



UNIFIED COUNCIL

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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: **UN439 (UPDATED)**

Solutions for Class : 10

MATHEMATICS

1. (C) Let α, β be the roots.

$$\therefore \alpha + \beta = -\frac{a}{b} \text{ \& } \alpha\beta = \frac{a}{b}$$

$$\text{Given } \alpha + \beta = \frac{\alpha}{\beta}$$

$$= -\frac{a}{b} = \frac{a}{b}$$

$$= 2\frac{a}{b} = 0$$

$$\frac{a}{b} = 0$$

2. (C) In $\triangle ABC$, $BC = 3$ cm and in $\triangle DEF$, $EF = 4$ cm.

Given, $\triangle ABC \sim \triangle DEF$

$$\Rightarrow \frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle DEF}$$

$$= \frac{BC^2}{EF^2} = \frac{9}{16}$$

$$\Rightarrow \frac{54}{\text{Area of } \triangle DEF} = \frac{9}{16}$$

$$\Rightarrow \text{Area of } \triangle DEF = 54 \times \frac{16}{9} \text{ cm}^2$$

$$= 96 \text{ cm}^2$$

3. (A) Disjoined sets.

4. (D) Given Area of triangle = 20 units²

$$\frac{1}{2}bh = 20 \text{ units}^2$$

$$\frac{1}{2} \times x \times b = 20 \text{ units}^2$$

$$x = \frac{40}{b} \text{ unit}$$

$$\therefore \left(\frac{40}{b}, 0 \right) \text{ be the coordinates of 'C'}$$

5. (A) $2y^2 + 9y = 0$

$$\Rightarrow y(2y + 9) = 0$$

$$\Rightarrow y = 0 \text{ or } 2y + 9 = 0$$

$$\Rightarrow y = \frac{-9}{2}$$

6. (D) $3748x + 5467y = 10085$

$$1731x + 7484y = 4034$$

$$\begin{matrix} (-) & (-) & (-) \end{matrix}$$

$$\hline 2017x - 2017y = 6051$$

$$2017(x - y) = 6051$$

$$x - y = \frac{6051}{2017} = 3$$

7. (A) Given a, b, c are in AP

$$\Rightarrow 2b = a + c$$

S.O.B.S.

$$4b^2 = a^2 + c^2 + 2ac \dots (1)$$

Given a, b, c are in GP

$$b^2 = ac \dots (2)$$

$$\Rightarrow \text{from 1 and 2}$$

$$4ac = a^2 + c^2 + 2ac$$

$$\Rightarrow a^2 - 2ac + c^2 = 0$$

$$(a - c)^2 = 0$$

$$a - c = 0$$

$$a = c$$

$$\text{If } a = c \text{ then } 2b = a + a$$

$$2b = 2a$$

$$a = b$$

$$\therefore a = b = c$$

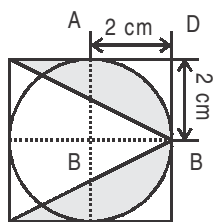
8. (B) $\operatorname{cosec}(75^\circ + \theta) - \sec(15^\circ - \theta)$
 $-\tan(55^\circ + \theta) + \cot(35^\circ - \theta)$
 $= \operatorname{cosec}(90^\circ - (15^\circ - \theta)) - \sec(15^\circ - \theta)$
 $-\tan(90^\circ - (35^\circ - \theta)) + \cot(35^\circ - \theta)$
 $= \sec(15^\circ - \theta) - \sec(15^\circ - \theta)$
 $-\cot(35^\circ - \theta) + \cot(35^\circ - \theta) = 0$

9. (B) $14 + 11 - 19 = 25 - 19 = 6$

10. (D) $\alpha\beta\gamma = +30$
 $(-6)\gamma = +30$
 $\Rightarrow \gamma = -5$

11. (C) $\log m + \log m^2 + \log m^3 + \dots + \log m^n$
 $= \log m + 2\log m + 3\log m + \dots + n\log m$
 $= \log m [1 + 2 + 3 + \dots + n]$
 $= \frac{n(n+1)}{2} \log m$

12. (A)



Area of ACD region $= 2 \text{ cm} \times 2 \text{ cm} - \frac{1}{4}$
 $\times 3.14 \times 2 \text{ cm} \times 2 \text{ cm} = 0.86 \text{ cm}^2$

Unshaded area $= 0.86 \text{ cm}^2 \times 2 + \frac{1}{2} \text{ cm}$
 $\times 4 \text{ cm} \times 4 \text{ cm} = 9.72 \text{ cm}^2$

Shaded area $= 4 \text{ cm} \times 4 \text{ cm} - 9.72 \text{ cm}^2$
 $= 6.28 \text{ cm}^2$

13. (B) HCF of two consecutive is natural numbers = 1.

