ANSWERS TO GENERAL PAPER, 2005

1. **C:** Solutes that are stable to heat may be recovered by ***evaporation to dryness***. Solutes that are not stable to heat are separated by ***crystallization*** e.g. $CuSO_4$, $C_{12}H_{22}O_{11}$ (sucrose), $FeSO_4$ etc.
Decantation is used to separate a mixture containing a liquid and insoluble solid particles, which separate into two distinct layers e.g. "soaked garri".
Distillation is used to recover solvents from a mixture of liquids, due to differences in boiling points. e.g. in the production of gin.
Sublimation is used to recover substances which when heated, change directly to vapour (gaseous state) e.g NH_4Cl, iodine, camphor.
Soaps are sodium or potassium salts of organic acids.

2. **A:** Soap is obtained by a chemical reaction termed "saponification" it is represented as

$$Fat/oil + NaOH \xrightarrow[\Delta]{} Soap + Alcohol$$

Heat is required in the reaction above.

A ***compound*** is formed when two or more different elements are chemically combined together.
The only option that suits the definition of a compound is "soap", with the general formula **RCOONa**

Milk and urine are mixtures (a mixture contains two or more substance that may be easily separated by physical methods. Other examples of mixtures are: air, sea-water, bronze, blood, palm-wine, soil, crude oil).
Gold is a metallic element (exist as single atoms).

Saponification simply means "***alkaline hydrolysis of an ester***". Alkaline hydrolysis of esters yield sodium alkanoates (assuming caustic soda is the alkali used). Long-chained sodium alkanoates are useful as soaps. When caustic potash (KOH) is used, soft soap is obtained.
Esters may also undergo acid hydrolysis but this process is reversible, requires concentrated H_2SO_4 as catalyst and doesn't yield soap.

3. **A:** Crystallization is used to produce pure products e.g. drugs, crystals, table sugar.

4. **B:** Iron II sulphide (FeS) is a compound. (See Q. 2 above).

5. **A**: This question is based on the ***"Law of Multiple Proportions"*** which states that

> *"When two elements A and B combine, to from more than one compound, the different masses of B that combined with a fixed mass of A are in simple ratio to one another".*

Since the oxygen combined with fixed masses of carbon, the "amount" of carbon is kept constant (i.e. one carbon atom in this case), and the "amount" of oxygen in the second oxide is twice that of the first, thus we have: $CO : CO_2$

6. **D:** This question is based on the gas law, ***"Avogadro's hypothesis"***, which may be stated as

"Equal volumes of all gases at the same temperature and pressure contain the same number of molecules".

(We can also say that they have the same number of moles).

Standard temperature $\Rightarrow$ 273K = 0°C
Standard pressure $\Rightarrow$ 760mmHg = 1atm
$1.01325 \times 10^5 Nm^{-2}$(Pa)
Molar volume = 22.4 dm^3 or 22.4L ≡ 22400cm^3
Deductions made from the Avogadro's hypothesis show that
"The molar volume of a gas is the volume occupied by one mole of that gas at STP and it is numerically equal to 22.4dm^3".

1 mole of CO_2 → 22400cm^3 (22.4dm3)
x mole of CO_2 → 50cm^3?

$$x = \frac{1 \times 50}{22400} = 0.0022mol$$

Also: 1 mole of SO_2 → 22400cm^3
x mole of SO_2 → 50cm^3?

$$x = \frac{1 \times 50}{22400} = 0.0022mol$$

7. $2C_2H_{6\,(g)} + 7O_{2\,(g)} \rightarrow 4CO_{2\,(g)} + 6H_2O$
2 Volumes 7 Volumes 4 Volumes

Since the reactants and products referred to in this question are all gases, **Gay-Lussac's Law of Combining Volume** may be employed.
(NB. The coefficient of the gases in the balanced equation are **also** the volumes required for a complete reaction).
From the stoichiometry
2 Volumes of C_2H_6 (ethane) → 4 Volumes of CO_2 (carbon (IV) oxide)

$$\therefore x\ dm^3\ of\ C_2H_6 \rightarrow 1.12dm^3\ of\ CO_2$$

$$x = \frac{2 \times 1.12}{4} = 0.56dm^3$$

C

8. $2O_3 \rightarrow 3O_2$
2 Vol 3 Vol
Still applying Gay-Lussac's:
There are 2 volumes of ozone. In this particular question, the two volumes represent 10dm^3. This value of 2 volumes (10dm^3) increases to 3 volumes of oxygen (which is 15dm^3).
Therefore, it increased by (15 – 10dm^3) = 5dm^3. **D**

