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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

CLASS - 9

Question Paper Code : 1B107

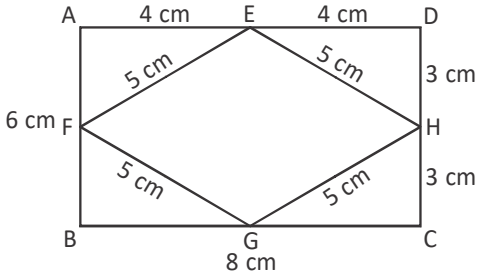
KEY

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

SOLUTIONS

MATHEMATICS

01. (D) Let ABCD be the rectangle with sides 8 cm and 6 cm.



The midpoints of the adjacent sides of ABCD are joined forming a Rhombus EFGH.

Area of Rhombus = $\left(\frac{1}{2}\times 6\times 8\right)$ cm^2

= 24 cm^2

02. (D) $\frac{a^2}{4}+\frac{b^2}{16}+4-\frac{ab}{4}-b+2a$

$=\left(\frac{a}{2}\right)^2+\left(\frac{-b}{4}\right)^2+2^2+2\left(\frac{a}{2}\times\frac{-b}{4}\right)$

$+2\left(\frac{-b}{4}\times 2\right)+2\left(2\times\frac{a}{2}\right)$

$=\left(\frac{a}{2}-\frac{b}{4}+2\right)^2$

$\therefore$ $\left(\frac{a}{2}-\frac{b}{4}+2\right)$ is a factor of

$\left(\frac{a^2}{2}+\frac{b^2}{16}-\frac{ab}{4}+b+2a+4\right)$

03. (C) Let 'k' to be added to $(x^3 - 3x^2 + 5x - 6)$

So, its exactly divisible by $(x + 3)$

$\therefore$ $p(x) = x^3 - 3x^2 + 5x - 6 + K$ & $p(-3) = 0$

$p(-3) = (-3)^3 - 3(-3)^2 + 5(-3) - 6 + K = 0$

$-27 - 27 - 15 - 6 + K = 0$

$\therefore$ $K = 75$

$\therefore$ 75 to be added

04. (D) Radius of the hemisphere, r = 4.2 cm.

Radius of the cylinder, r = 4.2 cm

Height of the cylinder, h = 12 cm

Total surface area of the article

= curved surface area of cylinder + curved surface area of 2 hemispheres

$= 2\pi rh + 2 \times 2\pi r^2 = 2\pi rh + 4\pi r^2$

$= 2\pi r(h + 2r)$

$= \left[2\times\frac{22}{7}\times4.2\times(12+2\times4.2)\right]$ cm^2

$= (26.4 \times 20.4)$ cm^2 = 538.56 cm^2

05. (D) Option (A)

$$x+\frac{1}{x}=\frac{5-\sqrt{21}}{2}+\frac{2}{5-\sqrt{21}}=\frac{(5-\sqrt{21})^2+2^2}{2(5-\sqrt{21})}$$

$$=\frac{25-10\sqrt{21}+21+4}{2(5-\sqrt{21})}$$

$$=\frac{50-10\sqrt{21}}{2(5-\sqrt{21})}$$

$$=\frac{10(5-\sqrt{21})}{2(5-\sqrt{21})}$$

= 5 which is a rational number.

(option B)

$$x + y = \frac{\sqrt{2}+1}{\sqrt{2}-1}+\frac{\sqrt{2}-1}{\sqrt{2}+1}$$

$$=\frac{(\sqrt{2}+1)^2+(\sqrt{2}-1)^2}{(\sqrt{2}-1)(\sqrt{2}+1)}$$

$$=\frac{(\sqrt{2})^2+2(\sqrt{2})(1)+1^2+(\sqrt{2})^2-2\sqrt{2}(1)+1^2}{(\sqrt{2})^2-1^2}$$

$$=\frac{2+1+2+1}{1}$$

$x + y = 6$

S.O.B.S.