\therefore HCF of 200 to 478 is 1

14. (B) $P = 3 + 5 + 7 + \dots$ 'n' terms

$$\Rightarrow S_n = \frac{n}{2} [2 \times 3 + (n-1)2]$$

$$= 3n + (n-1)n$$

$$= 3n + n^2 - n = n^2 + 2n$$

$$Q = 5 + 8 + 11 + \dots$$

$$\Rightarrow S_n = \frac{10}{2} [2 \times 5 + (10-1)3]$$

$$= 5 [10 + 27]$$

$$= 5 \times 37 = 185$$

Given $\frac{P}{Q} = 7$

$$\Rightarrow \frac{n^2 + 2n}{185} = 7$$

$$\Rightarrow n^2 + 2n - 1295 = 0$$

$$\Rightarrow n(n-35) + 37(n-35) = 0$$

$$\Rightarrow n = 35 \text{ or } -37$$

15. (B) In $\triangle MNG$ $\angle M = 90^\circ \Rightarrow MG^2 = NG^2 - MN^2$

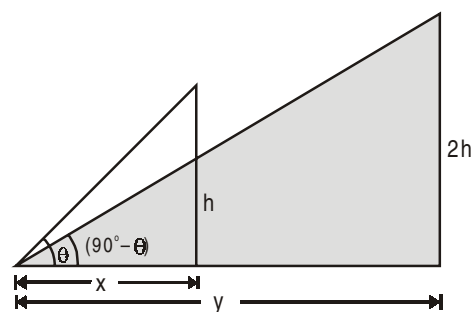
$$\therefore MG = 4 \text{ cm}$$

$$\therefore EG = 2 \text{ GM} = 8 \text{ cm}$$

$$GF = \sqrt{GE^2 + EF^2} = 10 \text{ cm}$$

$$\therefore \cos \theta = \frac{GE}{GF} = \frac{8 \text{ cm}}{10 \text{ cm}} = 0.8$$

16. (C) $\tan \theta = \frac{h}{x}$ and $\tan(90^\circ - \theta) = \frac{2h}{y}$



Multiplying the two equations, we get

$$1 = \frac{h}{x} \cdot \frac{2h}{y} \text{ or } 2h^2 = xy$$

17. (D) Given $x, 2x + 2, 3x + 3$ are in GP

$$\Rightarrow \frac{2x+2}{x} = \frac{3x+3}{2x+2}$$

$$\Rightarrow \frac{2(x+1)}{x} = \frac{3(x+1)}{2(x+1)}$$

$$\Rightarrow \frac{2(x+1)}{x} = \frac{3}{2}$$

$$x = -4$$

$$r = \frac{a_2}{a_1} = \frac{-6}{-4} = \frac{3}{2}$$

$$a_2 = 2x + 2 = -8 + 2 = -6.$$

$$a_3 = 3x + 3 = 3(-4) + 3 = -12 + 3 = -9.$$

$$a_4 = a_3 \times r = -9 \times \frac{3}{2} = -\frac{27}{2} = -13.5$$

18. (C) $0.2317 = \frac{2317}{10000}$

$$p = 2317 \text{ and } q = 10000$$

$$\Rightarrow q = (10)^4 = (2 \times 5)^4 = 2^4 \times 5^4$$

We find that 2 and 5 cannot be factors of $p = 2317$.

Thus, $p = 2317$ and $q = 10000$ are co-prime.

$$\text{Also, } q = 2^4 \times 5^4 \Rightarrow n = 4 \text{ and } m = 4$$

19. (A) $\text{Mass} = V \times D = \pi(R + r)(R - r)h \times D$

$$= \frac{22}{7} \left(\frac{4.5}{2} + 2 \right) \left(\frac{4.5}{2} - 2 \right) 77 \times 8 \text{ gm/cc}$$