2 → 10
3 → x
x = 15 − 10 = 5

9. **B:** According to the **kinetic theory of matter** for gases:
(i) Particles are in continuous motion in straight lines and so possess kinetic energy.
(ii) Collisions between gas particles and the walls of the container are perfectly elastic (i.e. there is conservation of energy).
(iii) The pressure exerted by a gas results from the bombardment of the walls of the container by the gas molecules

(iv) The cohesive forces between the gas molecules is negligible.
(v) The temperature of the gas sampled is measure of the average kinetic energy.

10. **B:** The gas that diffuses at the ***slowest rate*** is that gas that has the largest molecular weight. Conversely, the gas that diffuses at the ***fastest rate*** is that gas with the smallest molecular weight (this is based on **Graham's Law of diffusion and effusion**).
Ammonia = NH_3 = 17g/mol (Option A should have read ammonia)
Sulphur (IV) oxide = SO_2 = 64g/mol
Carbon (II) oxide = CO = 28g/mol
Nitrogen = N_2 = 28g/mol

In addition, a large molecular weight means a high density, while a low molecular weight implies a low density. Also, when two gases have the same molecular weight, their rates of diffusion will be the same, all other things being equal.

11. Using the 2,8,8 ... notation, the last number denotes the group in which the element is found!
P = 2,8,6 P is found in group VI e.g. O, S
R = 2,8,8,1 R is found in group I e.g. Li, Na, K.
Which is the likely formula for a compound formed between Na and O for instance?
= Na_2O or ONa_2 which in this context is PR_2.
Note that when the last number in the 2,8,8... notation is 8, the element would not belong to group 8, but to group 0 or 18.
The electronegativity differences between the elements may be used to predict whether the compound is ionic or covalent. (NB: If the electronegativity difference is high e.g. between a metal and non-metal, then the compound is predominantly ionic. Secondly if the electronegativity value is low e.g. between two non-metals, the compound is predominantly covalent!
The compound formed PR_2 is ionic, because it is formed between a metal and a non-metal..

B

12. Phosphorus has 15 protons (atomic number = 15), 15 electrons (in an atom, the number of protons must equal the number of electrons for it to be neutral), and 31 - 15 neutrons = 16 neutrons. Therefore:
p = 15, e = 15, n = 16

A

13. Electropositivity is a measure of the tendency of an element to form positive ions.
An arrangement of elements (metals) in decreasing order of their electopositivity (from top to bottom) is called an ELECTROCHEMICAL SERIES. Looking at the ECS, we find.

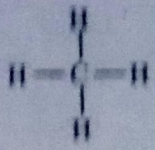
K
Na
Ca
Mg
Al
Zn
Fe
Sn
Pb
H
Cu
Hg
Ag
Au

The elements of interest have been written in bold. From the ECS above, the least electropositive element (which also has the least tendency to form positive ions) is Fe.
NB: The electronegativity values of the four species in the Pauling Scale are as follows: Na(0.93), Ca(1.00), Al (1.61) and Fe(1.83). Final answer is...

A

14. **C**

There are four (4) pairs of shared electrons in methane



Each of the lines joining C and H is a **covalent bond** in which a pair of electrons is shared. More so, the carbon atom (central) has a hybridization state of sp^3, which implies that the number of hybrid orbitals is 4. (Hybrid orbitals are used to form the covalent bonds of molecular orbitals).

15. **A**: Atmospheric Nitrogen is not very useful to animals and plants, unlike O_2 and CO_2 which are essential to animals and plants respectively.

16. **C**: What is commonly called "pure water" is actually "sachet water". The four natural sources of water are: rain, spring, river and lake (in decreasing order of purity). In other words, the purest form of water is rain water (excluding the effects of atmospheric pollution).