$x^2 + 2xy + y^2 = 36$

$x^2 + 2(1) + y^2 = 36$

$$[\because\ xy = \frac{\sqrt{2}+1}{\sqrt{2}-1}\times\frac{\sqrt{2}-1}{\sqrt{2}+1} = 1]$$

$x^2 + 2 + y^2 = 36$

$x^2 + y^2 = 36 - 2 = 34$

$x^2 + y^2 + xy = 34 + xy = 34 + 1 = 35$ which is a rational number

Option (C)

$$x + y = \frac{(3-2\sqrt{2})^2+(3+2\sqrt{2})^2}{(3+2\sqrt{2})(3-2\sqrt{2})}$$

$$=\frac{9-12\sqrt{2}+8+9+12\sqrt{2})+8}{9-8}$$

= 34 which is a rational number

Option (D)

$$\left(\frac{\sqrt{13}-\sqrt{11}}{\sqrt{13}+\sqrt{11}}\right)-\left(\frac{\sqrt{13}+\sqrt{11}}{\sqrt{13}-\sqrt{11}}\right)$$

$$=\frac{(\sqrt{13}-\sqrt{11})^2-(\sqrt{13}+\sqrt{11})^2}{(\sqrt{13}+\sqrt{11})(\sqrt{13}-\sqrt{11})}$$

$$=\frac{13-2\sqrt{143}+11-(13+2\sqrt{143}+11)}{(\sqrt{13})^2-(\sqrt{11})^2}$$

$$=\frac{24-2\sqrt{143}-24-2\sqrt{143}}{2}$$

$$=\frac{-4\sqrt{143}}{2}$$

$= -2\sqrt{143}$ which is an irrational number

06. (B) Given a = 100 m, b = 99 m and c = 89 m

$\therefore\ s = \frac{a+b+c}{2} = \frac{(100+99+89)\ m}{2} = \frac{288\ m}{2} = 144\ m$

Area of the field

$= \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{144 \times 44 \times 45 \times 55}\ m^2$

$= \sqrt{12\times12\times11\times4\times9\times5\times5\times11}\ m^2$

$= 12 \times 11 \times 2 \times 3 \times 5\ m^2$

$= 3960\ m^2$

07. (D) $\frac{\sqrt{1+x}+\sqrt{1-x}}{\sqrt{1+x}-\sqrt{1-x}}$

$= \frac{\sqrt{1+x}+\sqrt{1-x}}{\sqrt{1+x}-\sqrt{1-x}} \times \frac{\sqrt{1+x}+\sqrt{1-x}}{\sqrt{1+x}+\sqrt{1-x}}$

$= \frac{(\sqrt{1+x}+\sqrt{1-x})^2}{(\sqrt{1+x})^2-(\sqrt{1-x})^2}$

$= \frac{1+x+2\sqrt{1-x^2}+1-x}{1+x-1+x}$

$= \frac{2(1+\sqrt{1-x^2})}{2x}$

$= \frac{1+\sqrt{1-\frac{3}{4}}}{\left(\frac{\sqrt{3}}{2}\right)}$

$= \frac{1+\frac{1}{2}}{\frac{\sqrt{3}}{2}}$

$= \frac{3}{2}\times\frac{2}{\sqrt{3}}$

$= \sqrt{3}$

08. (D) Const:- Join BD

In ΔBCD given BC = CD

$\Rightarrow \angle BDC = \angle CBD = a$

In ΔBCD a + a + 50° = 180°

2a = 180° – 50° = 130°

$a = \frac{130^\circ}{2} = 65^\circ$

$\therefore$ In a cyclic quadrilateral ABDE, BDC = x

$\therefore\ x = \angle BCDB = 65^\circ$

09. (D) Given $x = \frac{1}{2-\sqrt{3}} = \frac{1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}}$

$= \frac{2+\sqrt{3}}{4-3} = 2+\sqrt{3}$

$\therefore\ x = 2 + \sqrt{3}$

$\Rightarrow x - 2 = \sqrt{3}$

Squaring on both sides

$x^2 - 4x + 4 = 3$

$\therefore\ x^2 - 4x + 1 = 0$

$x^2 - 4x + 1$ | $x^3 - 2x^2 - 7x + 6$ | $x + 2$

$x^3 - 4x^2 + x$

(–) (+) (–)

$2x^2 - 8x + 6$

$2x^2 - 8x + 2$

(–) (+) (–)

