistance, in downward direction only.
292)	d	Take off speed consists only of horizontal component of sped. $U = \frac{s}{t} = \frac{10}{t}$ To find time taken t, $S = ut + \frac{1}{2}at^2$ $-1.25 = 0 + \frac{1}{2}(-9.81)t^2$ T = 0.50 s Subst. t into (1): $u = \frac{10}{0.5} = 20\ ms^{-1}$
293)	a	For the ball in free fall, there is a constant acceleration, i.e. 9.81 ms^{-2}. Hence, the gradient of the velocity time graph must be constant and the graph must there-fore be a straight non-horizontal line (a vertical line has an infinite gradient value).
294)	b	From $v^2 = u^2 + 2aS$ $0 = u^2 + 2aS$ $a = \frac{-u^2}{2S} = \frac{-(20)^2}{2x10} = -20m/s^2$
295)	A	As $S = ut + \frac{1}{2}at^2$ $S_1 = \frac{1}{2}a(10)^2 = 50a$ As v = u + at Velocity acquired by particle in 10 sec V = a x 10 For next 10 sec, $S_2 = (10a)x\,10 + \frac{1}{2}(a)x\,(10)^2$ $S_2 = 150a$ $S_1 = S_2/3$
296)	d	$v = u + at = 10 + 2 x 4 = 18$ m /sec
297)	c	If particle starts from rest and moves with constant of distance covered by it will be 1 : 3 : 5 : 7 ..... (2n – 1) i.e. ratio of x and y will be 1 : 3 i.e. $\frac{x}{y} = \frac{1}{3}$ $=> y = 3x$
298)	a	$S_n = u + \frac{a}{2}[2n - 1]$ $S_{5th} = 7 + \frac{4}{2}[2x5 - 1] = 7 + 18 = 25m.$
299)	a	Distance travelled in n^{th} second = $u + \frac{a}{2}(2n - 1)$ Distance travelled in 5^{th} second = $0 + \frac{8}{2}$(2 x 5 -10 = 36 m
300)	c	Because acceleration is a vector quantity
301)	c	Instantaneous velocity $v = \frac{\Delta x}{\Delta t}$ By using the data from the table $v_1 = \frac{0-(-2)}{1} = 2m/s$, $v_2 = \frac{6-0}{1}$ =6 m/s $v_3 = \frac{16-6}{1}$= 10 m/s So, motion is non-uniform but accelerated.
302)	b	Only direction of displacement and velocity gets changed, acceleration is always directed vertically downward.
303)	d	U = 200 m/s, v = 100 m/s, s = 0.1 m $a = \frac{u^2-v^2}{2s} = \frac{(200)^2-(100)^2}{2 x 0.1} = 15 x 10^4 m/s^2$
304)	b	$v = u + at = u + \left(\frac{F}{m}\right)t = 20 + \left(\frac{100}{5}\right) x\,10 = 220$ m/s
305)	c	$h = \frac{1}{2}gt => t = \sqrt{2h/g}$ $t_a = \sqrt{\frac{2a}{g}}$ and $t_b = \sqrt{\frac{2b}{g}} => \frac{t_a}{t_b} = \sqrt{\frac{a}{b}}$
306)	a	Time taken by first stone to reach the water surface from the bridge be t, then $h = ut + \frac{1}{2}gt^2 => 44.1 = 0 x t + \frac{1}{2} x 9.8t^2$ $t = \sqrt{\frac{2x44.1}{9.8}}$ = 3 sec Second stone is thrown 1 sec later and both strikes simultaneously. This means that the time left for second stone = 3-1=2 sec Hence 44.1 = u x 2 $+ \frac{1}{2}9.8(2)^2$ → 44.1 – 19.6 = 2u => u = 12.25 m/s
307)	a	
308)	d	The separation between the two bodies, two seconds after the relase of second body $s = \frac{1}{2} x\,9.8\,[(3)^2 - (2)^2] = 24.5$ m
309)	a	$h = \frac{1}{2}gt^2 = \frac{1}{2} x\,10\,x\,(4)^2 = 80$ m
310)	d	Let the body after time t/2 be at x from the top, then $x = \frac{1}{2}g\frac{t^2}{4} = \frac{gt^2}{8}$ → $8x = gt^2$ ... (i) $h = \frac{1}{2}gt^2$ ... (ii)

		h = ½ 8x = 4x → $x = \frac{h}{4}$ height of the body from the ground = $h - \frac{h}{4} = \frac{3h}{4}$
311)	b	By applying law of conservation of energy mgR $= \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2Rg}$
312)	B	v = g x t = 32 x 1 = 32 ft / sec
313)	b	$v^2 = u^2 + 2gh \Rightarrow (3u)^2 = (-u)^2 + 2gh \Rightarrow h = \frac{4u^2}{g}$
314)	c	$t = \sqrt{\frac{2h}{g}}$ and h and g are same.
315)	c	$h = ut + \frac{1}{2}gt^2 \Rightarrow 81 = -12t + \frac{1}{2}x\ 10\ x\ t^2 \Rightarrow t = 5.4$ sec
316)	d	In the positive region the velocity decreases linearly (during rise) and in the negative region velocity increases linearly (during fall) and the direction is opposite to each other during rise and fall, hence fall is shown in the negative region.
317)	D	A collision in which both K.E and momentum is conserved is called Elastic collision
318)	D	An elastic collision is a collision in which there is no net loss in kinetic energy in the system as a result of the collision. Both momentum and kinetic energy are conserved quantities in elastic collisions.
319)	B	In an inelastic collision, such as a car hitting and getting embedded in a tree, kinetic energy is not conserved (some of it is transformed into other forms of energy, such as heat and sound). However, momentum is always conserved in any type of collision, provided there is no external net force acting on the system.
320)	<u>D</u>	
321)	C	$v_1' \approx v_1; v_2' \approx 2v_1$
322)	<u>B</u>	
323)		
324)	<u>D</u>	
325)	C	In same masses, the velocity interchanges.
326)	A	In same masses, the velocity interchanges.
327)	<u>D</u>	ELASTIC collision involves No gain, no loss of energy
328)	<u>D</u>	Principle of conservation of Momentum: Momentum is conserved providing no external forces act.
329)	C	The collision between two bodies be ELASTIC if bodies are solid and hard
330)	A	no loss of K.E and Momentum then collisions is called in-ELASTIC collision
331)	C	When two bodies stick together after the collision, the collision is said to be completely inelastic
332)	A	$M_i = m_2 = m$ and $v_2 = 0$ $V'_2 = \left(\frac{2m_1v_1}{m_1+m_2}\right) + \left(\frac{m_2-m_1}{m_1+m_2}\right)v_2$ $V'_2 = \left(\frac{2mm_1}{m+m}\right) + \left(\frac{m-m}{m+m}\right)(0) = \left(\frac{2mv_1}{2m}\right) + 0 = v_1$ $V'_2 = 15\ ms^{-1}$ or just remember if masses are same then velocity just interchnages.
333)	B	$M_1 >> m_2$ so $m_2 = 0$ and $v_2 = 0$ $V'_2 = \left(\frac{2m_1v_1}{m_1+0}\right) + \left(\frac{0-m_1}{m_1+0}\right)(0) - \left(\frac{2m_1v_1}{m_1}\right) + 0 = 2v_1$
334)	C	$V'_1 = \left(\frac{m_1-m_2}{m_1+m_2}\right)v_1 + \left(\frac{2m_2v_2}{m_1+m_2}\right)$ $V'_1 = \left(\frac{m-2m}{m+2m}\right)v + \left(\frac{2m(0)}{m+m}\right) = \left(\frac{-1}{3}\right)v = -\frac{v}{3}$ $V'_2 = \left(\frac{2m_1v_1}{m_1+m_2}\right) + \left(\frac{m_2-m_1}{m_1+m_2}\right)v_2$ $V'_2 = \left(\frac{2mv}{m+2m}\right) + \left(\frac{m-m}{m+m}\right)(0) = \left(\frac{2mv}{m+2m}\right) = \frac{2v}{3}$ or just remember if masses are same then velocity just interchnages.
335)	C	Linear Momentum is always conserved when no external force is applied during collision and the kinetic energy is conserved only if the collision is elastic. Hence, for inelastic collision of two satellites, linear Momentum is conserved but the total kinetic energy is reduced since some initial kinetic energy is lost in the forms of sound and heat energies.
336)	b	Final Momentum, p = sum of initial Momentum = 2(4) + 4(1) = 12 J
337)	b	By definition, for an elastic collision, the relative speed of approach between two atoms equals their relative speed of separation. Also total kinetic energy of the two atoms is conserved.
338)	B	Kinetic energy is conserved for elastic collision. $\frac{1}{2}mv^2 + \frac{1}{2}mv^2 = mv^2$
339)	c	Since linear Momentum is conserved, 20 – 12 = -2 + Momentum of Y Momentum of Y = 10 Ns
340)	A	By conservation of Momentum, Initial Momentum before release =

Momentum after collision
$0 = (m_x + m_y)v$
$V = 0$

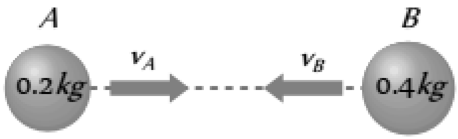
341) A Momentum is a vector and is given by mass x velocity
Momentum of lorry = $(2 \times 10^4)(20)$
= 4×10^5 Ns
Momentum of car = (900)(30)
= 2.7×10^4 Ns
Since they are in opposite direction,
Net Momentum = $(4 \times 10^5 - (2.7 \times 10^4)$
= 3.73×10^5 Ns

342) b



Impulse of wall = - impulse of ball
= -(mv – mu)
= $(80 \times 10^{-3})(-18 - 23)$
= -3.3 Ns
= 3.3 Ns (to the left, away from the wall)

343) c



Initial linear momentum f system = $m_A v_A + m_B v_B = 0.2 \times 0.3 + 0.4 \times v$
Finally both balls come to rest
Final linear momentum = 0
By the law of conservation of linear momentum
0.2 x 0.3 + 0.4 x v = 0
$v_B = -\frac{0.2\times0.3}{0.4} = -0.15$ m/s

344) C For a collision between two identical perfectly elastic particles of equal mass, velocities after collision get interchanged.

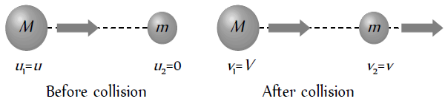
345) C

346) D

347) B We know that when heavier body strikes elastically with a lighter body then after collision lighter body will move with double velocity that of heavier body.
i.e. the ping pong ball move with speed of 2 x 2 = 4 m/s

348) D Change in momentum = $mv_2 - mv_1 = -mv - mv = -2mv$

349) C



$v_2 = \left(\frac{m_2-m_1}{m_1+m_2}\right)u_2 + \frac{2m_1u_1}{m_1+m_2} = \frac{2Mu}{M+m} = \frac{2u}{1+\frac{m}{M}}$

350) C Velocity exchange takes place when the masses of bodies are equal

351) D In perfectly elastic head on collision of equal masses velocities get interchanged

352) B $F = \frac{dp}{dt} = m\frac{dv}{dt} = \frac{mx2v}{\frac{1}{5}} = \frac{2x2x100}{\frac{1}{5}} =$
$2x10^4$N

353) B Impulse = change in momentum
$mv_2 - mv_1 = 0.1 \times 40 - 0.1 \times (-30)$

354) B In elastic head on collision velocities gets interchanged.

355) C H=u²Sin2θ/2g
Doubling the velocity , quadruples the height.

356) C H=u²Sin2θ/2g
R=u²Sin2θ/g=2u²SinθCosθ/g
As asked: R = H/4 so
$2u^2Sin\theta Cos\theta/g = \frac{u^2 sin^2\theta}{4\ 2g}$
$2\ Cos\theta = \frac{Sin\theta}{8} \rightarrow 16 = sin\theta/cos\theta$
Tan θ = 16

357) C Both ranges are same because angles are complementary.

358) A Projectile is launched; its velocity is maximum at Point of projection.

359) D Tanθ = 4 or 76⁰

360) a **R = vi² sin 2θ /g**
At given condition :
Maximum Range = Rmax = vi² /g
For maximum range sin 2θ = 1 which is possible if we put θ = 45
No get sin 2θ value 0.5 we will put angle 15 so
Sin 2θ = sin 2(15) = sin 30 = 0.5 = 1/2
R' = vi² (1/2)/g
R' = (1/2) vi² /g
R ' = 1/2 Rmax

361) B The textbooks say that the maximum range for projectile motion (with no air resistance) is 45 degrees

362) B Sum = 90

363) B R= Vi² sin2θ/g
If θ =45 then R = Vi² sin2(45)/g = Vi² sin90/g = Vi² (1)/g = Vi² /g →→ range is maximumat 45⁰

364) D On top, vertical velocity is zero while

		horizontal remains constant.
365)	D	If the angle of projection is 76 the maximum height is equal to the horizontal range.
366)	A	T/2 = $\sqrt{\frac{8H}{g}}/2 = \sqrt{\frac{8H}{4g}} = \sqrt{\frac{2H}{g}}$
367)	**A**	
368)	**C**	
369)	**C**	
370)	**B**	s vit + 1/2 $at^2 \rightarrow a = (s\text{-}vit)2/t^2 \rightarrow a = (170\text{-}0 \times 6.25)2/6.25^2 = 8.7\ ms^{-2}$
371)	**B**	$2gh = vf^2 - vi^2 \Rightarrow h = v^2/2g = (15)^2/2g = 11m$
372)	**C**	
373)	**D**	
374)	**B**	B/c at Max height Vy = 0 & Vx = Vo Cos θ
375)	**B**	Initial K.E = E, **K.E At highest point** = $\frac{1}{2} mv^2\cos^2\theta$ = (E) $\cos^2 45^{0=}$, E× $(0.7)^2$= .49E = .50E
376)	**D**	t = $\sqrt{2h/g} = \sqrt{2(490/9.8} = \sqrt{100}$ =10, **5:**
377)	**B**	
378)	**D**	
379)	**C**	When Angles θ& (90 - θ) are mutually complementary, Ranges for angles 30^0& 60^0 or 20^0& 70^0 etc. are same
380)	**D**	
381)	**B**	
382)	**C**	R = $\frac{v_0^2 \sin 2\theta}{g}$ = Rmax = $\frac{v_0^2}{g}$ = [θ = 45^0]
383)	**A**	
384)	**A**	
385)	**C**	
386)	**A**	T = 2Vθ Sinθ/g = $\frac{2\times 98 \times \sin 30^0}{9.8} = \frac{2\times98\times0.5}{9.8}$ = 10,
387)	**d**	The vertical component of acceleration is "g" which is same during the projectile motion.
388)	**B**	
389)	**C**	
390)	**A**	
391)	**A**	
392)	**D**	
393)	**D**	
394)	**D**	**Individualy it is always** 9.8 m/s^2 and acceleration of one relative to the other is zero.
395)		
396)		
397)	A	**R = vi^2 sin 2θ /g** **At given condition :** **Maximum Range = Rmax = vi^2 /g** **For maximum range sin 2θ = 1 which is possible if we put θ = 45**

		No get sin 2θ value 0.5 we will put angle 15 so **Sin 2θ = sin 2(15) = sin 30 = 0.5 = 1/2** **R' = vi^2 (1/2)/g** **R' = (1/2) vi^2 /g** **R ' = 1/2 Rmax**
398)	**D)**	
399)	**D**	
400)	A	Projectile motion: a) A baseball shot b) Bullet fired from a gun c) A football kicked
401)	D	Complementary angles
402)	A	Time to summit: $\frac{Vi\,\sin\theta}{g}$
403)	D	The football kicked in the air is an example of projectile motion
404)	B	Motion of projectile is two dimensional under gravity.
405)	D	the magnitude of the velocity of the projectile is v= $\sqrt{vi^2 - 2gtvi\,\sin\theta + g^2t^2}$
406)	C	The range of the projectile at 30^0 and 60^0 are equal to each other due to complementary angles.
407)	A	range of the projectile is maximum 45 degree.
408)	B	The trajectory (or path) of a projectile is Parabola.
409)	B	A football player will throw a football at maximum distance if the angle of projection is: 45^0. range of the projectile is maximum 45 degree.
410)	B	The velocity of projectile at its maximum height is $vi \cos\theta$ = V_{ix} because v_y component is zero.
411)	C	During projectile motion, the horizontal component of velocity Remains constant while vertical component Changes with time
412)	C	The range of projectile is the same for two angles which are mutually Complementary
413)	B	s vit + 1/2 $at^2 \rightarrow a = (s\text{-}vit)2/t^2 \rightarrow a = (170\text{-}0 \times 6.25)2/6.25^2 = 8.7\ ms^{-2}$
414)	B	B/c at Max height Vy = 0 & Vx = Vo Cos θ
415)	B	$K.E_{top} = K.E_{initial} \cos^2\theta$ $\cos^2 45^0$ = 0.7^2 = 0.5 = 50% $K.E_{top} = K.E_{initial}$ 0.5 = 0.5 E
416)	B	$K.E_{top} = K.E_{initial} \cos^2\theta$

		$\cos^2 30^0$ = 0.8^2 = 0.75 = 75% K.E $_{top}$ = K.E $_{initial}$ 0.75 = 0.75 E
417)	A	K.E $_{top}$ = K.E $_{initial}$ $\cos^2\theta$ $\cos^2 60^0$ = 0.5^2 = 0.25 = 25% K.E $_{top}$ = K.E $_{initial}$ 0.25 = 0.25 x 100 = 25J
418)	C	P.E $_{top}$ = K.E $_{initial}$ $\sin^2\theta$ $\sin^2 60^0$ = 0.8^2 = 0.75 = 75% P.E $_{top}$ = K.E $_{initial}$ 0.75 = 0.75 x 10 = 7.5
419)	D	t = $\sqrt{2h/g}$ = $\sqrt{2(490/9.8}$ = $\sqrt{100}$ =10, 5:
420)	B	H = $V^2 \sin^2\theta/2g$
421)	d	The vertical component of acceleration is "g" which is same during the projectile motion.
422)	D	Two projectiles are in flight at the same time. The acceleration of one relative to other Is zero. Individualy it is always 9.8 m/s^2 and acceleration of one relative to the other is zero.
423)	D	A stone thrown horizontally from the top of a tall building follows a path that is Parabolic
424)	B	The ballistic missiles are useful for Short range
425)	B	The Velocity of projectile is maximum At point of launching and just before striking. And at the top it is minimum.
426)	B	35^0, 55^0 = 90 degree so same range.
427)	D	
428)	D	R_{max} = h/4 → h = 4R
429)	D	the angle of projection for which its maximum height and horizontal range are equal is 76^0
430)	C	R = $\frac{v_0^2 \sin 2\theta}{g}$ = Rmax = $\frac{v_o^2}{g}$ = [θ = 45^0]
431)	A	A hunter aiming a bird in tree should aim A little above the bird because due to air , the arrow will move below the path.
432)	B	
433)	C	When Angles θ & (90 - θ) are mutually complementary, Ranges for angles 30^0& 60^0 or 20^0& 70^0 etc. are same
434)	A	correct relation between time of flight T and maximum height H, H=$gT^2/8$ or $T = \sqrt{\frac{8H}{g}}$
435)	B	Why Ballistic missile fails in some circumstances of precision due to air resistance
436)	b	Downward quantities are negative and upward are taken is positive.
437)	C	A ball is projected upwards. Its acceleration at the highest point is Directed downward. Do remember that at all points, the g is downward.
438)	B	$2gh=v_f^2-v_i^2 \Rightarrow h=v^2/2g=(15)^2/2g=$ 11m
439)	C	A ball is projected upwards. Its acceleration at the highest point is Directed downward. Do remember that at all points, the g is downward.
440)	D	A ball is just allowed to fall from the window of a moving train, it will hit the ground following Parabolic path
441)	D	A bomber drops a bomb, when it is vertically above the target. It misses the target b/c of Horizontal component of the velocity of bomber
442)	B	To improve the jumping record a long jumper should jump at an angle 45^0 because range is maximum at 45 degree.
443)	A	T = 2Vθ Sinθ/g = $\frac{2\times 98\times \sin 30^0}{9.8} = \frac{2\times 98\times 0.5}{9.8} =$ 10,
444)	B	The relation between height and range of a projectile projected at any angle "0" is: 4H = R Tanθ → If R = H 4H = H Tanθ => tan 0 = 4 => 0 = $\tan^{-1}$ (4) = 76°
445)	D	R = $\frac{v_1^2 \sin 20}{g} = \frac{v_1^2\, 2\sin 0\cos 0}{g} = \frac{2(v_1 \sin 0)(v_1 \cos 0)}{g}$ $= \frac{2(v_{ix})(v_{iy})}{g} = \frac{2(30)(20)}{10} = 120m$
446)	A	Ranges at angles (45° + 0) and (45° - 0) are equal. So, $R_1:R_2$ = 1:1
447)	A	Ranges at angles (45° + 5°) and (45° - 5°) are equal. So, $R_P = R_Q$
448)	C	R = $\frac{v_1^2 \sin 2\theta}{g} \Rightarrow R \propto \sin 2\theta$
449)	D	R = $\frac{v_1^2 \sin 2\theta}{g}$ and $R_{max} = \frac{v_1^2}{g}$ R = R_{max} sin2 θ or $R_{max} - \frac{R}{\sin 2\theta}$
450)	C	Due to force of gravity the vertical component of velocity varies point to point.
451)	A	The relation between height and range of a projectile projected at any angle "0" is 4H = R Tanθ For 45° => R = 4H
452)	D	Projectile motion is the 2-dimensional motion under the action of gravity. So, acceleration during projectile motion will be gravitational acceleration (g).
453)	D	The relation between height and range: 4H = R Tanθ, If R = H 4H = H Tanθ => Tanθ = 4 => 0 $\tan^{-1}$(4) = 76°
454)	B	Time of flight = $\frac{2v_1 \sin 0}{g}$

455) C Maximum height attained by body thrown vertically upward is

$H = \frac{v_1^2}{2g}$

$\frac{h_1}{h_2} = \frac{v_1^2/2g}{v_2^2/2g} = \frac{(100)^2}{(10)^2} = 100 \Rightarrow h_1 = 100h_2$

456) d For such a projector path described by a stone thrown into the air, the vertical component of the acceleration is always the acceleration is always the acceleration of free fall, g, taken as 9.8 ms^{-2}, towards centre of Eearth.

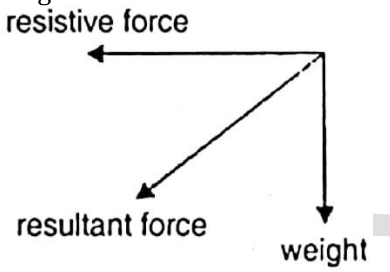
Thus, vertical component of acceleration at point P is the same as that at point T and is equal to g.

457) b At the highest point Q, the vertical component of sped is zero. The horizontal component of sped is non-zero. This means kinetic energy and Momentum at Q is non-zero.

There is no horizontal acceleration in projectile motion.

458) b At the highest point of projectile, there is resistive force acting opposite to the motion of ball. The force is to the left.

There is also a gravitational force, i.e. the weight of ball.



459) b $R_{max} = \frac{u^2}{g} = 16 \times 10^3 \Rightarrow u = 400$ m/s

460) c Due to constant velocity along horizontal and vertical downward force of gravity stone will hit the ground following parabolic path.

461) b Because the vertical componenets of velocities of both the bullets are same and equal to zero and t = $\sqrt{\frac{2h}{g}}$.

462) c The pilot will see tha ball falling in straight line because the reference frame is mobbing with the same horizontal velocity but the observer at rest will see the ball falling in parabolic path.

463) b Due to air resistance, it's horizontal velocity will decrease so it will fall behind the aeroplane.

464) c Because horizontal velocity is same for coin and the observer. So relative horizontal displacement will be zero.

465) A For both cases t = $\sqrt{\frac{2h}{g}}$ = constant.

Because vertical downward components of velocity will be zero for both the particles.

466) D $R = \frac{u^2 \sin 2\theta}{g}$

$H \propto u^2$. if initial velocity be doubled then range will become four times.

467) c $H = \frac{u^2 \sin^2\theta}{2g}$

$H \propto u^2$. If initial velocity be doubled then maximum height reached by the projectile will quadrupled.

468) a An external force by gravity is present throughout the motion so momentum will not be conserved.

469) a $\text{Range} = \frac{u^2 \sin 2\theta}{g}$; where $\theta = 90°$, R = 0 i.e. the body will fall at the point of projection after completing one dimensional motion under gravity.

470) c Because there is no accelerating or retarding force available in horizontal motion.

471) a Direction of velocity is always tangent to the path so at the top of trajectory, it is in horizontal direction and acceleration due to gravity is always in verticaly downward direction. It means angle between v and g are perpendicular to each other.

472) B $R_{15°} = \frac{u^2 \sin(2 \times 15°)}{g} = \frac{u^2}{2g} = 1.5 \text{ km}$

$R_{45°} = \frac{u^2 \sin(2 \times 45°)}{g} = \frac{u^2}{g} = 1.5 \times 2 = 3 \text{ km}$

473) A For vertical upward motion $h = ut - \frac{1}{2}gt^2$

$5 = (25 \sin\theta) \times 2 - \frac{1}{2} \times 10 \times (2)^2$

$25 = 50 \sin\theta \Rightarrow \sin\theta = \frac{1}{2} \Rightarrow$

$\theta = 30°$

474) B Range is given by $R = \frac{u^2 \sin 2\theta}{g}$

On moon $g_m = \frac{g}{6}$. hence $R_m = 6R$

475) D Acceleration through out the projectile motion remains constant and equal to g.

476) c Time of flight = $\frac{2u\sin\theta}{g} = \frac{2 \times 50 \times \sin 30}{10} = 5s$

477) b Change in momentum = $2mu \sin\theta$

= 2 x 0. 5 x 98 x sin30 = 45 N-s

No.	Ans	Explanation
478)	b	As $h = \frac{u^2\sin^2\theta}{2g}$ $\frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin\theta_2} = \frac{\sin^2\theta_1}{\sin\theta_2} = \frac{\sin^2 30°}{\sin^2 60} = \frac{1/4}{3/4} = \frac{1}{3}$
479)	A	$T = \frac{2u\sin\theta}{g} = 10$ sec => u sinθ = 50 m/s $H = \frac{u^2\sin^2\theta}{2g} = \frac{(u\sin\theta)^2}{2g} = \frac{50 \times 50}{2 \times 10} = 125\ m$
480)	B	For complementary angles range will be equal.
481)	b	$R = \frac{u^2\sin 2\theta}{g} = \frac{(500)^2 x \sin 30°}{10} = 12.5 \times 10^3 m$
482)	A	$T = \frac{2u\sin\theta}{g} => u = \frac{T \times g}{2\sin\theta} = \frac{2 \times 9.8}{2 \times \sin 30} = 19.6$ m/s
483)	C	$R = \frac{u^2\sin 2\theta}{g} = R \propto u^2$. So if the speed of projection doubled, the range will becomes four times, i.e., 4 x 50 = 200 m
484)	C	Range will be equal for complementary angles.
485)	A	When the angle of projection is very far from 45°then range will be minimum
486)	A	$H = \frac{u^2\sin^2\theta}{2g}$ and $T = \frac{2u\sin\theta}{g}$ So $\frac{H}{T^2} = \frac{u^2\sin^2\theta/2g}{4u^2\sin^2\theta/g^2} = \frac{g}{8} = \frac{5}{4}$
487)	B	Range = $\frac{u^2\sin 2\theta}{g}$. It is clear that range is proportional to the direction (angle) and the initial speed.
488)	C	$\frac{2u\sin\theta}{g} = 2$ sec => u sinθ = 10 $H = \frac{u^2\sin^2\theta}{2g} = \frac{100}{2g} = 5m$
489)	B	Only horizontal component of velocity (u cosθ)
490)	A	For complementary angle range is same.
491)	B	$T = \frac{2u\sin\theta}{g} = \frac{2x9.8x\sin 30}{9.8} = 1s$
492)	B	For same range angle of projection should be θ and 90-θ So, time of flights $t_1 = \frac{2u\sin\theta}{g}$ and $t_2 = \frac{2u\sin(90-\theta)}{g} = \frac{2u\cos\theta}{g}$ By multiplying = $t_1t_2 = \frac{4u^2\sin\theta\cos\theta}{g^2}$ $t_1t_2 = \frac{2}{g}\frac{u^2\sin 2\theta}{g} = \frac{2R}{g} => t_1t_2 \propto R$
493)	D	Maxmiumr ange = $\frac{u^2}{g} = 100$ m Maximum height = $\frac{u^2}{2g} = \frac{100}{2} = 50$ m
494)	C	$R_{max} = \frac{u^2}{g} = 100 => u = 10\sqrt{10} = 32$ m/s
495)	C	Since, horizontal component of velocity is constant, hence momentum is constant.
496)	C	$H = \frac{u^2\sin^2\theta}{2g}$ According to problem $\frac{u_1^2\sin^2 45°}{2g} = \frac{u_2^2\sin^2 60°}{2g}$ $\frac{u_1^2}{u_2^2} = \frac{\sin^2 60°}{\sin^2 45°} => \frac{u_1}{u_2} = \frac{\sqrt{3}/2}{1/\sqrt{2}} = \sqrt{\frac{3}{2}}$
497)	C	
498)	D	$R = \frac{u^2\sin 2\theta}{g} = \frac{2u_xv_y}{g}$ Range ∝ horizontal initial velocity (u) In path 4 range is maximum so football possess maximum horizontal velocity in this path.
499)	a	If air resistance is taken into consideration then range and maximum height, both will decrease.

Chapter 7
Oscillations

Simple hormonic Motion, its velocity and acceleration

1. Which one of the following varies when an object execute simple harmonic motion? ETEA 2018-eng
A)Angular frequency B)Total energy
C)Force D)Amplitude

2. If a hole is bored through the center of the earth and a pebble is dropped in it, then it will: ETEA 2018-eng
A)Stop at the center of the earth
B) Drop to the other side
C)Execute SHM
D) Fall with a constant velocity.

3. It is impossible for two particles, each executing simple harmonic motion, to remain in phase with each other if they have different: Eng-ETEA 2016
(a) Masses (b) Periods
(c) Amplitudes (d) Spring constants

4. Simple harmonic motion is a type of
A) rotational motion
B) circular motion

C) musical arrangement
D) vibratory motion

5. A body moves with simple harmonic motion and makes n complete oscillations in one second. What is its angular frequency?
a) N rad s^{-1} b) $\frac{1}{n} rad\ s^{-1}$
c) 2πn rad s^{-1} d) $\frac{2\pi}{n}$rad s^{-1}

6. The waveform of S.H.M. is
A) standing wave B) sine wave
C) square wave D) none

7. The acceleration of a projection on the diameter for a particle moving along a circle is
A) ωx B) ωx^2 C) $\omega^2 x$ D) ωx2

8. For a body executing S.H.M, its
a) Momentum remains constant
b) Potential energy remains constant
c) Kinetic energy remains constant
d) Total energy remains constant

9. A body in simple harmonic motion makes n complete oscillation in one second. The angular frequency of this motion is:
A)πrad-s^{-1} B) 1/π rad-s^{-1}
C) 2π rad-s^{-1} D) $\boldsymbol{\frac{n}{2\pi} rad - s^{-1}}$

10. A particle performs simple harmonic motion of amplitude 0.02m and freq 2.5 Hz, what is its maximum speed?
A) 0.0008 ms^{-1} B) 0.125 ms^{-1}
C) 0.157 ms^{-1} D) 0.314 ms^{-1}

11. If the displacement of a particle executing S.H.M is given by x = $\frac{5}{n}$ sin (20πf t) cms, its amplitude is:
A)$\frac{5}{n}$m B) $\frac{5}{n}$ cm C) 20πcms D) 100 cms

12. A body performing simple harmonic motion has a displacement x given by the equation x = 30sin50t. where t is the time in seconds. What ist he frequency of oscillations?
a) 0.020 Hz b) 0.13 Hz c) 8.0 Hz d) 30 Hz

13. A simple harmonic oscillator has a time period of 10 seconds.Which equation relates its acceleration a and displacement x?
a) A = -10 x b) A = -$(20\pi)x$
c) A = -$(20\pi)^2$ x d) A = -$(2\pi/10)^2$ x

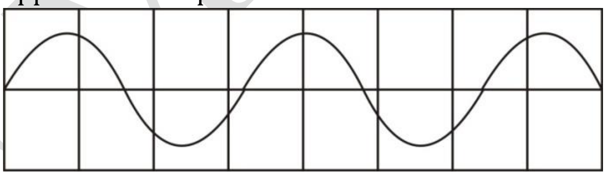
14. A particle performs simple harmonic motion of amplitude 0.020 m and frequency 2.5 Hz. What is its maximum speed?
a) 0.008 ms^{-1} b) 0.050 ms^{-1}
c) 0.125 ms^{-1} d) 0.314 ms^{-1}

15. Simple harmonic motion is defined as the motion of a particle such that
a) Its dispplacement x is always given by the expression x = x_0 sinωt.
b) Its dipsplacement x is related to its velocity v by the expression v = ωx.
c) Its acceleration is always $\omega^2 x_0$ and is directed at right angles to its motion.
d) Its acceleration is proportional to, and in the opposite direction to, the displacement.