$$= 2.057 \text{ kg}$$

20. (C) Given $x^2 + y = 10$ & $x + y = 10$

$$\therefore x^2 + y = x + y$$

$$x^2 = x$$

$$x^2 - x = 0$$

$$x(x - 1) = 0$$

$$x = 0 \text{ or } x = 1$$

$$\text{If } x = 0 \text{ then } y = 10 \text{ (0,10)}$$

$$\text{If } x = 1 \text{ then } y = 9 \text{ (1,9)}$$

$$\therefore \text{Both meet at (0,10) \& (1,9)}$$

$$\text{Distance between (0,10) \& (1,9)}$$

$$= \sqrt{(1-0)^2 + (9-10)^2} = \sqrt{2}$$

21. (D) The required distance

$$= \sqrt{[(\sqrt{3}+1) - (\sqrt{3}-1)]^2 + [(\sqrt{2}-1) - (\sqrt{2}+1)]^2}$$

$$= \sqrt{(2)^2 + (-2)^2} = 2\sqrt{2}$$

22. (B) Volume of shaded solid = $4 \times 6 \times 5 - 1 \times 2 \times 4 = 112 \text{ units}^3$.

23. (B) Given equations are

$$2x + 3y = 5 \quad \dots (1)$$

$$\text{and } x - y = 10 \quad \dots (2)$$

Multiplying eq. (2) by 3 and adding eq. (1) and eq. (2), we get

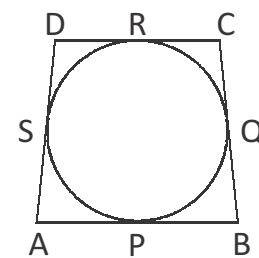
$$5x = 35$$

$$\Rightarrow x = 7$$

$$\text{and } y = -3.$$

\therefore The point (x, y) at which the submarine can be destroyed is $(7, -3)$.

24. (B) We know that the lengths of tangents to a circle from an external point are equal.



$$AP = AS \quad \dots (i)$$

$$BP = BQ \quad \dots (ii)$$

$$CQ = CR \quad \dots (iii)$$

$$DR = DS \quad \dots (iv)$$

Adding (i), (ii), (iii) and (iv), we get:

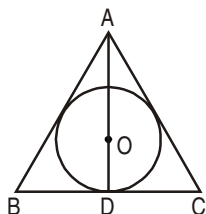
$$AP + BP + CR + DR = AS + BQ + CQ + DS$$

$$\Rightarrow (AP + BP) + (CR + DR) = (AS + DS) + (BQ + CQ)$$

$$\Rightarrow AB + CD = AD + BC$$

$$\Rightarrow AD = (AB + CD) - BC = \{(6 + 4) - 7\} \text{ cm} = 3 \text{ cm}$$

25. (D)



Draw $AD \perp BC$.

O lies on AD, and $(OD = \frac{1}{3}AD)$

$OD = 5 \text{ cm}$

$\Rightarrow AD = 15 \text{ cm}$

Now, $BD = x$ and $AB = 2x$.

By Pythagoras' theorem,

$$AB^2 = BD^2 + AD^2$$

$$\Rightarrow (2x)^2 = x^2 + (15)^2$$

$$\Rightarrow 4x^2 - x^2 = 225$$

$$\Rightarrow 3x^2 = 225$$

$$\Rightarrow x^2 = 75$$

$$\Rightarrow x = 5\sqrt{3} \text{ cm}$$

$$\begin{aligned} \therefore \text{Perimeter} &= AB + BC + AC \\ &= 3(2x) \\ &= 6 \times 5\sqrt{3} = 30\sqrt{3} \text{ cm} \end{aligned}$$

PHYSICS

26. (D) Radioactive wastes remain radioactive for thousands of years which is a major disadvantage of nuclear power

Option (A) : Nuclear power stations have very good safety records. There is no high risk of explosion as they are extremely safety conscious.

Option (B) : It is an advantage that nuclear power stations produce vast amounts of energy.

Option (C) : It is an advantage that nuclear power stations are sustainable.

27. (A) $V = 220 \text{ V}$

Power = 750 W

$$P = V \times I$$

$$\therefore 750 = 220 \times I$$

$$\therefore I = \frac{750}{220} = 3.4 \text{ A}$$

By Ohm's law $\frac{V}{I} = R$

$$\therefore R = \frac{220}{3.4} = 64.70 \Omega$$

28. (D) Statements (A), (B) and (C) are true of Faraday's laws of electromagnetic induction.