4

$\therefore\ x^2 - 2x^2 - 7x + 6 = (x^2 - 4x + 1)(x + 2) + 4$

$= 0\ (x + 2) + 4$

$= 4$

10. (B) Given lb = $(a^3 + 3a^2 + 3a + 1)\ cm^2$

$(a^2 + 2a + 1)cm \times b = (a^3 + 3a^2 + 3a + 1)\ cm^2$

$\therefore b = \frac{(a^3+3a^2+3a+1)cm^2}{(a^2+2a+1)cm} = (a+1)cm$

a^3+2a+1 | $a^3 + 3a^2 + 3a + 1$ | $a+1$

$a^3 + 2a^2 + a$

$a^2 + 2a + 1$

$a^2 + 2a + 1$

0

11. (A) Given $5x + 6 = 3x + 10$

$5x - 3x = 10 - 6$

$2x = 4$

$x = 2$

12. (C) 48°

13. (D) $3\pi r^2 = 1039.5 \text{ cm}^2$

$$= 1039.5 \times \frac{2}{2}\text{cm}^2 = \frac{2079}{2}\text{cm}^2$$

$$\Rightarrow 3 \times \frac{22}{7} \times r^2 = \frac{2079}{2}\text{cm}^2$$

$$\therefore r^2 = \frac{\cancel{2079}^{63}}{2} \times \frac{7}{\cancel{22}_{2}} \times \frac{1}{\cancel{3}_{1}} = \frac{3\times3\times7\times7}{2\times2}\text{cm}^2$$

$$r = \sqrt{\frac{9\times49}{4}} = \frac{3\times7}{2} = \frac{21}{2}\text{cm}$$

$\therefore$ Volume $= \frac{2}{3}\pi r^3$

$$= \frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{22}^{11}}{\cancel{7}_{1}} \times \frac{\cancel{21}^{3}}{\cancel{2}_{1}} \times \frac{21}{\cancel{2}_{1}} \times \frac{21}{2}$$

$= 2425.5 \text{ cm}^3$

14. (C) According to the graph, the line passes through the points (–3, 4), (0, 2) and (3, 0)

Of the options,

$2(x - 1) + 3y = 4$ is the required equation

because for (– 3, 4),

$2(-3 - 1) + 3(4) = 4$

$\Rightarrow$ $2(-4) + 12 = 4$

$\Rightarrow$ $4 = 4$ (True)

For (0, 2), $2(-1) + 3(2) = 4$

$\Rightarrow$ $-2 + 6 = 4$

$\Rightarrow$ $4 = 4$ (True)

For (3, 0), $2(3 - 1) + 0 = 4$

$\Rightarrow$ $2(2) = 4$

$\Rightarrow$ $4 = 4$ (True)

15. (C) Given AB || DC

$\Rightarrow \angle DAB + \angle ADC = 180°$ $\rightarrow(1)$

But AD || BC

$\Rightarrow \angle DAB + \angle ABC = 180°$ $\rightarrow(2)$

from (1) & (2) $\angle DAB + \angle ADC$

$= \angle DAB + \angle ABC$

$\angle ADC = \angle ABC$

$$\therefore \frac{4x}{3} - \frac{x}{2} + \frac{67°}{2} = \frac{x}{2} + \frac{5x}{3} - \frac{53°}{2}$$

$$\frac{67°}{2} + \frac{53°}{2} = \frac{x}{2} + \frac{5x}{3} - \frac{4x}{3} + \frac{x}{2}$$

$$= \frac{3x + 10x - 8x + 3x}{6}$$

$$\frac{120°}{2} = \frac{8x}{6}$$

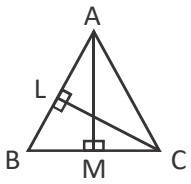
$$x = 60° \times \frac{3}{4} = 45°$$

$$\therefore \angle ABC = \frac{x}{2} + \frac{5x}{3} - \frac{53°}{2} = \frac{45°}{2} + \frac{5\times45°}{3} - \frac{53°}{2}$$

$$= 75° + \frac{45° - 53°}{2}$$

$$= 75° - \frac{8°}{2} = 75° - 4° = 71°$$

16. (D)



AB = 7.2 cm, BC = 4.8 cm, CL = 4 cm

Area of $\Delta ABC = \frac{1}{2} \times BC \times AM = \frac{1}{2} \times AB \times CL$

$$\Rightarrow \frac{1}{2} \times 4.8 \times AM = \frac{1}{2} \times 7.2 \times 4$$

$$\Rightarrow AM = \frac{7.2 \times 4}{4.8} = 6 \text{ cm}$$

17. (B) $0 + 0 = 0 \times 0$ and $2 + 2 = 2 \times 2$ (OR)