16. A body performs simple harmonic motion with a period of .0.063 s. the maximum sped of the body is 3.0 ms^{-1}.
What are the values of the amplitude x_0 and the angular frequency ω?

	x_0/m	ω/rad s^{-1}
A	0.030	100
B	0.19	16
C	5.3	16
D	33	100

17. The diagram below shows the trace on an oscilloscope screen when a sinusoidal signal was applied to the Y plates.



Given that the linear time base was set to 2.00 ms per division, what was the frequency of the signal?
a) 62.5 Hz
b) 156 Hz
c) 312 Hz
d) 625 Hz

18. A particle executing simple harmonic motion along y – axis has its motion described by the equation $y = A\sin(\omega t) + B$. The amplitude of the simple harmonic motion is
a) A
b) B
c) A + B
d) $\sqrt{A + B}$

19. A particle is moving in a circle with uniform speed. Its motion is
a) Periodic and simple harmonic
b) Periodic but not simple harmonic
c) A periodic
d) None of the above

20. Two particles are executing s.h.m. the equation of their motion are $y_1 = 10\sin\left(\omega t + \frac{\pi T}{4}\right), y_2 = 25\sin\left(\omega t + \frac{\sqrt{3}\pi T}{4}\right)$. What is the ratio of their amplitude
a) 1 : 1
b) 2 : 5s
c) 1 : 2

d) None of these

21. The periodic time of a body executing simple harmonic motion is 3 sec. after how much interval from time t = 0, its displacement will be half of its amplitude
a) $\frac{1}{8}$ sec
b) $\frac{1}{6}$sec
c) $\frac{1}{4}$sec
d) $\frac{1}{3}$sec

22. A system exhibiting s.h.m must possess
a) Inertia only
b) Elasticity as well as inertia
c) Elasticity, inertia and an external force
d) Elasticity only

23. If x = a sin $\left(\omega t + \frac{\pi}{6}\right)$ and x' = a $\cos\omega t$, then what is the phase difference between the two waves
a) π/3
b) π / 6
c) π /2
d) π

24. A simple pendulum performs simple harmonic motion with an amplitude A and time period T. the speed of the pendulum at $\mathbf{X} = \frac{A}{2}$ will be
a) $\frac{\pi 4\sqrt{3}}{T}$
b) $\frac{\pi A}{T}$
c) $\frac{\pi A\sqrt{3}}{2T}$
d) $\frac{3\pi^2 A}{T}$

25. A body is executing simple harmonic motion with an angular velocity 2 rad/s. The velocity of the body at 20 mm displacement, when the amplitude of motion is 60 mm, is
a) 40 mm/s
b) 60 mm/s
c) 113 mm/s
d) 120 mm/s

26. A body of mass 5 gm is executing S.H.M. about a point with amplitude 10 cm. its maximum velocity is 100 cm/sec. its velocity will be 50 cm/sec at a distance
a) 5
b) $5\sqrt{2}$
c) $5\sqrt{3}$
d) $10\sqrt{2}$

27. A simple harmonic oscillator has a period of 0.01 sec and an amplitude of 0.2 m. The magnitude of the velocity in m sec^{-1} at the centre of oscillation is
a) 20 π
b) 100
c) 40π
d) 100π

28. A particle executes S.H.M. with a period of 6 second and amplitude of 3 cm. its maximum speed in cm/sec is
a) π /2
b) π
c) 2 π
d) 3π

29. If a simple pendulum oscillates with an amplitude of 50 mm and time period of 2 sec, then its maximum velocity is
a) 0.10 m/s
b) 0.15 m/s
c) 0.8 m/s
d) 0.26 m/s

30. If the displacement of a particle executing S.H.M. is given by $y = 0.30\sin(20t + 0.64)$ in metre, then the frequency and maximum velocity of the particle is
a) 35 Hz, 66 m/s
b) 45 Hz, 66 m/s
c) 58 Hz, 113 m/s
d) 35 Hz, 132 m/s

31. The maximum velocity and the maximum acceleration of a body moving in a simple harmonic oscillator are 2m/s and 4m/s^2. then angular velocity will be
a) 3 rad/sec
b) 0.5 rad/sec
c) 1 rad/sec
d) 2rad/sec

32. The angular velocities of three bodies in simple harmonic motion are $\omega_1, \omega_2, \omega_3$ with their respectively amplitude as A_1, A_2, A_3. If all the three bodies have same mass and velocity, then
a) $A_1\omega_1 = A_2\omega_2 = A_3\omega_3$
b) $A_1\omega_1^2 = A_2\omega_2^2 = A_3\omega_3^2$
c) $A_1^2\omega_1 = A_2^2\omega_2 = A_3^2\omega_3$
d) $A_1^2\omega_1^2 = A_2^2\omega_2^2 = A^2$

33. The velocity of a particle performing simple harmonic motion, when it passes through its mean position is
a) Infinity
b) Zero
c) Minimum
d) Maximum

34. The acceleration of a particle in S.H.M. is
a) Always zero
b) Always constant
c) Maximum at the extreme position
d) Maximum at the equilibrium position

35. The displacement of a particle moving in S.H.M. at any instant is given by $y = a\sin\omega t$. The acceleration after time $t = \frac{T}{4}$ is (where T is the time period)
a) $a\omega$

b) $-a\omega$
c) $a\omega^2$
d) $-a\omega^2$

36. The amplitude of a particle executing S.H.M. with frequency of 60 Hz is 0.01 m. The maximum value of the acceleration of the particle is
a) $144\pi^2$ m/sec^2
b) 144 m/sec^2
c) $\frac{144}{\pi^2}$m/sec^2
d) $288\pi^2$m/sec^2

37. For a particle executing simple harmonic motion, which of the following statements is not correct
a) The total energy of the particle always remains the same
b) The restoring force of always directed towards a fixed point
c) The restoring force is maximum at the extreme position
d) The acceleration of the particle is maximum at the equilibrium position

38. In S.H.M. maximum acceleration is at
a) Amplitude
b) Equilibrium
c) Acceleration is constant
d) None of these

39. Which one of the following statements is true for the speed v and the acceleration a of a particle executing simple harmonic motion
a) When v is maximum, a is maximum
b) Value of a is zero, whatever may be the value of v
c) When v is zero, a is zero
d) When v is maximum, a is zero

Simple pendulum

40. The time period of a simple pendulum with mass m, is T. when the pendulum's mass m is replaced by another ball of mass 3 times the older mass such that the length of pendulum is not changed then its new time period will be: **ETEA-2022**
a) T b) 3T c) T/3 d) 2T

41. The ratio of P.E and total energy at extreme position in SHM will be equal to; **ETEA-2019**
a) 1 b)½
c) 1/4 d)zero

42. The energy of simple harmonic oscillator at a displacement 'x' is partly kinetic and partially potential. The total energy of simple harmonic oscillator remains constant everywhere. Which one of the following option will be correct about the simple harmonic oscillator? : **ETEA-2022**
a) Kinetic energy is maximum at extreme position
b) Potential energy is maximum at extreme position
c) Both kinetic and potential energies are minimum at mean position
d) Potential energy is maximum at mean position

43. A small block oscillates back and forth on a smooth concave surface of radius R. the time period of small oscillation is; **ETEA-2019**
a) $T = 2\pi\sqrt{\frac{R}{g}}$ b) $T = 2\pi\sqrt{\frac{2R}{g}}$
c) $T = 2\pi\sqrt{\frac{R}{2g}}$ d) None of the above

44. The restoring force in the simple pendulum of mass m is; **ETEA-2019**
a) mg cosθ b) mg sinθ
c)mg tanθ d) mg

45. A particle executes SHM along a straight line. Its amplitude is A The potential energy of the particle is equal to the kinetic energy when the displacement of the particle from the mean POSITION IS ; ETEA 2017-med
A.Zero
B. $\pm A/2$
c). $\pm A/\sqrt{2}$
D.2A

46. In S.H.M, the fraction of kinetic energy to total energy when displacement is one-half of the Amplitude is ETEA 2017-med
A.1/8 B.1/2
C.1/4 D.3/4

47. The time period of the simple pendulum is 2 second. If its length is increased by 4 times, then its period becomes; ETEA 2017-med
A. 16s B. 12s C.8s D. 4s

48. In SHM the acceleration of the particle is zero when its: ETEA 2018-med
A) Velocity is zero
B) Displacement is zero
C) Both velocity and displacement are zero
D)Both velocity and displacement are maximum
Hints: As a α-x if x=0 than a=0

49. A body in simple harmonic motion makes n complete oscillation in one second. The angular frequency of this motion is: ETEA 2015-Eng
A)πrad-s^{-1} B) 1/π rad-s^{-1}
C) 2π rad-s^{-1} D) $\frac{n}{2\pi} rad - s^{-1}$

50. A particle performs simple harmonic motion of amplitude 0.02m and freq 2.5 Hz, what is its maximum speed? Eng-ETEA 2009-ETEA 2015
A) 0.0008 ms^{-1} B) 0.125 ms^{-1}
C) 0.157 ms^{-1} D) 0.314 ms^{-1}

51. If the displacement of a particle executing S.H.M is given by x = $\frac{5}{n}$ sin (20πf t) cms, its amplitude is: Eng-ETEA 2015

A) $\frac{5}{n}$m B) $\frac{5}{n}$ cm
C) 20πcms D) 100 cms

52. The total energy of the body executing S.H.M is E. The K.E when the displacement is half of the amplitude is: Eng-ETEA 2015

A) $\frac{E}{a}$ B) $\frac{E}{4}$ C) $\frac{3E}{4}$ D) $\sqrt{\frac{3}{4}E}$

53. At what place, the motion of the bob of simple pendulum will be the slowest? Med-ETEA 2010
(a) At poles of earth
(b) At equator of earth
(c) Anywhere on the surface of earth
(d) None of these

54. A simple pendulum is suspended on the roof of a lift when the lift is moving downward with an acceleration a (a<g), then its time period is given by T= 2π$\sqrt{\frac{l}{g}}$ where g is equal to ; Eng-ETEA 2015
A) g B) g-a
C) (g+a D) g^2

55. If a tunnel is bored through the centre of the earth and a stone is dropped into it then the: Med- ETEA 2010
(a) Stone will stop at the centre of the earth
(b) Stone will move out fro other side of the tunnel
(c) Stone will perform simple harmonic motion
(d) None of these

56. The period of simple pendulum double when: Med-ETEA 2009
(a) Its length is double
(b) The mass of the bob is double
(c) Its length is made four time
(d) The mass and length of the pendulum is made two times

57. If the length of a simple pendulum is halved and mass is doubled then its time period. Eng-ETEA 2012
(a) Increases by $\sqrt{2}$ (b) Remains constant
(c) Cannot be predicted (d) Decreases by $\sqrt{2}$

58. While determining the expression for time period of simple pendulum, we keep the amplitude, Med-2005
(a) Large (b) Small
(c) Maximum (d) Zero

59. How much will be the length of a simple pendulum if its time period is one second Med-ETEA 2010
(a) 2.5 m (b) 0.25 m
(c) 25 m (d) 0.025 m

60. The displacement ‘x’ of a particle at time ‘t’ is given by x = 10 sin 4t. the particle oscillates with period. Med-ETEA 2014
(a) π/10s (b) π/5s
(c) π/4s (d) π/2s

61. If a hole is bored through the center of the earth and a pebble is dropped in it. Then it will: Med-ETEA 2014
(a) Execute SHM
(b) Drop to the other side
(c)Stop at the center of the earth
(d) None of the above

62. The period of a simple pendulum can be increased by: Eng-ETEA 2014
(a) Decreasing the length of the pendulum.
(b) Increasing the length of the pendulum.
(c) Increasing the mass of the bob.
(d) Decreasing the mass of the bob.

63. The total energy of a particle executing S.H.M. is: Med- ETEA 2016
(a) Inversely proportional to square of amplitude
(b) Directly proportional to the amplitude
(c) Zero
(d) Directly proportional to the square of amplitude

64. The time period of a simple pendulum is 2 seconds. If its length is increased by 4 times, then its period becomes: Med-ETEA 2016
(a) 16 s (b) 12 s
(c) 8 s **(d) 4 s**

65. The kinetic energy and potential energy of a particle executing simple harmonic motion will be equal when displacement is: (Where ‘a’ is the amplitude) Eng-ETEA 2016
(a) a$\sqrt{\frac{2}{3}}$ (b) $\frac{a}{2}$
(c) $\frac{a}{\sqrt{2}}$ (d) a √2

66. The time period ‘T’ of a simple pendulum depends on its length ‘I’ and acceleration due to gravity ‘g’ using unit dimension. The correct equation for time period is: **MDCAT - 2016**
a. $T = k\sqrt{\frac{g}{l}}$ where ‘k’ is constant
b. $T = k\sqrt{\frac{l}{g}}$ where ‘k’ is constant
c. $T = \frac{1}{k}\sqrt{\frac{g}{l}}$ where ‘k’ is constant
d. T = $\frac{1}{k}\sqrt{\frac{l}{g}}$ where ‘k’ is constant

67. When the length of simple pendulum is doubled, then ratio of its new time period to old time period is **MDCAT - 2019**

a. 2 ✓2
b. - ✓ 2
c. ✓ 2
d. 1/✓2

68. In simple harmonic motion, acceleration will be maximum, when object is at: **MDCAT - 2019**
a. Maximum displacement from the mean position
b. Center position
c. Mean position
d. Half of the maximum displacement from mean position

69. What is the speed of 2.0 kg metallic bob at mean position of a simple Pendulum, when releases from its extreme position 0.5m high? (g = $10m^{-2}$) **MDCAT - 2020**
A. 3.16 ms-1
B. 10 ms-1
C. 100 ms-1
D. 50 ms-1

70. At which of the following places, motion of simple pendulum becomes slowest **NUMS-2015**
Murree
Karachi
K-2
Peshawar

71. Equation of SHM, with amplitude 'a' is given by **NUMS-2015**
$X = a(\sin^2 wt + \cos^2 wt)$
$X = a(\sin w t \cos^2 wt)$
$X = a \sin w t$
$X = a^2 \sin (\sin w t)$

72. If the length of a second's pendulum is L, then the length of pendulum having a period 1 sec will be **NUMS-2015**
L/2
2L
4L
L/4

73. **Find the time period of a simple pendulum whose length is 88.2 cm. The value acceleration due to gravity is 9.8 m/s2 at the place where experiments is performed? FMDC 2013**
A) 1.885 sec
B) 1.233 sec
C) 2.05 sec
D) 4 sec

74. **A simple pendulum suspended from the ceiling of a train has a period 'T' when the train is a rest. When the train is accelerating with a uniform acceleration, the time period of simple pendulum will: FMDC 2013**
A) Decrease
B) Increase
C) Remain unchanged
D) Become infinite
E) Insufficient information

75. **Instantaneous acceleration of system executing SHM is directed FMDC 2017**
a) Towards the mean position
b) Away from the mean position
c) Perpendicular to the mean position upward
d) Perpendicular to the mean position downward

76. **If the mass of the bob of simple pendulum is doubled, its time period is: FMDC 2017**
a) One half
b) Doubled
c) Remains constant
d) One fourth

77. In simple harmonic motion, the restoring force is minimum at **KMU-CAT 2021**
a) mean position
b) extreme position
c) midpoint of mean and extreme position
d) none of the above

78. What should be the length of simple pendulum whose period is 6.28 second at a place where g = 10 ms^{-2}. **MDCAT - 2015**
a. 0.28 m
b. 10.8m
c. 6.28 m
d. 10 m

79. What should be the ration of kinetic energy to total energy for simple harmonic oscillator? **MDCAT - 2015**
a. $1 - \frac{x^2}{x_o^2}$
b. 1
c. $(x_o^2 - x^2)$
d. $\frac{1}{2}x^2$

80. The kinetic energy and potential energy of a particle executing simple harmonic motion will be equal for the displacement (where x_o is the amplitude); ETEA 2017-med
A. $x\sqrt{\frac{2}{3}}$ B. x/2
C. $x/\sqrt{2}$ D. $x\sqrt{2}$

81. A simple pendulum suspended form the ceiling of

a lift has time period T when the lift is at rest. When the lift falls freely, the time period is
A) infinite B) T/g
C) zero D) g/T

82. The restoring force acting on simple pendulum is given by
A) mg sin 2θ B) mg sin θ
C) mg cos 2θ D) mg cos θ

83. Natural frequency of simple pendulum depends upon
A) its mass
B) its length
C) square of its length
D) square root of its length

84. For a simple pendulum the restoring force is caused by
A) gravity B) spring
C) hand D) all of these

85. The time period of the simple pendulum is 2 second. If its length is increased by 4 times, then its period becomes;
A. 16s B. 12s C.8s D. 4s

86. At what place, the motion of the bob of simple pendulum will be the slowest?
a) At poles of earth
b) At equator of earth
c) Anywhere on the surface of earth
d) None of these

87. A simple pendulum is suspended on the roof of a lift when the lift is moving downward with an acceleration a (a<g), then its time period is given by T= $2\pi\sqrt{\frac{l}{g}}$ where g is equal to ;
A) g B) g-a C) (g+a d) g^2

88. If a tunnel is bored through the centre of the earth and a stone is dropped into it then the:
a) Stone will stop at the centre of the earth
b) Stone will move out fro other side of the tunnel
c) Stone will perform simple harmonic motion
d) None of these

89. The period of simple pendulum double when:
a) Its length is double
b) The mass of the bob is double
c) Its length is made four time
d) The mass and length of the pendulum is made two times

90. If the length of a simple pendulum is halved and mass is doubled then its time period.
a) Increases by $\sqrt{2}$ b) Remains constant
c) Cannot be predicted d) Decreases by $\sqrt{2}$

91. While determining the expression for time period of simple pendulum, we keep the amplitude,
a) Large b) Small
c) Maximum d) Zero

92. How much will be the length of a simple pendulum if its time period is one second
a) 2.5 m b) 0.25 m c) 25 m d) 0.025 m

93. The period of a simple pendulum can be increased by:
a) Decreasing the length of the pendulum.
b) Increasing the length of the pendulum.
c) Increasing the mass of the bob)
d) Decreasing the mass of the bob.

94. The time period of a simple pendulum is 2 seconds. If its length is increased by 4 times, then its period becomes:
a) 16 s b) 12 s c) 8 s d) 4 s

95. The kinetic energy and potential energy of a particle executing simple harmonic motion will be equal for the displacement (where x_o is the amplitude);
A. x $\sqrt{\frac{2}{3}}$ B. x/2 C.x/$\sqrt{2}$ D. x$\sqrt{2}$

96. The total energy of the body executing S.H.M is E. The K.E when the displacement is half of the amplitude is:
A) $\frac{E}{a}$ B) $\frac{E}{4}$ C) $\frac{3E}{4}$ D) $\sqrt{\frac{3}{4}}E$

97. A weight suspended from an ideal spring oscillates up and down with a period T. If the amplitude of the oscillation is doubled, the period will be:
a) T b) 1 c) 2T d) T

98. In simple pendulum the time period of oscillation is related to the length of pendulum as:
a) L/T=constant b) L/T^2=constant
c) L^2/T^2=constant d) L^2/T-constant

99. A simple harmonic oscillator consists of an particle of mass "m" and an ideal spring with spring constant "k". if the spring is cut in half and used with the same particle, the period will be:
a) 2T b) T/$\sqrt{2}$ c) $\sqrt{2}$T d) T

100. The time period of simple pendulum is 2 π then its angular frequency is:
a) 50 Hz b) 2 Hz c) 1 Hz d) 5 Hz

101. If "f" is the frequency, then how many times in a vibration do potential and kinetic energies of an oscillator becomes equal?
a) F times b) 2f times
c) f/2 times d) 4f times

102. In damped harmonic oscillation, which one deceases?
a) Amplitude of vibration
b) Both amplitude and energy

c) Energy of vibration
d) Neither amplitude nor energy

103. The motion of simple pendulum is SHM only if
a) Amplitude is large b) Mass is small
c) Amplitude is small d) Length is small

104. What should be the length of the simple pendulum (in meters) whose period is 1 sec at a place where g = 10 ms^{-2}
a) $1/2\pi$ b) $1/4\pi$
c) $10/2\pi^2$ d) $10/4\pi^2$

105. The bob of a simple pendulum is pulled to one side by a horizontal force from the mean position. The tension in the string is:
a) Less than before
b) Greater than before
c) Unchanged
d) It depends upon the forces

106. A pendulum 1.5 m and executes 100 vibrations in 246 seconds. Its period will be:
a) 2.46 s b) 24.6 s
c) 2.59 s d) 246 s

107. If the mass of pendulum is double, its time period is:
a) remains unchanged b) doubled
c) one third d) half

108. If a simple pendulum is shifted from Lahore to Murree, then its time period.
a) Does not change b) Decreases
c) Increases d) Slightly decreases

109. The product of frequency and time period of second pendulum is
a) 0.5 Hz b) 2 sec c) 1 sec d) 1

110. Length of the pendulum has time period of 1 second is:
a) 0.5 m b) 0.25 sec c) 0.5 m d) 0.25 m

111. Which of the following is not an example of SHM
a) Motion of pendulum
b) Motion of spring mass system
c) Vibration of tuning fork
d) Motion of fan

112. The period of a simple pendulum is 1 s on Earth. When brought to a planet where g is one-tenth that one Earth, its period becomes:
a) 1s b) 1/10 s
c) $1/\sqrt{10}\ s$ d) $\sqrt{10}\ s$

113. A simple pendulum of length "L" and mass "M" has frequency "f". to increase its frequency to 2f:
a) Increase its length to 4L
b) Decrease its length to L/2
c) Increase its length to 2L
d) Decrease its length to L/4

114. A simple pendulum suspended from the ceiling of a lift has time period "T", when the lift is at rest. When the lift falls freely, the time period is:
a) Infinite b) Zero
c) T/g d) g/T

115. The energy of SHM is constant at
a) means position
b) in between mean position
c) extreme position
d) all positions during SHM

116. Natural frequency of simple pendulum depends upon:
a) Its mass
b) Square of its length
c) Its length
d) Square root of its length

117. For what displacement the P.E becomes ¼ of its maximum value?
a) $X=x_o$ b) $X=x_o/4$ c) $X = x_o/2$ d) $X = x_o^2/2$

118. If the mass of the bob of a pendulum is doubled its time period is:
a) Halved b) Doubled
c) Unchanged d) Increases four times

121. When the length of simple pendulum is doubled, the ratio of its new time period is old time period is:
a) $2\sqrt{2}$ b) $-\sqrt{2}$ c) $\sqrt{2}$ d) $1/\sqrt{2}$

122. A child is swinging on swing in sitting position stands up. The time period of the swing will
a) Increase b) Decrease
c) Remain same
d) Increase if the child is tall and decrease if the child is short

123. A simple pendulum has a metal bob, which is negatively charged. If it is allowed to oscillate above a positively charged metallic plate, then its time period will:
a) Increase b) Decrease
c) Become zero d) Remain the same

124. A pendulum undergoing S.H.M. the velocity of the bob in the mean position is "v". if now its amplitude is doubled, keeping the length same, its velocity in the mean position will be:
a) v/2 b) v c) 2v d) 4v

125. The tension in the string of a simpe pendulum is:

a) Remains constant
b) Maximum in extreme position
c) Zero in mean position
d) Maximum at mean position

126. The length of a secondd's pendulum at the surface of Earth is 1m. the length of the second's pendulum at the surface of moon where g is 1/6th that at earth's surface is:
a) 1/6 m b) 6m
c) 1/36 m d) 36 m

127. The displacement of a particle performing SHM when K.E. = P.E. (amplitude = 4 cm) is:
a) $2\sqrt{2}$ cm b) 2 cm c) $1/\sqrt{2}$ cm d) $\sqrt{2}$ cm

128. A second's pendulum is placed in a space laboratory orbiting around the earth at a height "3R" form the earth's surface where "R" is Earth's radius. The time period of the pendulum will be
a) Zero b) $2\sqrt{3}$ c) 4 sec d) Infinity

129. A simple pendulum is attached to the roof of a lift has a time period of 2s is in a stationary lift. If the lift is allowed to fall freely the frequency of oscillations of pendulum will be:
a) Zero b) 2 Hz c) 0.5 Hz d) Infinity

130. The acceleration-displacement graph of a body executing SHM is a:
a) Straight line b) Sine curve
c) Circle d) Parabola

131. The frequency of second pendulum is:
a) 2 Hz b) 1 Hz c) 0.5 Hz d) 0.1 Hz

132. If mass attached is a spring is made four times, the time period becomes:
a) Doubled b) One half
c) Remains same d) Four times

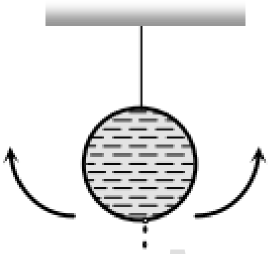
133. A body executes SHM with an amplitude x_o its energy is half kinetic and half potential when displacement is:
a) $\frac{x_o}{2}$ b) $\frac{x_o}{3}$ c) $\frac{x_o}{\sqrt{2}}$ d) $\frac{x_o}{4}$

134. When the length of a simple pendulum is doubled, find the ratio of the new frequency to the old frequency?
a) $\frac{1}{4}$ b) $\frac{1}{2}$ c) $\sqrt{2}$ d) $\frac{1}{\sqrt{2}}$

135. The period of simple pendulum is doubled, when
a) Its length is doubled
b) The mass of the bob is doubled
c) Its length is made four times
d) The mass of the bob and the length of the pendulum are doubled

136. The period of oscillation of a simple pendulum of constant length at earth surface is T. its period inside a mine is
a) Greater than T
b) Less than T
c) Equal to T
d) Cannot be compared

137. A simple pendulum is made of a body which is a hollow sphere containing mercury suspended by means of a wire. If a little mercury is drained off, the period of pendulum will



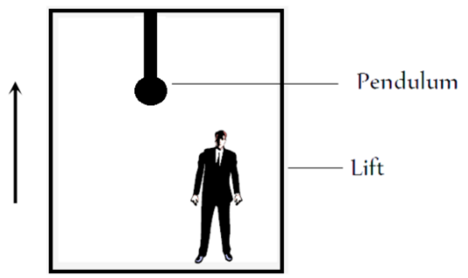
a) Remains unchanged
b) Increase
c) Decrease
d) Become erratic

138. A pendulum suspended from the ceiling of a train has a period T, when the train is at rest. When the train is accelerating with a uniform acceleration a, the period of oscillation will
a) Increase
b) Decrease
c) Remain unaffected
d) Become infinite

139. The mass and diameter of a planet are twice those of earth. the period oscillation of pendulum on this planet will be (if it is a second's pendulum on earth)
a) $\frac{1}{\sqrt{2}}$ sec
b) $2\sqrt{2}$ sec
c) 2 sec
d) $\frac{1}{2}$ sec

140. The time period of a second's pendulum is 2 sec. the spherical bob which is empty from inside has a mass of 50 gm. This is now replaced by another solid bob of same radius but having different mass of 100 gm. The new time period will be
a) 4 sec
b) 1 sec
c) 2 sec
d) 8 sec

141. A man measures the period of a simple pendulum inside a stationary lifts and finds it to be T sec. if the lift accelerates upwards with an acceleration g/4, then the period of the pendulum will be



a) T
b) $\frac{T}{4}$
c) $\frac{2T}{\sqrt{5}}$
d) $2T\sqrt{5}$

142. A simple pendulum is suspended form the roof of a trolley which moves in a horizontal direction with an acceleration a, then the time period is given by T = $2\pi\sqrt{\frac{1}{g'}}$ where g' is equal to
a) G
b) G-a
c) G+a
d) $\sqrt{g^2 + a^2}$

143. A second's pendulum is placed in a space laboratory orbiting around the earth at a height 3R, where R is the radius of the earth. The time period of the pendulum is
a) Zero
b) $2\sqrt{3}$ sec
c) 4 sec
d) Infinite

144. The length of the second pendulum on the surface of earth is 1 m. the length of seconds pendulum on the surface of moon, where g is 1/6th value of g on the surface of earth, is
a) 1/6 m
b) 6m
c) 1/36 m
d) 36 m

145. The period of simple pendulum is measured as T in a stationary lift. If the lift moves upwards with an acceleration of 5 g, the period will be
a) The same
b) Increase by 3/5
c) Decreased by 2/3 times
d) Increase by $\frac{1}{\sqrt{6}}$

146. The length of simple pendulum is increased by 1%. Its time period will
a) Increase by 1%
b) Increase by 0.5%
c) Decrease by 0.5%
d) Increase by 2%

147. A simple pendulum executing SHM is falling freely along with the support. Then
a) Its periodic time decreases
b) Its periodic time increases
c) It does not oscillate at all
d) None of these

148. The time period of a simple pendulum is 2 sec. if its length is increased 4 times, then its period becomes
a) 16 sec
b) 12 sec
c) 8 sec
d) 4 sec

149. If the metal bob of a simple pendulum is replaced by a wooden bob, then its time period will
a) Increase
b) Decrease
c) Remain the same
d) First increase then decrease

150. A pendulum has time period T. if it is taken on to another planet having acceleration due to gravity half and mass 9 times that of the earth then its time period on the other planet will be
a) $\sqrt{T}$
b) T
c) $T^{1/3}$
d) $\sqrt{2}T$

151. A simple pendulum is executing simple harmonic motion with a time period T. if the length of the pendulum is increased by 21%, the percentage increase in the time period of the pendulum of increased length is
a) 10%
b) 21%
c) 30%
d) 50%

152. If the length of simple pendulum is increased by 300%, then the time period will be increase by
a) 100%
b) 200%
c) 300%
d) 400%

153. The length of a seconds pendulum is
a) 99.8 cm
b) 99 cm
c) 100 cm
d) None of these

154. The acceleration due to gravity at a place is π^2 m/sec^2. Then the time period of a simple pendulum of length one metre is
a) $\frac{2}{\pi}$ sec
b) 2π sec

c) 2 sec
d) π sec

155. A plate oscillated with time period 'T'. suddenly, another plate put on the first plate, then time period
a) Will decrease
b) Will increase
c) Will be same
d) None of these

156. A simple pendulum of length l has a brass bob attached at its lower end. Its period is T. if a steel bob of same size, having density x times that of brass, replaces the brass bob and its length is changed so that period becomes 2T, then new length is
a) 2l
b) 4l
c) 4 l x
d) $\frac{4l}{x}$

157. In a seconds pendulum, mass of bob is 30 gm. If it is replaced by 90 gm mass. Then its time period will
a) 1 sec
b) 2 sec
c) 4 sec
d) 3 sec

158. The time period of a simple pendulum when it is made to oscillate on the surface of moon
a) Increase
b) Decreases
c) Remains unchanged
d) Becomes infinite

159. A simple pendulum is attached to the roof of a lift. If time period of oscillation, when the lift is stationary is T. then frequency of oscillation, when the lift falls freely, will be
a) Zero
b) T
c) 1/T
d) None of these

160. A simple pendulum, suspended from the ceiling of a stationary van, has time period T. if the van starts moving with a uniform velocity the period of the pendulum will be
a) Less than T
b) Equal to 2T
c) Greater than T
d) Unchanged

161. If the length of the simple pendulum is increased by 44%, then what is the change in time period of pendulum
a) 22%
b) 20%
c) 33%
d) 44%

162. The periodic time of a simple pendulum of length 1 m and amplitude 2 cm is 5 seconds. If the amplitude is made 4 cm, its periodic time in seconds will be
a) 2.5
b) 5
c) 10
d) $5\sqrt{2}$

163. The ratio of frequencies of two pendulum are 2 : 3, then their length are in ratio
a) $\sqrt{2/3}$
b) $\sqrt{3/2}$
c) 4/9
d) 9/4

164. Two pendulum begin to swim simultaneously. If the ratio of the frequency of oscillations of the two is 7 : 8, then the ratio of lengths of the two pendulums will be
a) 7 : 8
b) 8 : 7
c) 49 : 64
d) 64 : 49

165. If the length of a pendulum is made 9 times and mass of the bob is made 4 times then the value of time period becomes
a) 3T
b) 3/2 T
c) 4T
d) 2T

166. A simple pendulum is taken from the equator to the pole. Its period
a) Decrease
b) Increase
c) Remain the same
d) Decreases and then increases

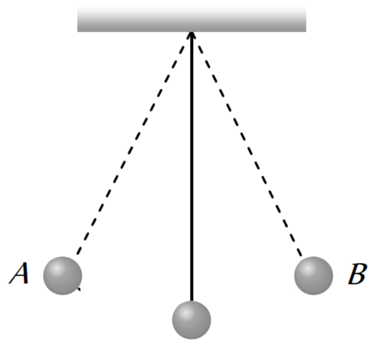
167. There is a simple pendulum hanging from the ceiling of a lift. When the lift is stand still, the time period of the pendulum is T. if the resultant becomes g/4, then the new time period of the pendulum is
a) 0.8 T
b) 0.25 T
c) 2T
d) 4T

168. Time period of a simple pendulum will be double, if we
a) Decrease the length 2 times
b) Decrease the length 4 times
c) Increase the length 2 times
d) Increase the length 4 times

169. The velocity of simple pendulum is maximum at
a) Extremes
b) Half displacement
c) Mean position

d) Every where

170. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of 10 cm (g = 9.8 m/s)



a) 2.2 m/s
b) 1.8 m/s
c) 1.4 m/s
d) 0.6 m/s

Mass spring system

171. If the period of oscillation of mass (M) suspended from a spring is 1s, then the period of 16M will be: **NUMS -2022**
a. 1s
b. 2s
c. 3s
d. 4s

172. To make frequency of spring oscillation four times, we have to: : **NUMS -2021**
A) Reduce mass to one fourth
B) Quadruple the mass
C) Reduce mass to one sixteenth
D) Double the mass.