17. Let's note some things about **hardness of water**

1. **Types**	**Temporary**	**Permanent**
2. **Causes**	$Ca(HCO_3)_2$	$CaSO_4$, $MgSO_4$
3. **Method of removal**	(1). Boiling, (2). addition of slaked lime ($Ca(OH)_2$)	(1). Addition of Na_2CO_3 (2). Caustic soda (NaOH). (3). Also addition of Sodium zeolite (or Permutit).
4. **Advantages of hard water**	(i) Tastes better. (ii) Drinking of hard water helps build strong bones and teeth. (iii) When transported in lead pipes, it does not cause lead poisoning.	
5. **Disadvantages**	(i) Wastage of soap (ii) It causes furring of kettles and boilers (iii) Cannot be used for dyeing of clothes and tanning of leather	

Generally, softening of hard water involves converting soluble calcium and/or magnesium salts into insoluble salts. That was, the calcium/magnesium ions that were in solution and caused hardness are expelled from it.

Addition of alum cannot be used to remove permanent hardness! Rather, alum is used in ***"flocculation"*** as part of water purification.

D

18. Solubility is a measure of the concentration of a solute in a solvent (usually water) at a particular temperature. It may be expressed as "grammes of solute per 100grammes of solution" (g/100g). Most times however, it is expressed as $mol.dm^3$, the same unit as ***molarity***.

18g of Na_2SO_4 → 100g

x g → 1000g?

$$x = \frac{18 \times 1000}{100} = 180\text{g of } Na_2SO_4$$

180g of Na_2SO_4 is found in 1000g (1kg) of solution

D

19. **Colloids** are "**false solutions**". Examples are starch solution, milk, albumen, protoplasm, fog, smoke, soap lather, emulsion, agar, jelly, clay, cod liver oil, butter etc.
Colloids are classified into eight – THE 8 COLLOIDAL SYSTEM.

No	Dispersed phase	Dispersed medium	Colloid type	Examples
1.	Gas	Liquid	Foam	Shaving creams, soap suds
2.	Gas	Solid	Solid foam	Styrofoam, pumice, lava
3.	Liquid	Gas	Liquid aerosol	Fog, hair spray, mist
4.	Liquid	Liquid	Emulsion	Milk, mayonnaise
5.	Liquid	Solid	Gel/solid emulsion	Gelatin, cheese
6.	Solid	Gas	Solid aerosol	Smoke, cloud
7.	Solid	Liquid	Sol/suspension	Blood, pigmented ink
8.	Solid	Solid	Solid sol/Alloy	Brass, glass

Note that there is no Gas-Gas colloidal system.
Ammonium chloride (NH_4Cl) forms a true solution, unlike the rest which are colloids!

20. **B:** Soapless detergents are often used to clear up oil spillage

D

21. pH ranges from 1 to 14. 7 is neutral, < 7 is acidic, while > 7 is basic
M with a pH of 1 is the most acidic.

D

22. **B:** The alkaline solution $Ca(OH)_2$ forms is referred to as **lime water**.

23. **B:** ***Hydrolysis*** is the splitting of a molecule by means of water. It is the basic principle behind digestion of carbohydrates, proteins and lipids.
Cracking is used in the petroleum industries to break up larger hydrocarbons into smaller ones. (It may be thermal cracking or catalytic cracking).
Oxidation is addition of oxygen; removal of hydrogen; addition of electronegative elements; removal of electropositive elements; loss of electrons; increase in oxidation number.
Reduction is removal of oxygen, addition of hydrogen; removal of electronegative elements; addition of electropositive elements; gain of electrons; decrease in oxidation number.

24. **C.** H_2S is a reducing substance
Oxidizing agents include O_2, Cl_2, H_2O_2, $KMnO_4$, $K_2Cr_2O_7$, conc. H_2SO_4, HNO_3.
Reducing agents include H, C, H_2S, NH_3, SO_2, $FeCl_2$, KI, CO and metals high in the activity series.
Oxidizing agents bring about oxidation of other chemical species and in the process become reduced. Reducing agents bring about reduction of other chemical species and at the end of the reaction, become oxidized.