29. (C) An object is placed at C, $\therefore u = -C = -2f$

$$\text{Mirror formula, } \frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

For concave mirror, $f = \text{negative}$

$$-\frac{1}{f} = \frac{-1}{2f} + \frac{1}{v}, \frac{1}{v} = -\frac{1}{f} + \frac{1}{2f}$$

$$\frac{1}{v} = \frac{-1}{2f} \Rightarrow v = -2f$$

30. (D) The resistance of a conductor increases with both length, temperature and a decrease in cross sectional area.

31. (D) A convex lens of focal length 50 cm is to be used.

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}, \quad \frac{1}{-50} - \frac{1}{-25} = \frac{1}{f}$$

$$-\frac{1}{50} + \frac{1}{25} = \frac{1}{f}, \quad \frac{-1+2}{50} = \frac{1}{f}, \quad \frac{1}{50} = \frac{1}{f},$$

$$f = 50 \text{ cm}$$

32. (C) $n_i \sin i = n_r \sin r$

(where n_i is the refractive index of the incident medium, n_r is the refractive index of the refracted medium, 'i' is the angle of incidence and 'r' is the angle of refraction)

$$(1) \sin 60^\circ = (1.5) \sin(r)$$

$$\sin r = 0.0577$$

$$r = 35.3^\circ$$

33. (A) Fossil fuels like coal, petroleum and natural gas are non-renewable sources of energy. On burning they produce carbon dioxide, heat light and water vapour. Fossil fuels once used cannot be reused.

34. (B)

P	$R = \frac{(120)^2}{24} = 600 \, \Omega$
Q	$R = \frac{(120)^2}{60} = 240 \, \Omega$
R	$R = \frac{(240)^2}{60} = 960 \, \Omega$

\therefore The ascending order of values of resistances is Q, P, R.

35. (D) According to Fleming's left hand rule, the force on P acts downwards and the force on Q acts upwards.
36. (D) For a concave lens, the image distance is always negative as all images formed are virtual and on the same side as the object.
37. (A) Wood that is burnt as a fuel is called firewood. Firewood has chemical energy. On burning chemical energy is converted into heat and light energy.
38. (D) About five-sixth portion of sclerotic part in our eyes is opaque. The coating within the sclerotic is called choroid.

39. (A) When light ray travels from one medium to another medium of different refractive index, there will be a weak reflected ray (ray PQ) at the boundary of the two mediums and the light ray that passes through will be refracted (ray PR)

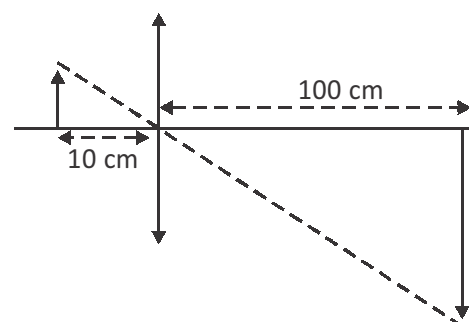
40. (B) $R \propto \frac{1}{A} \propto \frac{1}{r^2}$. Hence, $R \frac{1}{4} = 0.25 R$

41. (D) For tidal power to work, there must be a significant difference between the height of the water at low and high tides. Although the use of tidal power does not produce carbon dioxide, it could affect marine ecosystems in the area. Tidal power is only available when the tide is rising or falling - about 10 hours a day - so other renewable energy sources would be needed. However, the tides are a result of the pull of the moon on seas and oceans, so they will be present as long as the moon continues to exert gravitational force on the earth.

42. (D) The approximate diameter of our eye ball is about 2.3 cm. (Refer to Pg: 187 of Text book)

43. (C) Lenz's law states that the direction of the induced current is such that it always opposes the cause (motion of conductor) which produced it.

44. (A)



According to the geometry, the image is 10 times the size of the object as the object is 4 cm x 2 cm, the image must be 40 cm x 20 cm.

45. (D) The given three ways increase the rate of change of magnetic flux linking the circuit.

46. (B) When S_1 is closed and S_2 is opened, resistor R and the 6Ω are connected in series.

$$(R + 6) = (6 \text{ V}) \div (0.5 \text{ A})$$

$$R = 6\Omega$$

When S_1 and S_2 are both closed, 6Ω resistor and the 3Ω resistor are connected in parallel and the resistor R is in series with them.