173. A mass m is suspended from a spring of spring constant k. The angular frequency of oscillations of the spring is: ETEA 2018-med
A) k/m B) $\sqrt{\frac{k}{m}}$
C) m/k D) $\sqrt{\frac{m}{k}}$

174. A spring obeying Hook's law has an un stretched length of 50 mm and a spring constant of 400 Nm^{-1}. What is the tension in the spring when its overall length is 70mm? Med-ETEA 2013
(a) 8.0 N (b) 28 N
(c) 160 N (d) 400 N

175. A spring system executes simple harmonic motion. If a load is added to it then the time period of spring–mass system will be, Med -ETEA 2012
(a) Increased (b) Decreased
(c) The same (d) Halved

176. A weight suspended from an ideal spring oscillates up and down with a period T. If the amplitude of the oscillation is doubled, the period will be: Med-ETEA 2016
(a) T (b) 1
(c) 2T (d) T

177. In mass spring system mass 'm' is attached with spring of spring constant 'k' with period 'T_1'. Then the mass is replaced by '2m' with same spring, what is the time period 'T_2'. **MDCAT - 2017**
a. $T_2 = T_1$
b. $T_2 = 2T_1$
c. $T_2 = \sqrt{2}\,T_1$
d. $T_2 = T_1\sqrt{2}$

178. If the mass attached with a spring becomes four times, the time period of vibration becomes; **MDCAT - 2018**
a. One fourth
b. 3/4
c. Half
d. Double

179. To double the total energy for a mass spring system oscillating in SHM, by what factor must the amplitude increase? **NUMS-2015**
a) 4 b) 2 c) $\sqrt{2} = 1.414$ d) $\sqrt[4]{2} = 1.189$

180. Two springs of spring constants k1 and k2 are stretched by the same force. They are stretched by x1 and x2 respectively, If k1 >k2 then: ETEA 2017-eng
a)x1=x2 B)x1>x2
C)x1<x2 D) Depends on the length of the spring

181. A spring is stretched by 5 cm. Its potential energy is E. If it is stretched by 10 cm, its potential energy will be ETEA 2017-eng
A) 2 B) 4E
C) 8E D)16E

182. Two springs of spring constant k2 and K2 are arranged in parallel and a body of mass m is attached to it then calculate the time period of the system: ETEA 2018-med
A) $2\pi\sqrt{\frac{m}{k1+k2}}$ B) $2\pi\sqrt{\frac{2m}{k1+k2}}$
C) $2\pi\sqrt{\frac{mk1k2}{k1+k2}}$ D) $2\pi\sqrt{\frac{k1+k2}{m}}$

183. A wire-of area of cross section 'A" and original length 'l' is subjected to a load 'L'. A second wire of sme material with an area is '2A' and length '2l' is subjected to the same load 'L'. if the extension in first wire is 'X' and second wire is 'Y', find the ratio 'X/Y'. **MDCAT - 2015**
a. $\frac{1}{4}$

b. $\frac{1}{2}$
c. $\frac{1}{1}$
d. $\frac{1}{1}$

184. For vibrating mass-spring system, the expression of kinetic energy at any displacement "x" is given by:
a) $\frac{1}{2}kx_o^2\left(1-\frac{x^2}{x_o^2}\right)$ b) $\frac{1}{2}kx_o^2$
c) $\frac{1}{2}mw\left(1-\frac{x^2}{x_o^2}\right)$ d) $\frac{1}{2}mw^2x_o$

185. The instantaneous velocity of the mass attached to the end of an elastic spring is
a) $V_t = x_o\sqrt{m/k}\sqrt{1-(x^2/x_o^2)}$
b) $V_t = x\sqrt{m/k}\sqrt{1-(x^2/x_o^2)}$
c) $V_t = x_o\sqrt{k/m}\sqrt{1-(\frac{x^2}{x_o^2})}$
d) $V_t = x\sqrt{k/m}\sqrt{1-(\frac{x^2}{x_o^2})}$

186. A mass of 8.0 g oscillates in simple harmonic motion with an amplitude of 5.0 mm at a frequency of 40 Hz. Wht is the total energy of this simple harmonic oscillator?
a) 0.16 mJ b) 6.3 mJ c) 13 mJ d) 640 mJ

187. The maximum velocity V_o of the mass attached to the end of an elastic spring is
a) $V_o = x_o\sqrt{m/k}$ b) $V_o = x\sqrt{k/m}$
c) $V_o = x\sqrt{m/k}$ d) $V_o = x_o\sqrt{k/m}$

188. The S.I units of spring constant are:
a) $m-1$ b) $Nm-1$
c) $Nm-2$ d) $Nm2$

189. In mass spring system, mass "m" is attached with spring of constant "k" with time period "t_1" then mass is replaced by "2m" with the same spring. What will be the time period "T_2"?
a) $T_2 = \sqrt{2}\,T_1$ b) $T_2 = T_1$
c) $T_2 = 2T_1$ d) $T_2 = T_1/\sqrt{2}$

190. A wire has a spring constant of 5×10^4 N m^{-1}. It is stretched by a force to extension of 1.4 mm. calculate the strain energy stored in the wire:
a) 4.9×10^{-5} J b) 4.9J
c) 4.9×10^5 J d) 4.9×10^{-2} J

191. The period of oscillation of a mass "M" suspended from a spring of negligible mass is "T". if along with it another mass "M" is also suspended, the period of oscillation will now be
a) T b) $T/\sqrt{2}$ c) 2T d) $\sqrt{2}$T

192. The total mechanical energy of a spring-mass system in simple harmonic motion is $E = \frac{1}{2}mO^2A^2$. suppose the oscillating particle is replaced by another particle of double the mass while the amplitude "A" remains the same. The new mechanical energy will:
a) Becomes 2E b) Become E/2
c) Become $\sqrt{2}$E d) Remains same

193. What fraction of total energy is kinetic at half of amplitude during SHM?
a) 1/2 b) 1/4 c) 2/3 d) 3/4

194. A mass "M" is suspended form a spring of negligible mass. The spring is pulled a little and then released so that the mass executes SHM of time period "T". if the mass is increased by m, the time period becomes $\frac{5T}{3}$then the ratio is of "m" and "M" is:
a) $\frac{25}{9}$ b) $\frac{16}{9}$ c) $\frac{5}{3}$ d) $\frac{3}{5}$

195. Which of the following becomes maximum at means position?
a) P.E b) Acceleration
c) Displacement d) K.E

196. A particle undergoes simple harmonic motion having time period "T". the time taken in 3/8th oscillation is:
a) 3T/8 b) 55T/8
c) 5T/12 d) 7T/12

197. The product of frequency and time period is
a) 0 b) 2π c) π d) 1

198. Time period of horizontal mass spring system will be maximum
a) At Lahore b) At murree
c) At Mount Everest d) Equal at all places

199. The SI unit of spring constant is same as that of:
a) Force b) Surface tension
c) Pressure d) Intensity

200. If three identical springs each of constant "k" are hooked together the spring constant of resultant spring will be:
a) 3k b) k/9 c) 6k d) k/3

201. In SHM, the restoring force is directly proportional to:
a) Velocity b) Acceleration
c) Displacement d) Time period

202. A person ties four springs, each of constant k, in series. The resultant spring constant he gets will be:
a) 4k b) k/4 c) 16k d) k/16

203. The ratio of spring constants of two springs is 4 : 1, the respective ratio of the elastic energy stored int hem will be:
a) 1 : 4 b) 4 : 1 c) 16 : 4 d) 16 : 1

204. K.E of spring executing SHM at any instant of time is:
a) K.E. = ½ $Kx_o^2\left(1=\frac{x^2}{x_o^2}\right)$

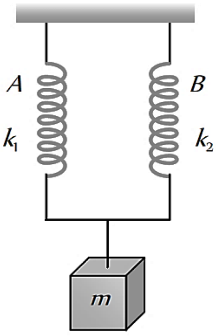
b) K.E = $(K.E)_{max}\left(1 = \frac{x^2}{x_o^2}\right)$
c) Both "A" and "B"
d) K.E = ½ Kx^2

205. What is the period of mass spring system during SHM if the ratio of mass to spring constant is ¼ ?
a) πs b) $2\,\pi s$ c) $1/\,\pi s$ d) ½ πs

206. A spring system executes simple harmonic motion. If a load is added to it then the time period of spring–mass system will be,
a) Increased b) Decreased
c) The same d) Halved

207. Two bodies M and N of equal masses are suspended form two separate massless springs of force constants k_1 and k_2 respectively. if the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude M to that of N is
a) $\frac{k_1}{k_2}$ b) $\sqrt{\frac{k_1}{k_2}}$
c) $\frac{k_2}{k_1}$ d) $\sqrt{\frac{k_2}{k_1}}$

208. A mass m is suspended by means of two coiled spring which have the same length in unstretched condition as a figure. Their force constant are k and k respectively. when set into vertical vibrations, the period will be

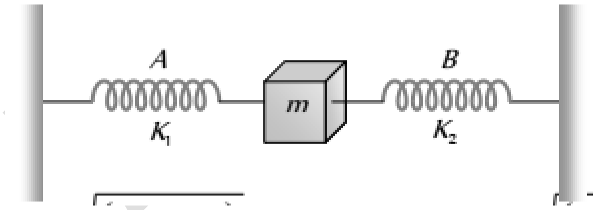


a) $2\pi\sqrt{\left(\frac{m}{k_1k_2}\right)}$
b) $2\pi\sqrt{m\left(\frac{k_1}{k_2}\right)}$
c) $2\pi\sqrt{\left(\frac{m}{k_1-k_2}\right)}$
d) $2\pi\sqrt{\left(\frac{m}{k_1+k_2}\right)}$

209. A spring has a certain mass suspended from it and its period for vertical oscillation is T. the spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is now
a) $\frac{T}{2}$
b) $\frac{T}{\sqrt{2}}$
c) $\sqrt{2}T$
d) 2T

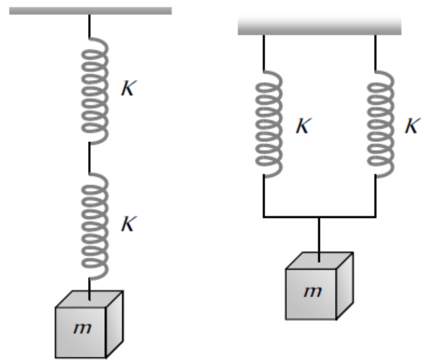
210. Two masses m_1 and m_2 are suspended together by a massless spring of constant k. when the masses are in equilibrium, m_1 is removed without disturbing the system. Then the angular frequency of oscillation of m_2 is
a) $\sqrt{\frac{k}{m_1}}$
b) $\sqrt{\frac{k}{m_2}}$
c) $\sqrt{\frac{k}{m_1+m_2}}$
d) $\sqrt{\frac{k}{m_1m_2}}$

211. In arrangement given in figure, if the block of mass m is displaced, the frequency is given by



a) $n = \frac{1}{2\pi}\sqrt{\left(\frac{k_1-k_2}{m}\right)}$
b) $n = \frac{1}{2\pi}\sqrt{\left(\frac{k_1+k_2}{m}\right)}$
c) $n = \frac{1}{2\pi}\sqrt{\left(\frac{m}{k_1+k_2}\right)}$
d) $n = \frac{1}{2\pi}\sqrt{\left(\frac{m}{k_1-k_2}\right)}$

212. Two identical spring of constant K are connected in series and parallel as shown in figure. A mass m is suspended from then. The ratio of their frequencies of vertical oscillations will be



a) 2 : 1
b) 1 : 1
c) 1 : 2
d) 4 : 1

213. A mass m is suspended from the two coupled springs connected in series. The force constant for springs are K_1 and K_2. The time period of the suspended mass will be

a) $T = 2\pi\sqrt{\left(\frac{m}{K_1+K_2}\right)}$

b) $T = 2\pi\sqrt{\left(\frac{m}{K_1+K_2}\right)}$

c) $T = 2\pi\sqrt{\left(\frac{m(K_1+K_2)}{K_1K_2}\right)}$

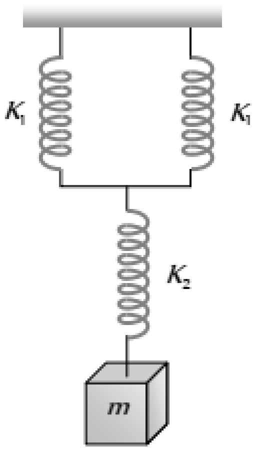
d) $T = 2\pi\sqrt{\left(\frac{mK_1K_2}{K_1+K_2}\right)}$

214. A spring is stretched by 0.20 m, when a mass of 0.50 kg is suspended. When a mass of 0.25 kg is suspended, then its period of oscillation will be ($g = 10\ m/s^2$)
a) 0.328 sec
b) 0.628 sec
c) 0.137 sec
d) 1.00 sec

215. A spring having a spring cosntant 'K' is loaded with a mass 'm'. The spring is cut into two equal parts and one of these is loaded again with the same mass. The new spring constant is
a) K/2
b) K
c) 2K
d) K^2

216. A uniform spring force constant k is cut into two pieces, the lengths of which are in the ratio 1 : 2. The ratio of the force constants of the shorter and the longer piece is
a) 1 : 3
b) 1 : 2
c) 2 : 3
d) 2 : 1

217. What will be the force constant of the spring system shown in the figure



a) $\frac{K_1}{2} + K_2$

b) $\left[\frac{1}{2K_1} + \frac{1}{K_2}\right]^{-1}$

c) $\frac{1}{2K_1} + \frac{1}{K_2}$

d) $\left[\frac{2}{K_1} + \frac{1}{K_1}\right]^{-1}$

Phase and Path difference

218. The quantity which specified the displacement as well as the direction of motion in simple harmonic motion is the, Med-ETEA 2011
(a) Phase angle (b) Angular frequency
(c) Path difference (d) None of these

219. A body performing SHM with displacement $x = x_0 \sin(wt + fi)$, when $t = 0$, $x = x_0$. Then what is the phase angle fi? **MDCAT - 2017**
a. π
b. $\pi/2$
c. $\pi/4$
d. $-\pi$

220. Angular displacement of a point moving in a circle 10 cm when displacement of projection of this point along vertical diameter of circle is 8.66 cm will be: **MDCAT - 2017**
a. 30°
b. 45°
c. 60°
d. 75°

221. Which of the following option describes the velocity v and acceleration a of a body in simple harmonic ...... When it is at its mean position? (where x = displacement, x0=amplitude and .... = angular velocity). **MDCAT - 2018**
a. $V = wx_o$ & $a = w^2x_o$
b. $V = o$ & $a = o$
c. $V = wx_o$ $a = o$
d. $V = o$ & $a = w^2x_o$

222. The quantity which specified the displacement as well as the direction of motion in simple harmonic motion is the,
a) Phase angle b) Angular frequency
c) Path difference d) None of these

223. It is impossible for two particles, each executing simple harmonic motion, to remain in phase with each other if they have different:
a) Masses b) Periods
c) Amplitudes d) Spring constants

224. The phase angle $\theta = \omega t$ of a body performing S.H.M indicates
a) only the direction of amplitude
b) only the magnitude of displacement
c) both magnitude and direction
d) none of them

225. The equation of displacement of a body executing SHM is $x=x_o \cos wt$, what is the initial phase:
a) 0° b) 60°

c) 90° d) 180°

Resonance and sharpness of resonance

226. The heating and cooking of food evenly by mocro wave oven is an example of: Eng-ETEA 2010
(a) Resonance (b) Specific heat
(c) Damped oscillation (d)None of these

227. MRI works on the principle of: Med-ETEA 2012
(a) Beats (b) Interference
(c)Resonance (d)Standing waves

228. Resonance occurs when the driving frequency is: **MDCAT - 2016**
A) Greater than natural frequency
B) Unequal the natural frequency
C) Less than natural frequency
D) Equal to the natural frequency

229. Tuning a radio is a best example of **MDCAT - 2016**
a. Natural resonance
b. Mechanical resonance
c. Free resonance
d. Electrical resonance

230. Sharpness of resonance is
A) directly proportional to damping force
B) inversely proportional to damping force
C) equal to square of damping force
D) equal to square of damping force

231. Which one down not work according to resonance?
A) T.V B) radio
C) microwave oven D) bulb

232. Electrical resonance is observed in
A) radio
B) microwave oven
C) both in radio and microwave oven
D) neither in radio nor in microwave oven

233. The energy absorbed by a body is _____________ at resonance.
A) maximum as well minimum
B) minimum only
C) maximum only
D) zero

234. Natural frequency of simple pendulum depends upon:
a) Its mass b) Its length
c) Square of its length
d) Square root of its length

235. The process in which energy is dissipated in oscillating system is called:
a) Resonance b) Damping
c) Forced oscillation d) None of these

236. In damped harmonic oscillation, which one deceases?
a) Amplitude of vibration
b) Energy of vibration
c) Both amplitude and energy
d) Neither amplitude nor energy

237. A physical system undergoing forced vibrations is known as
a) Driven harmonic oscillator
b) Resonance
c) Simple harmonic oscillator
d) None of above

238. Tuning of radio set is an example of
a) Mechanical resonance
b) Musical resonance
c) Electrical resonance
d) Free vibration

239. The heating and cooking of food evenly by micro wave oven is an example of:
a) Resonance b) Specific heat
c) Damped oscillation d)None of these

240. MRI works on the principle of:
a) Beats b) Interference
(c)Resonance (d)Standing waves

241. The amplitude of a vibrating body at resonance in vacuum is
a) maximum b) minimum
c) zero d) infinite

242. When damping is small, the amplitude of vibration at resonance will be
a) small b) unchanged
c) large d) none

243. A heavily damped system has a fairly flat resonance curve in
a) distance time graph
b) velocity time graph
c) acceleration time graph
d) amplitude frequency graph

244. The sharpness of the resonance curve of a resonating curve depends on
a) loss of K.E b) loss of P.E
c) frictional loss of energy
d) loss of mechanic energy

245. Resonance is an example of
a) Tuning fork b) Forced vibration
c) Free vibration d) Damped vibration

246. At resonance, the energy transfer becomes:
a) Minimum b) Maximum
c) Zero d) Negative

247. A 0.25 kg block oscillates on the end of the spring with a spring constant of 200N/m. if the system has an energy of 9.0 J, then the amplitude of the

oscillation is:
a) 0.3m b) 0.24m
c) 0.17m d) 4.9m

248. Resonance is dangerous in:
a) Microwave b) Tuning of radio
c) Aero planes wing d) Swing

249. When engine of a stationary car is left running, the vibrations are produced in the body of the car. These vibrations are best described under:
a) Resonant oscillations
b) Damped oscillations
c) Free oscillations
d) Forced oscillations

250. A sinusoidal force with a given amplitude is applied on an oscillator. The maintain the largest amplitude of oscillation the frequency of the applied force should be:
a) Half the natural frequency of the oscillator
b) 1/4 the natural frequency of the oscillator
c) Same as the natural frequency of the oscillator
d) Twice the natural frequency of the oscillator

251. Example of electrical resonance is:
a) Turning of a string instrument
b) Tuning of radio
c) Turning of violin d) All of these

252. Resonance curve is the graph between:
a) Kinetic and potential energies of the oscillating body
b) Amplitude and frequency of the oscillating body
c) Applied force the frequency of the oscillating body
d) Total energy and amplitude of the oscillating body

253. The resonance curve is flat if damping is:
a) Feeble b) Small c) Large d) Moderate

254. Sharpness of resonance is:
a) Directly proportional to damping force
b) Inversely proportional to damping force
c) Equal to square of damping force
d) Equal to square of damping force

255. Resonance is an example of
a) Tuning fork
b) Forced vibration
c) Free vibration
d) Damped vibration

256. In case of a force vibration, the resonance wave becomes very sharp when the
a) Restoring force is small
b) Applied period force is small
c) Quality factor is small
d) Damping force is small

257. A simple pendulum is set into vibrations. The bob of the pendulum comes to rest after some time due to
a) Air friction
b) Moment of inertia
c) Weight of the bob
d) Combination of all the above

258. A simple pendulum oscillates in air with time period T and amplitude A. as the time pass
a) T and A both decrease
b) T increases and A is constant
c) T increases and A decreases
d) T decreases and A is constant

Key

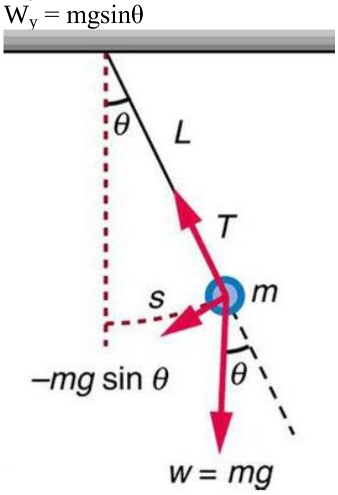
1)	C	
2)	C	
3)	C	To remain in phase for two particle, they must have same amplitude.
4)	D	Simple harmonic motion is a type of vibratory motion
5)	C	Angular frequency , $\omega = 2\pi f = 2\pi n\, rad\ s^{-1}$
6)	B	
7)	C	
8)	D	
9)	C	f=$\frac{\textbf{Number of cycle}}{\textbf{Seconds}} = \frac{2\pi nrad}{s}$ =2π rad-s^{-1}
10)	D	Velocity is given by: v =ω$\sqrt{r^2 - x^2}$, the speed is maximum when x = 2 so v becomes v = ω $\sqrt{r^2}$ = ωr = (2πf)r =2 x 3.14x2.5 x 0.02 = 0.314 ms^{-1} NOTE: for maimum velocity x=0 and for zerovelocity r = x
11)	B	Given; x = $\frac{5}{n}$ sin (20πf t) and we know that; x = x_0 sin (ωt) =x_0 sin (2πft) Comparing both equations we get; $x_0 = \frac{5}{n}\,cm$ where x_0 = amplitude

12)	C	Given the displacement of a S.H.M. X = 30sin50t . The angular frequency of the motion is thus $\omega = 2\pi f = 50\ rads^{-1}$ The frequency of oscillation is hence calculated to be F = $\frac{50}{2\pi} = 8.0\ Hz$
13)	D	$a = -\omega^2 x and\ \omega = \frac{2\pi}{T}$ Where T is the period A = $-(\frac{2\pi}{10})^2$ x
14)	D	Maximum speed is given by $v = r\omega$ Where r is the amplitude of oscillation = 0.020 m. $\omega$is the angular frequency which is relted to frequency f. $\omega = 2\pi f = 2\pi(2.5) = 15.71\ rads^{-1}$
15)	D	Simple harmonicmotion is described by the equation x = $-\omega^2 x$ which states that the acceleration of a particle is always proportional to, and in the opposite direction to, the displacement.
16)	A	Angular freuqncy , $\omega = \frac{2\pi}{T} = \frac{2\pi}{0.063} = 100\ rad\ s^{-1}$ $v_{max} = \omega x_0 => 3 = 100(x_0) => x_0 = 0.030\ m$
17)	B	The number of complete revolution shown on the screen is 2.5. 2.5T = (2.00 x 10^{-3})(8) => T = 6.4 x 10^{-3} s Frequency of the signal is given by $f = \frac{1}{T} = \frac{1}{6.4\ x\ 10^{-3}} = 156\ Hz$
18)	A	The amplitude is a maximum displacement form the mean position.
19)	B	
20)	B	$\frac{a_1}{a_2} = \frac{10}{25} = \frac{2}{5}$
21)	C	$y = a\sin\frac{2\pi}{T}t => \frac{a}{2} = a\sin\frac{2\pi t}{3} = \frac{1}{2}\sin\frac{2\pi t}{3}$ Sin $\frac{2\pi}{3} = \sin\frac{\pi}{6} => \frac{2\pi t}{3} = \frac{\pi}{6} => t = \frac{1}{4}$ sec
22)	B	
23)	a	$x = a\sin\left(\omega t + \frac{\pi}{6}\right)$ and $x' = a\cos\omega t = a\sin\left(\omega t + \frac{\pi}{2}\right)$ $\therefore \Delta\emptyset = \left(\omega t + \frac{\pi}{2}\right) - \left(\omega t + \frac{\pi}{6}\right) = \frac{\pi}{3}$
24)	A	Velocity of a particle executing S.H.M. is given by $\mathbf{v} = \omega\sqrt{a^2 - x^2} = \frac{2\pi}{T}\sqrt{A^2 - \frac{A^2}{4}} = \frac{2\pi}{T}\sqrt{\frac{3A^2}{4}} = \frac{\pi A\sqrt{3}}{T}$
25)	C	$v = \omega\sqrt{(a^2 - y^2)} = 2\sqrt{60^2 - 20^2} = 113$ mm/s
26)	C	It is given $v_{max} = 100$ cm / sec, a = 10 cm. $v_{max} = a\omega => \omega = \frac{100}{10} = 10$ rad/sec Hence $v = \omega\sqrt{a^2 - y^2} => 50 = 10\sqrt{(10)^2 - y^2}$ $\rightarrow y = 5\sqrt{3}$ cm
27)	C	At centre $v_{max} = a\omega = a.\frac{2\pi}{T} = \frac{0.2\ x\ 2\pi}{0.01} = 40\pi$
28)	B	$v_{max} = a\omega = a\frac{2\pi}{T} = 3x\frac{2\pi}{6} = \pi$ cm/s
29)	B	$v_{max} = a\omega = a\ x\frac{2\pi}{T} = (50\ x\ 10^{-3})x\frac{2\pi}{2} = 0.15$ m/s
30)	A	$f = \frac{\omega}{2\pi} = \frac{220}{2\pi} = 35$ Hz $v_{max} = \omega a = 220\ x\ 0.30$ m/s = 66 m/s
31)	d	$v_{max} = a\omega$ and $A_{max} = a\omega^2 => \omega = \frac{A_{max}}{v_{max}} = \frac{4}{2} = 2$ rad/sec
32)	A	Velocity is same. So by using v = aω $A_1\omega_1 = A_2\omega_2 = A_3\omega_3$
33)	D	In SHM at mean position velocity is maximum So v = aω (maximum)
34)	C	Acceleration = ω^2a at extreme position is maximum.
35)	D	$-a\omega^2$ when it is at one extreme point.
36)	A	Maximum acceleration = $a\omega^2$ = a x $4\pi^2 f^2$ = 0.01 x 4 x $(\pi)^2$ x $(60)^2 = 144\pi^2$m/sec
37)	D	Acceleration ∝ - displacement , and direction of acceleration is always directed towards the equilibrium position.
38)	A	$A_{max} = \omega^2 a$
39)	D	In S.H.M. v = $\sqrt{a^2 - y^2}$ and a = $-\omega^2$y when y = a $v_{min} = 0$ and $a_{max} = -\omega^2 a$
40)	A	The time period of a simple pendulum with mass m, is T. when the pendulum's mass m is replaced by another ball of mass 3 times the older mass such that the length of pendulum is not changed then its new time period will be T because time period is independent of mass of bob. It only depends upon length and gravity.
41)	A	T extreme P.E = T.E so its ration is 1:1 or 1
42)	B	Kinetic energy is maximum at mean position and maximum at extreme position. Potential energy is maximum at extreme position and minimum at mean position.
43)	A	For a small block oscillating in a concave surface of radius R (like a pendulum with a circular arc), the time period of small oscillations can be approximated to that of a

simple pendulum. The formula for the period T of a simple pendulum is given by: T = $2\pi\sqrt{\frac{l}{g}}$

Where L is the length of the pendulum (which in this case can be approximated as the radius R of the concave surface) and g is the acceleration due to gravity. T = $2\pi\sqrt{\frac{R}{g}}$

44) B
W_y component is in direction of restoring force.
W_y = mgsinθ



45) C
K.E = P.E
$\rightarrow \frac{1}{2}\,k\,(r^2 - x^2) = \frac{1}{2}kx^2$
$\rightarrow (r^2 - x^2) = x^2$
$\rightarrow r^2 = x^2 + x^2$
$\rightarrow r^2 = 2x^2$
$\rightarrow x^2 = r^2/2$
$\rightarrow x = \sqrt{r^2/2}$
$\rightarrow x = r/\sqrt{2}$
x = a/$\sqrt{2}$ where x is displacemt and a is amplitude

46) D
K.E=1/2k($x^2 - (x/2)^2$)
= K.E= `1/2k(x^2-x^2/4
=1/2 k(3x^2/4) = 3kx^2/8
= 3/4 (kx^2/2) =3/4 T.E

47) D
T = $2\pi\sqrt{\frac{l}{g}}$
T' = $2\pi\sqrt{\frac{4l}{g}}$
= 2[$2\pi\sqrt{\frac{l}{g}}$] = 2 T = 2 x 2 = 4 sec

48) B

49) C
f=$\frac{\textit{Number of cycle}}{\textit{Seconds}} = \frac{2\pi nrad}{s}$ =**2π rad-s^{-1}**

50) D
Velocity is given by: v =$\omega\sqrt{r^2 - x^2}$, the speed is maximum when x = 2 so v becomes v = ω $\sqrt{r^2}$ = ωr = (2πf)r =2 x 3.14x2.5 x 0.02 = 0.314 ms^{-1}
NOTE: for maimum velocity x=0 and for zerovelocity r = x

51) B
Given; x = $\frac{5}{n}$ sin (20πf t) and we know that; x = $\mathbf{x_0}$ sin (ωt) =$\mathbf{x_0}$ sin (2πft)
Comparing both equations we get; $x_0 = \frac{5}{n}cm$
where x_0 = amplitude

52) B
K.E = $\frac{1}{2}$k ($x_o^2 - x^2$)
When x = x_o/2 so = $\frac{1}{2}$k (x_o^2 - $(\frac{x_0}{2})^2$) = $\frac{1}{2}$k (x_o^2 - $\frac{x_0^2}{4}$) = $\frac{1}{2}$k x_o^2 (1- $\frac{1}{4}$) = $\frac{1}{2}$k x_o^2 (3/4)
We know that $\frac{1}{2}$k x_o^2 =E
So K.E= E $\frac{3}{4} = \frac{3E}{4}$

53) B
As earth I oval shape so at equator radius is more, g is low, time period will high ans motion will be slowest.
→ r α1/g
→ T α1/motion

54) B
When lift is moveing downward, the g decrease by an amount of a, so new g becomes G' = g-a

55) C
The stone is attracted by centre of earth and it will reach to ccentre, but due to inertie it doesnot stop at centre but continues its motion but again it is attracted by centre of easth and so on the stone make simple harmonic motion at the centre.

