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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : 1P104

KEY

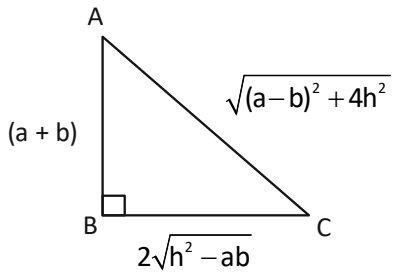
1. B	2. C	3. C	4. A	5. D	6. D	7. B	8. C	9. D	10. D
11. B	12. B	13. C	14. B	15. C	16. B	17. A	18. D	19. A	20. C
21. A	22. B	23. D	24. B	25. B	26. C	27. B	28. C	29. D	30. C
31. B	32. D	33. D	34. D	35. B	36. B	37. B	38. A	39. D	40. A
41. C	42. C	43. C	44. B	45. B	46. B	47. D	48. C	49. C	50. B
51. B	52. A	53. B	54. C	55. B	56. C	57. C	58. A	59. A	60. B

SOLUTIONS

MATHEMATICS

01. (B) In ΔABC, $\angle B = 90°$, Opposite side to

$\angle A = BC = 2\sqrt{h^2 - ab}$



Adjacent side to $\angle A = AB = (a + b)$

$AC^2 = AB^2 + BC^2$

$= (a+b)^2 + (2\sqrt{h^2 - ab})^2$

$= a^2 + 2ab + b^2 + 4(h^2 - ab)$

$= a^2 + 2ab + b^2 + 4h^2 - 4ab$

$= a^2 - 2ab + b^2 + 4h^2$

$AC = \sqrt{(a-b)^2 + 4h^2}$

$\cos A = \frac{\text{adJ side to } \angle A}{\text{hyp}} = \frac{(a+b)}{\sqrt{(a-b)^2 + 4h^2}}$

02. (C) Comparing $x^2 - 14x + 1 = 0$

with $ax^2 + bx + c = 0$

a = 1, b = –14, c = 1

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-14) \pm \sqrt{(-14)^2 - 4 \times 1 \times 1}}{2 \times 1}$$

$$= \frac{14 \pm \sqrt{196 - 4}}{2}$$

$$= 14 \pm \sqrt{192}$$

$$= \frac{14 \pm \sqrt{8 \times 8 \times 3}}{2}$$

$$= \frac{14 \pm 8\sqrt{3}}{2}$$

$$= \frac{\cancel{2}\left(7 \pm 4\sqrt{3}\right)}{\cancel{2}}$$

$= 7 + 4\sqrt{3}$ (or) $7 - 4\sqrt{3}$

03. (C) Volume of cone = $\frac{1}{3}\pi r^2 h$

$$= \frac{1}{3} \times \pi \times 21 \times 21 \times 84 \text{ cm}^3$$

Given $\frac{4}{3}\pi r^3 = \frac{1}{3}\pi \times 21 \times 21 \times 84 \text{ cm}^3$

$$r^3 = \frac{1}{\cancel{3}} \times \cancel{\pi} \times 21 \times 21 \times \cancel{84}^{21} \times \frac{\cancel{3}}{\cancel{4}_1} \times \frac{1}{\cancel{\pi}}$$

$r^3 = (21 \text{ cm})^3$

r = 21 cm

surface area of a sphere = $4\pi r^2$

$$= 4 \times \frac{22}{\cancel{7}} \times \cancel{21}^{3} \times 21 \text{ cm}^2$$

= 5544 cm^2

04. (A) 7 × 15 + 1, 7 × 16 + 1, 7 × 17 + 1, ... are in AP.

106, 113, 120,..... 995 are in AP

$a = 106$, $d = a_2 - a_1 = 113 - 106 = 7$

$a_n = 995$

a + (n – 1)d = 995

106 + (n – 1) × 7 = 995

(n – 1) × 7 = 995 – 106

$$(n - 1) = \frac{889}{7} = 127$$

n = 127 + 1

n = 128

$$S_n = \frac{n}{2}(a + l)$$

$$S_{128} = \frac{128}{2}(106 + 995)$$

= 64 × 1101

= 70,464

05. (D) Given $\Delta ABC \sim \Delta PQR$

$$\Rightarrow \frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR} = K$$

$$\therefore \frac{AB}{PQ} = K \Rightarrow AB = K(PQ)$$

similarly BC = K(QR)

CA = K(PR)

$\therefore$ AB + BC + CA = K(PQ) + K(QR) + K(PR)

