UNIFIED COUNCIL
Foundation for Success

UNIFIED COUNCIL OLYMPIADS

nstse
Test • Assess • Achieve

NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN489

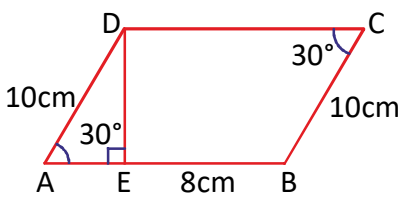
KEY

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

SOLUTIONS

MATHEMATICS

01. (C) Const: Draw DE⊥AB



In ΔADE, $\angle E = 90°$ & $\angle A = 30°$

$\therefore$ $5m\ 30° = \frac{DE}{DA}$ $\quad \frac{1}{2} = \frac{DE}{10cm}$

$DE = \frac{10cm}{2} = 5$ cm

$\therefore$ Area of the parallelogram ABCD = AB × DE = 8 cm × 5m = 40 cm^2

02. (B) $y = 5$ & $y = 1 + x$ intersect at (4, 5)

$y = 1 + x$ and $y = 1 - x$ intersect at (0, 1)

$y = 5$ and $y = 1 - x$ line intersect at (–4, 5)

A(4, 5), B(0, 1) and C(–4, 5)

Area of ΔABC =

$$\frac{1}{2}\left|4(1-5)+0(5-5)-4(5-1)\right|$$

$$=\frac{1}{2}\left|-16-16\right|$$

= 16 $units^2$

03. (D) r = 7 cm, x = 35 cm, l = 35, h = 21,

$v = \frac{\pi h}{3}(R^2 + R + r^2)$

Given $\pi r^2 = 154\ cm^2$, $\pi R^2 = 3850\ cm^2$

$\therefore \quad \frac{22}{7} \times r^2 = 154\ cm^2$

$r^2 = 154 \times \frac{7}{22}\ cm^2$

r = 7 cm,

$\frac{22}{7} \times R^2 = 3850\ cm^2$

$R^2 = 3850 \times \frac{7}{22}$

$R^2 = 25 \times 7 \times 7$

R = 35 cm

Give $\pi r^2 + \pi R^2 + \pi l(R + r) = 8624\ cm^2$

$[154 + 3850 + \frac{22}{7} \times l \times 42]\ cm^2 = 8624\ cm^2$

$132l = 4620$ cm

$l = \frac{4620}{132} = 35$

$h = \sqrt{l^2 - (R - r)^2}$

$h = \sqrt{l^2 - (R - r)^2}$

$= \sqrt{35^2 - 28^2}$

$= \sqrt{1225 - 784}$

$= \sqrt{441}$

h = 21 cm

Volume = $\frac{\pi h}{3}(R^2 + Rr + r^2)$

$= \frac{22}{7} \times \frac{21}{3}(1225 + 49 + 245)$

$= 22 \times 1518 = 33418\ cm^3$

04. (B) LHS = (1 + 2 + 3 – 4) + (5 + 6 + 7 – 8) + (9 + 10 +11 – 12) + ... +(197 + 198 + 199 – 200)

= 2 + 10 +18 + 26 + ... + 394

[$\because$ They are in AP $l_n = \frac{n}{2}(a + l)$]

$= \frac{50}{2}[2 + 394] = 396 \times \frac{100}{4} = 9900$

05. (B) 41(19 × 37 × 43 × 61 + 1)

= 41 × a natural number

$\therefore$ It a composite number and it a an even number

[$\because$ odd number + 1 is even number]

06. (A) Sum of the zeros $= -\frac{b}{a} = -\frac{0}{2} = 0$

07. (B) For option 'B' $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow$ option 'B' has unique solution

08. (C) Given $\alpha = \frac{3}{2}$ and $\alpha\beta = \frac{c}{a}$

$\frac{3}{2} \times \beta = 15$

$\beta = \cancel{15}^{5} \times \frac{2}{\cancel{5}_{1}}$

$\beta = 10$

$\therefore \quad \alpha^2 + \beta^2 = 10^2 + \left(\frac{3}{2}\right)^2$

$= 100 + \frac{9}{4}$

$= 100 + 2 + \frac{1}{4} = 102\frac{1}{4}$

(OR)