56) C
We know that T= $2\pi\sqrt{\frac{l}{g}}$ when lenth is made four times T= $2\pi\sqrt{\frac{4l}{g}}$ = T= $2\pi(2)\sqrt{\frac{l}{g}}$ = (T= $2\pi\sqrt{\frac{l}{g}}$) = 2T

57) A
We know that T= $2\pi\sqrt{\frac{l}{g}}$, so when L=L/2 and m = 2m then T= $2\pi\sqrt{\frac{2l}{g}}$ = $\sqrt{2}$(2π$\sqrt{\frac{l}{g}}$) = $\sqrt{2}$T

58) B
The amplitude is kept small because for small θ, sin θ= θ

59) B
We know that T= $2\pi\sqrt{\frac{l}{g}}$, L= $\frac{T^2 g}{4\pi^2}$
Putteing t=1 and g=9.8 and T=1 so L= $\frac{T^2 g}{4\pi^2}$ = $\frac{1^2 9.8}{4\times(3.14)^2} = \frac{9.8}{4\times 9.8} = \frac{1}{4}$= 0.25 m

60) D
We know that: x = $\mathbf{x_0}$ sin (ωt) $\mathbf{x_0}$ sin (2πft), given: x = 10 sin 4t. comparing both of these, we get 2πf = 4 → f= 4/2π= 2/π & T=1/f= π/2

61) A
The stone is attracted by centre of earth and it will reach to ccentre, but due to inertie it doesnot stop at centre but continues its motion but again it is attracted by centre of easth and so on the stone make simple harmonic motion at the centre.

62)	B	T= $2\pi\sqrt{\frac{l}{g}}$, time period is directly proportional to underroot of l , so increasing length will increase the temperatures; $\boxed{\text{NOTE:}}$ time period is independent to mas
63)	D	We know that E= $\frac{1}{2}k\,x_o^2$ where x_o is amplitude.so energy is directly proportional to the square of amplitude.
64)	D	We know that T= $2\pi\sqrt{\frac{l}{g}}$, if L=4L then T'= $2\pi\sqrt{\frac{4l}{g}}$ = (2)$2\pi\sqrt{\frac{l}{g}}$ =(2) T Putting T=2 then T'= 2 x 2 = 4s
65)	C	P.E= $\frac{1}{2}k\,x^2$, K.E = $\frac{1}{2}k\,(x_o^2-x^2)$, according to conditions P.E=K.E $\rightarrow \frac{1}{2}k\,x^2 = \frac{1}{2}k\,(x_o^2-x^2) \rightarrow x^2 = x_o^2-x^2 \rightarrow x^2 + x^2 = x_o^2 \rightarrow 2x^2 = x_o^2 \rightarrow x^2 = x_o^2/2$ taking underroot $x = \frac{x_o}{\sqrt{2}} = \frac{a}{\sqrt{2}}$
66)	B	
67)		
68)		
69)	A	**At extreme total energy = P.E = mgh = 2 x 10 x 0.5 = 10 J** **At means position total energy = K.E = 10 = $\frac{1}{2}$ mv^2** **10 = $\frac{1}{2}$ mv^2** **mv^2 = 20 $\rightarrow$ 2 v^2 = 20 $\rightarrow$ v^2 = 10 = 3.1**
70)	**C**	
71)	**C**	
72)	**D**	
73)	**A**	
74)	C	
75)	**A**	
76)	C	
77)	B	
78)	D	
79)	A	
80)	C	K.E = P.E $\rightarrow \frac{1}{2}\,k\,(r^2-x^2) = \frac{1}{2}kx^2$ $\rightarrow (r^2-x^2) = x^2$ $\rightarrow r^2 = x^2 + x^2$ $\rightarrow r^2 = 2x^2$ $\rightarrow x^2 = r^2/2$ $\rightarrow x = \sqrt{r^2/2}$ $\rightarrow x = r/\sqrt{2}$ x= a/$\sqrt{2}$ where x is displacemt and a is amplitude

81)	A	
82)	B	
83)	D	
84)	A	
85)	D	T = $2\pi\sqrt{\frac{l}{g}}$ T' = $2\pi\sqrt{\frac{4l}{g}}$ = 2[$2\pi\sqrt{\frac{l}{g}}$] = 2 T = 2 x 2 = 4 sec
86)	B	As earth I oval shape so at equator radius is more, g is low, time period will high ans motion will be slowest. → r α1/g → T α1/motion
87)	B	When lift is moveing downward, the g decrease by an amount of a, so new g becomes G' = g-a
88)	C	The stone is attracted by centre of earth and it will reach to ccentre, but due to inertie it doesnot stop at centre but continues its motion but again it is attracted by centre of easth and so on the stone make simple harmonic motion at the centre.
89)	C	We know that T= $2\pi\sqrt{\frac{l}{g}}$ when lenth is made four times T= $2\pi\sqrt{\frac{4l}{g}}$ = T= $2\pi(\mathbf{2})\sqrt{\frac{l}{g}}$ = (T= $2\pi\sqrt{\frac{l}{g}}$) = 2T
90)	A	We know that T= $2\pi\sqrt{\frac{l}{g}}$, so when L=L/2 and m = 2m then T= $2\pi\sqrt{\frac{2l}{g}}$ = $\sqrt{\mathbf{2}}$ ($2\pi\sqrt{\frac{l}{g}}$) = $\sqrt{\mathbf{2}}$ T
91)	B	The amplitude is kept small because for small θ, sin θ= θ
92)	B	We know that T= $2\pi\sqrt{\frac{l}{g}}$, L= $\frac{T^2g}{4\pi^2}$ Putteing t=1 and g=9.8 and T=1 so L= $\frac{T^2g}{4\pi^2}$ = $\frac{1^29.8}{4\times(3.14)^2}$ = $\frac{9.8}{4\times9.8}$ = $\frac{1}{4}$= 0.25 m
93)	B	T= $2\pi\sqrt{\frac{l}{g}}$, time period is directly proportional to underroot of l , so increasing length will increase the temperatures; $\boxed{\text{NOTE:}}$ time period is independent to mas
94)	D	We know that T= $2\pi\sqrt{\frac{l}{g}}$, if L=4L then T'=

		$2\pi\sqrt{\frac{4l}{g}} = (2)2\pi\sqrt{\frac{l}{g}} = (2)\,T$ Putting T=2 then T'= 2 x 2 = 4s
95)	C	K.E = P.E $\rightarrow \frac{1}{2}\,\boldsymbol{k}\,(\boldsymbol{r^2 - x^2}) = \frac{1}{2}kx^2$ $\rightarrow (\boldsymbol{r^2 - x^2}) = x^2$ $\rightarrow \boldsymbol{r^2} = x^2 + \boldsymbol{x^2}$ $\rightarrow \boldsymbol{r^2} = 2x^2$ $\rightarrow x^2 = \boldsymbol{r^2}/2$ $\rightarrow\; x = \sqrt{\boldsymbol{r^2/2}}$ $\rightarrow x = r/\sqrt{\boldsymbol{2}}$ $x = a/\sqrt{\boldsymbol{2}}$ where x is displacemt and a is amplitude
96)	B	$K.E = \frac{1}{2}k\,(x_o^2 - x^2)$ When $x = x_o/2$ so $= \frac{1}{2}k\,(x_o^2 - (\frac{x_0}{2})^2) = \frac{1}{2}k\,(x_o^2 - \frac{x_o^2}{4}) = \frac{1}{2}k\,x_o^2\,(1 - \frac{1}{4}) = \frac{1}{2}k\,x_o^2\,(3/4)$ We know that $\frac{1}{2}k\,x_o^2 = E$ So K.E= $E\,\frac{3}{4} = \frac{3E}{4}$
97)	A	We know that; $T = 2\pi\sqrt{\frac{m}{k}}$,the time period of SHM is independent of amplitude of oscillation.
98)	B	$T = 2\pi\sqrt{\frac{m}{k}}$ If a spring is cut into two halves then the spring constant of each half will be doubled. K' = 2k $T' = 2\pi\sqrt{\frac{m}{k'}} = 2\pi\sqrt{\frac{m}{2k}} = \frac{1}{\sqrt{2}}\left(2\pi\sqrt{\frac{m}{k}}\right) = \frac{1}{\sqrt{2}}T$
99)	C	$T = 2\pi\sqrt{\frac{l}{g}}$ As the time period of simple pendulum does not depends upon the mass of bob. So, it will remain same.
100)	B	In SHM $A \propto x \Rightarrow \frac{a}{x} = constant$
101)	A	The frequency of oscillating simple pendulum is given by: $F = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$ It is independent to amplitude.
102)	C	iii. Any pendulum undergoes simple harmonic motion when the amplitude of oscillation is small.
103)	B	F = - kx $F \propto -x$
104)	B	$K_e = nk = (4)(2000) = 8000$ N/m
105)	B	$W = \frac{0}{T}$ For one revolution $0 = 2\pi$ rad So, $w = 2\pi\left(\frac{1}{T}\right) = 2\pi f$
106)	A	$T = \frac{t}{100} = \frac{246}{100} = 2.46\,s$
107)	A	The time period of the simple pendulum is given by: $T = 2\pi\sqrt{\frac{l}{g}}$ At the time period of the simple pendulum is independent of mass of bob. So, if the suspended mass is doubled it does not affect the time period of simple pendulum.
108)	C	$T = 2\pi\sqrt{\frac{l}{g}}$ $T \propto \frac{1}{\sqrt{g}}$ As $G = \frac{GM}{R^2} \Rightarrow g \propto \frac{1}{R^2}$ $G_{Lahoe+} > g_{Murree}$ $T_{Murree} > T_{Lahore}$
109)	D	$f = \frac{1}{T} \Rightarrow fT = 1$
110)	D	$T = 2\pi\frac{l}{g} \Rightarrow T^2 = 4\pi^2\frac{l}{g} \Rightarrow l = \frac{gT^2}{4\pi^2} = \frac{(1)^2}{4} = 0.25\,m$ $(g = \pi^2)$
111)	D	Motion of fan is a rotatory motion
112)	D	$T = 2\pi\sqrt{\frac{l}{g}}$ $\frac{T'}{T} = \frac{2\pi\sqrt{\frac{l}{g/10}}}{2\pi\sqrt{\frac{l}{g}}} = \sqrt{10}$ $T' = \sqrt{10}\,T = \sqrt{10}\,(1) = \sqrt{10}\,s$
113)	D	$F = \frac{1}{2\pi}\sqrt{\frac{g}{L}} \Rightarrow f^2 = \frac{1}{4\pi^2 L}\frac{g}{l} \rightarrow L = \frac{g}{4\pi^2 f^2}$ $L' = \frac{g}{4\pi^2(2f)^2} = \frac{1}{4}\left(\frac{g}{4\pi^2 f^2}\right) = \frac{1}{4}L$
114)	A	$T = 2\pi\sqrt{\frac{l}{g-a}}$ For freely falling a = g $T = 2\pi\sqrt{\frac{l}{g-g}} = \infty$
115)	D	E = K.E + P.E = constant
116)	D	$F = \frac{1}{2\pi}\sqrt{\frac{g}{L}} \Rightarrow f \propto \frac{1}{\sqrt{L}}$
117)	C	At $x = x_o/2$ $U = \frac{1}{2}kx^2$ $U' = \frac{1}{2}k(x_o/2)^2 = \frac{1}{4}\left(\frac{1}{2}kx_o^2\right) = \frac{1}{4}u_{max}$

118) C
$T = 2\pi\sqrt{\frac{l}{g}}$
Time period of simple pendulum is independent of mass of bob.

119) D
$W = \sqrt{\frac{g}{l}} \rightarrow w \propto \frac{1}{\sqrt{l}}$

120) D
$T = 2\pi\sqrt{\frac{l}{g}}$
$6.28 = 2\pi\sqrt{\frac{l}{10}} \Rightarrow \sqrt{\frac{l}{10}} = 1 \Rightarrow l = 10\,m$

121) C
$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T \propto \sqrt{l}$
$\frac{T'}{T} = \sqrt{\frac{l'}{l}} = \sqrt{\frac{2l}{l}} = \sqrt{2}$

122) B
$T = 2\pi\sqrt{\frac{l}{g}}$
$T \propto \sqrt{l}$
As the length of pendulum is measured from center of mass of bob to the rigid support. When child stands up in the swing, length of pendulum will decrease. So, time period will also decrease.

123) B
The negatively charged Bob will be attracted by positively charged plate. Hence the net force in vertically downwards direction in increased. This leads to a new value of "g" which is obviously increased. With the new increased value of "g" being used in the formula we can conclude that the used in the expression of time period decrease at "T" is inversely proportional to acceleration due to gravity.
Therefore time period will decrease.

124) C
the velocity of boty performing SHM at mean position is given by:
$v_o = x_o w \Rightarrow v_o \propto x_o$ (w = constant)

125) D
In simple pendulum
T = mgcosθ
At mean position = 00°
T = mg (maximum)

126) A
$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T^2 = 4\pi^2\frac{l}{g} \Rightarrow l = \frac{gT^2}{4\pi^2}$
$L_E = \frac{gT^2}{4\pi^2}$
$L_m \frac{g_m T^2}{4\pi^2}$
$\frac{l_m}{l_E} = \frac{\frac{g_m T^2}{4\pi^2}}{\frac{g_E T^2}{4\pi^2}} = \frac{g_m}{g_E} = \frac{\frac{g_e}{6}}{g_E} = \frac{1}{6} \Rightarrow l_m = \frac{1}{6} l_E = \frac{1}{6} m$

127) A
K.E. = P.E.
$\frac{1}{2}k\,(x_o^2 - x^2) = \frac{1}{2}kx^2$
$x_o^2 - x^2 = x^2$
$2x^2 = x_o^2 \Rightarrow x^2 = \frac{x_o^2}{2} \Rightarrow x = \frac{x_o}{\sqrt{2}} = \frac{4}{\sqrt{2}}cm = 2\sqrt{2}\,cm$

128) D
Pendulum having time period equals to 2 seconds is known as 2nd pendulum.

129) A
$T = 2\pi\sqrt{\frac{l}{g-a}}$
As sace laboratory orbiting around the earth is a freely falling object. So, a = g
$T = 2\pi\sqrt{\frac{l}{g-g}} = \infty$
$F = \frac{1}{T} = \frac{1}{\infty} = 0$

130) C
By the definition of SHM
$A \propto -x$

131) A
$F = \frac{1}{T} = \frac{1}{2} = 0.5\,Hz$

132) C
$T = 2\pi\sqrt{\frac{m}{k}} \Rightarrow T \propto \sqrt{m}$

133) C
K.E = P.E
$\frac{1}{2}k(x_o^2 - x^2) = 1/2kx^2 \Rightarrow x_o^2 - x^2 = x^2$
$2x^2 = x_o^2 \Rightarrow x^2 = \frac{x_o^2}{2} \Rightarrow x = \frac{x_o}{\sqrt{2}}$

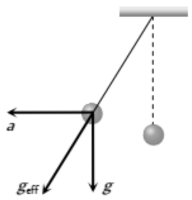
134) D
$F = \frac{1}{2\pi}\sqrt{\frac{g}{l}} \Rightarrow f \propto \frac{1}{\sqrt{l}}$
$$\frac{f'}{f} = \sqrt{\frac{l}{l}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$$

135) C
$\mathbf{T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T \propto \sqrt{l}}$

136) A
Inside the mine g decrease
Hence from $T = 2\pi\sqrt{\frac{l}{g}}$: T increase

137) B
When a little mercury is drained off, the position of c.g. of ball falls (w.r.t. fixed and) so that effective length of pendulum increases hence T increase.

138) B
Initially time period was $T = 2\pi\sqrt{\frac{l}{g}}$ When train accelerates, the effective value of g becomes $\sqrt{(g^2 + a^2)}$ which is greater than g



Hence, new time period, becomes less than the initial time period.

139) B
As we know $g = \frac{GM}{R^2}$
$\frac{g_{earth}}{g_{planet}} = \frac{M_e}{2M_e} x \frac{4R_p^2}{R_e^2} \rightarrow \frac{g_e}{g_p} = \frac{2}{1}$

Also $T \propto \frac{1}{\sqrt{g}} => \frac{T_e}{T_p} = \sqrt{\frac{g_p}{g_e}} => \frac{2}{T_p} = \sqrt{\frac{1}{2}}$

$T_p = 2\sqrt{2}$ sec

140) c $T = 2\pi\sqrt{\frac{l}{g}}$ (independent of mass)

141) C In stationary lift $T = 2\pi\sqrt{\frac{l}{g}}$

In upward moving lift $T' = 2\pi\sqrt{\frac{l}{(g+a)}}$

(a = acceleration of lift)

$$\frac{T'}{T} = \sqrt{\frac{g}{g+a}} = \sqrt{\frac{g}{\left(g+\frac{g}{4}\right)}} = \sqrt{\frac{4}{5}} \rightarrow T' = \frac{2T}{\sqrt{5}}$$

142) D $g' = \sqrt{g^2 + a^2}$

143) D In the given case effective acceleration g = 0 => $T = \infty$

144) A $T = 2\pi\sqrt{\frac{l}{g}} => \sqrt{\frac{l}{g}} = \text{constant}$

$l \propto g; => \frac{l_m}{1} = \frac{\frac{1}{6}g}{g} => l_m = \frac{1}{6}m$

145) D $\frac{T'}{T} = \sqrt{\frac{g}{g'+a}} = \sqrt{\frac{g}{g+5g}} = \sqrt{\frac{1}{6}} => T' = \frac{T}{\sqrt{6}}$

146) B $T \propto \sqrt{l} => \frac{\Delta T}{T} = \frac{1}{2}\frac{\Delta l}{l} = \frac{1}{2} x\ 1\% = 0.5\%$

147) c $T = 2\pi\sqrt{\frac{l}{g'}}$; for freely falling system effective g = 0

So $T = \infty$ or n = 0

It means that pendulum does not oscillate at all.

148) D $T \propto \sqrt{l} => \frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}} => \frac{2}{T_2} = \sqrt{\frac{l}{4l}} =>$

$T_2 = 4$ sec

149) C Remains the same because time period of simple pendulum T is independent of mass of the bob

150) d $T = 2\pi\sqrt{\frac{l}{g}} = T \propto \frac{1}{\sqrt{g}} => \frac{T_p}{T_e} = \sqrt{\frac{g_e}{g_p}} = \sqrt{\frac{2}{1}} => T' = \sqrt{2}T$

151) A If initial length $l_1 = 100$ then $l_2 = 121$

By using $T = 2\pi\sqrt{\frac{l}{g}} => \frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$

Hence, $\frac{T_1}{T_2} = \sqrt{\frac{100}{121}} => T_2 = 1.1\ T_1$

% increase = $\frac{T_2-T_1}{T_1}$ x $100 = 10\%$

152) A $\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}} => \frac{T_1}{T_2} = \sqrt{\frac{100}{400}}$

$T_2 = 2T_1$

Hence % increase = $\frac{T_2-T_1}{T_1}$ x 100 = 100%

153) B $T = 2\pi\sqrt{l/g} => l = \frac{gT^2}{4\pi^2} = \frac{9.8 \times 4}{4 \times \pi^2} = 99$ cm

154) C $T = 2\pi\sqrt{l/g} = 2\pi\sqrt{\frac{1}{\pi^2}}$ = 2 sec

155) C Time period is independent of mass of pendulum

156) B $T \propto \sqrt{l}$ Time period depends only on effective length. Density has no effect on time period. If length made 4 times then time period becomes 2 times.

157) B Time period is independent of mass of bob of pendulum

158) A At the surface of moon, g decrease hence time period increase $\left(\text{as } T \propto \frac{1}{\sqrt{g}}\right)$

159) A When lift falls freely effective acceleration and frequency of oscillations by zero.

$g_{eff} = 0 => T' = \infty$, hence a frequency = 0

160) D Effective value of 'g' remains unchanged.

161) B $T = 2\pi\sqrt{\frac{l}{g}} => \frac{T_2}{T_1} = \sqrt{\frac{l_2}{l_1}} = \sqrt{\frac{144}{100}} = \frac{12}{10}$

☐ T = 1.2 T

Hence % increase = $\frac{T_2-T_1}{T_1}$ x $100 = 20\%$

162) B As periodic time is independent of amplitude.

163) D Frequency $n \propto \frac{1}{\sqrt{l}} => \frac{n_1}{n_2} = \sqrt{\frac{l_2}{l_1}} => \frac{l_1}{l_2} = \frac{n_2^2}{n_1^2} = \frac{3^2}{2^2} = \frac{9}{4}$

164) D Suppose at t = 0 , pendulums begins to swim simultaneously. Hence, they will again swim simultaneously if $n_1T_1 = n_2T_2$

☐ $\frac{n_1}{n_2} = \frac{T_2}{T_1} = \sqrt{\frac{l_2}{l_1}} => \frac{l_1}{l_2} = \left(\frac{n_2}{n_1}\right)^2 = \left(\frac{8}{7}\right)^2 = \frac{64}{49}$

165) A $T = 2\pi\sqrt{\frac{l}{g}} => T \propto \sqrt{l}$, hence if l made 9 times T becomes 3 times. Also time period of simple pendulum does not depends on the mass of the bob.

166) A As we go from equator to pole the value of g increases. Therefore time period of simple pendulum $\left(T \propto \frac{1}{\sqrt{g}}\right)$ decreases. $\left(\because T \propto \frac{1}{\sqrt{g}}\right)$

167) C $T \propto \frac{1}{\sqrt{g}} => \frac{T_2}{T_1} = \sqrt{\frac{g_1}{g_2}} = \sqrt{\left(\frac{g}{g/4}\right)} = T_2 = 2T_1 = 2T$

168) C $T \propto \sqrt{l}$

169)	C	
170)	C	According to the principle of conservation of energy, $\frac{1}{2}mv^2 = mgh$ or v = $\sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.1} = 1.4$ m/s.
171)	D	$T=2\pi\sqrt{\frac{m}{K}}$ $T' = 2\pi\sqrt{\frac{16m}{K}}$ $\Rightarrow T' = 4 \times 2\pi\sqrt{\frac{m}{K}}$ T′=4T T′=4X1=4 Sec
172)	c	$T = 2\pi\sqrt{\frac{m}{k}}$ $F = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{k}{m/16}} = \frac{1}{2\pi}\sqrt{\frac{16k}{m}} = 4\ \frac{1}{2\pi}\sqrt{\frac{k}{m}}$
173)	B	
174)	A	By Hook's law F = KΔx, Here Δx = 70mm-50 mm = 20 mm = 0.02 cm and K = 400 Nm^{-1}. So F = 400 × 0.02 = 8N. **NOTE;** tension is simply a force.
175)	A	Formass spring sytem $T = 2\pi\sqrt{\frac{m}{k}}$, fre\om equation time period is directly proportional to$\sqrt{m}$ so increase in mass will increase the time period. **NOTE:** time period of simple pendulum is independent to mass whilt that of mass spring system directly proportional to $\sqrt{m}$.
176)	A	We know that; $T = 2\pi\sqrt{\frac{m}{k}}$,the time period of SHM is independent of amplitude of oscillation.
177)	C	$T_2 = \sqrt{2}\, T_1$
178)	D	Double
179)	**C**	
180)	C	
181)	B	
182)	a	Spring arranged in parallel, K_{eq} = k1+k2+k3…..
183)	C	
184)	A	The K.E of mass-spring system at any displacement "x" is given by: K.E. = $\frac{1}{2}kx_o^2\left(1-\frac{x^2}{x_o^2}\right)$
185)	C	
186)	B	Total energy = KE + elastic PE = maximum K.E = = $\frac{1}{2}mv_{max}^2$ = $\frac{1}{2}m(\omega x_{max})^2$ = $\frac{1}{2}m\omega^2 x_{max}^2$ = $\frac{1}{2}(8.0\ x\ 10^{-13})(2\pi x\ 40)^2(5.0\ x\ 10^{-13})^2$ = 6.3 mJ
187)	D	
188)	B	
189)	A	T = $2\pi\sqrt{\frac{m}{k}} => T \propto \sqrt{m}$ $\frac{T_2}{T_1} = \sqrt{\frac{m_2}{m_1}} = \sqrt{\frac{2m}{m}} = \sqrt{2} => T_2 = \sqrt{2}T_1$
190)	D	Energy = $\frac{1}{2}kx_o^2 = \frac{1}{2}(5\ x\ 10^4)\ (1.4x\ 10^{-3})^2$ = $\frac{1}{2}(5\ x\ 10^4)(1.4\ x\ 1.4\ x\ 10^{-6}) = \frac{196}{100}\ x\frac{5}{2}x\ 10^{-6+4}$ J = 4.9 x 10^{-2} J
191)	D	T = $2\pi\sqrt{\frac{M}{k}}$ T'= = $2\pi\sqrt{\frac{M}{k}} = \sqrt{2}(2\pi\frac{M}{k} = \sqrt{2}T$
192)	D	E = $\frac{1}{2}mw^2A^2 = \frac{1}{2}m\left(\sqrt{\frac{k}{m}}\right)^2 A^2 =$ $\frac{1}{2}m\left(\frac{k}{m}\right)A^2 = \frac{1}{2}kA^2$ If "A" same, the energy will remain same.
193)	D	K.E = $\frac{1}{2}kx_o^2\left(1-\frac{x^2}{x_o^2}\right) = T.E\left(1-\frac{x^2}{x_o^2}\right)$ = T.E$\left(1-\frac{\left(\frac{x_o}{2}\right)^2}{x_o^2}\right)$ = T.E $\left(1-\frac{1}{4}\right) = T.E\left(\frac{3}{4}\right)$
194)	B	T = $2\pi\sqrt{\frac{M}{k}}$ $\frac{5T}{3} = 2\pi\sqrt{\frac{M+m}{K}}$ $\frac{5T/3}{T} = \frac{2\pi\sqrt{\frac{M+m}{K}}}{2\pi\sqrt{\frac{M}{k}}} = \sqrt{\frac{M+m}{m}} = \sqrt{1+\frac{m}{M}}$ $\frac{5}{3} = \sqrt{1+\frac{m}{M}} => 1+\frac{m}{M} = \frac{25}{9} => \frac{m}{M} = \frac{25}{9} - 1 = \frac{16}{9}$
195)	D	K.E = $\frac{1}{2}k(x_o^2 - x^2)$ At mean position x = 0 K.E. = $\frac{1}{2}kx_o^2\ (maximum)$
196)	A	Time for 1 oscillation = T Time for 3/8th oscillation = 3/8 T
197)	D	F = $\frac{1}{T} => fT = 1$
198)	D	A = $-w^2x$ Acceleration is a vector quantity it will vary by varying the magnitude and direction.
199)	A	The unit if surface tension and spring constant is N/m

200) B As the springs are in parallel with same hook. So, $k_e = k + k + k = 3k$

201) B For series combination $K_e = \frac{k}{n} = \frac{k}{4}$

202) D $A = w^2x$
At mean ((equilibrium)) position x = 0
$A = w^2(0) = 0$ (minimum)

203) B As body starts from mean position after 7/2 vibration (3 and ½ vibration) the body will remain on the mean position.
K.E. = E, P.E. = 0

204) C $K.E = \frac{1}{2}kx_o^2\left(1 - \frac{x^2}{x_o^2}\right)$
$(K.E)_{max} = \frac{1}{2}kx_o^2\left(1 - \frac{0^2}{x_o^2}\right) = \frac{1}{2}kx_o^2$
$K.E = (K.E)_{max}\left(1 - \frac{x^2}{x_o^2}\right)$

205) A $T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{1}{4}} = \pi s$

206) A Formass spring sytem $T = 2\pi\sqrt{\frac{m}{k}}$, fre\om equation time period is directly proportional to$\sqrt{m}$ so increase in mass will increase the time period.
NOTE: time period of simple pendulum is independent to mass whilt that of mass spring system directly proportional to $\sqrt{m}$.

207) A Maximum velocity $= a\omega = a\sqrt{\frac{k}{m}}$
Given that $a_1\sqrt{\frac{K_1}{m}} = a_2\sqrt{\frac{K_2}{m}} \Rightarrow \frac{a_1}{a_2} = \sqrt{\frac{K_2}{K_1}}$

208) D Given spring system has parallel combination, so $k_{eq} = k_1 + k_2$ and time period $T = 2\pi\sqrt{\frac{m}{(k_1+k_2)}}$

209) B $T = 2\pi\sqrt{\frac{m}{k}}$. Also spring constant $(k) \propto \frac{1}{\text{Length (l)}}$, when the spring is half in length, then k becomes twice.
$\therefore T' = 2\pi\sqrt{\frac{m}{2k}} \Rightarrow \frac{T'}{T} = \frac{1}{\sqrt{2}} \Rightarrow T' = \frac{T}{\sqrt{2}}$

210) B $\omega = \sqrt{\frac{k}{m}}$

211) B With respect to the block the springs are connected in parallel combination.
∴ combined stiffness k = k+ k and n = $\frac{1}{2\pi}\sqrt{\frac{k_1+k_2}{m}}$

212) C $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \Rightarrow \frac{f_S}{f_P} = \sqrt{\frac{k_S}{k_P}} \Rightarrow \frac{f_s}{f_p} = \sqrt{\frac{\left(\frac{k}{2}\right)}{2k}} = \frac{1}{2}$

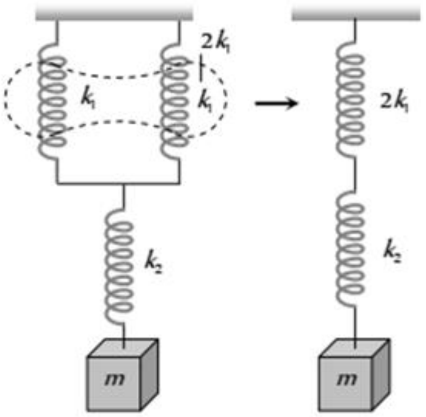
213) C In series $k_{eq} = \frac{k_1k_2}{k_1+k_2}$ so time period $T = 2\pi\sqrt{\frac{m(k_1+k_2)}{k_1k_2}}$

214) B Force constant $k = \frac{F}{x} = \frac{0.5 \times 10}{0.2} = 25$ N/m
Now $T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.25}{25}} = 0.628$ sec

215) C Spring constant (k) $\propto \frac{1}{\text{Length of the spring (l)}}$ as length becomes half, k becomes twice is 2k.

216) D Force constant (k) $\propto \frac{1}{\text{Length of the Spring (l)}}$
$\frac{k_1}{k_2} = \frac{l_2}{l_1} = \frac{2}{1}$

217) B In series combination
$\frac{1}{k_S} = \frac{1}{2k_1} + \frac{1}{k_2}$
$k_s = \left[\frac{1}{2k_1} + \frac{1}{k_2}\right]^{-1}$



218) A The angle θ = ωt wich specifies the displacement x and as wellas the direction of motion of the point oscillating SHM is called phase.