20 cm = K(PQ + QR + PR)

20 cm = K × 30 cm

$$K = \frac{20 \text{ cm}}{30 \text{ cm}} = \frac{2}{3}$$

$$\therefore \frac{AB}{PQ} = K$$

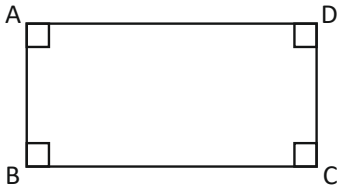
$$\Rightarrow \frac{8.2 \text{ cm}}{PQ} = \frac{2}{3}$$

$$PQ = \frac{3 \times \cancel{8.2}^{4.1} \text{ cm}}{\cancel{2}_1}$$

PQ = 12.3 cm

06. (D) Given 2(AB + BC) = 82 cm

$AB + BC = \frac{82}{2}$ cm



AB + BC = 41

squaring on both sides

$(AB + BC)^2 = 41^2$

$AB^2 + BC^2 + 2AB \times BC = 1681$

$AC^2 + 2AB \times BC = 1681$

$[\because AB^2 + BC^2 = AC^2]$

$29^2 + 2AB \times BC = 1681$

$841 + 2AB \times BC = 1681$

$2AB \times BC = 1681 - 841$

$AB \times BC = \frac{840^{420}}{\cancel{2}}$ cm

$\therefore$ Area of the rectangle = AB × BC = 420 cm^2

07. (B) Given $a_4 = 16 \Rightarrow a + 3d = 16 \longrightarrow (1)$

Given $S_{24} = 996$

$\Rightarrow \frac{\cancel{24}^{12}}{\cancel{2}}[2a + (24-1)d] = 996$

$2a + 23d = \frac{996}{12}$

$2a + 23d = 83 \longrightarrow (2)$

$2a + 23d = 83 \longrightarrow (2)$

eq.(1)×(2) $\Rightarrow$ $2a + 6d = 32$ (–) (–)

$17d = 51$

$d = \frac{\cancel{51}^{3}}{\cancel{17}_{1}}$

$a + 3(3) = 16 \longrightarrow (1)$

$a + 9 = 16$

$a = 16 - 9$

$a = 7$

08. (C) Distance between $(\sec^2\theta, \cos^2\theta)$ and $(\tan^2\theta, -\sin^2\theta)$

$= \sqrt{(\tan^2\theta - \sec^2\theta)^2 + (-\sin^2\theta - \cos^2\theta)^2}$

$= \sqrt{(-\sec^2\theta + \tan^2\theta)^2 + (-1)^2(\sin^2\theta + \cos^2\theta)^2}$

$= \sqrt{(-1)^2(\sec^2\theta - \tan^2\theta)^2 + (1)^2}$

$= \sqrt{1+1}$

$= \sqrt{2}$

09. (D) Given a – b = 14 m

& $\frac{1}{2}$ ab = 120 cm^2

ab = 240

$(a + b)^2 = (a - b)^2 + 4ab$

$= 14^2 + 4 \times 240$

$a + b = \sqrt{1156}$

a + b = 34 cm

$\therefore$ a = 24 cm & b = 10 cm

$\therefore$ $c^2 = a^2 + b^2 = 24^2 + 10^2 = 576 + 100$

= 676

c = 26 cm

Perimeter = a + b + c = 24 cm + 10 cm + 26 cm = 60 cm

10. (D) Given $\alpha = -1$

But $\alpha + \beta + \gamma = -a$

$-1 + \beta + \gamma = -a$

$\beta + \gamma = 1 - a$

$\alpha\beta + \beta\gamma + \gamma\alpha = b$

$\beta\gamma + \alpha(\alpha + \beta) = b$

$\alpha\beta = b + \beta + \gamma$

$= b + 1 - a$

$\alpha\beta = (b - a + 1)$

11. (B) Solving $x - 3y + 5 = 0$ & $2x + 7y - 3 = 0$

$2x - 6y + 10 = 0 \rightarrow (1) \times 2$

$2x + 7y - 3 = 0 \rightarrow (2)$

$-13y + 13 = 0$

$y = 1$

Substitute $y = 1$ in eq (2)

we get $x = -2$

$(-2, 1)$ lies on $kx + 4y + 2 = 0$

$-2k + 4 + 2 = 0$

$k = 3$

12. (B)

$$\begin{array}{r} 119\overline{)\,221\,(1} \\ 119 \\ \hline 102\overline{)\,119\,(1} \\ 102 \\ \hline 17\overline{)\,102\,(6} \\ 102 \\ \hline 0 \end{array}$$