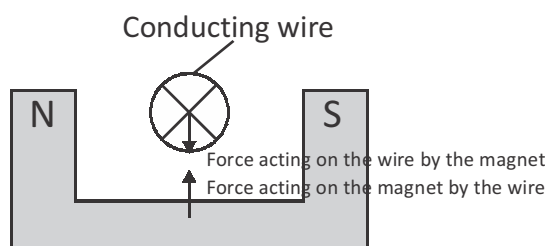
Effective resistance of 6Ω and 3Ω in parallel = 2Ω

Total effective resistance of the circuit = $6\Omega + 2\Omega = 8\Omega$

Reading in ammeter when S_1 and S_2 are both closed = $V \div R = (6 \text{ V}) \div (8\Omega) = 0.75 \text{ A}$

47. (A) When a strong direct current flows through the wire into the plane of the paper, there is a downward force acting on the current carrying wire by the magnet (use Fleming's left-hand rule).

According to Newton's 3rd law, there is an equal and opposite reaction force acting on the magnet by the wire. This force acts against the weight of the magnet to cause the reading on the scale to reduce.



48. (B) $m = \frac{l}{O} = \frac{v}{u} = \frac{3}{1}$

$$\therefore v = 3u \text{ or } \frac{v}{u} = \frac{3}{1}$$

When the position of the object and the image is interchanged then, $u' = v = v' = u$

$$\therefore m = \frac{v'}{u'} = \frac{u}{v}$$

$$\therefore m = \frac{1}{3}$$

Magnification is $\frac{1}{3}$.

49. (A) When a current carrying coil is placed in a uniform magnetic field, a torque is produced which causes turning movement in the coil.

50. (D) Resistance of a wire is inversely proportional to its area of cross section. Therefore, reducing the area of cross section by half will double the resistance without any change in the length.

CHEMISTRY

51. (C) In exothermic reactions, the bond energy of the reactants is greater than the bond energy of the products and the excess energy is released as heat. So, the products are at a lower energy level than the reactants.

52. (B) When ethanol is oxidised by air or by an oxidising agent, it will form ethanoic acid.

53. (C) Highly reactive metals (like potassium, sodium, calcium, magnesium and aluminium) are very stable and cannot be reduced by the most common reducing agent 'carbon' to obtain free metals. This is because these metals have more affinity (more attraction) for oxygen than carbon. So, carbon is unable to remove oxygen from these metal oxides and hence cannot convert them into free metals. Thus, the highly reactive metals cannot be extracted by reducing their oxides with carbon. Magnesium metal is extracted by electrolysis. In this method the metal compound is melted and then broken down by electricity to obtain pure metal.

54. (D) In double displacement reaction of an alkali with an acid involving the reaction of H^+ and OH^- ions to form H_2O molecule. The two compounds exchange their ions to form two new compounds salt and water.

55. (D) Vinegar is a weak acid as it has a low pH value of 2.2 to 2.4.

Option (A) : Vinegar (ethanoic acid) like all acids, contains the element hydrogen.

Option (B): Vinegar is a weak acid and can be sprinkled onto food and eaten.

Option (C) : Vinegar is used in cooking and flavouring food.

56. (D) Elements given in options (A) and (B) belong to alkali metals.

57. (D) A more reactive metal (Al) is displacing a less reactive metal (Fe) from its oxide. The reactions for the other options will not take place.

58. (C) As ethanoic acid is a weak acid and is only partially dissociated, more acid molecules need to undergo dissociation in order to form the hydrogen ions for complete neutralisation. The dissociation process is endothermic and requires energy. Hence, a less exothermic reaction results.

59. (B) MgO is most basic. N_2O_5 is strongly acidic, ZnO and Al_2O_3 are amphoteric.

60. (C) Sodium sulfate and water are the products of the neutralisation of sodium hydroxide and sulfuric acid.

Options (A) and (D) : Sodium sulfate and water (not hydrogen) are the products of neutralisation of sodium hydroxide and sulfuric acid.

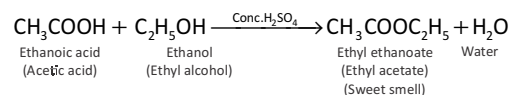
Option (B): Sodium sulfate (not chloride) and water would be the products of neutralisation of sodium hydroxide and sulfuric acid.

61. (C) A soap molecule is made up of two parts i.e., a long hydrocarbon non-ionic part of carboxylic acid (fatty acid) and a short ionic part containing $COO^- Na^+$ group

62. (A) The gas given off is likely to be carbon dioxide as the acid has reacted with carbonates in the marble.

63. (C) Copper reacts with the oxygen of air on prolonged heating to form a black substance copper (II) oxide.