25. This is based on **Faraday's Second Law of Electrolysis**. For questions like this (when the statement "**same quantity of electricity**" is used, the formula for solving is:

$$\frac{RAM_1}{RAM_2} = \frac{m_1 q_1}{m_2 q_2} \quad \ldots\ldots(1)$$

Where RAM = relative atomic mass, m = mass of substance deposited, q = charge on the ion

Let 1 = Al and 2 = Cu (from equation (i))
$RAM_1 = 27$, $m_1 = 18g$, $q_1 = 3$ (Al^{3+}), $RAM_2 = 64$, $m_2 = ?$ $q_2 = 2$ (Cu^{2+})

$$\frac{27}{64} = \frac{18 \times 3}{m_2 \times 2}$$

$$m_2 = \frac{64 \times 18 \times 3}{27 \times 2} = 64g$$

A

26. **Semiconductors** have a negative temperature coefficient of resistance. That means that their resistance decrease with an increase in temperature and vice versa. A typical example is germanium and silicon, a tetravalent atom (i.e. both have four valence electrons).
For example, **germanium** is an insulator at low temperatures but it becomes a good conductor at high temperatures.
All the options are true except option "D", which is only true for a pure metal. However, for a semi-conductor which is neither a metal nor a non-metal but a metalloid , resistivity decreases with increase in temperature. Also, the carriers of current are **holes** and **electrons**.

D

27. NB: It's important you look at the parameters provided. This is a case of a current-carrying conductor (a wire carrying current) under magnetic field. The force on a current-carrying conductor placed in a magnetic field is given by:

$$\mathbf{F = BIL\ sin\theta}$$

Where B = magnetic flux density = 0.14T, I = Current = 10A, L = Length = 2.5m, θ = angle = 60°.
NB: θ (angle) may not be given directly but terms like "perpendicular, straight line" may be used. And at such $\theta = 90°$ (perpendicular); 180° (straight line)
Solving: $F = BIL \sin\theta = 0.14 \times 10 \times 2.5 \sin 60° = 3.03N$

Remember there's no calculator! So to make it easy we use fractions, thus the above may be written as:

$$F = \frac{14}{100} \times 10 \times \frac{25}{10} \times 0.866$$

A

$$= \frac{14 \times 10 \times 25}{1000} \times \frac{866}{1000} = \frac{3031}{1000} = 3.03N$$

28. D
NB: Hysteresis loss is due to demagnetization of a magnetized core and, can be reduced by layer lamination of the core.

29. The **efficiency** of a transformer is usually < 100%.

The efficiency of a transformer, $E = \frac{Power\ output}{Power\ input} \times 100\%$

Depending on the parameters provided, Power "**P**" can be $P = I^2R$ or $P = IV$. However, from this question $P = IV$ will be used since both current and voltage are involved.
Note that: Power output = 100W, Power input $= I_p V_p = I_p \times 25 = 25I_p$

$$E = \frac{Power\ output}{I_p V_p} \times 100\%$$

$$80 = \frac{100}{25 I_p} \times 100$$

$$I_p = \frac{100 \times 100}{80 \times 25} = 5A$$

A

30. **Fundamental quantities** are the following:
Length (metre), Mass (kilogram), Time (seconds), Electric charge (Coulomb), Amount (mol), Temperature (Kelvin), Luminous intensity (Candela).

None

31. **D:** Sir J.J Thomson visualized an atom as a homogenous sphere consisting of equal number of positive and negative charges. This is called the **"plum-pudding model"** of the atom. The **postulates** include:

- **Small angle scattering** → One of the predictions of this model. Owing to the diffuse nature of the positive charges, alpha particles directed towards them will be scattered only through small angles.
- **Stability of the atom** → It predicts that number of positive charges equal number of negative charges which proves electrical neutrality of the atom, and hence stability.
- **Ionization process** → Results from gain or loss of electrons. This does not have much to do with atomic structure.
- **Variation of effective atomic radius** → Thompson's model does not place electrons in energy levels (orbits). The concept of energy quantization and hence atomic radius was elucidated from the **Rutherford-Bohr's model**.