HCF of 119 & 221 = 17

$\therefore$ $119m - 221 = 17$

$119m = 17 + 221$

$$m = \frac{238}{119}$$

$m = 2$

13. (C) $AB = \sqrt{81 + 25} = \sqrt{106}$

$BC = \sqrt{25 + 81} = \sqrt{106}$

$AC = \sqrt{16 + 196} = \sqrt{212}$

$\therefore$ $AB = BC$ & $AC^2 = AB^2 + BC^2$

Given vertices form right angled isosceles triangle.

14. (B) Given a, $\frac{a^{n+1}+b^{n+1}}{a^n+b^n}$, b are in AP

$\therefore$ $$\frac{a+b}{2} = \frac{a^{n+1}+b^{n+1}}{a^n+b^n}$$

If n = 0 then, we get LHS = RHS

15. (C) Given $\angle A = \angle CBD$

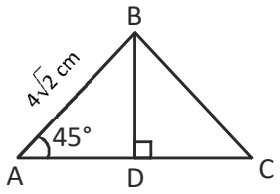
$\angle ABD = \angle C$ [$\because$ $\angle D = 90°$]

$\therefore$ $\Delta ADB \sim \Delta BDC$ [$\because$ A.A similarity]

$\therefore$ $$\frac{AB}{BC} = \frac{BD}{DC} \Rightarrow \frac{5.7\text{ cm}}{BC} = \frac{3.8\text{ cm}}{5.4\text{ cm}}$$

$\therefore$ BC = 8.1 cm

16. (B) Const:- BD $\perp$ AC



In ΔABD $\sin 45° = \frac{BD}{AB}$

$$\frac{1}{\sqrt{2}} = \frac{BD}{4\sqrt{2}\text{ cm}}$$

BD = 4 cm

Area of $\Delta ABC = \frac{1}{2} \times BD \times AC = \frac{1}{2} \times 4\text{ cm} \times 7\text{ cm} = 14\text{ cm}^2$

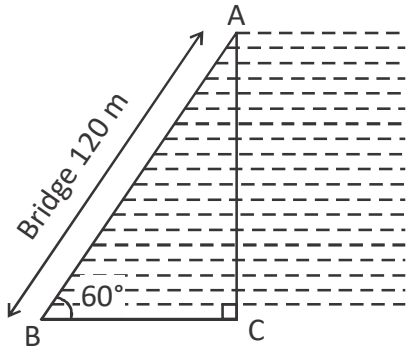
17. (A) Given $\sqrt{(2-4)^2 + (3-k)^2} = 8$

$4 + 9 + k^2 - 6k = 64$

$k^2 - 6k - 51 = 0$

$\therefore$ $$k = \frac{6 \pm \sqrt{36 + 204}}{2} = 3 \pm 2\sqrt{15}$$

18. (D) Construction : AC $\perp$ BC



In ΔABC, $\angle ABC = 60°$ and $\angle C = 90°$

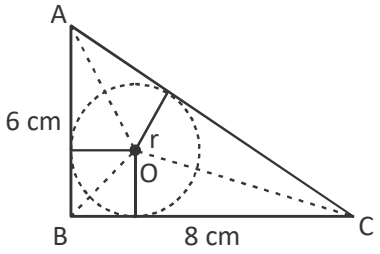
$$\sin 60° = \frac{AC}{AB}$$

$$\frac{\sqrt{3}}{2} = \frac{AC}{120\ m}$$

$$AC = \cancel{120}^{60}\ m \times \frac{\sqrt{3}}{2}$$

width of the river (AC) = $60\sqrt{3}$ metres

19. (A) Given, a circular piece is cut from the triangle sheet ABC with AB = 6 cm, BC = 8 cm



Now in Δ ABC by Pythagoras theorem,

$AC^2 = AB^2 + BC^2 = 6^2 + 8^2 = 36 + 64 = 100$

AC = 10 cm

Area of Δ ABC,

$$= \frac{1}{2} \times b \times h = \frac{1}{2} \times 8 \times 6 = 24\ cm^2$$

Also,

Area of Δ ABC,

= Area of Δ OBC + Area of Δ OBA + Area of Δ OAC

$$24 = \frac{1}{2} \times 8 \times r + \frac{1}{2} \times 6 \times r + \frac{1}{2} \times 10 \times r = \frac{1}{2} \times r(6+8+10)$$

