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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN426

Solutions for Class : 10

Mathematics

1. **(A)** Given $\sin^2 A + \sin A = 1$

$\Rightarrow \sin A = 1 - \sin^2 A$

$\Rightarrow$ Sin A = $\cos^2 A$ ...(i)

[$\because$ $1 - \sin^2 A = \cos^2 A$]

Consider, $\cos^2 A + \cos^4 A$

= $\sin A + \sin^2 A$ [from Eq. (i)]

= 1

2. **(C)** Given, 20% of x = y

$\Rightarrow \frac{20}{100} \times x = y$

$\Rightarrow \frac{1}{5} x = y$

$\Rightarrow x = 5y$ ...(i)

and 60% of (x + y) = 360

$\Rightarrow \frac{60}{100} \times (x + y) = 360$

$\Rightarrow x + y = 600$

$\Rightarrow 5y + y = 600$ [from Eq.(i)]

$\Rightarrow 6y = 600$

$\Rightarrow y = 100$

$\therefore x = 5 \times 100 = 500$

3. **(B)** Given, $ax^2 + bx + c = 0$

has the roots $\sin\alpha$ and $\cos\alpha$.

$\therefore$ sum of the roots $\Rightarrow \sin\alpha + \cos\alpha = \frac{-b}{a}$

$\Rightarrow (\sin\alpha + \cos\alpha)^2 = \left(\frac{-b}{a}\right)^2$

$\Rightarrow 1 + 2\sin\alpha.\cos\alpha = \frac{b^2}{a^2}$

but, product of the roots $\Rightarrow \sin\alpha.\cos\alpha = \frac{c}{a}$

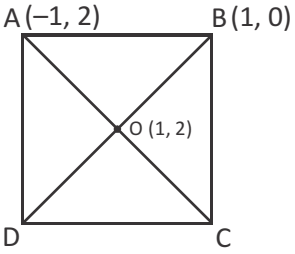
$\Rightarrow 1 + 2\frac{c}{a} = \frac{b^2}{a^2}$

$\Rightarrow \frac{a+2c}{a} = \frac{b^2}{a^2} \Rightarrow a + 2c = \frac{b^2}{a}$

$\Rightarrow a^2 + 2ac = b^2$

$\Rightarrow b^2 = a^2 + 2ac$

4. **(A)**



Equation of diagonal AC,

Let A (–1, 2) = (x_1, y_1)

0 (1, 2) = (x_2, y_2)

$(x - x_1)(y_2 - y_1) = (y - y_1)(x_2 - x_1)$

$(x + 1)(2 - 2) = (y - 2)(1 + 1)$

$0 = (y - 2)(2) \Rightarrow \frac{0}{2} = y - 2 \Rightarrow 0 = y - 2$

Hence, $\boxed{y = 2}$ is the equation of diagonal AC. Now, the equation of diagonal BD.

$\Rightarrow (x - 1)(2 - 0) = (y - 0)(1 - 1)$

$\Rightarrow (x - 1)(2) = 0$

$\Rightarrow x - 1 = \frac{0}{2} = 0$

$\therefore \boxed{x = 1}$ is the equation of diagonal BD.

5. **(A)** If 'P' is a prime number such that 'p' divides a^2, then 'P' divides a.

6. **(B)** In ΔABC, $\angle B = 90^\circ$ AB = 5 cm, AC = 10 cm

Now, in right angled ΔABC

$$\cos A = \frac{AB}{AC} = \frac{5}{10} = \frac{1}{2} = \cos 60^\circ$$

$$\Rightarrow \quad \angle A = 60^\circ$$

$$\therefore \angle C = 180^\circ - (\angle A + \angle B)$$

$$= 180^\circ - (60^\circ + 90^\circ) \quad = 180^\circ - 150^\circ = 30^\circ$$

7. **(B)** Given, In an AP

$t_4 = 8 \Rightarrow a + 3d = 8 \Rightarrow a = 8 - 3d \rightarrow (1)$

and also, $S_{12} = 156$

$$\Rightarrow \frac{\cancel{12}^{6}}{\cancel{2}} [2a + 11d] = \cancel{156}^{26}$$