32. **C:** The **excited state** describes an electron that has been promoted to a higher energy level. When they get to infinity, it's called **ionization** and the new energy value is 0.0eV.

33. **C:** **Ionization energy** is the minimum amount of energy required to remove an electron from an atom to infinity to form a **positive ion**. When gaseous atoms are used in measuring this energy, it's called first Ionization energy.

34. Louis de Broglie, a French scientist experimented on matter and discovered it has a both **wave** and **particle** properties, i.e. the duality of matter. Hence, the formula for the dual nature of matter (the wave-particle paradox) connecting wavelength to the momentum of the particle was propounded. It is given as:

$$\lambda = \frac{h}{\rho} = \frac{h}{mv}$$

Where ρ = momentum of the wave particle = m × v (m = mass and v = velocity)

So, from the question using $\lambda = \frac{h}{\rho}$, where $\rho = m \times v = 0.01 \times 10 = 0.1$ kgm/s

h = plank constant = 6.63×10^{-34} Js

De-Broglie's wavelength, $\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{0.1} = 6.63 \times 10^{-33}\ m$

C

35. **γ-radiation** has no charge and no charge; it is written as ${}^{0}_{0}\gamma$. Thus, emitting γ-radiation does not affect Z or A.

C

36. **Octave** means **Eight**. Simply multiply the frequency of the given note by 8.
Thus: 8 × 256 Hz = 2048Hz

A

37 **D**
Quality is the characteristic of a note that distinguishes it from another note of the same pitch and loudness. It depends on the **overtones** or **harmonics** present in the note.
Pitch depends on **frequency** and varies proportionately with it.

38. The sound of an echoing device is gotten from the relationship connecting the velocity of sound with the distance such that the velocity "v" of an echoing sound wave is:

$$v = 2d/t$$

Where: d = the distance between the source of sound and the obstacle (or depth of the sound in water) where the sound wave was reflected.

$$d = \frac{vt}{2}$$

But, $v = f\lambda \quad \Rightarrow d = \frac{f\lambda t}{2} = \frac{130 \times 2.0 \times 0.5}{2} = 65m$

A

39. When the lead shot falls through a height, **h** to the ground, **potential energy** is lost by it. For the law of energy conservation to be obeyed, this energy must be completely converted to another energy form, without dissipation. In order to bring about a temperature rise, this energy must be converted to **heat energy**.

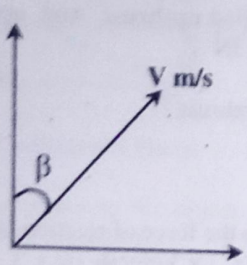
Potential energy = mgh
Heat energy leading to temperature rise = $mc\Delta t$
Hear lost = heat gained
$mgh = mc\Delta t$ (cancelling 'm' from both sides)
$gh = c\Delta t$
For 100 of such inversions, we have
$110 \times gh = c\Delta t$

$$\Delta t = \frac{100gh}{c}$$

$$= \frac{100 \times 10 \times 1.0m}{130} = 7.7K$$

D

40. Diagrammatic representation



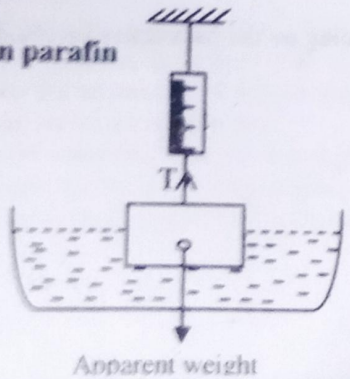
From the diagram shown above "V" is the project velocity and V is between two components xand y axes. This means V is a rector that must be resolved both vertically (along y-axis) and horizontally (along x-axis).
Therefore, along y-axis, $V_y = V\cos\beta$ (NB: It is Cosine because it makes angle β with the y-axis)
And along x-axis $V_x = V\sin\beta$ (NB: It is Sine because it makes **no** angle β with the x-axis).