48 = r (24)

r = 2 cm

$\therefore$ Perimeter of circle = $2\pi r$

$$= 2\pi \times 2 = 4\pi$$

20. (C) Given $R = \frac{8\ cm}{2}$ and $r = \frac{4\ cm}{2}$ and

Volume of cone = Volume of hollow sphere

$$\frac{1}{3}\pi r_1^2 h = \frac{4}{3}\pi(R^3 - r^3)$$

$$\frac{1}{3}\pi \times (4\ cm)^2 \times h = \frac{4}{3}\pi(4^3 - 2^3)cm^3$$

$$h = \frac{\cancel{4}}{\cancel{3}}\cancel{\pi} \times (64-8) \times \cancel{3} \times \frac{1}{\cancel{\pi}} \times \frac{1}{\cancel{16}_{4} cm^2}$$

$$= \frac{56\ cm}{4}$$

h = 14 cm

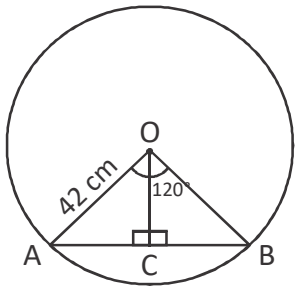
21. (A) $(2mc)^2 = 4(1 + m^2)(c^2 - a^2)$

$\cancel{4}\ m^2c^2 = \cancel{4}\ (1 + m^2)(c^2 - a^2)$

$\cancel{m^2c^2} = c^2 - a^2 + \cancel{m^2c^2} - m^2a^2$

$c^2 = a^2 + m^2a^2 = a^2(1 + m^2)$

22. (B) Draw OC $\perp$ AB



$$\angle AOC = \frac{120^\circ}{2} = 60^\circ$$

In Δ AOC, $\angle C = 90^\circ$

$\angle OAC = 180^\circ - 90^\circ - 60^\circ = 30^\circ$

$$\text{Sin } 30^\circ = \frac{OC}{AC}$$

$$\frac{1}{2} = \frac{OC}{42\ cm}$$

$$OC = \frac{42\ cm}{2} = 21\ cm$$

$$\text{Cos } 30^\circ = \frac{AC}{AD}$$

$$\frac{\sqrt{3}}{2} = \frac{AC}{42\ cm}$$

$$AC = \frac{42 \times \sqrt{3}\ cm}{2}$$

$$AB = 2\ AC = 2 \times \frac{42 \times \sqrt{3}\ cm}{2}$$

= 42 × 1.73 cm

AB = 72.66 cm

$$\text{Area of } \Delta AOB = \frac{1}{2} \times AB \times OC$$

$$= \frac{1}{2_1} \times \cancel{72.66}^{36.33} \times 21\ cm^2$$

= 762.93 cm^2

Area of the minor segment = Area of the sector AOB – area of Δ AOB

$$= \frac{\cancel{120}^{1}}{\cancel{360}\ \cancel{3}_{1}} \times \frac{22}{\cancel{7}_{1}} \times \cancel{42}^{6^2}\ cm \times 42\ cm - 762.93\ cm^2$$

$$= 1848\ cm^2 - 762.93\ cm^2$$

$$= 1085.07\ cm^2$$

Area of the major segment = Area of the circle – area of the minor segment

$$= \frac{22}{\cancel{7}_{1}} \times \cancel{42}^{6}\ cm \times 42\ cm - 1085.07\ cm^2$$