$\Rightarrow 2a + 11d = 26$

$\Rightarrow 2 (8 - 3d) + 11d = 26$ [from (1)]

$\Rightarrow 16 - 6d + 11d = 26$

$\Rightarrow 5d = 26 - 16 = 10$

$\Rightarrow d = 10/5 = 2$ in (1)

(1) $\Rightarrow a = 8 - 3 (2) = 8 - 6 = 2.$

also given $t_p = 1000$

$\Rightarrow a + (p - 1)d = 1000$

$\Rightarrow 2 + (p - 1) (2) = 1000$

$\Rightarrow 1 + p - 1 = 1000/2$

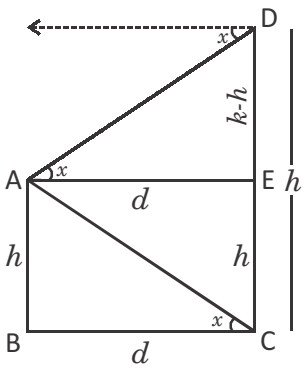
$\Rightarrow p = 500$

8. **(D)** $4x + 7y = 0$ and $10x + ky = 25$ are coincident lines

$$\Rightarrow \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

$$\Rightarrow \frac{4}{10} = \frac{7}{k} \Rightarrow k = \frac{70}{4} = \frac{35}{2}$$

9. **(C)**



Let 'A' be the position of the top of the tower AB = h, observed from D and C which are top and bottom of another tower CD = K say.

Let BC = AE = d

From right ΔABC, $\tan y = \frac{h}{d}$

$$d = \frac{h}{\tan y} \rightarrow (1)$$

From right ΔADE, $\tan x = \frac{k-h}{d}$

$$\Rightarrow d = \frac{k-h}{\tan x} \rightarrow (2)$$

from (1) & (2)

$$\frac{h}{\tan y} = \frac{k-h}{\tan x}$$

$h \tan x = k \tan y - h \tan y$

$h (\tan x + \tan y) = k \tan y$

$$\therefore k = h \left(\frac{\tan x + \tan y}{\tan y} \right)$$

$\Rightarrow k = h (\tan x . \cot y + 1)$

Hence, height of second tower $= h (1 + \tan x . \cot y)$

10. **(D)** For m = 1 and n = 2

$ax + bx^2 + c = 0$

$\Rightarrow bx^2 + ax + c = 0$ ...(i)

for m = 2 and n = 1,

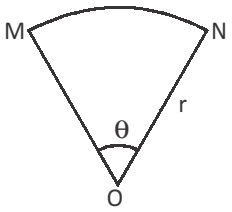
$ax^2 + bx + c = 0$ ... (ii)

Both Eqs. (i) and (ii) are quadratic

11. **(C)** Let $\angle MON = \theta$ radian, then

Perimeter = $2r + r\theta$ ... (i)

and area = $\frac{1}{2} r^2 \theta$



But area is 100 cm^2.

$$\therefore \quad \frac{1}{2} r^2 \theta = 100$$

$$\Rightarrow \quad r\theta = \frac{200}{r} \quad \text{... (ii)}$$

From Eqs. (i) and (ii), we get

$$\text{Perimeter} = 2r + \frac{200}{r}$$

12. **(B,D)** Let A (x, y), B(0, 0) and C (1, 1).

Since, the points are collinear.

$\therefore$ Area of $\Delta ABC = 0$

$$\Rightarrow \frac{1}{2}\{x(-1) + 0\,(1 - y) + 1(y)\} = 0$$

$$\Rightarrow \quad -x + y = 0$$

$$\Rightarrow \quad x - y = 0$$

also satisfies $x^2 - y^2 = 0$

13. **(C)** By division algorithm, we have

$$f(x) = g(x)q(x) + r(x)$$

To find r(x), we have

$$\begin{array}{r} x-2 \\ x^2-x+1\overline{)\,x^3-3x^2+x+2} \\ \underline{x^3-x^2+x} \\ -2x^2+2 \\ \underline{-2x^2+2x-2} \\ -2x+4 \end{array}$$

So, $r(x) = -2x + 4$

$-2x + 4$ must be subtracted.