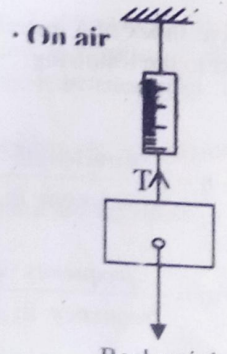
B

Note: Let's consider the time "t" as given in the question, the suitable equation of motion that comes to mind is: $v = u + gt$ (replace u with v, since v here is the projected velocity, not u)

Along horizontal, $Vx = V\sin\beta + gt$
Recall that along horizontal $g = 0$. Hence $t = 0$ in the formula too. Therefore $V_x = V\sin\beta$

41.





When suspended on air, the tension in the string will be equal to the real weight of the object. Thus:

T = W (vertical equilibrium).

When suspended on paraffin, the weight read from the spring balance will be less than its real weight. This is due to an upward force exerted by the paraffin to the mass called **upthrust.**

Thus: T = W - U

Real weight, W = mg = 0.2 × 10 = 2.0N

First, find the volume of the object using, $Vol = \frac{mass}{density} = \frac{0.2}{600} = 3.33\times10^{-4}$

Now, $\frac{1}{10}$ of the volume of the solid above is immersed in the liquid (paraffin),

Volume of paraffin = $\frac{1}{10}\times 3.3\times10^{-4} = 3.3 \times 10^{-5}\ m^3$

Now, find the mass of the paraffin since you know its density and volume.

Mass of paraffin = density × volume = $900 \times 3.3 \times 10^{-5}$ kg = 0.03 kg

Now , note that immediately you immerse the object into liquid (paraffin), some weight of the liquid will be displaced. This displaced weight is called **upthrust**. And, upthrust can be gotten from the mass of the liquid thus: U = 0.03 × 10 (i.e. m × g) = 0.3N

Now, Tension = Weight of the object – Upthrust

= (0.2 × 10) – 0.3

= 2 – 0.3 = 1.7N ≈ 2N

B

42. Thrust exerted by gas on rocket is equal to the force of ejection of the gas. This force is given by:

F = Rate of ejection ($kg.s^{-1}$) × Velocity ($m.s^{-1}$)

= $20 \times 5 \times 10^3$

= $1.0 \times 10^5\ ms^{-1}$

A

43. Radius of curvature = 10.0cm

∴ Focal length of lens = $\frac{R}{2} = \frac{16}{2} = 8cm = 0.08m.$

Power of the lens = $\frac{1}{f} = \frac{1}{0.08} = 12.5$

(The power of a lens is the inverse of the focal length. It is measured in **dioptres**. The unit of focal length however is in **metres**!, not centimetres)

44. **NB:** The Refractive Index of a material varies depending on the parameters involved i.e. Refractive Index varies with respect to the following:

Wavelength:

Refractive Index: $\eta = \frac{wavelength\ in\ air}{wavelength\ in\ medium}$

Frequency:

Refractive Index: $\eta = \frac{frequency\ in\ air}{frequency\ in\ medium}$

Velocity:

Refractive Index: $\eta = \frac{velocity\ in\ air}{velocity\ in\ medium}$

Looking at the question, the third equation is suitable.

So, using: Refractive Index: $\eta = \frac{v\ in\ air}{v\ in\ medium}$

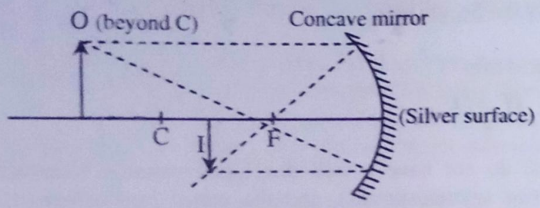
$$1.5 = \frac{3\times10^8}{V_{medium}}$$

$$V_{medium} = \frac{3\times10^8}{1.5} = 2\times10^8$$

Refractive index of medium = 2×10^8 m/s

45. **NB:** "Object at infinity" is same as saying, "object is beyond centre of curvature". Also, note that the closer the object to the pole of the mirror, the larger the image produced and vice-versa.