$$= 5544\ cm^2 - 1085.07\ cm^2$$

$$= 4458.93\ cm^2$$

23. (D) $\alpha = a - d,\ \beta = a,\ \gamma = a + d$

Given α, β, γ are in AP

$$\Rightarrow \alpha + \beta + \gamma = -\frac{b}{a}$$

a – d + a + a + d = 9

3a = 9

a = 3

$\alpha \beta \gamma$ = 21

(a – d) (a) (a + d) = – 21

(3 – d) (3) (3 + d) = – 21

(3 – d) (3 + d) = – 7

$9 - d^2 = -7$

$d^2 = 16$

$d = \pm 4$

If a = 3 & d = 4 then a – d = – 1, a + d = 7

If a = 3 & d = – 4 then a – d = 7 , a + d = – 1

$\therefore$ a + d – (a – d) = 2d = 8

24. (B) Circumferce of circular path

$$= 2\pi r = 2 \times \frac{22}{7} \times 14\ m$$

= 88 m

Time taken to cover 88 m to Harish

$$= \frac{88\ m}{17.6\ KMPH} = \frac{88\ m}{17.6 \times \frac{5\ m}{18\ sec}}$$

= 18 seconds

Time taken to cover 88 m to krishna

$$= \frac{88\ m}{26.4\ KMPH} = \frac{88\ m}{26.4 \times \frac{5\ m}{18\ sec}}$$

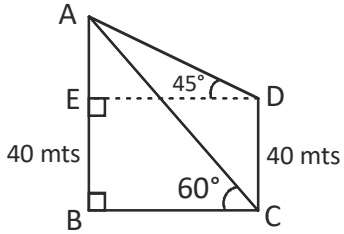
= 12 seconds

LCM of 18 seconds and 12 seconds is 36 seconds.

25. (B) In ΔABC, $\angle ACB = 60°$

$$\Rightarrow \tan 60° = \frac{AB}{BC}$$

$$\sqrt{3} = \frac{x + 40}{BC}$$



$$BC = \frac{x + 40\ mts}{\sqrt{3}} \rightarrow (1)$$

In ΔADE $\tan 45^\circ = \frac{x}{ED}$

$1 = \frac{x}{ED}$

ED = x mts

$\therefore$ BC = x mts $\rightarrow$ (2) [$\because$ ED = BC]

from (1) & (2) $x = \frac{x + 40 \text{ mts}}{\sqrt{3}}$

$(\sqrt{3}x - x) = 40$ mts

$x = \frac{40 \text{ mts}}{\sqrt{3} - 1} \times \frac{\sqrt{3} + 1}{\sqrt{3} + 1}$

$= 20(1.732 + 1)$ mts

$= 20 \times 2.732$ mts

$= 54.64$ mts

Height of the building (AB) = x + 40 mts

= 54.64 mts + 40 mts

= 94.64 mts

PHYSICS

26. (C) When switch S is open effective resistance is 2R. When switch S is closed, effective resistance becomes $\left(R + \frac{R}{2}\right) = \frac{3R}{2}$, So, it decreases, thereby current increases.

27. (B) Assume that the painter is facing the centre of the mirror. To see the maximum range, he has to look at the two extreme ends of the mirror. By applying the laws of reflection, angle of incidence = angle of reflection as per the figure given below, the maximum length of painted wall, the painter can see is 2 m.

28. (C) If the index finger points towards the north and the middle finger towards the east, when using Fleming's left-hand rule, the direction of motion or that of the force acting on the conductor will be in the top.

29. (D) $D_m = A$; $\mu = \frac{3}{2}$

$$\mu = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin A}{\sin\frac{A}{2}}$$

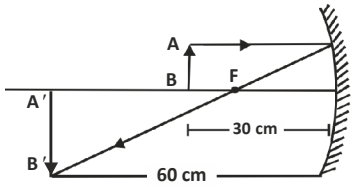
$$= \mu = \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}} = 2\cos\frac{A}{2}$$

$$\cos\frac{A}{2} = \frac{3}{2} \times \frac{1}{2} = \frac{3}{4} = 0.75$$

$\therefore \frac{A}{2} = 41^0$. (or) $A = 82^0$

30. (C) Alloys of nichrome and manganin have high melting points and low thermal expansion. Hence, they can be used as heating elements.

31. (B)



u = –30 cm and v = –60 cm.

Thus $m = \frac{h_i}{h_o} = -\frac{v}{u} = -\frac{-60 \text{ cm}}{-30 \text{ cm}} = -2$ or

$h_i = 2\ h_o = -2 \times 2.0 \text{ cm} = -4 \text{ cm}$

The height of the image is 4 cm. The minus sign shows that it is on the other side of the principal axis, i.e, it is inverted.

32. (D) Options (A), (B) and (C) increase the strength of the magnetic field. Decreasing the number of turns of wire in the coil does not increase the strength of magnetic field produced by a current carrying circular coil

33. (D) When white light is passed through a prism, it splits into seven colours. Each colour of light is characterised by a particular wavelength of light. Hence, each colour of light has its own index of refraction. Longer wavelengths (e.g. red) are refracted the least while shorter wave length (e.g., violet) is refracted the most.