Given $\frac{3}{2}$ is the root of

$x^2 - 40x + 15 = 0$

$$\left(\frac{3}{2}\right)^2 - 4a\left(\frac{3}{2}\right) + 15 = 0$$

$$\frac{9}{4} - 6a + 15 = 0$$

$$\frac{9 - 24a + 60}{4} = 0$$

$$24a = 69$$

$$a = \frac{\cancel{69}^{23}}{\cancel{24}_{8}}$$

$$p(x) = x^2 - \cancel{4}\left(\frac{23}{\cancel{8}_{2}}\right)x + 15 = 0$$

$$\Rightarrow \quad \frac{2x^2 - 23x + 30}{2} = 0$$

$$2x^2 - 23x + 30 = 0$$

$$\alpha + \beta = -\frac{b}{a} = \frac{23}{2}$$

$$\alpha\beta = \frac{c}{a} = \frac{30}{2} = 15$$

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

$$= \left(\frac{23}{2}\right)^2 - 30$$

$$= \frac{529}{4} - 30$$

$$= \frac{529 - 120}{4}$$

$$= \frac{409}{4}$$

$$= 102\frac{1}{4}$$

09. (A) Given LCM + ~~HCF~~ = 1,94,292_____ (1)

LCM – ~~HCF~~ = 1,93,788_____ (2)

_____(–) (–)_____

2 LCM = 388080

$$LCM = \frac{388080}{2} = 1,94,040$$

1,94,040 + HCF = 1,94,292

HCF = 1,94,292 – 1,94,040

= 252

But product of two numbers

= LCM × HCF

$2520 \times x = 194040 \times 252$

$$x = \frac{194040 \times 252}{2520} = 19404$$

10. (A) Given $4\sin^2\theta + 10\sin^2\theta + 10\cos^2\theta = 11$

$4\sin^2\theta + 10 = 11$

$4\sin^2\theta = 1$

$$\therefore \quad \sin^2\theta = \frac{1}{4}$$

$$\sin\theta = \frac{1}{2} = \sin 30°$$

$$\therefore \quad \theta = 30°$$

$\tan\theta + \cot\theta = \tan 30° + \cot 30°$

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

$$= \frac{1+3}{\sqrt{3}} = \frac{4}{\sqrt{3}}$$

11. (C) Let a be the first term and d be the common difference of the given AP. Then,

$$S_n = \frac{n}{2} \cdot [2a + (n-1)d]$$

$$\therefore \quad 3\left[\frac{8}{2}(2a + 7d) - \frac{4}{2}(2a + 3d)\right]$$

$= 3[4(2a + 7d) – 2(2a + 3d)] = 6(2a + 11d)$

$$= \frac{12}{2} \cdot (2a + 11d) = S_{12}$$

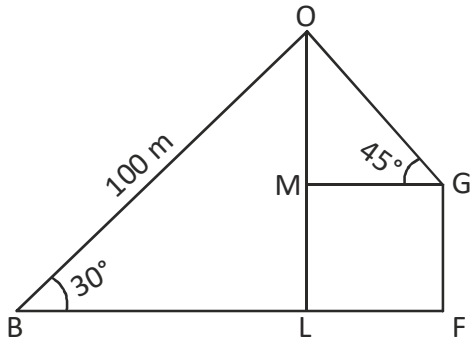
Hence, $S_{12} = 3(S_8 - S_4)$

12. (B) Let O be the position of the bird, B be the position of the boy and FG be the building at which G is the position of the girl

Let OL , BF and GM, OL

Then, BO = 100 m, $\angle OBL = 30°$,

FG = 20 m and $\angle OGM = 45°$.