Real means image is in front of the mirror and on the same plane with the object.
Looking at the diagrammatic representation below:



Where: C = Centre of Curvature, F = Principal Focus

Now, comparing the image produced above to the object, it is obvious that image is Diminished, Real, Inverted (below the axis) and at the Principal Focus.

A

46 C: **Eclipse** of the sun occurs when the moon lies in-between the sun and the earth and so casts its shadow on the earth. **Total eclipse** in seen in the **umbra region**, and **partial eclipse** in the **penumbra region**.

47. D: **Reverberation** occurs as **multiple echoes** which dampen out gradually.

48. A. A **stale egg** when placed against the source of day light (UV-light) appear totally opaque.

49. D: **Electromagnetic waves** in order of **decreasing wavelength** and **increasing energy** include:

Radio waves, microwaves, infrared, visible light, ultraviolet rays, X-rays and gamma-rays.
(NB: By this arrangement, it implies that γ-rays are the most energetic of all and has the shortest wavelength. Radio waves have the longest wavelength and are the least energetic). The **general properties** of electromagnetic waves are as follows:
- They are given off when electrons move to a ground state. Thus they are quantized energy.
- They are transverse waves and are thus polarizable.
- They have no charge and so cannot be deflected in electromagnetic (E-M) fields.

50 **B**

51. Alleles are **"alternative forms of the gene for a particular trait"**. An allele may be ***dominant*** (when the trait is expressed in both the heterozygous and homozygous forms) or ***recessive*** when it is expressed only in the homozygous form it is the masked in the heterozygous form. Dominant alleles are denoted with upper case letters, while recessive alleles are denoted with lower case letters.

B

52. **D**

53. **A:** **Biosphere** on the other hand refers to the aspect of the environment where living things are found: usually, land ***(lithosphere)***, water ***(hydrosphere)*** and air ***(atmosphere)***.
The term **"Arboreal"** refers to animals that live on tree e.g. monkeys, bats, chameleon, tree snakes etc.
Biomes are large natural terrestrial ecosystems, which are identified by the vegetation e.g. mangrove swamps, tropical rain forest, savanna, Montane forest.

54. **B:** The **hygrometer** measures humidity. Notice that this instrument is different from the ***hydrometer*** which measures relative density (specific gravity) of liquids.
Rainfall is measured by means of a rain gauge.
Temperature is measured using a thermometer. **Light** is measured by means of a photometer (light meter).
Pressure (atmospheric air) is measured using the barometer (for **fluids**, it is the manometer).
Wind direction is obtained by the wind vane. **Wind speed** is measured by the anemometer. **Water turbidity** may be measured by the Secchi disc.

55. **A:** SO_2 is a major cause of acid rain

$$H_2O + SO_2 \rightarrow H_2SO_3$$

56. **A:** The mosses (bryophytes) do not have a well developed vascular (conducting) system. The ferns (pteridophytes), whispering tree (gymnosperms), and the maize (angiosperms) have a well developed vascular system which serve the purpose of absorbing water and mineral salts from the soil and also translocating food manufactured by photosynthesis.

57. **D:** ***Tuberculosis*** is spread by respiratory droplets i.e. by coming in contact with persons with the disease who are actively coughing. It is caused by *Mycobacterium tuberculosis*
The vector for the ***malaria*** parasite (plasmodium species e.g. *P. falciparum, P. ovale, P. vivax* and *P. malariae)* is the female anopheles mosquito.
The ***yellow fever*** virus is spread by a mosquito vector (Aedes mosquito). The causative organism is an ***arbovirus***.
Cholera caused by the bacteria, *Vibrio cholera*. It is contracted by ingestion of food and water contaminated with faeces. The housefly is a vector.

58. **B:** ***Candida albicans*** is a fungus that causes mouth, vaginal, nail and skin infections.

59. **C:** There are five (5) classes of vertebrates namely
(i) **Pisces** (fishes) – e.g Tilapia, shark etc
(ii) **Amphibia** – e.g. frogs, toads, newts, salamanders,
(iii) **Reptilia** – e.g. Lizards, crocodiles, snakes
(iv) **Aves** (birds) – e.g. pigeon, sparrow etc,
(v) **Mammalia** – e.g. dog, cat, duck-billed platypus, spiny anteater

Starfish is an invertebrate belonging to the class ***"Echinodermata"***.