64. (B) When ethanoic acid is warmed with ethanol in the presence of a few drops of concentrated sulphuric acid, a sweet smelling ester called ethyl ethanoate is formed:



65. (A) Atomic numbers : 12 (Mg), 38 (Sr), 4(Be) 88 (Ra) represent alkaline earth metals.

66. (C) Oxidation is the addition of oxygen or removal of hydrogen or electrons from a compound or element.

67. (D) (i) Melting of ice is an endothermic process as it absorbs heat from the surroundings to change from ice to water.

(ii) Ethanol molecules evaporate by absorbing heat from the surroundings on the surface.

(iii) Iodine crystals on heating change directly from solid to gaseous state.

An exothermic process releases net heat energy from the formation of bonds. When water vapour molecules come together to form liquid droplets, weak inter-molecular attractive forces are formed by releasing heat.

68. (C) Sulphur is a non-metal and does not conduct electricity. Metals can conduct electricity in both solid and molten states. The given substance X is an ionic compound i.e., (sodium chloride) that has high melting point and can only conducts electricity in molten state.

69. (C) X must be an acid (citric acid) if it reacts with magnesium to produce hydrogen gas (which gives a pop sound when a burning splinter was placed near the gas).

Options (A), (B) and (D) : These substances are not acids.

70. (B) The Al^{3+} cation will migrate to the cathode and be reduced by gaining electrons.

BIOLOGY

71. (D) When we see an object that is near or far, an image is formed on the retina of the eye. It plays an important role in sensing the images of various objects in the surroundings.

72. (A) A swollen part in the upper region of the trunk above the girdle is due to the removal of phloem tissue at the girdle and due to the accumulation of food in the phloem in the cortical cells.
73. (C) Process P is pollination, Q is fertilization ovary becomes fruit and ovules mature into seeds.
74. (B) I-R, II-P, III-Q, IV-S
Symbiotic relationship – Lichens
Parasitic plant – Viscum
Ruminant – Cow
Saprophyte – Mould
75. (D) Plants take in carbon dioxide during photo-synthesis to synthesis their food and give out oxygen. Animals take in oxygen and give out carbon dioxide during respiration.
76. (D) During the process of exchange of gases, a carbon dioxide molecule that enters the alveolus is carried to bronchiole, bronchus and trachea. From trachea it is exhaled out through nostrils.
77. (A) We get muscle cramps after heavy exercise is due to the partial breakdown of glucose to produce lactic acid.
78. (C) As X and Y are storage roots, they cannot make food by themselves. During photosynthesis, the leaves make food and transport it downwards through the phloem tubes in the stem. The excess food is stored as starch in X and Y.
79. (C) Partly digested food enters the small intestine. Digested food passes through the walls of the small intestine into the bloodstream. Undigested food enters another stretch of tube called the large intestine where water is absorbed.
80. (C) Gas P - Oxygen and Gas Q - Carbon dioxide.
81. (B) The phloem in stems is always on the outside of vascular bundle.
82. (A) In the given figure 'P' is red blood cells. It helps in exchange of gases.
83. (D) Part labelled 'X' in the given figure is Henle's loop. Reabsorption of water and ions take place here.
84. (B) Pancreas is called both as an exo and endocrine gland.
85. (D) Diffusion is the overall movement of substances from a region of higher concentration to a region of lower concentration. Ensuring a concentration gradient and reducing the distance across which the substances have to move help diffusion to take place more efficiently. Tubes which connect different parts of the organism bring substances nearer to the tissues but do not directly affect diffusion.
86. (C) Coordination of movements is controlled by cerebellum.
87. (B) Pollen grains germinate on stigma by absorbing water and nutrients.
88. (C) The digestive system breaks the food down into simpler forms, making it easier for the body to absorb. Energy stored in the food is only released when cells use the food during respiration.
89. (C) The ureter connects the kidney to bladder where the urine is temporarily stored before it is expelled through the urethra to the outside of the body.
90. (B) T - Root hairs absorb water and mineral salts from soil
P - Xylem tubes carry water and mineral salts to other parts of the plant
R - The leaves receive water and mineral salts
Q - The leaves make food in the presence of sunlight
S - Phloem tubes transport food to other parts of plant

GENERAL AWARENESS

- | | | |
|----------|---------|---------|
| 91. (A) | 92. (A) | 93. (D) |
| 94. (A) | 95. (D) | 96. (C) |
| 97. (A) | 98. (C) | 99. (A) |
| 100. (D) | | |