Given $x + y = xy \Rightarrow x = xy - y$

$x = y(x - 1)$

$$y = \frac{x}{x-1}$$

If $x = 0$ then $y = 0$ &

If $x = 2$ then $y = 2$

18. (C) LHS

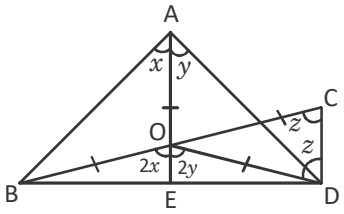
$$= \sqrt[3]{\left(\sqrt[3]{x}\right)^3 + 3\left(\sqrt[3]{x}\right)^2 3y + 3\sqrt[3]{x}\sqrt[3]{y} + \left(\sqrt[3]{y}\right)^3}$$

$$= \sqrt[3]{\left(\sqrt[3]{x} + \sqrt[3]{y}\right)^3}$$

$$= \left(\sqrt[3]{x} + \sqrt[3]{y}\right)^{3\times\frac{1}{3}}$$

$$= \sqrt[3]{x} + \sqrt[3]{y}$$

19. (D)



'O' is equidistant from A, B, C and D

$\therefore$ 'O' is the centre of the circle

$\therefore$ $\angle BCD$

$= \angle BAD = 70°$

[$\because$ Angle in the semicircle]

(OR)

'O' is circumcentre of ΔABC

$\angle BAD$ & $\angle BAC$ are angles in the same segment

$\Rightarrow \angle BCD = \angle BAD = 70°$

Const:- External AO up to E (or)

In ΔAOB, given OA = OB

$\Rightarrow \angle OBA = \angle OAB = x$

In ΔAOD given OA = OD

$\Rightarrow \angle ODA = \angle OAD = y$

$\therefore \angle BOE = x + x = 2x$

$\angle DOE = y + y = 2y$

$\therefore \angle BOD = \angle BOE + \angle DOE$

$= 2x + 2y = 2(x + y) = 2 \times 70°$

$= 140°$

$\therefore \angle DOC = 180° - \angle BOD = 40°$

In ΔCOD, OC = OD $\Rightarrow \angle ODC = \angle OCD = z$

In ΔCOD, $z + z + 40° = 180°$

$z = 70°$

$\therefore \angle BCD = z = 70°$

20. (C) From the given figure, we have

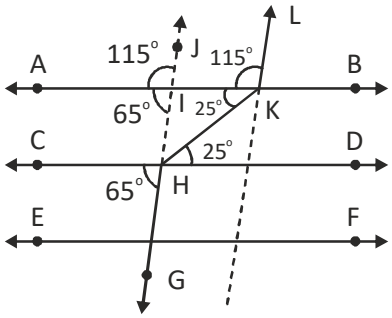
AD = BC

$\Rightarrow$ AD – CD = BC – CD

[Equal are subtracted from equals]

$\Rightarrow$ AC = BD

21. (D)



$\angle HKI = 25°$

[Alternate angles since AB||CD]

$\angle AIH = \angle CHG = 65°$

[Corresponding angles]

$\Rightarrow \angle JIA = 180° - 65° = 115°$ [Linear pair]

$\angle LKI = \angle JIA = 115°$

[Corresponding angles since, GJ||KL]

$\angle HKL = \angle HKI + \angle LKI = 25° + 115° = 140°$

22. (C)

23. (B) $\left[\frac{1}{x-2} - \frac{4}{x^2-4}\right] =$

$$\left[\frac{x+2-4}{x^2-4}\right] = \frac{(x-2)}{(x+2)(x-2)} = \frac{1}{(x+2)}$$

24. (B) x = 2024 is line is parallel to x = 0 line i.e., Y-axis

25. (B) If an isosceles triangle with one angle is 60°, then it is equilateral triangle

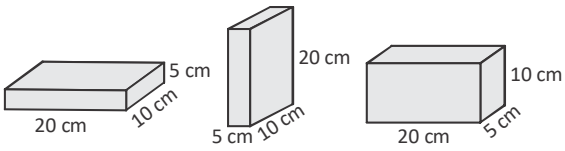
$\therefore$ Area of ΔABC

$$= \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4} \times 20 \times 20 \text{ cm}^2$$

$$= 100\sqrt{3} \text{ cm}^2$$

PHYSICS

26. (B)



* The force applied on a surface in a direction perpendicular or normal to the surface is called thrust. It will remain the same for all the positions of the block.

* Pressure is defined as thrust exerted per unit area.

$$\text{Pressure} = \frac{\text{Thrust}}{\text{Area}}$$

* We are aware that the same force applied to a smaller area would result in more pressure, and vice versa for a bigger area.