60. **C**

61. **C:** **Ecological niche** refers to the specific position or place an organism occupies in a habitat with respect to its behavior, feeding habits and breeding habits e.g. caterpillar lives on leaves and feeds on them, hawks are carnivorous birds with very good eyesight; they prey on smaller animals e.g. the chicks of hens.

Community: This the sum total of all the living organisms of different species occupying a habitat e.g. An aquatic habitat made up of microorganisms, animals (fishes, frogs, copepods, insects) and plants (algae, water lilies, white mangrove) constitute a community!
Ecosystem: This is a self-sustaining system made up of living and non-living things and how they interact with one another.
Habitat: This is the place that is suitable to the life of an organism; e.g. the habitat of fishes is in water.

62. **D:** The mitochondria is the **"power-house"** of the cell i.e. it produces ATP for cellular activities. It is found in the cytoplasm. (ATP is often referred to as the 'energy currency of the cell')

63. **B**

		Humans	Rabbit
Cervical vertebrae	–	7	7
Thoracic vertebrae	–	12	12
Lumbar vertebrae	–	5	7
Sacral vertebrae	–	5	3 - 4
Coccyx	–	3-5	16

The number of the cervical vertebrae is usually 7 in vertebrates.

64. **A:** "**Transpiration pull**" is the "force" that moves water (absorbed by the roots of the plant) up the xylem vessels to the cells of the leaf.
Continuous absorption of water by the root hairs build up a pressure which causes water to move across the root cells and up the xylem vessels to a certain height. This is the "**Root pressure**".
Xylem vessels are organized into fine tubes extending from the roots to the leaves. The force of adhesion causes water to rise up the xylem vessels. This effect of water adhesion is termed **"capillary action"**.

65. **C:** Platelets are involved in the clotting of blood to prevent excessive bleeding. White blood cells protect the body against diseases; either by engulfing pathogens in the blood stream or by producing antibodies (immunoglobulins) which help the body fight the diseases. Red blood cells contain haemoglobin and thus are able to transport oxygen from the lungs to the tissues, and carbon (IV) oxide produced by cellular respiration back to the lungs for exhalation.

66. **A:** Blood has
(i) a cellular component (white blood cells, red blood cells and platelets) and
(ii) a fluid part (plasma).
NB: White blood cells are otherwise known as leukocytes, red blood cells are called erythrocytes, while platelets are also known as thrombocytes.

67. **C:** (Respectively). The mouth parts of the fly is adapted for sponging i.e. taking in of liquid or digested food.
The mouth parts of the grasshopper and cockroach is adapted for biting and chewing.
The mouth parts of the mosquito and aphids are adapted for piercing and sucking.
That of moths and butterfly are adapted for sucking.

68. **C**

69. **D**

70. **A:** Vestigal organs are parts of an animal that have become reduced in size and function due to disuse, according to "Lamarck's theory of evolution". Examples in man are the appendix, coccyx, sparse body hairs, rudimentary mammary gland of males. Others in animals are degenerated leg and pelvic bones in snakes, the right ovary in the domestic hen, degenerated toe bones in horses, etc.

71. **A:** Meiosis is the type of cell division that occurs during gametogenesis (formation of gametes, i.e. male and female sex cells). It causes a halving of the diploid chromosome number (2n) to haploid (n).
In flowers meiosis occurs in the male sex organ (anther of the stamen) and the female sex organ (carpels).

72. **C: Tactic movement** (derived from the word "taxis") is when a whole organism e.g. an animal, moves towards or away from a stimulus.
Tropic movement refers to movement of a part of a plant to a directional stimulus (either positively or negatively) e.g. phototropism – response to light.
Nastic movement is the response of part of a plant to non-directional stimuli e.g. closing of morning glory flower at night.

73. **D.** e.g. in the secretion of enzymes by the pancreas. Excretion refers to the removal of "useless" substances from the body.

74. **B.** Light is absolutely required for photosynthesis! It provides the activation energy needed for the reaction between water and CO_2 to form glucose, which is thereafter stored as starch.