219) B $\pi/2$

220) C 60°

221) C $V = wx_o\ a = o$

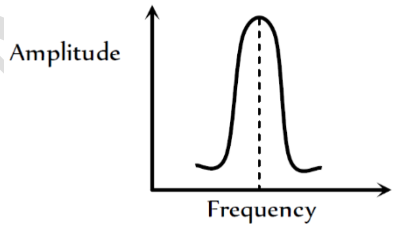
222) A The angle θ = ωt which specifies the displacement x and as well as the direction of motion of the point oscillating SHM is called phase.

223) C To remain in phase for two particle, they must have same amplitude.

224) C

225) C $X = 0.01 \sin(100\pi t)$
By comparing
$W = 100\pi \Rightarrow \frac{2\pi}{T} = 100\pi \Rightarrow T = \frac{1}{50} = 0.02\ sec$

226) C Radio, microwave oven and MRI are example of resonance

227)	A	Radio, microwave oven and MRI are example of resonance
228)	D	Equal to the natural frequency
229)	D	Electrical resonance
230)	b	
231)	D	
232)	A	
233)	C	
234)	D	
235)	B	
236)	C	
237)	A	
238)	C	
239)	C	Radio, microwave oven and MRI are example of resonance
240)	A	Radio, microwave oven and MRI are example of resonance
241)	D	
242)	C	
243)	D	
244)	C	
245)	B	When a periodic force acts on a body and the time period of the periodic force is equal to the natural time period of the vibrating body, then the amplitude of the vibration markedly increases. This process is called resonance.
246)	D	The energy of the oscillation coems from the driving source. At resonance, the transfer of energy is maximum.
247)	C	.
248)	A	
249)	C	
250)	B	Resonance occurs when the frequency of the applied force is equal to one of the natural frequencies of the vibration of the forced or driven harmonic oscillator then the amplitude of the vibration markedly increses.
251)	B	Radio and microwaves are the applications of electrical resonance.
252)	C	
253)	A	
254)	B	
255)	B	
256)	d	Less damping force gives a taller and narrower resonance peak 
257)	A	
258)	C	

Chapter 12 Current Electricity

Current and Drift velocity

1. Ampere. Second is the unit of: **ETEA-2023**
A. Power B. Charge
C. Potential difference D. Current

2. The slope-of the charge-time graph for a charging capacitor gives: **ETEA-2023**
A) Current B) Voltage
C) Force D) Energy

3. The SI unit of electric charge is; **ETEA-2019**
a) AS b) VS^{-1}
c) A d) S

4. In a conducting electric wire, the electric current flows due to: **ETEA-2022**
a) Protons b) Ions
c) Holes d) Electrons

5. In 10 minutes 3000 coulomb of free electrons enter one end of a conductor and 3000 coulomb leave the other end. The current is:
ETEA 2016-32 Eng
(a) 5A (b) 10A
(c) 30A (d) Zero

6. An electric current of 1 A is passing through a cross section of the coil in 1 second. How many electrons are involved in providing a current of 1A? The charge on 1 electron is 1.602×10^{-19} C. ETEA 2012-55 Med:, ETEA 2012-110 Eng:
(a)3.21×10^{18} (b) 2.2×10^{16}
(c) 1.602×10^{19} (d)6.42 × 1018

7. When will 1C of charge pass a point in an electrical circuit? ETEA 2016-72 Eng
(a) When 1A moves through a voltage of 1V
(b) When a power of 1W is used for 1s
(c) When the current is 5mA for 200s
(d) When the current is 10 A for 10s

8. There is a current of 3.2 amps in a conductor. The

number of electrons that cross any section normal to the direction of flow per second is:
ETEA 2017-Eng

A.2x 10^{19} B.0.2 x 10^{19}
C.20 x 10^{19} D.200 x 10^{19}

9. A student kept her 60 watt and 120 volt study lamp turned on from 2:00 PM until 2:00 AM. How many coulombs of charge went through it? ETEA 2017-Eng

A.3600 B.7200
C.18000 D.21600

10. Ampere hour is a unit of: ETEA 2009-131 Med:

(a) Current (b) Time
(c) Quantity of charge (d) Power

11. A student measures a current as 0.5A. Which of the following correctly expresses this result? ETEA 2012-144 Eng:

(a) 50mA (b) 50MA
(c) 500MA (d) 500 mA

12. When will 1 C of charge pass a point in an electrical circuit? ETEA 2017-16 Med

A) When 1A moves through a voltage of 1V
B) When a power of NOW is used for 1s
C) When the current is 5mA for 200s
D) When the current is 10A for 10s

13. For ohmic substance, the electron drift velocity is proportional to: ETEA 2015-87 Med

A) Cross sectional of the sample
B) The length of sample
C) The mass of an electron
D) The electric field in the sample

14. One coulomb per second is equal to:

a) one volt b) one ampere
c) one watt d) one ohm

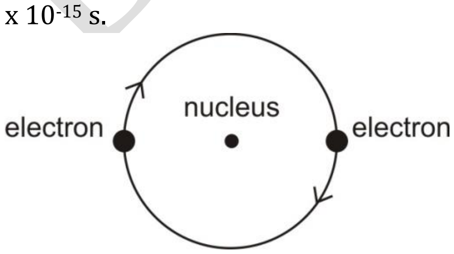
15. In 10 minutes 3000 coulomb of free electrons enter one end of a conductor and 3000 coulomb leave the other end. The current is:

a) 5A b) 10A c) 30A d) Zero

16. The SI unit of current is:

a) ohm b) coulomb c) volt d) ampere

17. The diagram Shows a model of an atom ¡n which two electrons move round a nucleus ¡n a circular orbit. The electrons complete one full orbit ¡n 1.0 x 10^{-15} s.



What is the current caused by the motion of the electrons in the orbit?

a) 1.6 x 10^{-34} A b) 3.2 x 10^{-34} A
c) 1.6 x 10^{-4} A d) 3.2 x 10^{-4} A

18. Ampere hour is a unit of:

a) Current b) Time
c) Quantity of charge d) Power

19. A student measures a current as 0.5A. Which of the following correctly expresses this result?

a) 50mA b) 50MA c) 500MA d) 500 mA

20. When will 1 C of charge pass a point in an electrical circuit?

A) When 1A moves through a voltage of 1V
B) When a power of NOW is used for 1s
C) When the current is 5mA for 200s
D) When the current is 10A for 10s

21. Current of 4.8 amperes is flowing through a conductor. The number of electrons per second will be

a. $\mathbf{3\ x\ 10^{19}}$
b. $\mathbf{7.68\ x\ 10^{21}}$
c. $\mathbf{7.68\ x\ 10^{20}}$
d. $\mathbf{3\ x\ 10^{20}}$

22. Which one is not the correct statement

a. 1 volt x 1 coulomb = 1 joule
b. 1 volt x 1 ampere = 1 joule/secnd
c. 1 volt x 1 watt = 1 H.p
d. Watt-hour can be expressed in eV

23. In a conductor 4 coulombs of charge flows for 2 seconds. The value of electric current will be

a. 4 volts
b. 4 amperes
c. 2 amperes
d. 2 volts

24. 62.5 x 10^{18} electrons per second are flowing through a wire of area of cross-section 0.1m^2, the value of current flowing will be

a. 1A
b. 0.1 A
c. 10 A
d. 0.11 A

25. 5 amperes of current is passed through a metallic conductor. The charge flowing in one minute in coulombs will be

a. 5
b. 12
c. 1/12
d. 300

Ohm's Law and potential difference

26. A resister has a resistance of 200 ohms. If a current of 0.5 amperes flows through it, what is the voltage drop across the resistor? **ETEA-2023**
a) 400 volts b) 110 volts
c) 120 volts d) 0.002 volts

27. Ohm's law states that the current is directly proportional to _____ and inversely proportional to ______: **ETEA-2023**
a) Resistance, current
b) Resistance, voltage
c) Voltage, current
d) Voltage, resistance

28. The bird perching on a high-power line does not get electric chock. This is because: **ETEA-2023**
a) The whole body of the bird sitting on the live wire is at the same potential and hence no current flows through the body
b) The whole body of the bird sitting on the live wire is a zero potential and hence no current flows through the body
c) Because the air medium between the live wire and the earth contains large number of charge particles
d) Because the air medium between the live wire and the earth contains large number of electrons

29. The resistance of the conducting material depends upon: **ETEA-2023**
a) The nature of the conductor
b) Dimension of the conductor
c) Physical state of the conductor
d) All of these

30. The SI unit of electric potential is: **ETEA-2023**
a) Volt b) Coulomb
c) Ampere d) Ohm

31. if the amount of work W is required to move a charge Q from one point to another then the potential difference between the two points is given by: **ETEA-2023**
a) v = W/Q b) V=Q/W
c) Q=W/V d) Q=V/W

32. Potential circuit is made when: : **ETEA-2022**
A. Current is divided
B. Emf source is divided
C. Resistance is divided
D. Number of electrons are divided

33. The example of a non-ohmic resistance is: ETEA 2017-Eng
A.Ge-resistance B.Carbon resistance
C.Copper wire D. Diode

34. Which of the following are Ohmic materials? ETEA 2012-167, ETEA 2008-87, ETEA 2013-99 Med:
(a)Semiconductors (b)Tungsten filament
(c)Thermistor (d)Metals

35. What is the current in a 2×10^6 ohms resistor having a potential difference of 6×10^3 volts? 2005-43 Med:
(a) 1×10^{-3}A (b) 2×10^{-3} A
(c) 3×10^{-3} A (d) 4×10^{-3} A

36. One of the following is an Ohmic device: **MDCAT-2020**
A. Filament bulb. B. Semiconductor diode.
C. Transistor. D. Copper wire.

37. An alpha particle is accelerated through a potential difference of 10^6 volts. Its K.E is; **ETEA-2019**
a) 1 MeV b)2 MeV c) 4MeV d) 8 MeV

38. $\frac{volt}{ampere}\, farad$, expected dimension is; **ETEA-2019**
a) $M^0 L^0 \mathbf{T}^{-1} \mathbf{A}^{-2}$ b) $M^1L^1T^{-2} A^{+2}$
c) $M^0L^0T^1A^2$ d) None

39. A magnitude of the current in metals is proportional to the applied voltage as long as temperature of conductor is kept constant. It is statement of: **NUMS -2022**
a. Joule's law
b. Gauss's law
c. Ohm's law
d. Ampere's law

40. The current flowing through a conductor is directly proportional to the applied potential difference across its ends provided that temperature remains constant is statement of:
a) Boyle's Law b) Charles's Law
c) Joule's Law d) Ohm's Law

41. The VI-graph of Ohm's law is:
a) Hyperbola b) Ellipse
c) Parabola d) Straight

42. Mathematical form of ohm's law is
a) I = VR b) I = V/R
c) I = R/V d) R = IV

43. Ohm's law is valid for only current flowing in
a) Conductors b) Transistors
c) Diodes d) Electric Areas

44. Which of the following are Ohmic materials?
(a)Semiconductors (b)Tungsten filament

(c)Thermistor (d)Metals

45. Ohm is the unit of:
a) I b) C c) E d) R

46. If a potential difference across a resistor is doubled:
a) Only the current is doubled
b) Only the resistance is doubled
c) Only the current is halved
d) Only the resistance is halved

47. Which equation is used to define resistance?
a) Energy = $(\text{current})^2$ x resistance x time
b) Potential difference current x resistance
c) Power x $(\text{current})^2$ x resistance
d) Resistivity = resistance x area + length

48. The resistivity of iron is $1 \, x \, 10^{-7}$ ohm – m. the resistance of a iron wire of particular length and thickness is 1 ohm. If the length and the diameter of wire both are doubled, then the resitivity in ohm – m will be
a. $1 \, x \, 10^{-7}$
b. $2 \, x \, 10^{-7}$
c. $4 \, x \, 10^{-7}$
d. $8 \, x \, 10^{-7}$

49. When the length and area of cross-section both are doubled, then its resistance
a. Will become half
b. Will be doubled
c. Will remain the same
d. Will become four times

50. The resistance of a wire is 20 ohms. It is so stretched that the length becomes three times, then the new resistance of the wire will be
a. 6.67 ohms
b. 60.0 ohms
c. 120 ohms
d. 180.0 ohms

51. The resistivity of a wire
a. Increases with the length of the wire
b. Decreases with the area of cross-section
c. Decreases with the length and increases with the cross-section of wire
d. None of the above statement is correct

52. Ohm's law is true
a. For metallic conductors at low temperature
b. For metallic conductors at high temperature
c. For electrolyte when current passes through them
d. For diode when current flows

53. The example for non-ohmic resistance is
a. Copper wire
b. Carbon resistance
c. Diode
d. Tungsten wire

54. A certain wire has a resistance R. the resistance of another wire identical with the first except have twice its diameter is
a. 2R
b. 0.25R
c. 4R
d. 0.5R

55. A wire of length 5m and radius 1mm has a resistance of 1 ohm. What length of the wire of the same material at the same temperature and of radius 2mm will also have a resistance of 1 ohm
a. 1.25 m
b. 2.5m
c. 10m
d. 20m

56. When there is an electric current through a conducting wire along its length, then an electric field must exist
a. Outside the wire but normal to it
b. Outside the wire but parallel to it
c. Inside the wire but parallel to it
d. Inside the wire but normal to it

57. Through a semiconductor, an electric current is due to drift of
a. Free electrons
b. Free electrons and holes
c. Positive and negative ions
d. Protons

58. The specific resistance of all metals is most affected by
a. Temperature
b. Pressure
c. Degree of illumination
d. Applied magnetic field

59. The positive temperature coefficient of resistance is of
a. Carbon
b. Germanium

c. Copper
d. An electrolyte

60. The resistance of a wire of uniform diameter d and length L is R. the resistance of another wire of the same material but diameter 2d and length 4L will be
a. 2R
b. R
c. R/2
d. R/4

61. A certain piece of silver of given mass is to be made like a wire. Which of the following combination of length (L) and the area of cross-sectional (A) will lead to the smallest resistance
a. L and A
b. 2L and A/2
c. L/2 and 2A
d. Any of the above, because volume of silver remains same

62. The resistance of wire is 10Ω. Its length is increased by 10% by stretching. The new resistance will now be
a. 12 Ω
b. 1.2 Ω
c. 13 Ω
d. 11 Ω

63. The reciprocal of resistance is
a. Conductance
b. Resistivity
c. Voltage
d. None of the above

64. A solenoid is a potential difference 60 V and current flows through it is 15 amperes, then the resistance of coil will be
a. 4 Ω
b. 8 Ω
c. 0.25 Ω
d. 2 Ω

65. All of the following statements are true except
a. Conductance is the reciprocal of resistance and is measure in Simen
b. Ohm's law is not applicable at very low and very high temperature
c. Ohm's law is applicable to semiconductors
d. Ohm's law is not applicable to electron tubes, discharge tubes and electrolytes

66. The resistivity of a wire depends on its
a. Length
b. Area of cross-section
c. Shape
d. Material

67. The conductivity of a superconductor is
a. Infinite
b. Very large
c. Very small
d. Zero

68. The resistance of a coil is 4.2 Ω and 100°C and the temperature coefficient of resistance of its material is 0.004/°C. its resistance at 0°C is
a. 6.5 Ω
b. 5 Ω
c. 3 Ω
d. 4 Ω

69. Masses of three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistance are
a. 1 : 3 : 5
b. 5 : 3 : 1
c. 1 : 15 : 125
d. 125 : 15 : 1

70. Two wires that are made up of two different materials whose specific resistance are in the ratio 2 : 3, length 3 : 4 and area 4 : 5. The ratio of their resistances is
a. 5 : 6
b. 6 : 8
c. 5 : 8
d. 1 : 2

71.
Resistance, Conductance, Resistivity, Conductivity and Effect of temperature on resistance

72. Which of the following quantities is correctly matched to its unit? : **ETEA-2023**
a) Electric charge : ampere (A)
b) Current :volt (V)
c) Electric power: watt (W)
d) Resistance : coulomb

73. For 0.05 Siemens of conductance, resistance will

be: **ETEA-2023**
A. 10 B. 20
C. 200 D. 100

74. A wire of length L has resistivity p. If the wire is divided in two halves, then resistivity of each halve is: **ETEA-2023**
A. ρ/2 B. ρ C. 2ρ D. ρ /3

75. Of the following, the copper conductor that has the least resistance must be: **ETEA-2023**
A. thick, short and cool B. thin, long and hot
C. thick, long and hot D. thin, short and cool

76. A conductor has length equal to π meteres and radius r meters. Its resistance will be equal to : **ETEA-2022**
A) R = pr^{-1} B) R = pr^{-2}
C) $R = pr^{-3}$ D) R = pr^{-4}

77. When two conductors each of resistance R are attached in series to external circuit, their net resistance is: **ETEA-2022**
a) R b) 2A c) 3R d) 4R

78. A conductor has resistance R. If its length is stretched to twice the actual value and its radius is reduced to one third of its original value. the new resistance will be: **ETEA-2022**
A) 3R B) 9R C) 18R D) 27R

79. When a wire is compressed and its radius becomes 2R then its resistance will be: **NMDCAT-2020**
A. 16R B. 4R C. 1/16 R D.1/4R

80. The change in resistance of metallic conductor at temperature below 0°C is: **NMDCAT-2020**
A. Non linear. B. Curve.
C. Linear. D. Curvilinear.

81. The resistance of pure metal increases with : **NUMS -2022**
a. Increase in temperature
b. Increase in pressure
c. Decrease in temperature
d. Decrease in pressure

82. A wire is stretched so that radius of cross section becomes half, then Resistance of wire will be: : **NUMS -2021**
A) 4R B) R/4 C) 8R D) 16R

83. The temperature coefficient of the semi-conductor is negative because **NUMS-2020**
a) Resistance increases with increase of temperature
b) Resistance decreases with increase of temperature
c) Resistance decreases with decrease of temperature
d) Resistance remains same with increase of temperature

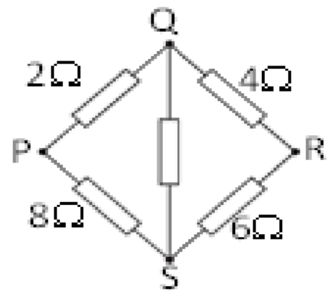
84. If length of wire becomes two times of its original value and area becomes one half to its original value then resistance of the wire becomes **NUMS-2020**
a) Doubled b) four times
c) one half d) One fourth

85. The unit of resistivity is **NUMS-2020**
a) Ohm b) Ohm meter
c) Ohm/meter d) Meter/Ohm

86. 1 kilowatt hour = **NUMS-2020**
a) 1.6×10^{-19} J b) 3.6×10^{6} J
c) 9.1×10^{-31} J d) 1.67×10^{-27}J

87. It is a null type resistance device for measuring potential differences **NUMS-2020**
a) Galvanometer b) Ohmmeter
c) Ammeter d) Potentiometer

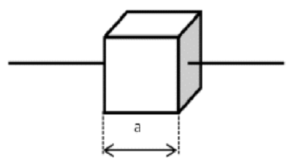
88. Four resistors are connected in a square as shown



The resistance may be measured between any two junctions. Between which two junctions is the measured resistance greatest? ETEA 2018-Med
A)P and Q B)Q and S
C)R and S D)S and P

89. The reciprocal of the conductance is called: ETEA 2018-Med
A) Conductivity B)Resistivity
C)Resistance D)Inductance

90. A metal cube with sides of length "a" has electrical resistance R between opposite faces



What is the resistance between the opposite faces of a cube of the same metal with sides of length 3a? ETEA 2018-Med
A) 9R B) 3R
C) R/3 D) R/9

91. A filament lamp has a resistance of 180Ω when the current in it is 500 mA. What is the power dissipated in the lamp? ETEA 2018-Med
A)45 W B)90 W
C)290 W D)360 W
Hints: $P=IV=I^2 R=(0.5)^2 \times 180=45W$

92. Wire a has the same length and resistance a wire B. the diameter of A is double that of B. what is the ratio of the resistivity of wire A to that of wire B?

ETEA 2018-Eng

A) 1:2 B)4 : 1
C) 1:4 D)2: 1

Hints:$\rho1/\rho2=A1/A2=d_1^2/d_2^2=(2B)^2/B^2 = 4/1 = 4:1$

93. Three resistors of resistances 20Ω, 4Ω and 6Ω are connected in parallel across a D.C supply. The ratio of the current through the 2Ω resistor to the current through the 4Ω resistor is: ETEA 2018-Eng

A)I: 2 B)2:1
C)1:4 D)1 : 6

94. Four 20 Ω resistors are connected in parallel and combination is connected to a 20 V emf device. Thecurrent in the device is: ETEA 2015-97 Med

A) 0.25 A B) 1.0 A
C) 4.0 A D) 5.0 A

95. Several resistors are connected in parallel the resistance of their equivalent resistor will: ETEA 2014-99: Med

a) Increase b) Decrease
c) Not change d) None of these

96. A 50 Ω resistance wire is stretched such that its length is doubled and its cross section area becomes half. The new resistance is: ETEA 2008-195 Med:

(a) 100 Ω (b) 200 Ω
(c) 50 Ω (d) 150 Ω

97. A wire of uniform cross section A, length 1 and resistance R is cut into two equal pieces. The resistivity of each piece will be: ETEA 2011-112 Med:

(a) The same (b) One fourth
(c) Double (d) One half

98. A cylindrical wire 4.0m long has a resistance of 31Ω and is made of metal of resistivity 1.0×10^4Ωm. What is the radius of cross section of the wire? ETEA 2012-117 Eng:

(a) 1.0×10^{-4} m (b)2.0×10^{21} m
(c) 6.4×10^{8} m **(d) 2.0×10^{-4} m**

99. The unit of conductance is; ETEA 2007-169 Med:

(a) Ohm (b) Ohm-meter^{-1}
(c) Ohm-meter (d) mho

100. The resistance of a conductor having a length of one meter and an area of cross section one square meter is called ETEA 2011-113 Eng:

(a) Conductance (b) Resistivity
(c) conductivity (d) mho

101. Two metallic conductors have the same value of resistivity. These conductors can be differentiated from the values of their: ETEA 2011-115 Med:

(a) Temperature coefficient (b) resistances
(c) conductance (d) conductivity

102. Two wires P and Q have resistances R_P and R_Q respectively. Wire P is twice as long as wire Q and has twice the diameter of wire Q. the wire are made of the same material. What is the ratio R_P / R_Q? ETEA 2012-136Eng

(a) 0.5 (b) 1
(c) 2 (d) 4

103. Several resistors are connected in parallel the resistance of their equivalent resistor will: ETEA 2010-04 Eng:

(a) Increases (b) Decreases
(c) Not change (d) None

104. The resistances of 3 ohm 4 ohm and 5 ohm are connected in parallel if the potential difference across 3 ohm resistor be 12 volt then the potential difference across 4 ohm and 5 ohm will be: ETEA 2010-109 Eng:

(a) 3volt (b) 6volt
(c) 9 volt (d) 12 volt

105. Two heating coils X and Y of resistance R_x and R_y respectively deliver the same power when 12V is applied across x and 6V is applied across y. what is the ration of R_x/R_y=? ETEA 2012-172 Eng:

(a) ¼ (b) 6
(c) 2 (d) 4

106. Three equal resistors connected in parallel have equivalent resistance R/3. When they are connected in series then the equivalent resistance is: ETEA 2013-96 Med:

(a) R/3 (b)R
(c)2R (d) 3R

107. The resistors of 5 Ω , 4 Ω and 3 Ω are connected in parallel. If the potential difference across 4 Ω resistor is 6 volt, then the potential difference across 5 Ω and 3 Ω will be: ETEA 2011-116 Eng:

(a) 6 volt (b) 3 volt
(c) 12 volt (d) 9 volt

108. A wire of resistance 4Ω is bent into a circle. The resistance between the ends of a diameter of the circle is: ETEA 2014-21; Med

(a) 4Ω (b) 1 Ω
(c) 1/4 Ω (d) 1/16 Ω

109. A wire of resistance 3.0 Ω is stretched to twice its original length. The resistance of new wire will be: ETEA 2014-12;Med

(a) 1.5 Ω (b) 3.0 Ω
(c) 6.0 Ω (d)32.0

110. By how many times does doubling the diameter of a wire and making it 10 times longer increase its resistance? ETEA 2014-196 Med:

(a) 2.5 times (b) 5 time s(c) 10 times (d) 30 times

111. A student connect a 6 volt battery and a 12 volt battery in series and then connects this combination across a 10Ωresistor. What is the current is the

resistor? ETEA 2014-164: Med
a) 0.8 A b) 1.8 A
c) 0.9 A d) 2.6 A

112. The resistance of three arms of the balanced wheat stone bridge are 50 ohm. The resistance in the 4th ohm: ETEA 2007-193 Med:
(a) 25ohm (b) 50 ohm
(c) 75 ohm (d) 100 ohm

113. Conductivity is: ETEA 2015-48 Eng
A) The same as resistivity B) Expressed in Ω^{-1}
C)Equal to 1/ resistance D) Expressed in $(\Omega\text{-m})^{-1}$

114. If the potential difference across a resistor is doubled: ETEA 2016-24 Med
(a) Only the current is doubled
(b) Only the current is halved
(c) Only the resistance is doubled
(d) Only the resistance is halved

115. The temperature coefficient of resistance of a semiconductor is: ETEA 2016-159 Med
(a) Positive **(b) Negative**
(c) Imaginary (d) Zero

116. A certain wire has resistance R. Another wire, of the same material, has half the length and half the diameter of the first wire. The resistance of the second wire is: ETEA 2016-191 Eng
(a) R/4 (b) R/2 **(c) R** (d) 2R

117. The resistance of a device is designed to change with temperature. What is the device? ETEA 2017-08Med
A)A light dependent resistor
B)A potential divider
C)A semiconductor diode
D)A thermistor

118. A cell of internal resistance 2.0Ω and electromotive force (e.m.f) 1.5V is connected a resistor of resistance 3.00. What is the potential difference across the 3.02Ω resistor? ETEA 2017-17 Med
A) 5V B) 1.2V C) 0.9V D) 0.6V

119. When we are measuring the internal resistance of a cell by potentiometer, the emf of the battery must be greater than the: ETEA 2018-Med
A)emf of the cell B)P.D in the circuit
C)Current in the cell D)Current in the circuit

120. A typical mobile phone battery has an e.m.f.of 5.0 V and internal resistance of 200 m Ω, what is the terminal P.D. of battery when it supplies current of 500 mA? ETEA 2018-Med
A)4.8 V B)4.9 C)S.O V D)5.1 V

121. A generator produces 100 KW of power at a potential difference of 10kV. The power is transmitted through cables of total resistance of 5Ω. How much power is dissipated in the cables? ETEA 2018-Eng
A)50 W B) 250 W
C)500 W D)1000 W.

122. The total driving force of the battery to draw current through a circuit is called: ETEA 2011-118 Med:
(a) voltage of battery (b) power of battery
(c) Emf of battery (d) all of these

123. The circuit in which the terminal voltage of the battery is equal to the emf of the battery is the: ETEA 2011-119 Eng:
(a) open circuit (b) close circuit
(c) short circuit (d) electric circuit

124. When a wire is compressed and its radius becomes 2R then its resistance will be: MDCAT - 2020
A. 16R
B. 4R
C. 1/16 R
D.1/4R

125. The change in resistance of metallic conductor at temperature below 0°C is: MDCAT - 2020
A. Non linear.
B. Curve.
C. Linear.
D. Curvilinear.

126. The power of an electric bulb is 100W. it is connected to 110V power supply. The resistance of electric bulb will be NUMS-2020
A) 110 ohm
b) 121 ohm
c) 20 ohm
d) 200 ohm

127. If power is 100 watt and voltage is 220. Find the resistance NUMS-2016
a. 2.5
b. 3.5
c. 4.5
d. 5.5

128. Let an emf of 120 volt of negligible internal resistance connected across a resistance of 1000 ohm. Then the current flowing through the circuit will be
120 A
120×10^{3} A
120×10^{-3} A
None

129. **A fused can be savior against:** FMDC 2015
a) High voltage
b) High current
c) High power
d) Heating of wires

130. **A current of 2A is passing though an inductor of 2mH. Energy stored by it is**

FMDC 2015
a) 8mJ
b) 10mJ
c) 6mJ
d) 4mJ

131. **What is a typical value for the order of magnitude of the resistivity of copper?** **FMDC 2017**
a) $10^{-8}\ \Omega$ m
b) $10^{-10}\ \Omega$ m
c) $10^{-6}\ \Omega$ m
d) $10^{2}\ \Omega$ m

132. Two lamps are connected in series to a 250 V power supply. One lamp is rated 240 V, 60 W and the other rated 10 V, 2.5 W. Which statement most accurately describe what happens? ETEA 2017-Med
A. Both lamps light at less than their normal brightness.
B. Both lamps light at their normal brightness.
C. Only the 240 V lamp lights.
D. The 10 V lamp blows.

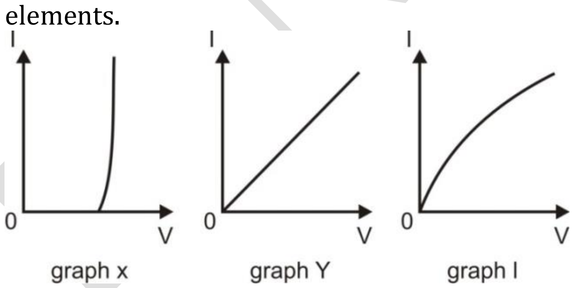
133.

Special resistors combinations

134. Three equal resistors connected in parallel have equivalent resistance R/3. When they are connected in series then the equivalent resistance is:
a) R/3 b)R c)2R d) 3R

135. The resistors of 5Ω, 4Ωand 3Ω are connected in parallel. If the potential difference across 4 Ω resistor is 6 volt, then the potential difference across 5Ω and 3Ω will be:
a) 6 volt b) 3 volt c) 12 volt d) 9 volt

136. The graphs show the variation with potential difference V of the current I for three circuit elements.



The three circuit elements arc a metal who at constant temperature, a semi-conductor diode and a filament lamp.
Which row of the table correctly identifies these graphs?