* As a result, when an iron block is placed along its length, less pressure is applied, and when it is placed along its breadth, more pressure is applied.

  Hence, when a rectangular iron block is kept over a table with different faces touching the table, the block applies the same thrust and different pressures in various circumstances.

27. (D) As speed is constant in a fixed direction (upwards), acceleration is 0. From Newton's 2nd law, resultant force F = ma = m(0) = 0 N.

28. (A) Speed of a body = slope of graph.

(i) Speed of a body from O to A = slope of OA part of graph.

$$\frac{AD}{OD} = \frac{2\text{ km}}{1\text{ h}} = 2\text{ km h}^{-1}$$

(ii) Speed of a body from B to C = slope of BC part of the graph.

$$= \frac{CG}{BG} = \frac{CG}{EF} = \frac{(4-2)\text{km}}{\frac{1}{2}\text{h}} = 4\text{ km h}^{-1}$$

29. (B) Kinetic energy of a moving object depends on mass and velocity. KE = $\frac{1}{2}mv^2$

If a horse and a calf are running with the same speed, the kinetic energy of the calf will be lesser than horse, because mass of calf is always less than a horse.

30. (B) Weight of a girl is same in all the three cases. So, the pressure exerted by the box will be maximum when area is least, i.e., when breadth and width form the base.

31. (D) Given, Force(F) = 1 N

Mass of the body (m) = 10 kg

We have, F = ma (Newton's 2nd law)

$$a = \frac{F}{m} = \frac{1}{10} = 0.1\text{ m s}^{-2}$$

Distance covered (S) = 100 cm = 1 m

Time taken (t) = 4 s

$$S = ut + \frac{1}{2}at^2$$

$$1 = u(4) + \frac{1}{2}(0.1)(4^2)$$

$$1 = 4u + \left(\frac{1}{2}\right)(0.1)(16)$$

1 = 4u + 0.8

4u = 0.2

$$u = \frac{0.2}{4} = 0.05\text{ m s}^{-1} = 5\text{ cm s}^{-1}$$

32. (D) A car is at rest when the distance-time graph is parallel to the time axis.

The car was at rest from

(i) 0 to 6 s = 6 s.

(ii) 10 to 12 s = 2 s

6 s + 2 s = 8 s

33. (D) Work is calculated by multiplying the magnitude of the force on an object by the distance moved in the direction of the force.

34. (D) Using Newton's 3rd law, the same tension or force pulls on both the trolleys. Let mass of X and Y be 2 m and m respectively.

Force on X = Force on Y.

$2\ m \times 2\ m/s^2 = m \times a = 4\ m/s^2$

where a is the initial acceleration of Y.

35. (C) According to Archimedes' Principle, an object in a fluid is buoyed up (lifted) by a force equal to the weight of the fluid it displaces.

As the weight of water displaced is less than the weight of the nail, the buoyant force acting on it due to water will also be less and the nail sinks in the water.

CHEMISTRY

36. (D) Atomicites of ozone, sulphur, phosphorus and argon are given bellow:

Ozone (O_3) = 3

Sulphur (S_8) = 8

Phosphorus (P_4) = 4

Argon (Ar) = 1

37. (C) Rusting of an article made up of iron is called corrosion. It is a chemical change because a new substance hydrated iron oxide called rust is formed.

$$4Fe + 3O_2 \xrightarrow{\text{Water}} \underset{\text{(Rust)}}{2Fe_2O_3.xH_2O}$$

Iron + Oxygen $\longrightarrow$ Hydrated iron oxide

38. (D) The higher the temperature difference between the water and the room temperature, the higher the rate of evaporation. Hence, water in through 'S' at 95 °C has the highest rate of evaporation.

39. (C) Ammonia gas NH_3 contains 4 atoms (1N and 3H)

Option (A) Ammonia gas NH_3 has two elements (nitrogen and hydrogen)

Option (B) Ammonia gas NH_3 has molecules with two elements (nitrogen and hydrogen)

Option (D) The size of atoms cannot be determined from the chemical formula.

40. (D) All the given statements are true of elements and compounds.

41. (A) Matter has mass and occupies space but non-matter has no mass and does not occupy space.

Clouds consists of tiny droplets of water that are gathered together.

Snow is water in the solid state.

Wind is moving air. Air is a mixture of gases.

Thunder, (sound is a form of energy) shadow and music are non-matter. Air, water, chair, sand, cotton and feather are matter as they have mass and occupy space.