14. **(A)** From the data given, we can say

volume of cone = volume of hollow cylinder

$$\Rightarrow \frac{1}{3}\pi r^2 h = \frac{4}{3}\pi\left(R^3 - r^3\right)$$

$$\Rightarrow r^2 h = 4\,(R^3 - r^3)$$

$$\Rightarrow 4^2.h = 4\,(4^3 - 2^3)$$

$$\Rightarrow 16\,h = 4\,(64 - 8)$$

$$\Rightarrow h = \frac{\cancel{4} \times \cancel{56}^{14}}{\cancel{16}_{\cancel{4}}}$$

$\therefore$ h = 14 cm

15. **(D)** Required coordinates

$$= \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$

m : n = 5 : 2, $(x_1, y_1) = (-3, 5)$,

$(x_2, y_2) = (4, -9)$

$$\Rightarrow \quad \left(\frac{5(4)+2(-3)}{5+2}, \frac{5(-9)+2(5)}{5+2}\right)$$

$$= \quad \left(\frac{20-6}{7}, \frac{-45+10}{7}\right) = \left(\frac{14}{7}, \frac{-35}{7}\right)$$

$$= \quad (2, -5)$$

16. **(C)** HCF of 45 and 72 = 9

number of mathematics bundles = 45 ÷ 9 = 5

number of physics bundles = 72 ÷ 9 = 8

Hence, the least number of bundles that can be made = 5 + 8 = 13

17. **(C)** The given equation is $x^2 - 8x + p = 0$

$\alpha + \beta = 8,\ \alpha\beta = p$

$\alpha^2 + \beta^2 = 40$ (Given)

$(\alpha + \beta)^2 - 2\alpha\beta = 40$

$\Rightarrow$ p = 12

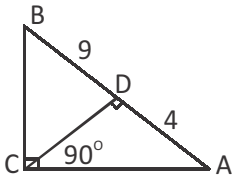
18. **(C)** We have,

$A_1 : A_2 = 16 : 25$

$$\frac{C_1}{C_2} = \sqrt{\frac{A_1}{A_2}} = \sqrt{\frac{16}{25}} = \frac{4}{5}$$

$\therefore$ The ratio of circumferences is 4 : 5.

19. **(B)**



In ΔACB and ΔADC,

$$\angle A = \angle A \quad \text{[common angles]}$$

$$\angle ACB = \angle ADC \quad [\text{ each } 90^o]$$

$$\Rightarrow \quad \Delta ACB : \Delta ADC \qquad ...(i)$$

Now, in ΔADC and ΔCDB,

$$\angle ADC = \angle CDB \text{ [each = } 90^o]$$

$$\angle ACD = \angle DBC$$

[from Eq. (i)]

$\therefore$ $\Delta ADC : \Delta CDB$ [by AA similarity]

Now, $\frac{AD}{DC} = \frac{CD}{DB}$

$\Rightarrow$ AD $\square$ DB = CD^2

$\Rightarrow$ $9 \times 4 = CD^2$

$\Rightarrow$ $CD = 3 \times 2$

$= 6$ cm

20. **(B)** Let $f(a) = a^3 - 3a^2 + a + 2$

$q(a) = a - 2$ and $r(a) = (-2a + 4)$

Then $f(a) = g(a)\,q(a) + r(a)$

$$\Rightarrow \quad g(a) = \frac{f(a) - r(a)}{q(a)}$$

Hence, $g(a) = a^2 - a + 1$.

21. **(C)** Let the three numbers be x, y and z.