	Metal wire at constant temperature	Semiconductor diode	Filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

137. Four 20 Ω resistors are connected in parallel and combination is connected to a 20 V emf device. The current in the device is:
A) 0.25 A B) 1.0 A C) 4.0 A D) 5.0 A

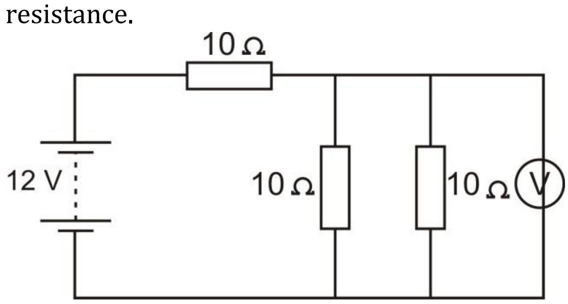
138. Several resistors are connected in parallel the resistance of their equivalent resistor will:
a) Increase b) Decrease
c) Not change d) None of these

139. Two wires P and Q have resistances R_P and R_Q respectively. Wire P is twice as long as wire Q and has twice the diameter of wire Q. the wire are made of the same material. What is the ratio R_P / R_Q?
a) 0.5 b) 1 c) 2 d) 4

140. Several resistors are connected in parallel the resistance of their equivalent resistor will:
a) Increases b) Decreases
c) Not change d) None

141. The resistances of 3 ohm 4 ohm and 5 ohm are connected in parallel if the potential difference across 3 ohm resistor be 12 volt then the potential difference across 4 ohm and 5 ohm will be:
a) 3volt b) 6volt c) 9 volt d) 12 volt

142. In the circuit shown, the voltmeter has infinite resistance.



What is the voltmeter reading?
a) 3 V b) 4 V c) 6 V d) 8 V

143. Resistance of a conductor depends upon
A) nature of conductor
B) dimension of conductor
C) physical state of the conductor
D) all of above

144. How 500 ohm resistors are connected so as to give an effective resistance of 750 ohm:
a) Three resistance of 500 ohm each in parallel
b) Three resistance of 500 ohm each in series
c) Two resistance of 500 ohm each in parallel
d) Two resistance of 500 ohm each, in parallel and the combination in series with another 500 ohm resistance

145. Five cylindrical wire are made of the same material. Their lengths and radii are:
Wire 1: length l, radius r
Wire 2: length l/4, radius r/2
Wire 3: length l/2, radius r/2
Wire 4: length l, radius r/2
Wire 5: length 5l, radius 2r
Rank the wires according to their resistances, least to greatest
a) 1,2,3,4,5 b) 1 and 2 tie, then 5,3,4
c) 5,4,3,2,1, d) 1,3,4,2,5

146. Nine identical wires, each of diameter "d" and length "L", are connected in parallel, the combination has the same resistance as a single similar wire of length "L" but those diameter is:
a) 3d b) d/3 c) 9d d) d/9

147. The resistance of resistor 1 is twice the resistance of resistor 2. The two are connected in parallel and a potential difference is maintained across the combination. Then:
a) the current in 1 is twice that in 2
b) the current in 1 is half that in 2
c) the potential difference across 1 is twice that across 2
d) the potential difference across 1 is half that across

148. Of the following, the copper conductor that has the least resistance is:
a) Thin, long and hot b) Thick, short and cool
c) Thick , long and hot d) Thin, short and cool

149. A current of 0.3A is passed through a lamp for 2 minutes using a 6 V power supply. The energy dissipated by this lamp during the 2 minutes is:
a) 1.8 J b) 36 J c) 20 J d) 216 J

150. If we cut a wire of resistance "R" in two equal parts and then make a bundle of both parts of a wire. The resistance of bundle, will be:
a) $\frac{1}{2}R$ b) $2R$ c) $\frac{1}{4}R$ d) $4R$

151. Two conductors are made of the same material and have the same length. Conductor "A" is a solid wire of diameter 1m. conductor "B" is a hollow tube of inside diameter 1m and outside diameter 2m. the ratio of their resistance, R_A/R_B, is:
a) 1 b) 2 (C)$\sqrt{2}$ d) 3

152. What would be the equivalent resistance of circuit having three resistance of 9 Ω each, connected in parallel.
a) 6 Ω b) 3 Ω c) 27 Ω d) 1 Ω

153. A 12.8 Ω wire is cut into some equal parts. When these parts are connected in parallel then obtained result was 1/5 Ω. The number of parts are:
a) 2 b) 4 c) 6 d) 8

154. Four 20 Ω resistors are connected in parallel and the combination is connected to a 20 V emf device. The current in the device is:
a) 0.25A b) 1.0A c) 4.0A d) 5.0A

155. Four 20 Ω resistors are connected in parallel and the combination is connected to a 20 V emf device. The current in any one of the resistors is:
a) 0.25A b) 1.0A c) 4.0A d) 5.0A

156. Four 20 Ω resistors are connected in series and the combination is connected to a 20V emf device. The current in any one of the resistors is:
a) 0.25A b) 1.0A c) 4.0A d) 5.0A

157. Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire "P" has a diameter of 2 mm. wire "Q" has a diameter of 1mm. what is the ratio I_P/I_Q ?
a) 1/4 b) 2 c) 1/2 d) 4

158. When 2 Ω, 4 Ω and 6 Ω resistor are connected in parallel, their resultant equivalent resistance will be
a) 12 Ω b) 12/11 Ω
c) 11/12 Ω d) Data is insufficient

159. When a potential difference V is applied between the ends of a wire of diameter d and length L, the current in the wire is i. what is the current when a potential difference of 2 V is applied between the ends of a wire of the same material of diameter 2d and the length 2L? assume that the temperature of the wire remains constant.
a) 1 b) 21 c) 41 d) 81

160. If the length and diameter of conductor is doubled the resistance is:
a) Remain same b) Half
c) Double d) Four time

161. A 50 Ω resistance wire is stretched such that its length is doubled and its cross section area becomes half. The new resistance is:
a) 100 Ω b) 200 Ω c) 50 Ω d) 150 Ω

162. A wire of uniform cross section A, length 1 and resistance R is cut into two equal pieces. The resistivity of each piece will be:
a) The same b) One fourth
c) Double d) One half

163. A cylindrical wire 4.0m long has a resistance of 31Ω and is made of metal of resistivity 1.0×10^{4}Ωm. What is the radius of cross section of the wire?
a) 1.0×10^{-4} m (b)2.0×10^{21} m
c) 6.4×10^{8} m d) 2.0×10^{-4} m

164. Conductance is a quantity used to describe the:
a) Physical state of the conductor

b) Dimension of the conductor
c) Electrical properties of material
d) All of them

165. Siemen is the unit of:
a) Resistance b) Resistivity
c) Conductance d) Conductivity

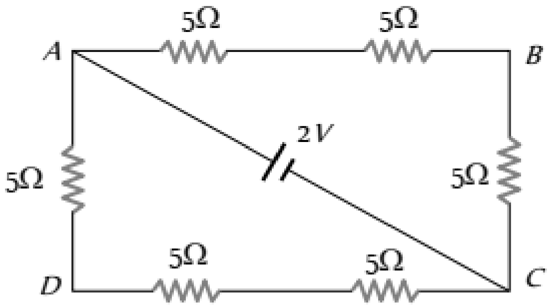
166. The reciprocal of the conductance is called:
A) Conductivity B)Resistivity
C)Resistance D)Inductance

167. The unit of conductance is;
a) Ohm b) Ohm-meter^{-1}
c) Ohm-meter d) mho

168. The resistance of a conductor having a length of one meter and an area of cross section one square meter is called
a) Conductance b) Resistivity
c) conductivity d) mho

169. Conductivity is:
A) The same as resistivity B) Expressed in Ω^{-1}
C)Equal to 1/ resistance D) Expressed in $(\Omega\text{-m})^{-1}$

170. The potential difference between points A and B of adjoining figure is

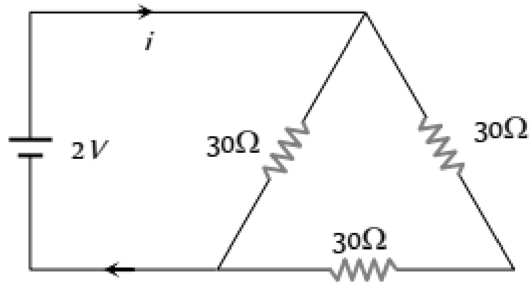


a. $\frac{2}{3}V$
b. $\frac{8}{9}V$
c. $\frac{4}{3}V$
d. $2V$

171. Two resistors of resistance R_1 and R_2 having $R_1 > R_2$ are connected in parallel. For equivalent resistance R, the correct statement is
a. $R > R_1 + R_2$
b. $R_1 < R < R_2$
c. $R_2 < R < (R_1 + R_2)$
d. $R < R_1$

172. A wire of resistance R is divided in 10 equal parts. These parts are connected in parallel, the equivalent resistance of such connection will be
a. 0.01 R
b. 0.1 R
c. 10 R
d. 100 R

173. The current in the adjoining circuit will be



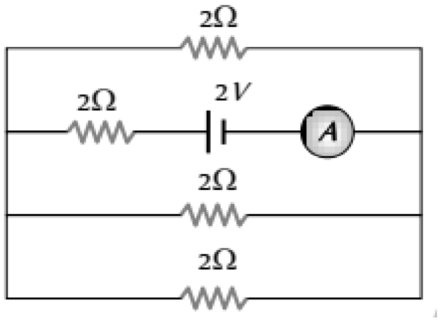
a. $\frac{1}{45}\,ampere$
b. $\frac{1}{15}\,ampere$
c. $\frac{1}{10}\,ampere$
d. $\frac{1}{5}\,ampere$

174. There are 8 equal resistances R. two are connected in parallel, such four groups are connected in series, the total resistance of the system will be
a. R/2
b. 2R
c. 4R
d. 8R

175. Three resistances of one ohm each are connected in parallel. Such connection is again connected with 2/3 Ω resistor in series. The resultant resistance will be
a. $\frac{5}{3}\Omega$
b. $\frac{3}{2}\Omega$
c. 1Ω
d. $\frac{2}{3}\Omega$

176. The lowest resistance which can be obtained by connecting 10 resistors each of 1/10 ohm is
a. 1/250 Ω
b. 1/200 Ω
c. 1/100 Ω
d. 1/10 Ω

177. The reading of the ammeter as per figure shown in

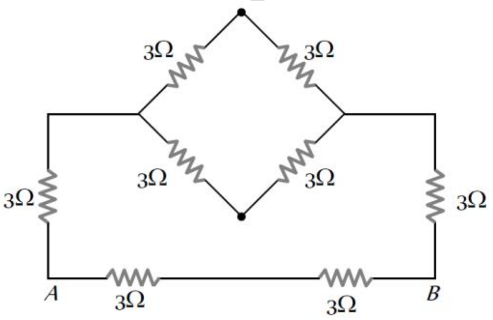


a. $\frac{1}{8}a$
b. $\frac{3}{4}A$
c. $\frac{1}{2}A$
d. $2A$

178. Three resistors each of 2 ohm are connected together in a triangular shape. The resistance between any two vertices will be
a. 4/3 ohm
b. 3/4 ohm
c. 3 ohm
d. 6 ohm

179. There are n similar conductors each of resistance R. The resultant resistance comes out to be x when connected in parallel. If they are connected in series, the resistance comes out to be
a. x / n^2
b. n^2x
c. x/n
d. nx

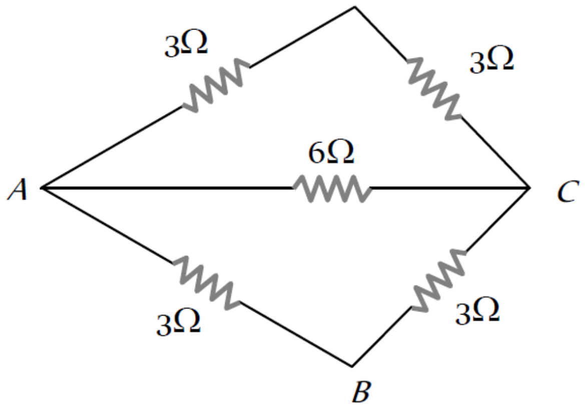
180. Equivalent resistance between A and B will be



a. 2 ohm
b. 18 ohm
c. 6 ohm
d. 3.6 ohm

181. A wire has a resistance of 12 ohm. It is bent in the form of equilateral triangle. The effective resistance between any two corners of the triangle is
a. 9 ohms
b. 12 ohms
c. 6 ohm
d. 8/3 ohms

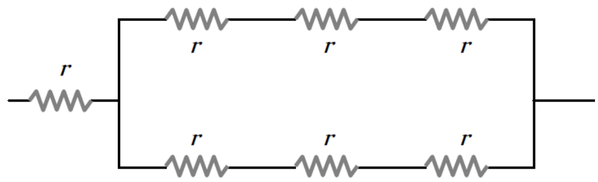
182. The effective resistance between the points A and B in the figure is



a. 5 Ω
b. 2 Ω
c. 3 Ω
d. 4 Ω

183. Three resistances of magnitude 2, 3, and 5 ohm are connected in parallel to a battery of 10 volts and of negligible resistance. The potential difference across 3Ω ressitance will be
a. 2volts
b. 3volts
c. 5volts
d. 10 volts

184. Referring to the figure below, the effective resistance of the network is



a. 2r
b. 4r
c. 10r
d. 5r/2

185. Given three equal resistors, how many different combinations of all the three resistors can be made
a. Six

b. Five
c. Four
d. Three

186. Lamps used for household lighting are connected in
a. Series
b. Parallel
c. Mixed circuit
d. None of the above

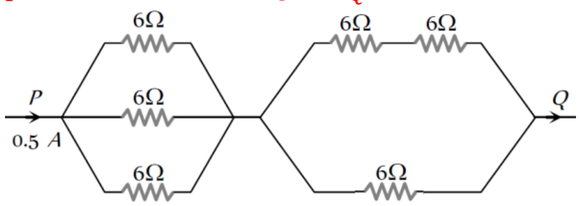
187. The equivalent resistance of resistors connected in series is always
a. Equal to the mean of component resistors
b. Less than the lowest of component resistors
c. In between the lowest and the highest of component resistors
d. Equal to sum of component resistors

188. A cell of negligible resistance and e.m.f. 2 volts is connected to series combination of 2, 3 and 5 ohm. The potential difference in volts between the terminals of 3 ohm resistance will be
a. 0.6
b. 2/3
c. 3
d. 6

189. Four wires of equal length and of resistances 10 ohms each are connected in the form of a square. The equivalent resistance between two opposite corners of the square is
a. 10 ohm
b. 40 ohm
c. 20 ohm
d. 10/4 ohm

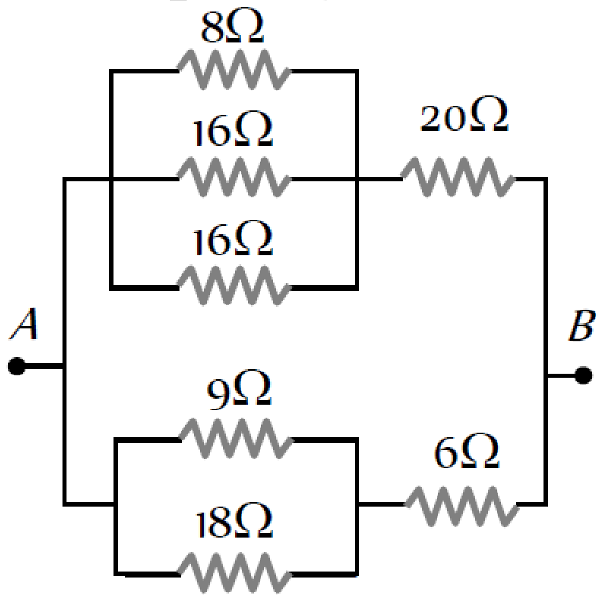
190. Resistors of 1, 2, 3 ohm are connected in the form of a triangle. If a 1.5 volt cell of negligible internal resistance is connected across 3 ohm resistor, the current flowing through this resistance will be
a. 0.25 amp
b. 0.5 amp
c. 1.0 amp
d. 1.5 amp

191. Resistances of 6 ohm each are connected in the manner shown in adjoining figure. With the current 0.5 ampere as shown in figure, the potential difference $V_P - V_Q$ is



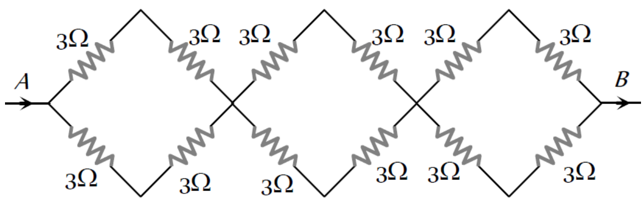
a. 3.6 v
b. 6.6 v
c. 3.0 v
d. 7.2 v

192. The equivalent resistance of the arrangement of resistances shown in adjoining figure between the points A and B is



a. 6 ohm
b. 8 ohm
c. 16 ohm
d. 24 ohm

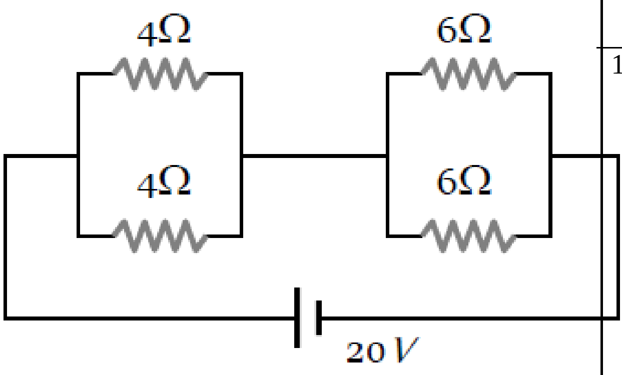
193. In the network of resistors shown in the adjoining figure the equivalent resistance between A and B is



a. 54 ohm
b. 18 ohm
c. 36 ohm

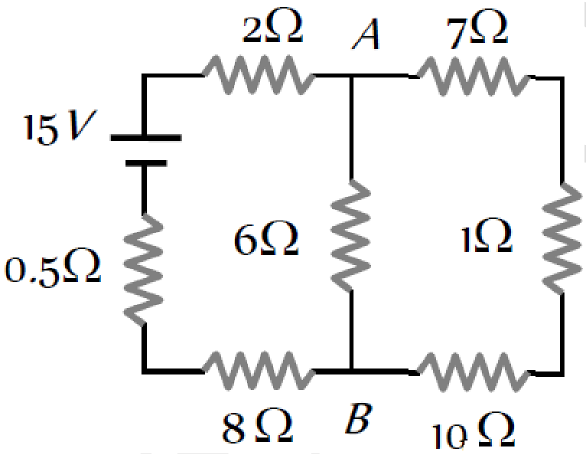
d. 9 ohm

194. Four resistances are connected in a circuit in the given figure. The electric current flowing through 4 ohm and 6 ohm resistance is respectively



a. 2 amp and 4 amp
b. 1 amp and 2 amp
c. 1 amp and 1 amp
d. 2 amp and 2 amp

195. The current from the battery in circuit diagram shown is

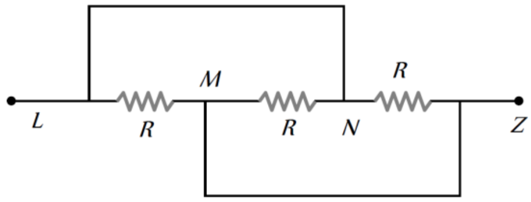


a. 1A
b. 2A
c. 1.5 A
d. 3 A

196. Three resistances, each of 1 ohm, are joined in parallel. Three such combinations are put in series, then the resultant resistance will be
a. 9 ohm
b. 3 ohm
c. 1 ohm
d. $\frac{1}{3}$ohm

197. A student has 10 resistors of resistance 'r', the minimum resistance made by him from given resistors is
a. 10 r
b. $\frac{r}{10}$
c. $\frac{r}{100}$
d. $\frac{r}{5}$

198. Three resistances each of value R are connected as shown in the figure the equivalent resistance between M and N is



a. R
b. 2R
c. $\frac{R}{2}$
d. $\frac{R}{3}$

199. A copper wire of resistance R is cut into ten parts of equal length. Two pieces each are joined in series and then five such combinations are joined in parallel. The new combination will have a resistance
a. R
b. $\frac{R}{4}$
c. $\frac{R}{5}$
d. $\frac{R}{25}$

200. A wire has resistance 12Ω. It is bent in the form of a circle. The effective resistance between the two points on any diameter is equal to
a. 12 Ω
b. 6 Ω
c. 3 Ω
d. 24 Ω

201. Three resistors each of 4Ω are connected together to form a network. The equivalent resistance of the network cannot be
a. 1.33 Ω
b. 3.0 Ω
c. 6.0 Ω
d. 12.0 Ω

202. A wire of resistance R is cut into 'n' equal parts. These parts are then connected in

parallel. The equivalent resistance of the combination will be

a. nR

b. $\frac{R}{n}$

c. $\frac{n}{R}$

d. $\frac{R}{n^2}$

203. N equal resistors are first connected in series and then connected in parallel. What is the ratio of the maximum to be minimum resistance

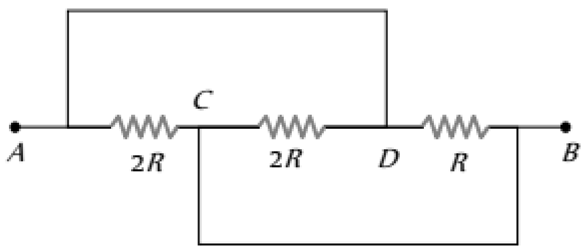
a. N

b. $\frac{1}{n^2}$

c. n^2

d. $\frac{1}{n}$

204. What is the equivalent resistance between A and B



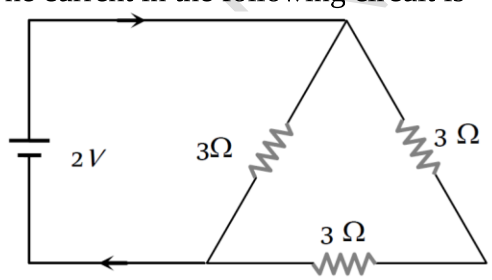
a. $\frac{2}{3}R$

b. $\frac{3}{2}R$

c. $\frac{R}{2}$

d. 2R

205. The current in the following circuit is



a. $\frac{1}{8}A$

b. $\frac{2}{9}A$

c. $\frac{2}{3}A$

d. $1A$

206. 10 wires (same length, same area, same material) are connected in parallel and each has 1Ω resistance, then the equivalent resistance will be

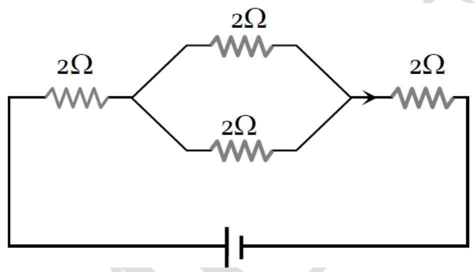
a. 10Ω

b. 1 Ω

c. 0.1 Ω

d. 0.001 Ω

207. The equivalent resistance of the circuit shown in the figure is



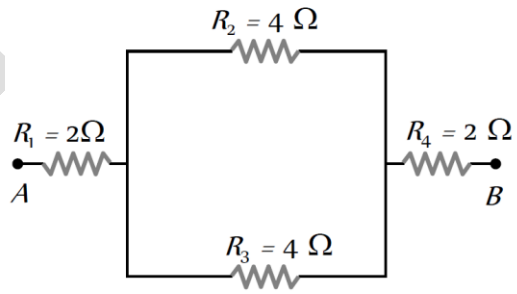
a. 8 Ω

b. 6 Ω

c. 5 Ω

d. 1 Ω

208. In the given figure, the equivalent resistance between the point A and B is



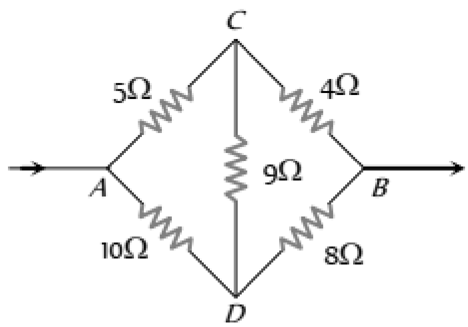
a. 8 Ω

b. 6 Ω

c. 4 Ω

d. 2 Ω

209. Five resistors are connected as shown in the diagram. The equivalent resistance between A and B is

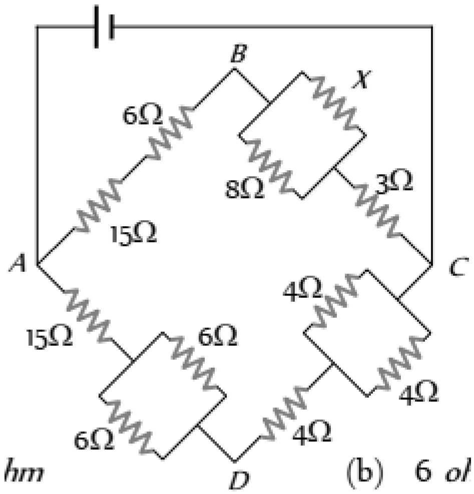


a. 6 ohm

b. 9 ohm

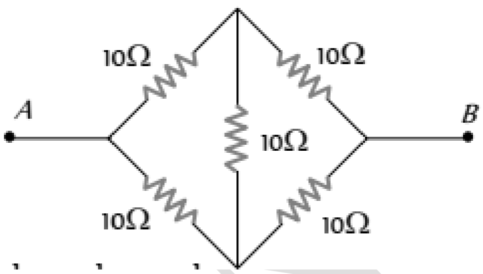
c. 12 ohm
d. 15 ohm

210. In the figure given the value of X resistance will be, when the p.d. between B and D is zero



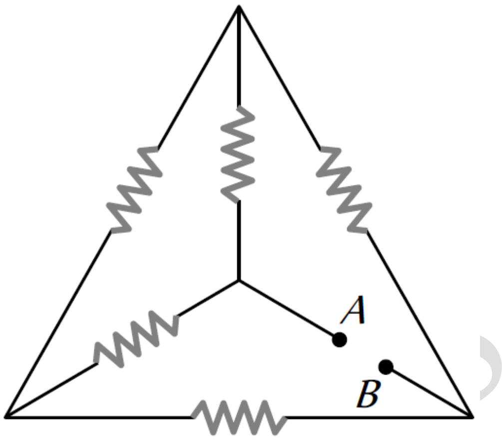
a. 4 ohm
b. 6 ohm
c. 8 ohm
d. 9 ohm

211. The effective resistance between points A and B is



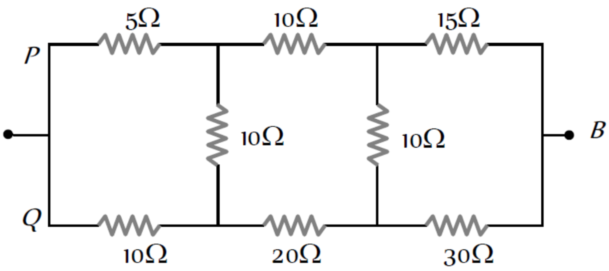
a. 10 Ω
b. 20 Ω
c. 40 Ω
d. None of the above three values

212. In the network shown in the figure, each of the resistance is equal to 2Ω. The resistance between the points A and B is



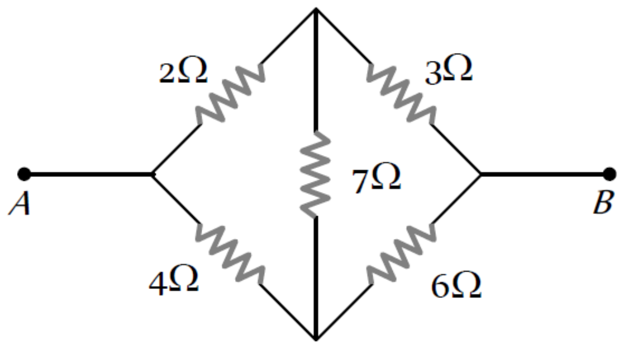
a. 1Ω
b. 4 Ω
c. 3 Ω
d. 2 Ω

213. In the arrangement of resistance shown below, the effective resistance between points A and B is



a. 20Ω
b. 30 Ω
c. 90 Ω
d. 110 Ω

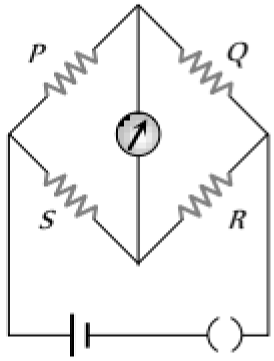
214. Five resistances are connected as shown in the figure. The effective resistance between the points A and B is



a. $\frac{10}{3}\Omega$
b. $\frac{20}{3}\Omega$

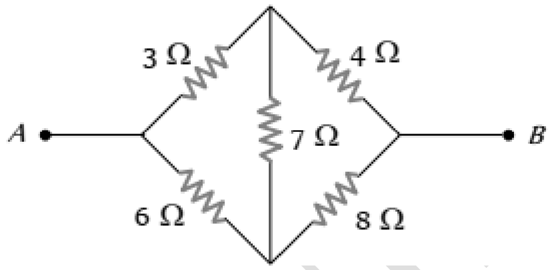
c. 15 Ω
d. 6 Ω

215. In the Wheatstone's bridge shown P = $2\Omega, Q = 3\Omega, R = 6\Omega and\ S = 8\Omega$. In order to obtain balance, shunt resistance across 'S' must be



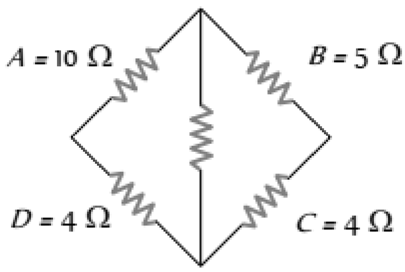
a. 2Ω
b. 3 Ω
c. 6 Ω
d. 8 Ω

216. In the given figure, equivalent resistance between A and B will be



a. $\frac{14}{3}\Omega$
b. $\frac{3}{14}\Omega$
c. $\frac{9}{14}\Omega$
d. $\frac{14}{9}\Omega$

217. In a typical wheatstone network, the resistances in cyclic order are A = 10Ω, B = $5\Omega, C = 4\Omega and\ D = 4\Omega$ for the bridge to be balanced



a. 10Ω should be connected in parallel with A
b. 10Ω should be connected in series with A
c. 5Ω should be connected in series with B
d. 5Ω should be connected in parallel with B

218. If a rod has resistance 4Ω and if rod is turned as half cycle then the reistance along diameter
a. 1.56 Ω
b. 2.44 Ω
c. 4 Ω
d. 2 Ω

219.
Thermistor

220. A thermistor is a semiconductor device whose resistance: ETEA 2018-Eng
A)Decreases as its temperature increase
B)Doesn't vary as its temperature increases
C)Decreases as its temperature decreases
D)Doesn't vary as its temperature decrease

221.
EMF, work, internal resistance and Electric power

222. 1 volt x 1 ampere is equal to: **ETEA-2023**
A. 1 coulomb B. 1 newton
C. 1 watt D. 1 hp

223. In how many hours a 1000 watt AC will consume one unit of electricity? **ETEA-2023**
A. 0.5 hr B. 1 hr
C. 1.5 hr. D. 2 hr

224. A certain X-ray tube requires a current of 5mA at a voltage of 60kV. The rate of energy dissipation (in watts) is: **ETEA-2023**
A. 560 B. 300 C. 200 D. 800

225. Two electric bulbs "A" and "B" of power 500W and 2000W respectively are connected to 240V supply. The ratio of current passing through bulb "A" to the current passing through bulb "B" is: **ETEA-2022**
a) 1:2 b) 1:4 c) 1:8 d) 1:16

226. Power transfer will be maximum when: **NUMS - 2021**
A) R>r
B) R<r
C) R = r
D) R = 1 / r

227. Which of the following pairs have the same units and dimensions. ETEA 2012-182 Med:
(a) Resistance and Resistivity

(b) Conductivity and Resistivity
(c) Emf & P.D
(d) Resistivity and Temp co-efficient of resistivity

228. A current of 20.0A flows through a battery with an emf of 6.20 V. If the internal resistance of the battery is 0.01Ω, what is the terminal voltage? ETEA 2014-01 Med:
(a) 6.40V (b) 31.0V (c) 1.24V (d) 6.00V

229. 0ne v0lt can be defined as? **FMDC 2012**
A. 1J w0rk d0ne in m0vng unit p0sitve charge fr0m 0ne p0int to an0ther
B. rati0 of energy dissipated at 0ne and other p0int
C. rati0 of p0wer dissipated at 0ne and other p0int

230. **A light bulb has resistance of 150, find the voltage while the current is 1.5A? FMDC 2013**
A) 250 v B) 300 v
C) 224 v D) 225 v

231. **The terminal voltage of a battery is observed to fall when the battery supplies a current to an external resistor. What quantities are needed to calculate the fall in voltage? FMDC 2017**
a) The battery's e.m.f and its internal resistance
b) The battery's e.m.f and the current
c) The current and the battery's internal resistance
d) The current and the external resistance

232. The birds sitting on an overhead transmission line suffer no harmful effects because: ETEA 2012-191 Med:
(a)Their bodies have high resistance
(b)Their feet are good insulators
(c)There is negligible potential difference between their feet
(d)Wires are insulated

233. Which of the following is not vector quantity? ETEA 2012-75 Med:
(a) E.F. Intensity (b) G.F. Intensity
(c) Magnetic Induction (d) Emf

234. If two bulbs of 25W and 100W respectively, each rated at 220 volts are connected in series with the supply of 440 volts. Which of the bulb will fuse? ETEA 2016-31 Eng
(a) 100W bulb **(b) 25 W bulb**
(c) Both (a) & (b) (d) None of the above

235. Terminal Voltage "V1" of the battery is greater than emf of the battery when **NUMS-2020**
a) Battery is charging
b) battery is discharging
c) battery is connected with R
d) battery is connected with voltmeter

236. If the resistance of a conductor is zero, current will be **NUMS-2019**
a) Minimum b) Infinity
c) Zero d) Maximum

237. The emf of a battery is equal to its terminal potential difference: ; **ETEA-2019**
a) Under all condition
b) Only when the battery is being charged
c) When a large current is in the battery
d) Only when there is no current in the external circuit

238. A car battery has EMF of 12 volts and internal resistance 5x 10^{-2} ohm. If it draws 60 ampere current, then terminal voltage of the battery will be; **ETEA-2019**
a) 5 volts b) 3 volts c) 15 volts d) 9 volts

239. The amount of work done per coulomb of the charge passing through a conductor is:
a) IR b) VI c) V d) VQ

240. Power dissipated as heat in the conductor of resistance "R" due to electric current "I" is given by:
a) IR b) I^2R c) T^2Rt d) VIt

241. Heat generated by a 40 watts bulb in one hour is:
a) 4800 J b) 14400 J c) 144000 J d) 140 J

242. Electrical energy is measured by:
a) watt b) power horse
c) kilo watt d) kilowatt hour

243. When the internal resistance of a source is equal to the load resistance, the minimum output power is given by:
a) $P_{out} = E^2/r$ b) $P_{out} = 2E^2r$
c) $P_{out} = \frac{E^2}{4r}$ d) $P_{out} = E^2r$

244. Power output is given by
a) $P_{out} = \frac{E^2R}{(R+r)^2}$ b) $P_{out} = \frac{E^2R}{(R-r)^2+4Rr}$
c) $P_{out} = I^2R$ d) all of them

245. A filament lamp has a resistance of 180Ω when the current in it is 500 mA. What is the power dissipated in the lamp?
A)45 W B)90 W C)290 W D)360 W

246. Which of the following pairs have the same units and dimensions?
a) Resistance and Resistivity
b) Conductivity and Resistivity
c) Emf & P.D
d) Resistivity and Temp co-efficient of resistivity

247. A current of 20.0A flows through a battery with an emf of 6.20 V. If the internal resistance of the battery is 0.01Ω, what is the terminal voltage?
a) 6.40V b) 31.0V c) 1.24V d) 6.00V

248. The expression for determining the power dissipation in an electric circuit:

a) P=VI b) $P=I^2R$ c) $P=V^2/R$ d) All

249. Four bulbs of 10W, 20W, 30W and 40W are connected in parallel, the bulb that will shine more is:
a) 10W b) 30W c) 20W d) 40W

250. Power dissipated in two parallel resistor is inversely proportional to their:
a) Potential difference b) Current
c) Resistance d) All of these

251. A source of 200V provides a current of 10.0 Amperes to a house. The power delivered by the source is:
a) 20 watt b) 2000 watt c) 40 watt d) 200 watt

252. An electric bulb rated at 220V 140 watt is connected to 110V power line, the current that flows in it is:
a) 1.27 A b) 2.27A c) 1.83A d) 2.83A

253. A student kept her 60 watt, 120 volt study lamp turned on from 2:00 PM until 2:00 AM. How many coulombs of charge went through it?
a) 3,600 b) 18,000 c) 7,200 d) 21,600

254. An certain resistor dissipates 0.5 W when connected to a 3V potential difference. When connected to a IV potential difference, this resistor will dissipate:
a) 0.5W b) 1.5W c) 0.167W d) 0.056W

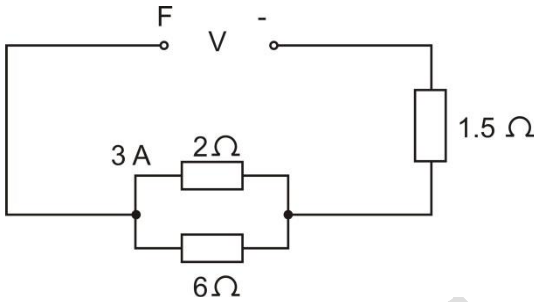
255. A flat iron is marked “120V, 600W”. in normal use, the current in it is:
a) 2A b) 4A c) 5A d) 7.2A

256. A certain x-ray tube requires a current of 7 mA at a voltage of 80 kV. The rate of energy dissipation (in watts) is:
a) 560 b) 5600 c) 26 d) 11.4

257. A 100W, 200V bulb is connected to a 160V supply. The actual power consumption would be:
a) 64W b) 100W c) 72W d) 90W

258. Two 110 V light bulbs, one “25W” and the other “100W”, are connected in series to a 110 V source. Then
a) The current in the 100 W bulb is greater than that in the 25 W bulb
b) The current in the 100 W bulb is less than that is the 25 W bulb
c) 100 W bulb has greater resistance
d) 25W bulb has greater resistance

259. In the circuit shown, there is a current of 3 A in 2Ω resistor.



What are the values of the current I delivered by, and the voltage V across the power supply?