From right ΔOLB, we have

$$\frac{OL}{BO} = \sin 30° \Rightarrow \frac{OL}{100\text{ m}} = \frac{1}{2}$$

$$\Rightarrow OL = 100\text{ m} \times \frac{1}{2} = 50\text{ m}.$$

OM = OL – ML = OL – FG

= 50 m – 20 m = 30 m

From right ΔOMG, we have

$$\frac{OM}{OG} = \sin 45° = \frac{1}{\sqrt{2}}$$

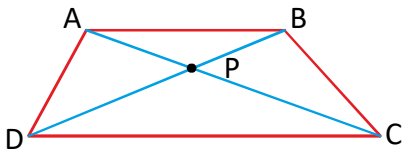
$$\Rightarrow OG = \sqrt{2} \times OM = \sqrt{2} \times 30\text{ m}$$

$$\Rightarrow OG = 30 \times 1.41\text{ m} = 42.3\text{ m}.$$

Distance of the bird from the girl = 42.3 m

13. (B) $\Delta APB \sim \Delta CPD$ [$\because$ A – A similarity]

$$\therefore \quad \frac{AP}{CP} = \frac{PB}{PD}$$



$$\frac{4}{4(x-1)} = \frac{2x-1}{(2x+4)}$$

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

$$2x + 4 = 2x^2 - 2x - x + 1$$

$$2x^2 - 5x - 3 = 0$$

$$2x^2 - 6x + x - 3 = 0$$

$$2x(x - 3) + 1(x - 3) = 0$$

$$(x - 3)(2x + 1) = 0$$

$$\therefore x = 3 \quad \text{or} \quad x = \frac{-1}{2}$$

14. (B) Given side of ABCD touches the circle,

$\therefore$ AB + CD = AD + BC

9 cm + 12 cm = 8 cm + AD

$\therefore$ AD = 21 cm – 8 cm = 13 cm

15. (C) If speed is 60 km/h he travels 300 km in 5 hours

If speed is 75 km/h he travels 300 kms in 4 hours

Hence original speed = 60 km/h

16. (D) $x^6 - 3x^4 + 3x^2 - 1$

$= (x^2)^3 - 3(x^2)^2 + 3(x^2)(1) - 1^3$

$= (x^2 - 1)^3 = (x + 1)^3 (x - 1)^3$

$x^3 + 3x^2 + 3x + 1 = (x + 1)^3$

$\therefore$ HCF $= (x + 1)^3$

17. (A) $AB = \sqrt{(5-10)^2 + (-5+5)^2} = 5$

$BC = \sqrt{(5-5)^2 + (7+5)^2} = 12$

$CA = \sqrt{(10-5)^2 + (7+5)^2} = 13$

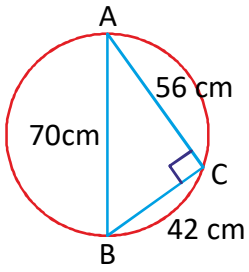
$\therefore$ $12^2 + 5^2 = 13$

Given vertices form a right angled triangle

In a right angled triangle right angled vertex is the orthocenter

$\therefore$ B(5, –5) is the orthocenter.

18. (B) Angle in a semicircle = 90°



$\therefore$ $\angle ACB = 90°$

$AB^2 = AC^2 + CB^2$

$70^2 = AC^2 + 42^2$

$4900 - 1764 = AC^2$

$AC = \sqrt{3136}$ cm = 56 cm

Area of $\Delta ABC = \frac{1}{2} \times AC \times BC$

$= \frac{1}{2} \times 42 \times 56$ cm^2

$= 1176$ cm^2

Area of circle $= \pi R^2 = \frac{22}{7} \times 35 \times 35$ cm^2

$= 3850$ cm^2

$\therefore$ Area of the circle except triangle ABC

Area = 3850 cm^2 – 1176 cm^2 = 2674 cm^2

19. (B) Given both equations have infinite solutions

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

$\frac{c}{12} = \frac{3}{c} = \frac{c+3}{-c}$

$\therefore$ $\frac{c}{12} = \frac{3}{c} \Rightarrow c^2 = 36$

$c = \pm\sqrt{36} = \pm 6$

But $\frac{3}{c} = \frac{c+3}{-c}$

$c + 3 = \frac{-3c}{c}$

$\therefore$ $c = -3 - 3 = -6$

20. (C) Let the three zeros of p(x) be a – d, a, a + d. Which are AP.