Now, according to the question,

$x \times y = 42$

and $y \times z = 78$

$\Rightarrow x \times y \times y \times z = 42 \times 78$

$\Rightarrow x \times y^2 \times z = 7 \times 6 \times 6 \times 13$

$= 7 \times 6^2 \times 13$

$\therefore x = 7$

$y = 6$

and $z = 13$

Now, $x + y + z = 7 + 6 + 13 = 26$

22. **(A)** Given, $a_m = a + (m - 1)d$

$a_n = a + (n - 1)d$

and $a_p = a + (p - 1)d$

According to the question,

$a_m = 2a_n$

$\Rightarrow a + (m - 1)d = 2[a + (n - 1)d]$

$\Rightarrow a + (m - 1)d = 2a + (2n - 2)d$

$\Rightarrow a + md - d = 2a + 2nd - 2d$

$\Rightarrow (m - 2n - 1 + 2)\, d = a$

$\Rightarrow a = (m - 2n + 1)d \quad \ldots$ (i)

Now, $a_n = 3a_p$

$\Rightarrow a + (n - 1)d = 3[a + (p - 1)d]$

$\Rightarrow a + (n - 1)d = 3a + 3(p - 1)d$

$\Rightarrow 2a = (n - 1 - 3p + 3)d$

$\Rightarrow 2a = (n - 3p + 2)d$

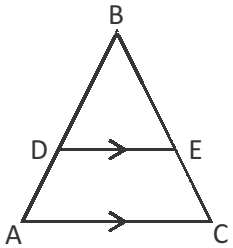
From Eq. (i), we have

$2(m - 2n + 1)d = (n - 3p + 2)d$

$\Rightarrow 2m - 4n + 2 = n - 3p + 2$

$\Rightarrow 2m - 5n + 3p = 0$

23. **(B)**



Given, In ΔABC, DE // AC.

$\therefore \Delta DBE : \Delta ABC$ (this can be proved)

also given, area of $\Delta DBE = \frac{1}{2}$ are of ΔABC.

$\Rightarrow \frac{\text{area}(\Delta DBE)}{\text{area}(\Delta ABC)} = \frac{1}{2}$

by a theorem, we have ratio of areas of two similar triangles in equal to the ratio of squares of any two corresponding sides.

$\therefore \frac{BD^2}{AB^2} = \frac{1}{2}$

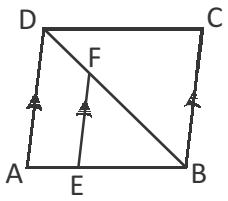
$\frac{BD}{AB} = \frac{1}{\sqrt{2}}$

$\Rightarrow \frac{1}{1} - \frac{BD}{AB} = 1 - \frac{1}{\sqrt{2}}$

$\Rightarrow \frac{AB - BD}{AB} = \frac{\sqrt{2} - 1}{\sqrt{2}}$

$\Rightarrow \frac{AD}{AB} = \frac{\sqrt{2} - 1}{\sqrt{2}}$

24. **(B)**



Given, EF // BC

but BC // AD (□ ABCD is a parallelogram)

$\therefore$ EF // AD.

now In ΔABD, EF // AD

$\therefore$ we can prove $\Delta ABD : \Delta EBF$.

when two triangles are similar then the ratio of their areas is equal to the ratio of squares of any two corresponding sides. (by a theorem)

$\therefore \frac{\text{area of } \Delta ABD}{\text{area of } \Delta EBF} = \frac{AB^2}{EB^2} = \frac{5^2}{3^2} = \frac{25}{9} \rightarrow (1)$

Given $\frac{AE}{EB} = \frac{2}{3}$

$\frac{AE + EB}{EB} = \frac{2 + 3}{3}$

$\frac{AB}{EB} = \frac{5}{3}$

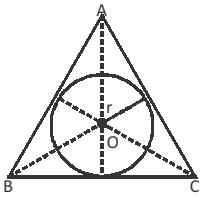
now, $\frac{\text{area of } \Delta ABD - \text{area of } \Delta EBF}{\text{area of } \Delta EBF}$

$= \frac{25-9}{9}$

$\Rightarrow \frac{\text{area of trapezium } (AEFD)}{\text{area of } \Delta EBF} = \frac{16}{9} \rightarrow (2)$

(1) ÷ (2) $\frac{\text{area of } \Delta ABD}{\text{area of trapezium } \Delta EBF} = \frac{25}{16}$

25. **(B)** We have, a circle of radius r is inscribed in a triangle of area 'Δ'.