	I / A	V / V
A	3	10.5
B	4	9
C	4	12
D	12	18

260.

Thermocouple

261. Thermocouples covert: ETEA 2016-21 Eng
(a) Chemical into electrical energy
(b) Heat into electrical energy
(c) Mechanical into electrical energy
(d) Light into electrical energy

262.

Kirchoff’s Law

263. Four wires meet at a junction. The first carries 4A into junction, the second carries 5A out of the junction and 3rd carries 2A out of the junction. The 4th carries; **ETEA-2019**
a) 7A out of the junction
b) 7A into the junction
c) 3A out of the junction
d) 3A into the junction

264. Kirchhoff’s first law/rule corresponds to **MDCAT - 2019**
a. Law of conservation of energy
b. Law of conservation of charge
c. Law of conservation of momentum
d. Law of conservation of mass

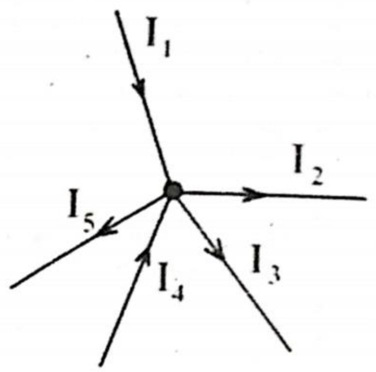
265. Kirchhoff's first law is based upon law of conservation of ETEA 2018- Eng
A)Charge B)Energy
C)Mass D) Momentum

266. Kirchoff’s first law is based upon law of conservation of: ETEA 2012-29 Eng:
(a) charge (b) energy
(c) mass (d) momentum

267. Four wires meet at a junction. The first carries 4A in to the junction, the second carries 5A out of the junction, and third carries 2A out of the junction. The fourth carries: ETEA 2015-89 Med
A) 7A out of junction B) 7A into junction

C) 3A out of junction D)3A into the junction

268. Which of the following is true concerning the diagram below? **NUMS-2019**



NUMS-2019

$I_1 + I_2 + I_3 + I_4 + I_5 = 0$

$I_1 - I_2 - I_3 + I_4 - I_5 = 0$

$-I_1 + I_2 + I_3 - I_4 + I_5 = 0$

Both b & c

269. Kirchoff's current law (KCL) is based upon law Of conservation of **KMU-CAT 2021**

A) Mass

B) Energy

C) Momentum

D) Charge

270. Kirchhoff's first law is based upon law of conservation of

A)Charge B)Energy C)Mass D) Momentum

271. **Kirchhoff's first rule is:**

(a) ∑V=0 (b) ∑ I=0 (c) ∑ R=0 (d) ∑ T=0

272. Kirchhoff's first rule is also known as:

a) Kirchhoff's Point Rule

b) Kirchhoff's Rule for Static Charges

c) Kirchhoff's Loop Rule

d) Kirchhoff's Rule for Point Charges

273. A complex system consisting of a number of resistors can be solved by:

a) ohm's law b) joule's law

c) Kirchhoff's first rule d) Lenz's law

274. Kirchhoff's second rule is based on conservation of:

a) Energy b) Voltage c) Charge d) Mass

275. The algebraic sum of voltages changes around a closed circuit or loop is zero, is Kirchhoff's

a) 1st law b) 2nd law c) 3rd law d) 4th law

276. Kirchhoff's second rule is also known as:

a) Kirchhoff's Loop Rule

b) Kirchhoff's Rule for Static Charges

c) Kirchhoff's Point Rule

d) Kirchhoff's Rule for Point Charges

277. Kirchhoff's second rule is given in mathematical form as:

a) $E_1\text{-}IR_1\text{-}E_2\text{-}IR_2=0$ b) $E_1+I_2R\text{-}E_2\text{-}I_1R_1=0$

c) $E_1\text{-}IR_1+E_2\text{-}IR_2=0$ d) $E_1\text{-}IR_1\text{-}E_2+IR_2=0$

278. Kirchhoff's 2nd is the manifestation the law of conservation of:

a) Change b) Momentum

c) Energy d) All of these

279. The sum of the electrical currents into a point in a circuit is equal to the sum of the currents out of the point. Which of the following is correct?

a) This is Kirchhoff's first law, which results from the conservation of charge.

b) This is Kirchhoff's first law, which results from the conservation of energy.

c) This is Kirchhoff's second law, which results from the conservation of charge.

d) This is Kirchhoff's second law, which results from the conservation of energy

280. Four wires meet at a junction. The first carries 4A into the junction, the second carries 5A out of the junction, and the third carries 2A out of the junction. The fourth carries:

a) 7A out of the junction

b) 3A out of the junction

c) 7A into the junction

d) 3A into the junction

281. The terminal voltage of a battery is observed fall when the battery supplies a current to external resistor.

What quantities are needed to calculate the fall ¡n voltage?

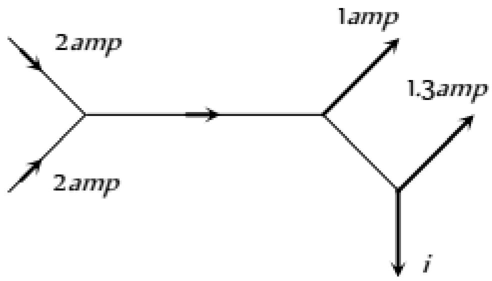
a) the battery's e.m.f. and its internal resistance

b) the battery's e.m.f. and the current .

c) the Current and the battery's internal resistance

d) the current and the external resistance

282. The figure below shows currents in a part of electric circuit. The current I is



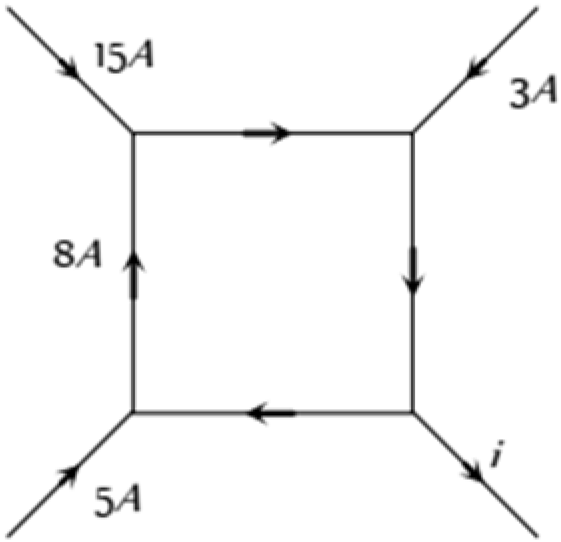
a. 1.7 amp

b. 3.7 amp

c. 1.3 amp

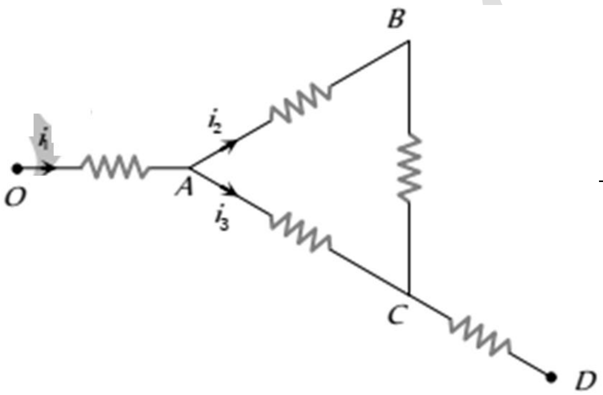
d. 1 amp

283. The figure shows a network of currents. The magnitude of currents is shown here. The current i will be



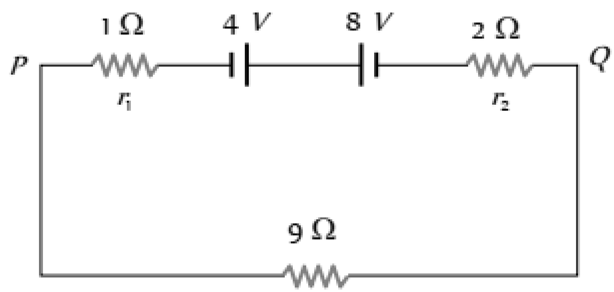
a. 3A
b. 13A
c. 23A
d. – 3A

284. The current in the arm CD of the circuit will be



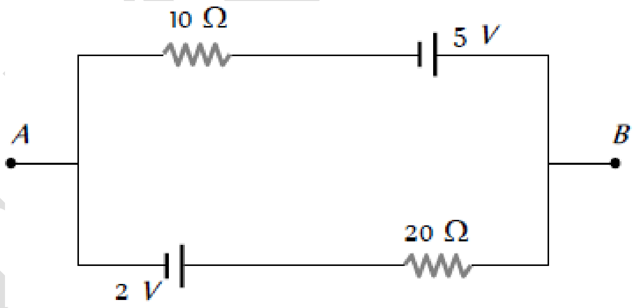
a. $i_1 + i_2$
b. $i_2 + i_3$
c. $i_1 + i_3$
d. $i_1 - i_2 + i_3$

285. Two battries of e.m.f. 4V and 8 V with internal resistance 1Ω and 2Ω are connected in a circuit with a resistance of 9Ω as shown in figure the current and potential difference between the points P and Q are



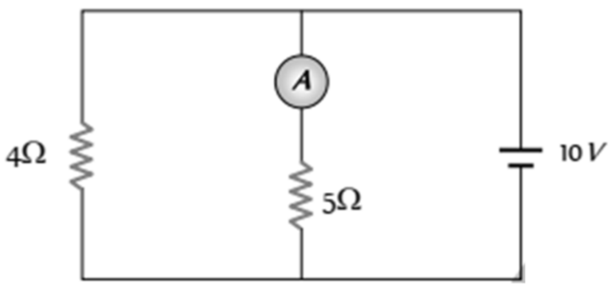
a. $\frac{1}{3}A\ and\ 3V$
b. $\frac{1}{6}A\ and\ 4V$
c. $\frac{1}{9}A\ and\ 9V$
d. $\frac{1}{2}A\ and\ 12\ V$

286. The current in the given circuit is



a. 0.1 A
b. 0.2 A
c. 0.3 A
d. 0.4 A

287. In the circuit, the reading of the ammeter is (assume internal resistance of the battery be zero)

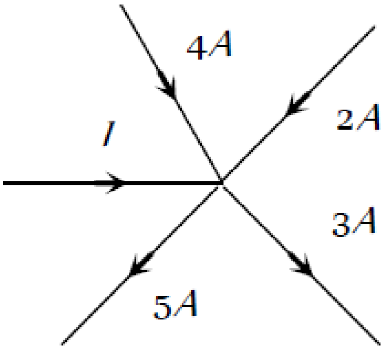


a. $\frac{40}{29}A$
b. $\frac{10}{9}A$
c. $\frac{5}{3}A$
d. $2A$

288. Current provided by a battery is maximum

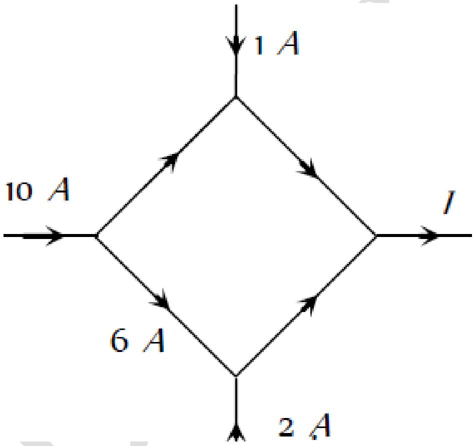
when
a. Internal resistance equal to external resistance
b. Internal resistance is greater than external resistance
c. Internal resistance is less than external resistance
d. None of these

289. In the given current distribution what is the value of l



a. 3A
b. 8A
c. 2A
d. 5A

290. The figure shows a network of current. The magnitude of currents is shown here. The current l will be



a. 3A
b. 9A
c. 13A
d. 19A

Potentiometer

291. Potentiometer is the instrument works on the principle of: ETEA 2009-57 Med:
(a)Kirchhol's 1st law (b) Wheatstone bridge
(c)Combination of resistance (d)Kirchhoff's 2nd law

Wheatstone bridge

292. Potentiometer is the instrument works on the principle of:
(a)Kirchhol's 1st law
b) Wheatstone bridge
(c)Combination of resistance
(d)Kirchhoff's 2nd law

293. An instrument for accurately determining the value of an unknown resistance:
a) Galvanometer b) Voltmeter
c) Ammeter d) Wheatstone Bridge

294. A Wheatstone bridge consists of:
a) 2 Resistors b) 4 Resistors
c) 2 Diodes d) 4 Diodes

295. The condition for balanced Wheatstone Bridge is:
a) $R_1/R_2=R_3/R_4$ b) $R_3/R_2 = R_1/R_4$
c) $R_1/R_3 = R_4/R_2$ d) $R_1/R_4 = R_2/R_3$

296. Under balanced condition, the wheatstone bridge principle is
a) $\frac{R_1}{R_2}=\frac{R_3}{R_4}$ b) $\frac{R_1}{R_2}=\frac{R_4}{R_3}$ c) $\frac{R_1}{R_3}=\frac{R_2}{R_4}$ d) $\frac{R_3}{R_1}=\frac{R_2}{R_4}$

297. Three arms of a balanced wheatstone bridge are of 75 ohms resistance each. What is the resistance of fourth arm?
a) 225 ohm (b)150 ohm (c)75 ohm (d)300 ohm

298. When the Wheatstone bridge is balanced, then:
a) maximum current flows through the galvanometer
b) potential difference across the Galvanometer is zero
c) potential difference across the Galvanometer is maximum
d) galvanometer shows full deflection

299. In a Wheatstone bridge, what is the value of R_4 for a deflection if R_1=5 ohms R_2= 10 ohms and R_3= 15 ohms:
a) 20 ohms b) 30 ohm c) 40 ohms d) 50 ohms

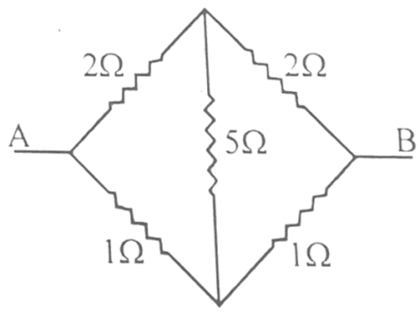
300. The post office box is an apparatus whose construction is based upon the principal of a:
a) galvanometer b) voltmeter
c) ammeter d) Wheatstone bridge

301. The condition for the Wheatstone bridge to be balanced is given by:
a) $R_1R_2= R_3/X$ b) $R_2 R_1= R_3/X$
c) $R_1R_2= X/R_3$ d) $R_1R_3= R_2/X$

302. In slide wire bridge method, the unknown resistance determined by the relation
a) $X= (l_2 /l_1)\times R$ b) $X=(1 /l_2)\times R$
c) $X= R/ l_1 l_2$ d) $X= l_1/ l_2R$

303. Find out the value of "R_{eq}" between oints "A" and

"B"

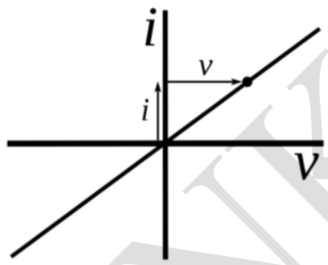


a) $\frac{5}{4}\Omega$ b) 100Ω c) $\frac{4}{3}\Omega$ d) None

Key

1.	B	I = q/t → q = It Coloumb = ampere x second
2.	A	I = q/t = slope
3.	A	I = Q/t→ Q = IT
4.	D	In a conducting electric wire, the electric current flows due to Electrons, in semi-conductors due to holes and protons, and in electrolyte due to ions.
5.	A	T= 10 min= 600 sec and q= 3000 col →1=q/t=3000/600=5
6.	D	I = $\frac{Q}{t} = \frac{ne}{t}$ & n = $\frac{It}{e} = \frac{1\times1}{1.602\times10^{-19}}$ = 6.42×10^{18}
7.	C	1=Q/t→ Q=It→5mA x 200s= 0.005 x 200 = 1.000
8.	A	I=q/t=ne/t → n=It/e=3.2 x 1 /1.6 x 10^{-19} =
9.	C	Q=It=(P/V)t=(60/120)x(12x3600)=21600
10.	C	I = $\frac{Q}{t}$⇒ Q = I x t = ampere hour → (Ampere x time)
11.	D	0.5 A= 0.5 mA/m = 0.5/10^{-3} mA = 0.5 x 10^{3} mA = 500 mA
12.	C	Q=It = 5 x 10^{-3} x 200 = 1C
13.	A	Larger the cross-sectional area lesser will be the resistance
14.	B	I= Q/t → 1A = 1C/1s
15.	A	T= 10 min= 600 sec and q= 3000 col →1=q/t=3000/600=5
16.	D	
17.	d	Using the formula Q = it, $I = \frac{2x1.6x10^{-19}}{1.0x10^{-15}} = 3.2\ x\ 10^{-4}A$
18.	C	I = $\frac{Q}{t}$⇒ Q = I x t = ampere hour → (Ampere x time)
19.	D	0.5 A= 0.5 mA/m = 0.5/10^{-3} mA = 0.5 x 10^{3} mA = 500 mA
20.	C	Q=It = 5 x 10^{-3} x 200 = 1C
21.	A	Number of electrons flowing per second $\frac{n}{t} = \frac{i}{e}$ = 4.8 / 1.6 x $\mathbf{10^{-19}}$ = $\mathbf{3\ x\ 10^{19}}$
22.	**C**	Because 1 H.P = 746 J/s = 746 watt
23.	**C**	$i = \frac{q}{t} = \frac{4}{2} = 2ampere$
24.	**C**	$i = \frac{ne}{t} = \frac{62.5\ x\ 10^{18} x\ 1.6\ x\ 10^{-19}}{1} =$ $10\ ampere$
25.	**D**	Charge = current x Time = 5 x 60 = 300 C
26.	B	V = IR = 0. 5 x 200 = 100 volt
27.	D	Ohm's law states that the current is directly proportional to V and inversely proportional to R I = V/R
28.	A	When a bird is perched on a single wire, its two feet are at the same electrical potential, so the electrons in the wires have no motivation to travel through the bird's body. No moving electrons means no electric current. 
29.	D	The resistance of the conducting material depends upon a) The nature of the conductor b) Dimension of the conductor c) Physical state of the conductor
30.	A	The SI unit of electric potential is Volt.

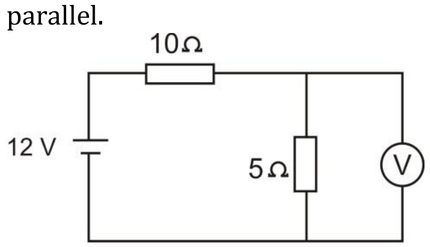
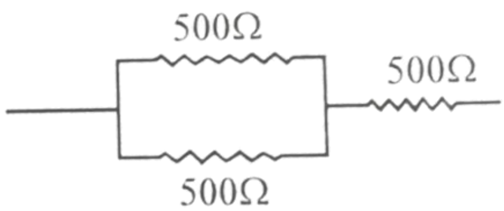
		V = W/q = J/C = volt
31.	A	if the amount of work W is required to move a charge Q from one point to another then the potential difference between the two points is given by V = W/Q
32.	C	Potential circuit is made when Resistance is divided
33.	A	
34.	D	Metals are ohmic material.
35.	C	I = $\frac{v}{R}$ = $\frac{6\times6\times10^3}{2\times10^6}$ = $3 \times 10^{3-6}$A=3×10^{-3}A
36.	D	**Filament bulb, thermistor and semiconductor diode are non-ohmic materials while metals are ohmic devices or substances.**
37.	B	V =W/q , W =qV =2eV = $2e10^6$V = $2x10^6$eV = 2MeV
38.	D	V =IR → R = V/I $\frac{V}{I}C = RC = time\ constant$
39.	C	Ohm's law of current electricity states that the current flowing in a conductor is directly proportional to the potential difference across its ends provided the physical conditions and temperature of the conductor remains constant.

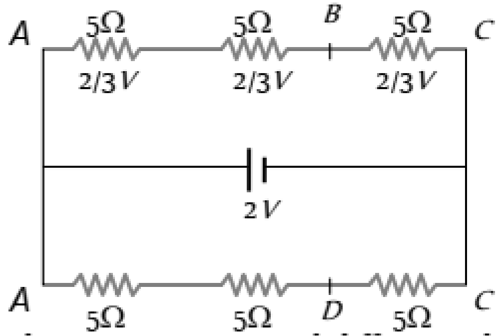


40.	d	The current flowing through a conductor is directly proportional to the applied potential difference across its ends provided that temperature remains constant is statement of Ohm's Law
41.	d	The VI-graph of Ohm's law is Straight
42.	B	Mathematical form of ohm's law is I = V/R
43.	A	Ohm's law is valid for only current flowing in Conductors
44.	D	Metals are ohmic material.
45.	D	
46.	A	$1 \propto V$ (According to Ohm's law)
47.	b	By Ohm's law: $R = \frac{V}{I} => V - R\ x\ I$
48.	A	Resistivity of some material is its intrinsic property and is constant at particular temperature. Resistivity does not depend upon shape.
49.	C	$R_1 \propto \frac{l}{A} => R_2 \propto \frac{2l}{2A} i.e. R_2 \propto \frac{l}{A}$ $\therefore R_1 = R_2$
50.	D	In case of stretching of wire $R \propto l^2$ ⇨ If length becomes 3 times so resistance becomes 9 times i.e. R' = 9 x 20 = 180Ω
51.	D	Resistivity is the property of the material. It does not depend upon size and shape.
52.	A	Because with rise in temperature resistance of conductor increase, so graph between V and I becomes non linear.
53.	C	Because V-I graph of diode is non-linear.
54.	B	$R \propto \frac{1}{A} => R \propto \frac{1}{r^2} \propto \frac{1}{d^2}$
55.	D	$R \propto \frac{l}{r^2} => \frac{R_1}{R_2} = \frac{l_1}{l_2}\ x\ \frac{r_2^2}{r_1^2} => \frac{1}{1}$ $= \frac{5}{l_2} x \left(\frac{2}{1}\right)^2 => l_2$ $= 20m$
56.	C	
57.	B	In semiconductors change carries are free electrons and holes
58.	A	With rise in temperature specific resistance increases
59.	C	For metallic conductor temperature co-efficient of resistance is positive.
60.	B	$R \propto \frac{l}{A} \propto \frac{l}{d^2} => \frac{R_1}{R_2} = \frac{l_1}{l_2} x \left(\frac{d_2}{d_1}\right)^2 =$ $\frac{L}{4L}\left(\frac{2d}{d}\right)^2 = 1$ $= R = R = R$
61.	C	$R = p\frac{l}{A}$
62.	A	Since $R \propto l^2$ => if length is increased by 10% resistance is increases by almost 20% Hence new resistance R' = 10 + 20% of 10 = 10 + $\frac{20}{100} x\ 10 = 12\Omega$
63.	A	The reciprocal of resistance is called conductance
64.	A	Resistance = $\frac{Potential\ difference}{Current}$

65.	**C**	Ohm's Law is not obeyed by semiconductors.
66.	**D**	Resistivity depends only on the material of the conductor.
67.	**A**	A particular temperature, the resistance of a superconductor is zero => $G = \frac{1}{R} = \frac{1}{0} = \infty$
68.	**C**	$R_t = R_0(1 + \alpha t)$ ⇨ $4.2 = R_0(1 + 0.04\ x\ 100) = 1.4\ R_0 => R_0 = 3\Omega$.
69.	**D**	$R \propto \frac{l^2}{m} => R_1 : R_2 : R_3 =$ $\left(\frac{l_1}{m_1}\right)^2 : \left(\frac{l_2}{m_2}\right)^2 : \left(\frac{l_3}{m_3}\right)^2$ $= \frac{25}{1} : \frac{9}{3} : \frac{1}{5} = 25 : 3 : \frac{1}{5} => 125 : 15 : 1.$
70.	**C**	Resistance = $p\frac{l}{A}$ $\therefore \frac{R_1}{R_2} = \frac{p_2}{p_2} x \frac{l_1}{l_2} x \frac{A_2}{A_1} = \frac{2}{3} x \frac{3}{4} x \frac{5}{4} x = \frac{5}{8}$
71.		
72.	C	Electric power: watt (W) Current unit is ampere Resistance unit it ohm Charge unit is coloumb.
73.	B	R =1/G = 1/0.05 = 20
74.	B	Resistivity depends upon the nature
75.	A	R = ρL/A R will be less for short L and larger area (thicker) and low temperature(cool)
76.	B	$R = \rho L/A = \rho L/\pi r^2$ In current situation: $R = \rho\pi/\pi r^2 = \rho/r^2$
77.	B	R = R + R = 2R
78.	C	Increase due to length 4 times. Increase due to radius 9 times so total increase . so total increase is 36 times, no option is correct. But if we ignore the case of stretching, 2 x9 = 18R
79.	C	**Sol: Taking Volume Constant...** **A - Cross section area of wire (πr^2)** **L- Length of wire.** **A2.L2 = A1.L1** **r2 = 2.r1 (As diameter is doubled)** **A2= 4.A1** **This gives.... L2 = L1/4** **If radius (diameter) is doubled length becomes one fourth.** **Resistance is proportional to L/A.** **R2 =R1/16.**
80.	C	**Sol: The *resistance* increases as the *temperature* of a *metallic conductor* increase with increase in temperature .The graph between resistance and temperature is linear for both increasing and decreasing.**
81.	A	With the increase in temperature, the random motion of electrons increases. As a result, the number of collisions of electrons with the positive ions increases in a metal. Hence, the resistance of a metal increases with increase in temperature.
82.		
83.	B)	
84.	**B)**	
85.	**B)**	
86.	B)	
87.	D)	
88.	B	
89.	C	
90.	C	
91.	A	
92.	B	
93.	B	
94.	C	$\frac{1}{Req} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \frac{1}{R4}$, *Hence* Req=5Ω and I $= \frac{V}{R} = \frac{20}{5} =$ **4.0 A**
95.	B	$\frac{1}{Req} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \cdots.. + \frac{1}{Rn}$ =Req is decreased
96.	B	We know that R=ρL/A making L → 2L and A → A/2 the R becomes =ρ 2L/A/2 = =2 x 2 ρL/A =4ρL/A =4R. 4 x 50 = 200Ω
97.	A	Resistivity depends on nature of material not on its dimesntion
98.	D	$R = \rho L/A = \rho L/\pi r^2 \rightarrow r^2 = \rho L/\pi R$ putting values $r^2 = 1.0\times10^4$ x 4/3.14 x 32
99.	d	The unit oc resistance is opposite to that of resistance conductance = 1/ohm= ohm^{-1} = mho
100.	B	
101.	A	
102.	A	$R_p : R_q = \frac{1}{2} : 1 = 1 : 2 = \frac{1}{2} = 0.5$
103.	B	$\frac{1}{Req} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \cdots.. + \frac{1}{Rn}$ =Req is decreased
104.	D	In parallel voltage remain same
105.	d	Px : Py $\frac{v^2}{Rx} : \frac{v^2}{Ry} = \frac{(12)^2}{Rx} : \frac{(6)^2}{Ry} = \frac{144}{Rx} : \frac{36}{Ry} \Rightarrow \frac{Rx}{Ry} = \frac{144}{36} = 4$
106.	D	**Req:** (In Series) = R+R+R= 3R
107.	A	In parallel voltage remain same while in series the current remains same
108.	B	