$\therefore$ $a - \cancel{d} + a + a + \cancel{d} = -\frac{b}{a} = -\frac{15}{1}$

$3a = -15$

$a = -\frac{15}{3}$

$a = -5$

One of the zeros is (–5).

21. (A) Let the radius be r and height be h

Given $2\pi rh : \pi rl = 8 : 5$

$2h : \sqrt{h^2 + r^2} = 8 : 5$

$\frac{2h}{\sqrt{h^2 + r^2}} = \frac{8}{5}$

$\frac{4h^2}{h^2 + r^2} = \frac{64}{25}$

$100h^2 = 64h^2 + 64r^2$

$36h^2 = 64r^2$

$\frac{36}{64} = \frac{r^2}{h^2}$

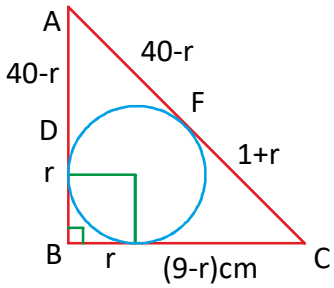
$\frac{r}{h} = \frac{\sqrt{36}}{\sqrt{64}} = \frac{6}{8} = \frac{3}{4}$

r : h = 3 : 4

22. (C) Given $\angle B = 90°$

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

$= 40^2 + 9^2$



$AC = \sqrt{1681} = 41$

Let the radius of the circle be 'r'

$\therefore$ BD = r & AD = 40 – r AF = 40 – r

BE = r

CE = 9 – r

CF = AC – AF = 41 cm – (40 – r)cm = (41 – 40 + r)cm

CF = (1 + r)cm

But CE = CF

9 – r = 1 + r

2r = 8

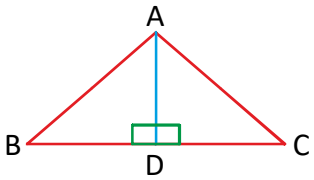
r = 4 cm (or)

$\Delta = rs$

$$r = \frac{\Delta}{s} = \frac{\frac{1}{2}\times 40\times 9\,cm^2}{\frac{1}{2}(40+41+9)cm}$$

$$= \frac{40\times 9\ cm}{90} = 4\ cm$$

23. (D) In ΔADC, $AC^2 = AB^2 + DC^2$



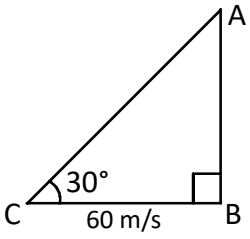
$= AD^2 + (BC - BD)^2$

$= AD^2 + BC^2 + BD^2 - 2BC \times BD$

$AC^2 = AD^2 + DB^2 + BC^2 - 2BC \times BD$

$AC^2 = AB^2 + BC^2 - 2BC \times BD$

24. (D) In ΔABC, $\angle B = 90°$ & $\angle C = 30°$ & BC = 60 m



$$\tan 30° = \frac{AB}{BC} = \frac{AB}{60\ m}$$

$$\frac{1}{\sqrt{3}} \times 60m = AB$$

$$AB = \frac{60m}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{60\sqrt{3}\,m}{3} = 20\sqrt{3}\,m$$