We know that,

Area of ΔABC = Area of ΔAOB + Area of ΔBOC + Area of ΔAOC

$= \frac{1}{2} \times r \times AB + \frac{1}{2} \times r \times BC + \frac{1}{2} \times r \times AC$

$= \frac{1}{2} \times r\,(AB + BC + AC)$

$= \frac{1}{2} \times r \times 2s$

$\Rightarrow \Delta = rs$

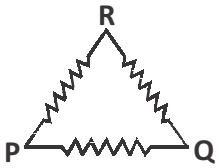
$\therefore r = \frac{\Delta}{s}$

Physics

26. **(B)** The correct sequence of energy changes in the hydroelectric generator is Potential energy $\rightarrow$ Kinetic energy $\rightarrow$ Electrical energy.

When the water falls down through a large height from the dam, it flows very fast (its potential energy is changed into kinetic energy). A high pressure jet of fast flowing water pushes on the blades of turbine with a great force and makes the turbine rotate rapidly. The turbine is connected to a generator through its shaft. When the turbine rotates, its shaft also rotates and drives the generator. The generator produces electricity.

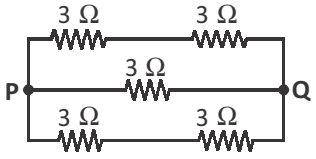
27. **(D)** $R_{PQ} = \frac{(4+4)x4}{4+4+4} = \frac{8}{3}\,\Omega$



28. **(C)** Current flowing in a straight wire will always produce a circular magnetic field around the wire.

29. **(C)** During refraction, frequency remains the same as it is a property of source. In denser medium speed of light decreases. Hence, wavelength decreases. When a beam of monochromatic light from a rarer medium like vacuum or air gets refracted into a denser medium like glass with a refractive index of 1.5, it bends towards the normal. Hence, the speed of light decreases due to change in media from air to glass when light goes from a rarer medium to a denser medium, both the speed and wavelength decreases.

30. **(C)**



$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

where

$\frac{1}{R} = \frac{1}{6} + \frac{1}{3} + \frac{1}{6} = \frac{1+2+1}{6} = \frac{4}{6}$

or R = $\frac{6}{4} = 1.5\ \Omega$

31. **(C)** Sunlight is dispersed as it passes through a drop of rain water. Thus, a rainbow is formed as a result.

Options (A), (B) and (D): The light phenomena taking place is dispersion, not reflection, absorption or recombination. Thus, these options are incorrect.

32. **(C)** We know that:

$$\text{Refractive index} = \frac{\text{Speed of light in air}}{\text{Speed of light in medium}}$$

So, Speed of light in medium =

$$\frac{\text{Speed of light in air}}{\text{Refractive index}}$$

The speed of light will be the maximum in that medium (or substance) which has the lowest refractive index. Now, out of kerosene, turpentine, water and diamond, water has the lowest refractive index of 1.33. So, the light will have maximum speed in water or light will travel fastest in water.

33. **(D)** The waste products of nuclear fission reactions (produced at nuclear power station) are radioactive which keep on emitting harmful nuclear radiations for thousands of years. So, it is very difficult to store or dispose off nuclear wastes safely. Improper nuclear waste storage or disposal can result in environmental contamination.

34. **(C)** As the resistance of a conductor (wire) is directly proportional to its length, when the length is doubled, its resistance also gets doubled. If the length of a wire is halved, then its resistance also gets halved.

The resistance of a conductor (wire) is inversely proportional to its area of cross-section. When the area of cross-section of a wire is doubled, its resistance gets halved and if the area of cross-section of wire is halved, then its resistance will get doubled. Hence, if the length of the conductor (wire) is halved (L/2) and area of cross-section is doubled (2A), it will lead to a smallest resistance.

35. **(A)** The magnitude of the force experienced by a current-carrying conductor when placed in a magnetic field will be maximum if the directions of current and magnetic field are perpendicular to each other.