34. (D) $\angle i = 45°$

$\angle r = 30°$

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin 30°} = \frac{\left(1/\sqrt{2}\right)}{\left(1/2\right)} = \sqrt{2}$$

35. (B) Resistivity, $\rho = \frac{R \times A}{l}$

Here, Resistance, $R = 2 \times 10^{-2}\ \Omega$

Area of cross-section, $A = 1.7 \times 10^{-6}\ m^2$

And, Length, $l = 4$ m

$$\rho = \frac{2 \times 10^{-2} \times 1.7 \times 10^{-6}}{4}$$

$= 0.85 \times 10^{-8}\ \Omega$ m

Thus, the resistivity of copper is

0.85×10^{-8} ohm-metre.

CHEMISTRY

36. (B) Cu can displace Ag from $AgNO_3$ because it is more reactive than silver.

37. (B) The correct chemical equation is as given below.

$CH_4 + 2O_2 + \text{heat} \rightarrow CO_2 + 2H_2O$

38. (A) HCl addition to ethylene forms $CH_3–CH_2–Cl$. OH groups of NaOH substitutes Cl and gives $CH_3–CH_2–OH$ which undergoes oxidation and finally gives CH_3COOH. Hence, X – addition, Y – substitution and Z – oxidation.

39. (D) When metal carbonates react with an acid 'X' a salt NaCl and 'Y', being CO_2 gas is evolved.

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

40. (A) Copper has a high melting point, it is a good conductor of electricity and is malleable. These are the reasons why copper is used in the making of vessels and electrical wires.

41. (C) At room temperature both hydrogen and oxygen are gases. This two elements in gaseous state combine to form water in liquid state.

42. (C) CO_2 dissolves in (react with) NaOH.

$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

Both ethene (C_2H_4) and ethane (C_2H_6) burn completely to give CO_2 and H_2O.

Ethane is saturated and does not react with Br_2 (ethene does).

43. (C) Statements (ii) and (iv) are true. When HCl gas is passed through water, water being a polar covalent compound ionises in the solution as

$H^+Cl^-(aq) \rightarrow H^+ + Cl^-$

44. (B) Silver chloride is sensitive to sunlight and decomposes slowly to form grey metal silver and chlorine gas.

45. (B) Roasting is the appropriate method being described.

BIOLOGY

46. (B) Chloroplasts are common in mesophyll cells.

47. (D) X - Anther; Y - Stigma; Z - Ovary.

48. (C) The process in which a cell uses its plasma membrane to engulf a large particle giving rise to an internal compartment called the phagosome. This process is called phagocytosis.

49. (C) Pulmonary vein carries oxygenated blood from lungs.

50. (B) Amniotic fluid acts as a shock absorber and helps to protect the foetus from mechanical injury.

51. (B) In the given figure P is central nervous system, Q - brain and R - spinal nerves.

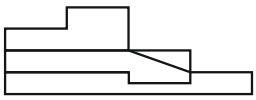
52. (A) Part labelled 1 is liver. Bile juice is a fluid that is secreted and released by the liver and stored in the gallbladder. Bile juice emulsifies fat molecules.

53. (B) Testosterone hormone promotes the development of deep voice in males.

54. (C) When we boil the leaf in alcohol, it remove the chlorophyll from the green leaf before carrying out the starch test on a leaf.

55. (B) Part (iv) is the ovary and part (v) is the ovule. These parts will develop into the fruits and seeds after fertilisation.

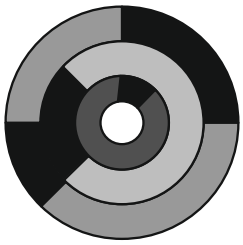
CRITICAL THINKING

56. (C) 

57. (C) Conclusion I: The statement mentions that prices remained range-bound during October after an initial rise. However, it does not provide enough evidence to generalize that prices usually stabilize after an initial upward move. This is a specific observation for October and cannot be considered a usual trend.

Conclusion II: The statement does not mention anything about the dependency of prices on the demand for the metals. Therefore, concluding that prices are not dependent on demand is not supported by the given statement.

Hence, neither conclusion I nor conclusion II follows from the statement.paint

58. (A) 

59. (A) Option A is correct because it directly relates to the reason for the investment; the company is looking to emerging markets like India for growth due to stagnant sales in developed markets.

Option B is not entirely supported by the text, which emphasizes the importance of India due to growth potential but does not state that India is the only market where growth is possible.

Option C is not mentioned in the passage, so there is no basis to conclude that a good understanding between specific individuals led to the investment.

Option D is incorrect because options B and C are not adequately supported by the text.

Therefore, the correct answer is A) Stagnation in sales in the US and European markets.

60. (B)