25. (A) Given $S_n = 3n^2 + 2n$

$\therefore$ $S_1 = 3(1)^2 + 2(1) = 3 + 5 = 5 = a_1$

$S_2 = a_1 + a_2 = 3(2)^2 + 2(2) = 12 + 4 = 16$

$\therefore$ $5 + a_2 = 16$

$a_2 = 16 - 5 = 11$

$a_1 + d = 11$

$5 + d = 11$

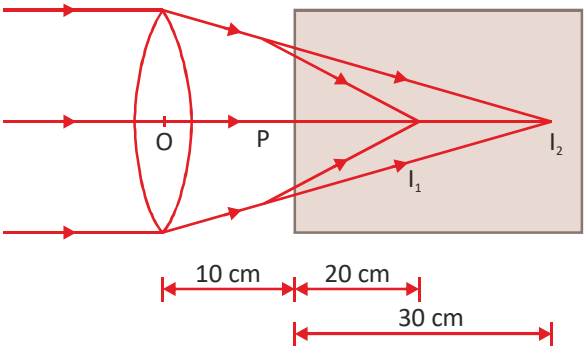
$d = 6$

$a_{10} = a + 9d = 5 + 9(6) = 59$

PHYSICS

26. (C) The resistors in parallel will provide multiple paths for the current. Due to it, the total resistance will be decreasing and approaching to zero by adding more resistors in parallel.

27. (C) Parallel rays incident on convex lens were to converge at its focus i.e., at 30 cm from the lens or at 20 cm (= PI_1) from the refracting surface. Due to refraction at P, rays converge at I_2.



$\therefore$ $PI_2 = \mu(PI_1) = \frac{3}{2}\times 20 = 30\ cm$

$\therefore$ $OI_2 = PI_2 + OP = 30 + 10 = 40$ cm.

i.e., rays converge at 40 cm from the lens.

28. (D)

(i) For distant vision correction

f = ?, P = – 5.5 D

$$f = \frac{100}{P} = \frac{100}{-5.5} = -18.2 \text{ cm}$$

(ii) For near vision correction, P = + 1.5 D

Therefore, $f = \frac{100}{P} = \frac{100}{+1.5} = +66.7 \text{ cm}$.

29. (D) The refractive indices of four substances are given below:

(a) Water 1.33 (b) Kerosene oil 1.44 (c) Mustard oil 1.46 (d) Glycerine 1.47

Higher the refractive index of a liquid, more it will change the direction of light passing through it. The ray would bend the most, when it goes from rarer medium (air) to the most denser medium. As refractive index of glycerine is the highest among other liquids, so, glycerine would bend the most.

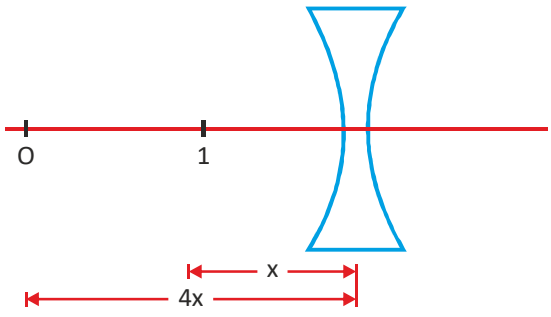
30. (B) The direction of conventional current is opposite to the direction of electron flow. To determine the force, Fleming's Left Hand rule is used.

31. (C) As refracted ray emerges normally from opposite surface, $r_2 = 0$.

As $A = r_1 + r_2 \quad \therefore \quad r_1 = A$

Now, $\mu = \frac{\sin i_1}{\sin r_1} = \frac{i_1}{r_1} = \frac{i}{A}$, $i = \mu A$.

32. (B) A concave lens forms virtual image 1 of a point object O.



As $m = \frac{1}{4} = \frac{v}{u}$

$\therefore \quad u = 4v$

If $v = -x$, $u = -4x$

Distance between object and image

$|OI| = 4x - x = 3x = 10$ cm,

$x = \frac{10}{3}$ cm

$\therefore u = -\frac{40}{3}\text{cm}$ and $v = \frac{-10}{3}\text{cm}$

From $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{f} = -\frac{3}{10} + \frac{3}{40} = -\frac{9}{40}$

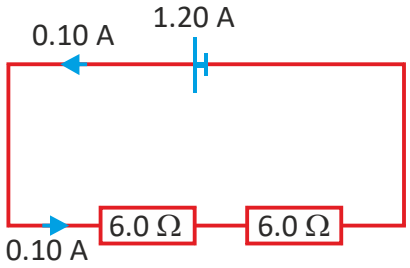
$f = -\frac{40}{9}\text{cm} = -4.4 \text{ cm}.$

33. (C) A D.C. motor requires a split ring commutator. Using FLHR, the direction of rotation of the coil is in the anticlockwise direction.