36. **(B)** $\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1} = \frac{c_1}{c_2}$

$$\frac{\sin 45^\circ}{\sin 30^\circ} = \frac{3\times10^8}{c_2} \Rightarrow c_2 \frac{3\times10^8}{\sqrt{2}}$$

$= 2.12 \times 10^8$ m/s

37. **(D)** Coal and oil are both chemical sources of energy. Option (C) is incorrect as uranium is a nuclear source of energy, not chemical.

38. **(A)** Human beings (and all other animals having their eyes at the front of their head) are said to have stereoscopic vision which gives the perception of depth. All the predators (like tiger, lion, etc.,) have their eyes at the front of head so that they can judge the distance of their prey accurately and catch them easily.

39. **(D)** A convex lens has two foci. The two foci of a convex lens are at equal distances from the optical centre, one on either side of the lens. Since, all the light rays actually pass through the principal focus of a convex lens, it has real focus. Like a convex lens, a concave lens also has two foci, one on each side of the concave lens. If the parallel rays fall on the concave lens from the right side, then they will appear to diverge from a point F'. Thus, F' is the second focus of the concave lens. Since, the light rays do not actually pass through the focus of a concave lens, it has a virtual focus. The principal focus real or virtual of a lens always lies on the principal axis.

40. **(A)** Let the two resistances be R_1 and R_2,

$S = R_1 + R_2$

$$\Rightarrow \frac{1}{P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R_1 R_2} \Rightarrow P = \frac{R_1 R_2}{R_1 + R_2}$$

Now, $S = nP$

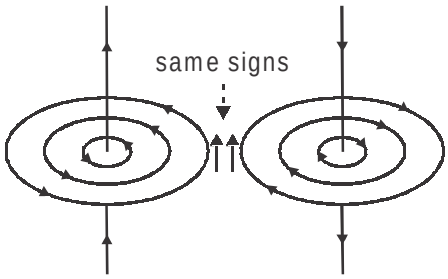
$$\Rightarrow R_1 + R_2 = n\left(\frac{R_1 R_2}{R_1 + R_2}\right)$$

Now $R_1 = R_2 = R$, $\therefore 2R = \frac{nR^2}{2R} \Rightarrow n = 4$

41. **(A)** The water passed through a coiled pipe in a solar water heater increases its surface area so that more heat can be absorbed as the water passes through.

42. **(A)** Presbyopia is a condition in which a person is suffering from both myopia and hypermetropia. It can be corrected by using bifocal lenses in which upper portion is a concave lens and the lower portion is a convex lens.

43. **(C)** By using the right-hand grip rule, it can be deduced that the two circular fields are shown below. The two fields are in the same direction in between the two wires. This implies that there is a repulsive force between the two wires caused by the interaction of the fields. (stronger field between the wires and weaker field outside them).

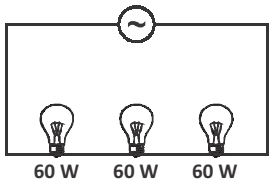


44. **(A)** $m = -\frac{1}{4} = \frac{v}{u}$ (Image is real and inverted)

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f};\ \frac{1}{-u/4} - \frac{1}{u} = \frac{1}{f};$$

$$\frac{-5}{u} = \frac{1}{f} \Rightarrow u = -5\ f = 150\ cm$$

45. **(C)** Electric bulbs connected in series.

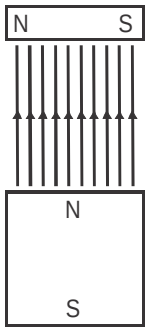


Power rating of each bulb is 60 W. In series connection the three bulbs share the power. Therefore each bulb will light up with a power = $\frac{60W}{3}$ = 20 W.

46. **(D)** Light travels slower through a denser medium. The correct order is glass, water and air. This is because glass is the densest, followed by water and air, the least dense of the three.

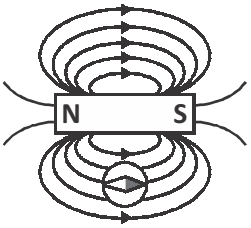
Options (A), (B) and (C): The order in which the given mediums are arranged in these options is wrong.