109.	C	
110.	A	
111.	B	**In series the voltage are added,Hence the net voltage will be =6V+12V=18V** **Thus; I=V/R =18/10=1.8A**
112.	B	
113.	D	Conductivity=б = $\frac{L}{RA}$
114.	A	
115.	B	
116.	c	
117.	D	
118.	C	I = V / R+r = 1.5/3+2 = 3/10 = V =IR = 3 x [3/10] = 9/10 = 0.9 volt
119.	A	
120.	B	I = V / R+r → Emf=I(R+r) E= IR+Ir = V +Ir = Thus V=E-Ir = 5-0.1 = 4.9
121.	C	
122.	D	
123.	A	In open circuit the terminal voltage of the battery is qual to the battery.
124.	c	**Taking Volume Constant...** **A - Cross section area of wire (πr^2)** **L- Length of wire.** **A2.L2 = A1.L1** **r2 = 2.r1 (As diameter is doubled)** **A2= 4.A1** **This gives.... L2 = L1/4** **If radius (diameter) is doubled length becomes one fourth.** **Resistance is proportional to L/A.** **R2 =R1/16.**
125.	C	**The *resistance* increases as the *temperature* of a *metallic conductor* increase with increase in temperature .The graph between resistance and temperature is linear for both increasing and decreasing.**
126.	**B**	
127.	A	
128.	**A**	
129.	B	
130.	C	
131.	**B**	
132.	D	

133.		
134.	D	Req: (In Series) = R+R+R= 3R
135.	A	In parallel voltage remain same while in series the current remains same
136.	b	The ratio of V to I is resistance, which is the reciprocal of the gradient of I against V graph. A metal wire at constant temperature will have a constant resistance. A semiconductor diode will experience a sudden crease ¡n current when voltage is forward bias. The resistance of filament lamp will increase as temperature (or current) increases.
137.	C	$\frac{1}{Req}=\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\frac{1}{R4}$, *Hence* Req=5Ω and I $=\frac{V}{R}=\frac{20}{5}$= 4.0 A
138.	B	$\frac{1}{Req}=\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\cdots..+\frac{1}{Rn}$ =Req is decreased
139.	A	$R_p : R_q = \frac{1}{2} : 1 = 1 : 2 = \frac{1}{2} = 0.5$
140.	B	$\frac{1}{Req}=\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\cdots..+\frac{1}{Rn}$ =Req is decreased
141.	D	In parallel voltage remain same
142.	b	Note that the 2 vertical resistors are in parallel.  Net resistance of 2 parallel is $R = \left(\frac{1}{10}+\frac{1}{10}\right)^{-1} = 5\,\Omega$ The p.d. across 5 Ω V = $(\frac{5}{5+10})$ (12) = 4V
143.	D	Resistance of a conductor depends upon A) nature of conductor B) dimension of conductor C) physical state of the conductor
144.	D	 $R_e = \frac{500}{2} + 500 = 750\,\Omega$
145.	B	R = $p\frac{L}{A} = P\frac{L}{\pi r^2} => R \propto \frac{L}{r^2}$ Wire 1 : $\frac{l}{r^2}$

		Wire 2 : $\frac{l/4}{(r/2)^2} = \frac{l}{r^2}$ Wire 3: $\frac{l/2}{(r/2)^2} = 2\left(\frac{l}{r^2}\right)$ Wire 4: $\frac{l}{(r/2)^2} = 4\left(\frac{l}{r^2}\right)$ Wire 5: $\frac{5l}{(2r)^2} = \frac{5}{4}\left(\frac{l}{r^2}\right) = 1.25\left(\frac{l}{r^2}\right)$
146.	A	$R_e = R$ $\frac{R}{9} = R$ $\frac{Pl}{9\pi d^2} = \frac{pL}{\pi d'^2} => 9d'^2 => d'^2 => d' = 3d$
147.	B	In parallel combination $I = \frac{V}{R} => 1 \propto \frac{I}{R}$
148.	B	$R = \frac{PL}{A}$ and $R \propto T$ $R \propto \frac{L}{A}$ and $R \propto T$
149.	D	$R = \frac{V}{I} = \frac{6}{0.3} = 20\,\Omega$ $H = I^2Rt = (0.3)^2(20)(12) = 9(2)(12) = 216$ J
150.	C	Resistance of each part = R/2 The resistance of bundle, $R_e = \frac{\frac{R}{2}}{2} = \frac{R}{4}$
151.	D	$\frac{R_A}{R_B} = \frac{pL/A_A}{pL/A_B} = \frac{A_B}{A_A} = \frac{\pi d_B^2}{\pi d_A^2} = \frac{(2^2-1^2)}{1^2} = 3$
152.	B	$R_e = \frac{R}{n} = \frac{9}{3} = 3\Omega$
153.	D	Resistance of each part = $\frac{12.8}{n}$ $R_e = \frac{R}{n} = \frac{\frac{12.8}{n}}{n} = = \frac{12.8}{n^2}$ $N^2 = \frac{R}{R_e} = \frac{12.8}{1/5} = 12.8(5) = 64 => n = \sqrt{64} = 8$
154.	C	$R_e = R/n = 20/4 = 5\,\Omega$ $I = \frac{V}{R_e} = \frac{20}{5} = 4A$
155.	B	$R_e = R/n = 20/4 = 5\,\Omega$ $I = \frac{V}{R_e} = \frac{20}{5} = 4A$ When identical resistance are connected in parallel, same current flows each resistance (equally divides) so, current through each resistance = 1 A
156.	A	$R_e = nR = 4(20) = 80\,\Omega$ $I = \frac{V}{R_e} = \frac{20}{80} = 0.25\,A$ When identical resistances are connected in series. Same current all resistances. So, current through each resistance = 0.25A
157.	B	R = pL/A=4pL/ 〖πd〗^2 =>R ∝1/d^2 As Dp = 2dQ So, RQ = 4RP In parallel combination current divides I = V/R=>1 ∝1/R IP = 4IQ=> I_P/I_Q =4
158.	B	$\frac{1}{R_e} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6} = \frac{6+3+2}{12} = \frac{11}{12} => R_e = \frac{12}{11}$
159.	C	$R = \frac{pL}{A} = \frac{4pL}{\pi d^2}$ $I = \frac{V}{R} = \frac{V}{4pL/\pi d^2} = \frac{V\pi d^2}{4pL}$ $R' = \frac{4pL}{\pi d^2} = \frac{4p(2L)}{\pi(2d)^2} = \frac{1}{2}\left(\frac{4pL}{\pi d^2}\right) = \frac{1}{2}R$ $I' = \frac{V'}{R'} = \frac{2V}{R/2} = 41$
160.	B	$R = \frac{pL}{A} = \frac{4pL}{\pi d^2}$ $R' = \frac{4pL}{\pi d^2} = \frac{4p(2L)}{\pi(2d)^2} = \frac{1}{2}\left(\frac{4pL}{\pi d^2}\right) = \frac{1}{2}R$
161.	B	We know that R=ρL/A making L → 2L and A → A/2 the R becomes =ρ 2L/A/2 = =2 x 2 ρL/A =4ρL/A =4R. 4 x 50 = 200Ω
162.	A	Resistivity depends on nature of material not on its dimesntion
163.	D	R= ρL/A = ρ L/π r^2 →r^2 = ρL/πR putting values r^2 = 1.0×10^4 x 4/3.14 x 32
164.	C	Resistance and conductance are the electrical properties of material.
165.	C	Conductance = $\frac{1}{R} = \Omega^{-1} = seimen$
166.	C	The reciprocal of conductance is resistance.
167.	d	The unit of resistance is opposite to that of resistance conductance = 1/ohm= ohm^{-1} = mho
168.	B	R = ρ L/A putting L and A = 1 so R=ρ
169.	D	Conductivity=6 = $\frac{L}{RA}$
170.	**C**	The given circuit can be redrawn as follows  For identical resistance, potential difference distributes equally among all. Hence potential difference across each resistance is $\frac{2}{3}V$, and potential difference between A and B is $\frac{4}{3}$ V.
171.	**D**	Equivalent resistance of parallel resistors is always less than any of the member of the resistance system.
172.	**A**	Each part will have resistance r = R/10 Let equivalent resistance be $r_R then$

$\frac{1}{r_R} = \frac{1}{r} + \frac{1}{r} + \frac{1}{r}$ ……….. . 10 times

$\therefore \frac{1}{r_R} = \frac{10}{r} = \frac{10}{R/10} = \frac{100}{R} => r_R = \frac{R}{100} =$ 0.01 R

173. **C** $R_{equivalent} = \frac{(30+30)30}{(30+30)+30} = \frac{60 \ x\ 30}{90} =$ 20Ω

$\therefore i = \frac{V}{R} = \frac{2}{20} = \frac{1}{10} ampere$

174. **B** Resistance of parallel group = $\frac{R}{2}$

∴ Total equivalent resistance = 4 x $\frac{R}{2} = 2R$

175. **C** Resistance of 1 ohm group = $\frac{R}{n} = \frac{1}{3}\Omega$

This is in series with $\frac{2}{3}\Omega$ resistor.

∴Total resistance = $\frac{2}{3} + \frac{1}{3} = \frac{3}{3}\Omega = 1\Omega$

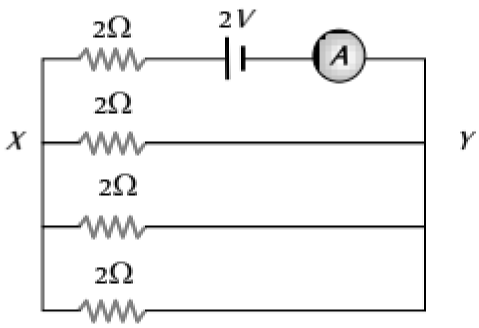
176. **C** Lowest resistance will be in the case when all the resistors are connected in parallel

$\frac{1}{R} = \frac{1}{0.1} + \frac{1}{0.1}$ ……. 10 times

$\frac{1}{R} = 10 + 10$ …….. 10 times

$\frac{1}{R} = 100$ i.e. R = $\frac{1}{100}\Omega$

177. **B** Resistance across $XY = \frac{2}{3}\Omega$



Total resistance

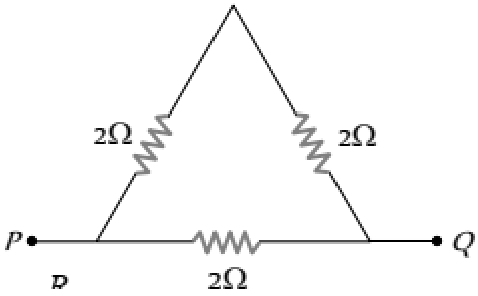
$= 2 + \frac{2}{3} = \frac{8}{3}\Omega$

Current through ammeter

$= \frac{2}{8/3} = \frac{6}{8} = \frac{3}{4}A$

178. **A** Equivalent resistance of the combination

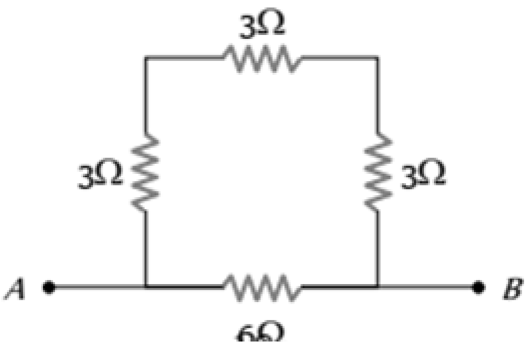
$= \frac{(2+2)x2}{2+2+2} = \frac{8}{6} = \frac{4}{3}\Omega$



179. **B** In parallel, x = $\frac{R}{n}$, R = nx

In series, R+R+R … n times = nR = n(nx) = n^2 x

180. **D** The circuit reduces to



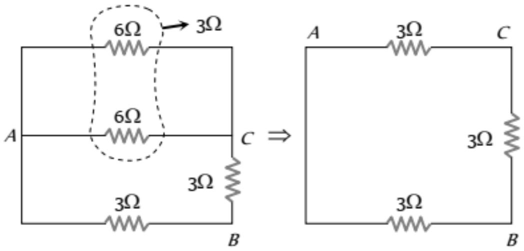
$R_{AB} = \frac{9\ x\ 6}{9+6} = \frac{9\ x\ 6}{15} = \frac{16}{5} = 3.6\ \Omega$

181. **D** As resistance ∝ Length

Resistance of each arm = $\frac{12}{3}$ = 4Ω

⇨ $R_{effective} = \frac{4\ x\ 8}{4+8} = \frac{8}{3}\Omega$

182. **B** Given circuit is equivalent to



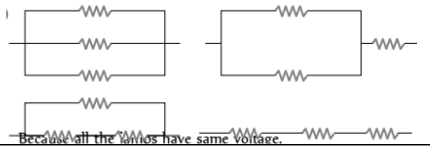
So the equivalent resistance between points A and B is equal to

$R = \frac{6\ x\ 3}{6+3} = 2\Omega$

183. **D** Potential difference across all resistors in parallel combination is same.

184. **D** $R = r + \frac{3r}{2} = \frac{5r}{2}$

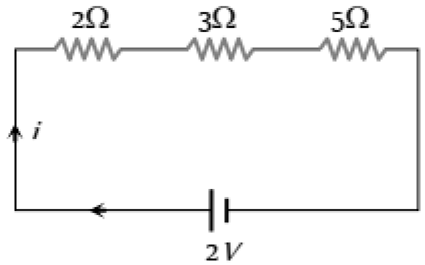
185. **C** $2^{n-1} = 4$



186. **B** Because all the amps have same voltage.

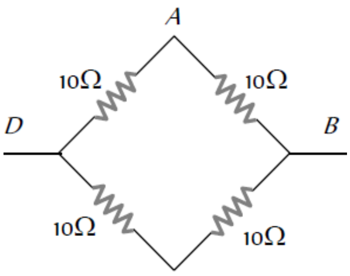
187. **D** $R_{series} = R_1 + R_2 + R_3 + \dots\dots$

188. **A** Current supplied by cell $i = \frac{2}{2+3+5} = \frac{1}{5}A$



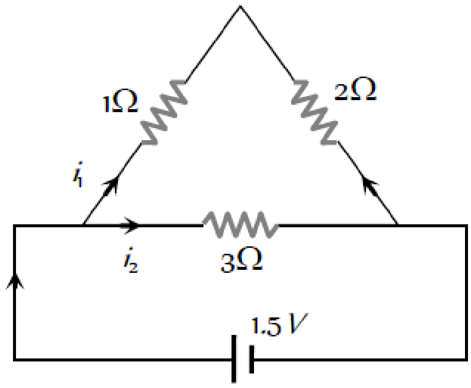
So potential difference across 3 will be
V = $3 \times \frac{1}{5} = 0.6\ V$

189. **A** According to the problem, we arrange four resistance as follows



Equivalent resistance = $\frac{20 \times 20}{40} = 10\Omega$

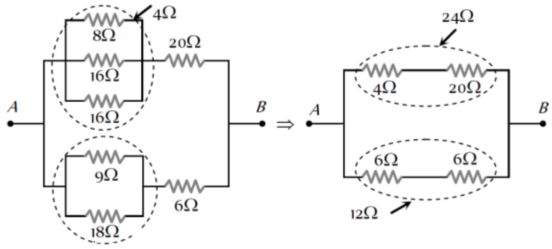
190. **B** $i_1 + i_2 = \frac{1.5}{3/2} = 1\text{amp}$



$\frac{i_1}{i_2} = \frac{3}{3} \Rightarrow i_1 = i_2 \because i_2 = 0.5\ A = i_1$

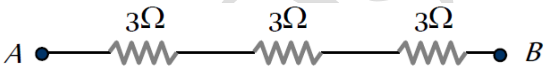
191. **C** $V_P - V_q = \left(\frac{6}{3} + \frac{12 \times 6}{12+6}\right)(0.5) = (2+4)(0.5) = 3V$

192. **B**



R_{AB} = 8 ohm

193. **D** The network can be redrawn as follows

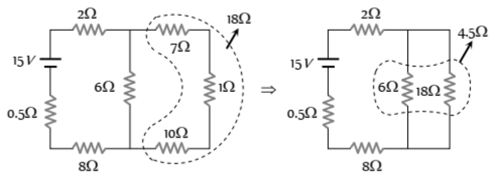


⇨ $R_{eq} = 9\Omega$

194. **D** Equivalent resistance = $\frac{4 \times 4}{4+4} + \frac{6 \times 6}{6+6} = 5ohm$

the current in the circuit = $\frac{20}{5} = 4\ ampere$ hence the current flowing through each resistance = 2 ampere.

195. **A** The given circuit can be simplified as follows



On further solving equivalent resistance R =15Ω

Hence current from the battery $i = \frac{15}{15} = 1A$

196. **C** $\frac{1}{R} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1} = \frac{3}{1} \Rightarrow R = \frac{1}{3}ohm$

Now such three resistance are joined in series, hence total $R = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1\ ohm$

197. **B** To obtain minimum resistance, all resistors must be connected in parallel.Equivalent resistance of combination = $\frac{r}{10}$

198. **D** Three resistances are in parallel

$\therefore \frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$

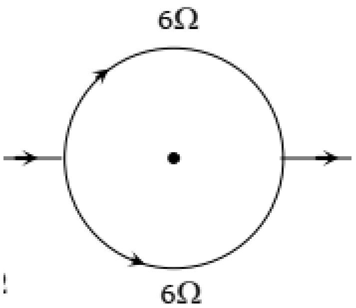
The equivalent resistance R' = $\frac{R}{3}\Omega$

199. **D** $R \propto l$

Hence every new piece will have a

resistance $\frac{R}{10}$. If two pieces are connected in series, then their resistance $= \frac{2R}{10} = \frac{R}{5}$
If 5 such combinations are joined in parallel, then net resistance $= \frac{R}{5\,x5} = \frac{R}{25}$

200. **C** $R_{eq} = \frac{6}{2} = 3\Omega$



201. **B** If all are in series then $R_{eq} = 12\Omega$
If all are in parallel then $R_{eq} = \frac{4}{3}\Omega = 1.33\ \Omega$
If two are in series then parallel with third, $R_{eq} = \frac{8}{3} = 2.6\ \Omega$
If two are in parallel then series with third, $R_{eq} = 6\Omega$

202. **D** Resistance of each part will be $\frac{R}{n}$; such n parts are joined in parallel so $R_{eq} = \frac{R}{n^2}$.

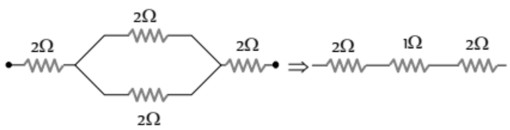
203. **C** $R_{max} = nR$ and $R_{min} = R/\,n \Rightarrow \frac{R_{max}}{R_{min}} = n^2$

204. **C** The circuit consists of three resistance (2R, 2R and R) connected in parallel.

205. **D** Resistance across the battery is
$$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6} \Rightarrow R_p = 2\Omega$$
$\Rightarrow I = \frac{2}{2} = 1A$

206. **C** $R' = \frac{R}{n} = \frac{1}{10} = 0.1\Omega$

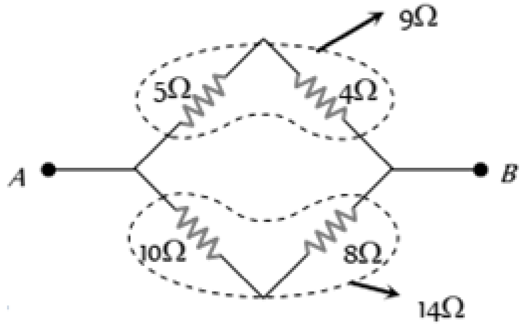
207. **C** The given circuit can be redrawn as follows



⇨ $R_{eq} = 5\Omega$

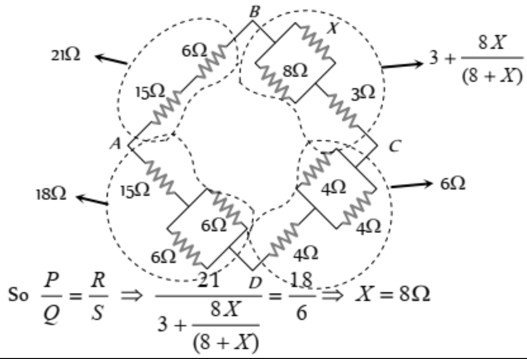
208. **B** $R_{AB} = R_1 + \frac{R_2R_3}{R_2+R_3} + R_4 = 2 + \frac{4\,x\,4}{4+4} + 2 = 6\Omega.$

209. **A** Since the given bridge is balanced, hence there will be no current through 9Ω resistance. This ressitance has no effect and must be ignored in the calculations.



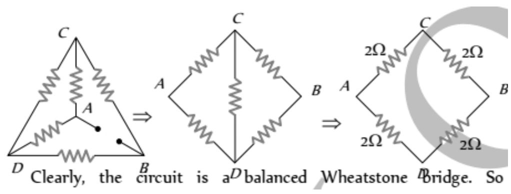
$R_{AB} = \frac{9\,x\,18}{27} = 6\Omega$.

210. **C** Potential difference between B and D is zero, it means Wheatstone bridge is in balanced condition



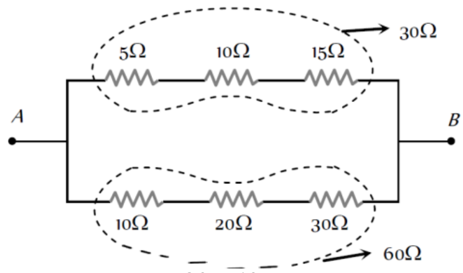
211. **A** This is balanced Wheatstone bridge. Therefore no current will flow from the diagonal resistance 10Ω
∴ Equivalent resistance $= \frac{(10+10)x(10+10)}{(10+10)+(10+10)} = 10\ \Omega.$

212. **D** The equivalent circuits are as shown below



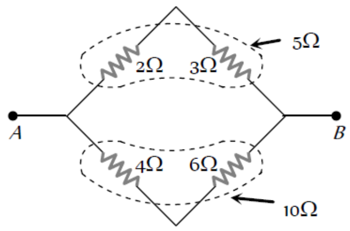
Clearly, the circuit is a balanced Wheatstone bridge. So effective resistance between A and B is 2Ω.

213. **A** By the concept of balanced Wheatstone bridge, the given circuit can be redrawn as follows



⇨ $R_{AB} = \frac{30 \times 60}{(30+60)} = 20\Omega$

214. **A** The given circuit is balanced Wheatstone bridge type, hence it can be simplified as follows

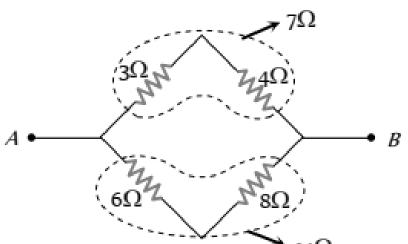


⇨ $R_{AB} = \frac{10}{3}\Omega$

215. **D** Let the value of shunt be r. hence the equivalent resistance of branch containing S will be $\frac{Sr}{S+r}$

In balance condition, $\frac{P}{Q} = \frac{Sr/(S+r)}{R}$. This gives r = 8Ω.

216. **A** The given circuit is a balanced Wheatstone bridge, hence it can be redrawn as follows



$\Rightarrow R_{eq} = \frac{7 \times 14}{(7+14)} = \frac{14}{3}\Omega$.

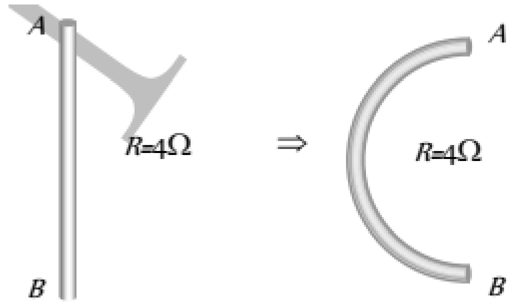
217. **A** For a balance Wheatstone bridge.

$\frac{A}{B} = \frac{D}{C} => \frac{10}{5} = \frac{4}{4}$ (Unbalanced)

$\frac{A'}{B} = \frac{D}{C} => \frac{A'}{5} = \frac{4}{4} => A' = 5\Omega$

A' (5Ω) is obtained by connecting a 10Ω resistance in parallel with A.

218. **C**



219.

220. A

221.

222. C P = VI
Watt = volt x ampere

223. B P =W/t → W = Pt
1 unit = 1 Kwatt/hour = 1000 watt/hour

224. B P = VI = 60kv x 5mA = 60x1000 x 5 x 10^{-3} = 60000 x 5/1000 = 60x5 = 300

225. B P = VI → I = P/V

$$\frac{I_1}{I_2} = \frac{P_1V_2}{V_1P_2}$$

Voltage is same:

$$\frac{I_1}{I_2} = \frac{P_1}{P_2} = \frac{500}{2000} = \frac{1}{4}$$

226. c If the load resistance is less or greater than the source resistance, then the power delivered to the load will be Minimum
When internal resistance of a source of the emf = load resistance then power is Maximum

227. C Emf and potential difference both have same unit and dimensiton.

228. D Vt = E-IR =6.20-0.01(20)=6.00V

229. A

230. **D**

231. C

232. C There is negligible potential difference between their feet and wire so no flow of current occurs.

233. D

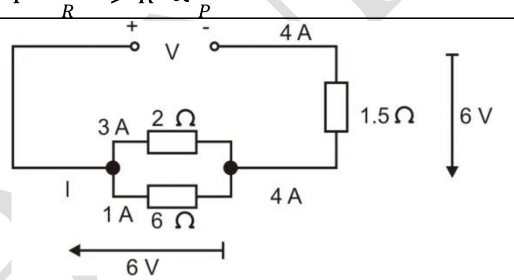
234. B

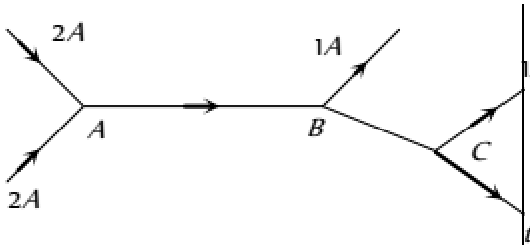
235. A)

236. **B** Explanation
If the resistance of a circuit equals to zero, then the curren will increase to infinity

237. D v_t = E-Ir
If I=0, then v_t = E

238. D V_t = E- IR
V_t = 12 – 60x $5x10^{-2}$
V_t = 12-3 = 9 volts

239.	C	V = W/q
240.	B	P = VI = I^2R
241.	C	P = W/t → W = Pt = 40 x 60 x60 = 144000 J
242.	D	Electrical energy is measured by kilowatt hour
243.	C	$P_{out} = \frac{E^2}{4r} = \frac{E^2}{4R}$
244.	D	
245.	A	P=IV=I^2 R=$(0.5)^2$ x180=45W
246.	C	Emf and potential difference both have same unit and dimensiton.
247.	D	Vt = E-IR =6.20-0.01(20)=6.00V
248.	D	
249.	D	In parallel combination the bulb with higher power rating will shine more
250.	D	$P = \frac{v^2}{R} => P \propto \frac{1}{R}$
251.	B	P = VI = (200)(10) = 2000 W
252.	A	$P = VI => I = \frac{P}{V} = \frac{140}{110} = 1.27\ A$
253.	D	$P = VI => I = \frac{P}{V} = \frac{60}{120} = 0.5\ A$ Q = It = (0.5)(12 x 3600) = 6 x 3600 = 21600 C
254.	D	$P = \frac{V^2}{R} => R = \frac{V^2}{P} = \frac{3^2}{0.5} = 18\ \Omega$ $P' = \frac{1^2}{18} = 0.056\ W$
255.	C	$P = VI => I = \frac{P}{V} = \frac{600}{120} = 5\ A$
256.	A	P = VI = (80 x 10^3)(7 x 10^{-3}) = 560W
257.	A	$P = \frac{V^2}{R} => R = \frac{V^2}{P} = \frac{200^2}{100} = 400\Omega$ $P = \frac{V^2}{R} = \frac{160^2}{400} = \frac{160 \times 160}{400} = 64W$
258.	D	$P = \frac{V^2}{R} => R \propto \frac{1}{P}$
259.	c	 Current delivered by the power supply = 3 A + 1A = 4A Voltage across the power supply = 6V + 6V = 12 V
260.		
261.	D	In thermocouples heat energy is converted into electrical energy.
262.		
263.	D	Coming = outgoing 4 + x= 5 +2→ X = 3A coming or According to Kirchhoff's Current Law, the total current entering a junction must equal the total current leaving the junction. The total current entering the junction is 4A (from the first wire), and the total current leaving the junction is 5A + 2A = 7A (from the second and third wires). Therefore, the fourth wire must carry 3A into the junction to balance the current.
264.		
265.	A	First law = KCL →I=Q/t →Q =law of conservation of charge
266.	A	Kirchoffs first law is based on law of conservation of charge and kirchoffs second law is based on law of conservation of energy.
267.		According to KCL i.e I1+I4=I2+I3
268.	**d**	Explanation Krchhoff's rule states that the sum of the currents flowing towards a point is equal to the sum of all current flowing away from that point. Thus both option b and c are correct.
269.	D	
270.	A	First law = KCL →I=Q/t →Q =law of conservation of charge
271.	C	
272.	A	
273.	C	
274.	A	
275.	B	
276.	A	
277.	A	
278.	C	Kirchhoff's 2^{nd} rule verifies the law of conservation of energy in electrical problems
279.	A	According to Kirchhoff's 1^{st} law the sum of all the currents flowing towards a point is equal to the sum of all the current flowing away from the point. The above equation verifies law of conservation of charge. If there is no sink or source of charge at the point, the total charge flowing towards a point must be equal to the total charge flowing away from the point.
280.	D	Current into the junction = current out of the junction 4+1 = 5+2 1 = 3 A into the junction
281.	d	By Kirchoff's 2nd law, fall ¡n voltage is E Ir : IR. Hence, only current (I) and external resistance (R) is required. .
282.	**A**	According to Kirchhoff's first law At junction A, $i_{AB} = 2 + 2 = 4A$ At junction B, $i_{AB} = i_{BC} - 1 = 3A$

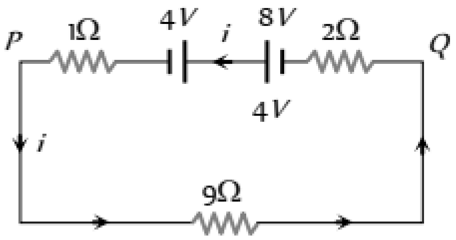


At junction C, $i = i_{BC} - 1.3 = 3 - 1.3 = 1.7\ amp$

283. **C** By Kirchhoff's current law.

284. **B** According to Kirchhoff's law $i_{CD} = i_2 + i_3$

285. **A** Applying Kirchhoff's voltage law in the given loop.



-2i + 8 – 4 – 1 x 9i = 0 => $i = \frac{1}{3}A$

Potential difference across PQ = $\frac{1}{3} x\ 9 = 3V$

286. **A** Applying Kirchhoff's voltage law of in the loop

$-10i + 5 - 20i - 2 = 0 => i = 0.1A$

287. **D** Applying Kirchhoff's law in the first mesh

$10 = 5\ x\ i => i = \frac{10}{5} = 2A$

288. **A**

289. **C** From Kirchhoff's junction law

⇨ $4 + 2 + i - 5 - 3 = 0 => i = 2A$

290. **C** On applying Kirchhoff's current law $i = 13\ A$

291. B Potentiometer is based on principle of wheatstone bridge.

292. B Potentiometer is based on principle of wheatstone bridge

293. D

294. B

295. A

296. A

297. C

298. B

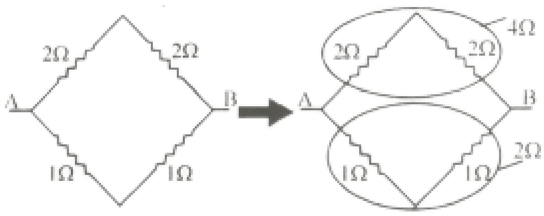
299. B

300. B

301. A

302. A

303. C As the wheatstone bridge is balanced. So, common resistance (5 Ω) is not used.



$R_e = \frac{(4)(2)}{4+2} = \frac{4}{3}\Omega$

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