34. (B) Water is a denser medium. So, when light travels from water to air, i.e., denser to rarer medium, it will bend away from the normal. As a result of which the aeroplane will appear to be higher than its actual position.

35. (A) Resistance of the resistor

$= \frac{V}{I} = \frac{1.2}{0.2} = 6.0\ \Omega$



Current flowing through each resistor

$= \frac{V}{R} = \frac{1.20}{(6.0+6.0)} = 0.10 \text{ A}$

Current flowing through each cell

$= \frac{V}{R} = 0.10 \text{ A}$

Voltage across the resistors = 1.20 V.

CHEMISTRY

36. (B) Pure metals are mixed with small amounts of other metals or even non-metals such as carbon to form alloys. Structure shown in option (A) is an ionic crystal lattice.

Structure shown in option (C) represents a section of a polymer.

Structure shown in option (D) is a giant covalent molecule e.g. SiO_2.

37. (C) When zinc reacts with dilute sulphuric acid, hydrogen gas is given off. When the burning matchstick is brought near the test tube containing hydrogen gas, hydrogen burns with a pop sound.

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2(g)$

This is a displacement reaction in which Zn displaces hydrogen from the acid.

In the given figure

(i) a displacement reaction has taken place, (ii) Zinc being more reactive than, (iii) i.e., H (hydrogen) produces gas X which is (iv) H_2 and it burns with a (v) pop sound.

38. (A) As alkane X has the lowest boiling point (weakest) intermolecular attractions), it must be the smallest alkane in the series, i.e., methane (CH_4).

39. (D) The correct match is

P-III, Q-I, R-II, S-IV

P.

$Na_2CO_3 + 2H_2O \longrightarrow 2NaOH + H_2CO_3$

Sodium carbonate — Stron base — Weak acid

Q.

$Na_2SO_4 + 2H_2O \longrightarrow 2NaOH + H_2SO_4$

Sodium sulphate — Stron base — Strong acid

R.

$Cu_3(PO_4)_2 + 6H_2O \longrightarrow 3Cu(OH)_2 + 2H_3PO_4$

Copper phosphate — Weak base — Strong acid

S.

$(NH_4)_2CO_3 + 2H_2O \longrightarrow 2NH_4OH + H_2CO_3$

Ammonium carbonate — Weak base — Weak acid

40. (A) Limestone is added into the Blast furnace to remove acidic impurities. It decomposes to CaO, which reacts with SiO_2 (sand) to form slag, $CaSiO_3$.

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

41. (D) There is an excess of the alkali in the final mixture as only 5 cm^3 of it is required for complete neutralisation with the acid. This excess amount of OH^- ions is now dissolved in the larger volume of solution (15 cm^3), hence, their concentration should be lower than the initial 1 mol/dm^3.

42. (B) Unsaturated carbon compound like coal do not burn completely and produces a yellow sooty flame with unburnt or partially burnt carbon particles. After the coal is burnt, a blackish grey ash is produced.

So, the correct observation is made by student Q.

43. (B) Set up II will produce smoke as the oil taken in spatula contains unsaturated hydrocarbon which burns with luminous flame and produces more smoke.

44. (D) Lemon juice has citric acid. Vinegar has acetic acid common salt is neutral and does not change the pH paper to greenish blue. Addition of the above three substances does not change the pH paper to greenish-blue as they are mostly acidic.

Hence, addition of an antacid like baking soda can change the acidic soil which can change the pH paper from yellowish - orange to green or greenish blue.

45. (C) The correct matching is

P - iv; Q - iii; R - i; S - ii.

The most abundant element in universe - Hydrogen

Largest constituent of atmosphere - Nitrogen

Most abundant non-metal in earth's crust - Oxygen

Most abundant metal in earth's crust - Aluminium

BIOLOGY

46. (D) Enzyme Renin coagulates milk into curd.

47. (C) A mass of crushed food moistened with saliva is called bolus.

48. (B) X - carbon dioxide;Y - sunlight and Z - oxygen.