47. **(D)** The magnetic field always exits from the N-pole. The N-pole of the bar magnet will be repelled and the S-pole of the bar magnet will be attracted. This will cause a 90° clockwise rotation immediately.



48. **(D)** It is only because of our eyes that we are able to see the wonderful world and colours around us and identify the objects. Working of the human eye as a camera makes it one of the most valuable and sensitive organ of the body.

49. **(B)** The magnetic field of a bar magnet is shown below. The compass needle will point towards the direction of the magnetic field.



50. **(C)** As the applied voltage is higher than the rated voltage, both the bulbs will fuse.

Chemistry

51. **(B)** It is a photochemical decomposition as one compound breaks down to produce two substances using light.

52. **(C)** To form 3 molecules of H_2O, there should be 6 H in the compound that is completely burnt.

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

53. **(A)** The ammonium ion consists of covalent bonds between nitrogen and hydrogen atoms. An ionic bond is formed between the positively charged ammonium ion and negatively charged chloride ion.

54. **(D)** When the silver spoon is electroplated using aqueous copper (II) sulfate, the spoon is made the cathode and copper (II) ions in the solution will be reduced to copper and deposited on the spoon.

55. **(D)** Chlorine has many uses :

(i) It is used for making solvents for dry cleaning (such as trichloroethane).

(ii) It is used in the production of bleaching powder and hydrochloric acid

(iii) It is used to make plastic such a polyvinyl chloride (PVC), pesticides, chlorofluoro-carbons (CFCs), chloroform, carbon tetrachloride, paints and dye-stuffs.

(iv) It is used to sterilise drinking water supply and water in swimming pools.

56. **(D)** Elements in the same group have the most similarity as they have the same number of valence electrons.

57. **(A)** In neutralisation, an acid reacts with an alkali to form salt and water only. Ethanoic acid is neutralised by sodium hydroxide to form sodium ethanoate (salt) and water.

$$CH_3COOH + NaOH \rightarrow CH_3COO^-Na^+ + H_2O$$

58. **(D)** The descending/decreasing order of reactivity of given metals with oxygen is aluminium, zinc, iron and copper.

(i) Aluminium metal burns in air, on heating to form aluminium oxide.

(ii) Zinc metal burns in air only on strong heating to form zinc oxide.

(iii) Iron metal does not burn in air even on strong heating. Iron reacts with the oxygen of air on heating to form iron (II, III) oxide.

(iv) Copper metal also does not burn in air even on strong heating. Copper reacts with the oxygen of air on prolonged heating to form a black substance copper (II) oxide.

59. **(B)** Alkali metal oxide (K_2O) is most basic.

60. **(D)** The pH of the liquid after addition of the acid depends on the amount of acid added.

(i) If acid is added in excess, the mixture would be acidic, at pH 3.

(ii) If enough acid is added to neutralise the sodium hydroxide, the mixture would be neutral, at pH 7.

(iii) If a little acid is added, the mixture would be slightly less alkaline than sodium hydroxide, at pH 9.

(iv) The mixture would not become more alkaline and reach pH 14.

61. **(B)** The homologous series of alcohol has all its members' names ending with '-ol' which represents the alcohol group present in their molecules.

62. **(D)** Amount of anhydrous sodium carbonate = 37 / (23.0×2+12.0 + 16.0×3) = 0.349 mol

Amount of water lost = (100 − 37)/ 18.0 = 3.50 mol

Amount of water of crystallisation per mole of sodium carbonate = 3.50/0.349 = 10.0 mol

Hence, hydrated sodium carbonate has the formula $Na_2CO_3.10H_2O$.

63. **(D)** The reaction of sodium with water is exothermic (very explosive).

64. **(D)** A suitable catalyst will speed up the given reaction. As the reactant is a solid, its fine powder gives a larger surface area to increase the reaction.

65. **(C)** Graphite is a good conductor of electricity and used to make electrodes in dry cells and electric arcs. It has delocalised electrons within each layer of carbon atoms to conduct electricity. Graphite is soft and slippery. Its powder is used as a lubricant. The carbon atoms in graphite are covalently bonded together in hexagons, which are arranged in layers. The forces of attraction between the layers of carbon atoms are very weak and allow the layers to slide over each other.