42. (C) Gram atomic weight of S = 32 g

$\rightarrow$ 32 g contains 6.023×10^{23} atoms.

Number of atoms in 6.4 g of Sulphur

$$= \frac{6.4}{32} \times 6.023 \times 10^{23} = 0.2 \times 6.023 \times 10^{23}$$

$= 1.2 \times 10^{23}$ atoms.

43. (C) A mixture consists of more than one kind of substances and can be separated to individual substances through physical processes. Heterogeneous mixture is a mixture whose substances are distributed unevenly throughout (more than in one phase). An example of a heterogeneous mixture is a mixture of petrol and water.

44. (D) There are spaces between the particles of water and alcohol. When they are mixed together, the water and alcohol particles move into these spaces. This causes the final volume to be less than 100 ml.

45. (D) Ferrous sulphate – $FeSO_4$

Magnesium nitrate – $Mg(NO_3)_2$

Ratio = 4 : 6 = 2 : 3

BIOLOGY

46. (B) Organelles labelled 2 is mitochondria. Mitochondria is responsible for cellular respiration.

47. (C) Lysosomes are reservoirs of hydrolytic enzymes.

48. (D) By eating plants and animals.

49. (A) Light energy first enters the food chain, which is absorbed by the producers (i.e. grass) found at the beginning of the food chain. Light energy is then converted to form chemical energy during photosynthesis.

50. (B) Structure Q is the phloem tissue.

51. (C) Structure X is a chloroplast that contains chlorophyll, the green pigment that captures light energy for making food and gives leaves their green colour.

52. (B) In a 4-link food chain, the biomass of the food producers is much higher than the biomass of each population of food consumers. The population of the tertiary food consumers (highest predators) in the 4-link food chain will have the least biomass.

53. (A) Substance X is lignin prevents the collapse of xylem vessel.

54. (B) Mitchondria are the power houses of cells. They are present more where the muscles require large amounts of energy.

55. (D) Sun $\rightarrow$ plant $\rightarrow$ herbivore $\rightarrow$ carnivore.

CRITICAL THINKING

56. (B) After interchanging the slots of S and T, the dance form at 9:30 am will still be Karnataka (Option B).

	9:00 am (S)	9:15 am (Q)	9:30 am (T)	9:45 am (P)	10:00 am (R)
Tamil Nadu (T)			✔		
Telangana (P)				✔	
Maharashtra (Q)		✔			
Karnataka (S)	✔				
Odisha (R)					✔

57. (A) Conclusion (I) :

The statement explicitly claims that the LCD screen is "the best in the market till date." This means the advertisement is indeed claiming that this particular Sony LCD TV set has the best LCD screen available in the market so far.

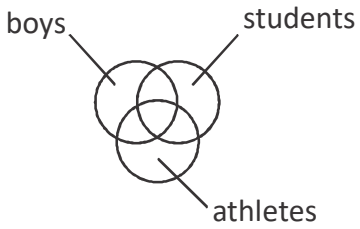
Thus, Conclusion (I) follows from the statement.

Conclusion (II) :

The statement claims that the TV "has the best quality surround sound experience among any Sony TV," but it does not compare the surround sound experience to all TV sets in the market, only to other Sony TVs.

Thus, Conclusion (II) does not follow from the statement.

58. (D) Some boys are athletes, and some boys are students. Also, some students are athletes. So, they are partly related to one another.

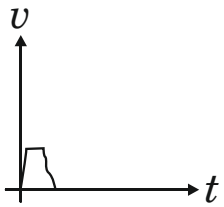


59. (Delete)

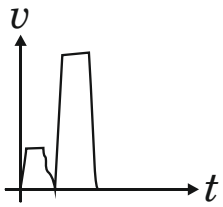
60. (D) Based on given information the question divided into 4 parts

(1) Running, (2) subway underground, (3) subway underground, (4) walking

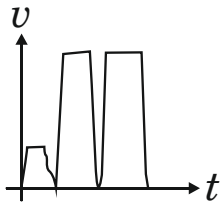
Increase to running speed : A slope up from zero to a higher speed.



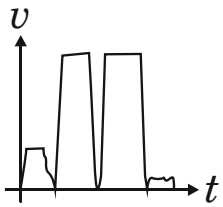
Sudden increase to underground speed: A sharp increase to an even higher constant speed.



Sudden increase to underground speed: A sharp increase to an even higher constant speed.



Sudden decrease to walking speed : A sharp drop to a lower constant speed.



The End