49. (A) The blood glucose levels are regulated by insulin.

50. (C) Sexual reproduction involves two types of gametes, their fusion and zygote formation offspring produced are different.

51. (D) The gas X that is released is oxygen. It can light up a glowing splinter. It is needed for combustion. It is needed by all organisms.

52. (D) The plant hormone cytokinin is used for introducing shoot morphogenesis.

53. (B) The gametes have half the number of chromosomes.

54. (D) The left ventricle possesses a thicker wall than the right ventricle because it pumps the blood at a higher pressure since blood from the left ventricle goes to all areas of the body while the right ventricle only has to pump blood to the lungs which is a much shorter distance, therefore less pressure is required.

55. (C) Lacteals are lymph vessels responsible for absorbing fat in the small intestine. Occurring in the finger-like villi of the ileum, lacteals have a milky appearance and drain into the lymphatic system. Before fat can pass into the lacteal, bile from the liver causes its emulsification into small droplets by the action of the enzyme lipase.

CRITICAL THINKING

56. (C)

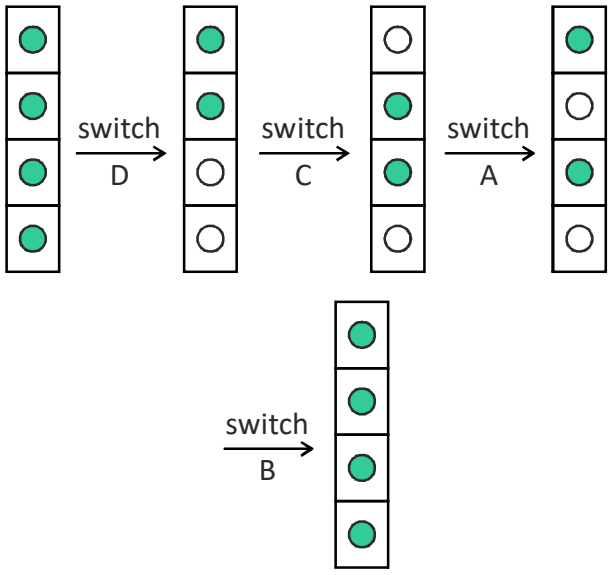
1) This can't be hypothesized from the given statement because preference in the sense of popularity has been given to mobile instead of T.V.

2) This can't be hypothesized from the given statement because there is direct comparison between T.V and mobile phone in statement. There is nothing mentioned about outdoor activities in the statement.

3) This can be hypothesized from the given statement as it is mentioned in the given statement that youngsters spend most of their time on mobile phones.

4) This can't be hypothesized from the given statement because nothing is mentioned about that older generation is comfortable in using mobile phones or not.

57. (D) Switch D is faulty



But the result Figure 2 is

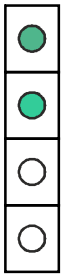
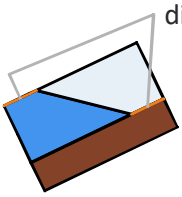


Figure 2

lights 3 and 4 are in reverse. Hence, switch D is fault.

58. (C)

same distance



59. (D) The prices of petrol and diesel being stagnant in the domestic market and the increase in the same in the international market must be backed by independent causes.

60. (B) Starting with option (A), we see that this option lists turning south onto Third Street and then west on Main Street. Main Street is one block south of the street you'd like to be on, so this option is not the most efficient route.

In option (B), you see that the first turn after heading west on Mall Road is to turn south onto Rajpath Road, then east to Tripolia Bazar, which will put the officer at the scene of the collision. This option matches the route you figured out before reading the answers, so b is more than likely the right choice.

However, it's always best to continue reading the answers to make sure you don't pass up an option that turns out to be better than the one you originally figured. Option (C) has Officer Chandrapal; turning east on Main Street, which is heading away from the call and does not end up at Rajpath Road. Option (D) is not the best answer because the corner of Rajpath Road and Main Street is one block too far to the south. The only reason you'd choose either of these options would be not knowing which was the northwest corner of City Hall.

The End