66. **(C)** As silver is less reactive, it will not displace hydrogen from dilute acids.

67. **(B)** An amphoteric oxide reacts with both an acid and an alkali to form respective salts.

$$ZnO(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2O(l)$$

$$ZnO(s) + 2NaOH(aq) \rightarrow Na_2ZnO_2(aq) + H_2O(l)$$

68. **(C)** When acidified water (H_2O) is electrolysed, hydrogen and oxygen gases are given off.

Options (A), (B) and (D): Carbon dioxide and nitrogen are not given off.

69. **(A)** The electronic configuration of element Y is 2.4. Hence, it is a non-metal, and is located in Group IV and Period 2. It does not lose or gain 4 electrons during a chemical reaction as it is energetically unfavourable. Instead, it shares its electrons with another element to form covalent bond(s).

70. **(C)** Hydrogen gas is given off when acids react with metals. Carbon dioxide gas is given off when acids react with carbonates.

Biology

71. **(C)** It has been found that people living in very high mountains have many more red corpuscles in their blood than people living in plains due to the low air pressure as they requires more red corpuscles to supply the body cells with oxygen.

72. **(A)** Platelets are involved in the clotting of blood when tissues have been damaged and white blood cells are involved in immune functions and hence important for fighting off infections.

73. **(D)** Bacteria and fungi are decomposers.

74. **(A)** The pollen transferred from anther to stigma is called pollination, the process in which embryo develops into seedling is called germination, fertilised egg in humans gets implanted in uterus and when egg in humans is not fertilised menstruation occurs.

75. **(C)** Insulin stimulates the liver to convert glucose into glycogen. Without insulin, glycogen will be absent in the liver.

76. **(C)** Some white blood cells change their shape and are able to creep through the endothelial cells making up capillary walls to reach areas of inflammation.

77. **(C)** Parts of a leaf labelled as I and III exposed to sunlight changes to black when dipped in iodine solution because sunlight is essential for photosynthesis.

78. **(A)** Pollen is first released and then transferred to the stigma (pollination). Subsequently, the pollen grain germinates and pollen tube grows. During this time, the generative nucleus in the pollen tube divides to produce male gametes. Finally, fertilisation occurs with the fusion of the male gamete with the ovum.

79. **(B)** Law of 10% or Lindemann's law states that there is 10% loss of energy in each level of the food chain.

80. **(B)** Organs which have same basic structure but different functions are called homologous organs, forelimb of a man and wing of a bird.

81. **(B)** Pollen grains contain male gametes, which can only be formed via meiosis. Ova are female gametes, which are also be formed via meiosis. The zygote forms via fertilisation, the fusion of a male with a female gamete. No cell division is involved during this process (2). The formation of new potato plants from a tuber involves asexual reproduction, where all daughter plants from the same tuber will be genetically identical to the parent plant.

82. **(A)** Cerebellum maintains posture and equilibrium of the body.

83. **(B)** (ii), (iii), (iv), (i)
When amoeba undergoes fission, nucleus divides first and then the cytoplasm.

84. **(B)** $\text{Glucose} \xrightarrow[\text{glycolysis}]{\text{cytoplasm}} \text{Pyruvate} \xrightarrow[\text{oxygen}]{\text{mitochondria}}$
$CO_2 + H_2O + \text{Energy}$

85. **(C)** The growth of pollen tube towards the ovule is called chemotropism.

86. **(A)** In the given figure 'P' is fallopian tube. Fertilization takes place in fallopian tube.

87. **(B)** Bryophyllum reproduced by leaf buds.

88. **(A)** Leaves, banana peel, flower and news paper made from the pulp of plant are biodegradable.

89. **(A)** The given description is about alveolus.

90. **(D)** Vasopressin regulates the urine formation and ionic balance in the body.

91. **(B)** 92. **(A)** 93. **(D)**

94. **(C)** 95. **(B)** 96. **(A)**

97. **(B)** 98. **(D)** 99. **(C)**

100. **(B)**