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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN465

KEY

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SOLUTIONS

MATHEMATICS

1: (B) Let the point on Y – axis be P(0, y)

P(0, y) divided the join of A(2, 3) and B(–5, 7) in the ratio $m_1 : m_2$

$$\therefore P(0, y) = \left(\frac{-5m_1 + 2m_2}{m_1 + m_2}, \frac{7m_1 + 3m_2}{m_1 + m_2}\right)$$

$$\therefore \frac{-5m_1 + 2m_2}{m_1 + m_2} = 0 \Rightarrow -5m_1 + 2m_2 = 0$$

$$\frac{2}{5} = \frac{m_1}{m_2}$$

$\therefore m_1 : m_2 = 2 : 5$

2: (D) Given In ΔABD, $\angle B = 90°$

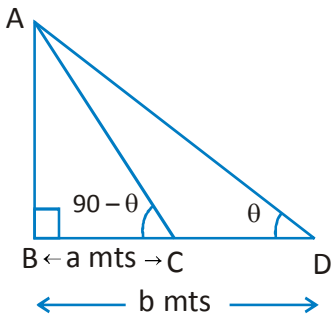
$\angle D = \theta$ & $\angle ACB = 90° - \theta$

BC = a mts & BD = b mts

[$\because$ given $\angle D$ & $\angle ACB$ are complementary angles]

In ΔABD $\tan\theta = \frac{AB}{b \text{ mts}}$ $\rightarrow$ (1)

In ΔABC $\tan(90 - \theta) = \frac{AB}{a \text{ mts}}$



$$\text{Cot}\theta = \frac{AB}{a \text{ mts}}$$

$$\Rightarrow \frac{1}{\tan\theta} = \frac{AB}{a \text{ mts}}$$

$$\tan\theta = \frac{a \text{ mts}}{AB} \rightarrow (2)$$

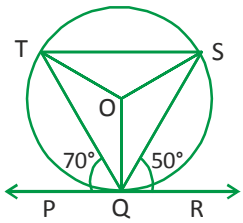
From (1) & (2) $\frac{AB}{b \text{ mts}} = \frac{a \text{ mts}}{AB}$

$\Rightarrow AB^2 = ab \text{ mts}^2$

Height of tower $(AB) = \sqrt{ab}$ mts

3: (C) $\angle OQS = 90° - 50° = 40°$

$\therefore \angle OSQ = \angle OQS = 40°$



$\therefore \angle OQS = 180° - 40° - 40° = 100°$

$$\therefore \angle QTS = \frac{\angle OQS}{2} = 50°$$

$\angle TQP = 70°$

[$\because$ Given] $\Rightarrow \angle TQO = 20°$

$\therefore$ $\angle OTQ = \angle TQO = 20°$

$\Rightarrow \angle OTS = \angle QTS - \angle OTQ = 50° - 20°$

$\therefore$ $\angle OTS = \angle x = 30°$ [$\because$ OT = OS]

4: (A) $210 = 5 \times 7 \times 2 \times 3$

$65 = 5 \times 13$

$\therefore$ HCF of 210 & 65 = 5

Given $199 \times 5 + 55y = 5$

$199 \times 5 - 5 = -55y$

$$\frac{\cancel{198}^{18} \times \cancel{5}}{-\cancel{55}_{11}} = y$$

$y = -18$

$\therefore$ $y^2 = (-18)^2 = 324$

5: (D) Let the three sides of a right angled triangle be a, a + d, a + 2d respectively [$\because$ Given sides are in AP]

$\therefore (a + 2d)^2 = a^2 + (a + d)^2$

$$\cancel{a^2} + 4ad + 4d^2 = \cancel{a^2} + a^2 + 2ad + d^2$$

$\Rightarrow a^2 - 2ad - 3d^2 = 0$

$a^2 - 3ad + ad - 3d^2 = 0$

$a(a - 3d) + d(a - 3d) = 0$

$\Rightarrow (a - 3d)(a + d) = 0$

$a - 3d = 0$ or $a + d = 0$

$\therefore$ a = 3d & a = –d rejected because side of triangle is always positive

$\therefore$ 3d, 4d and 5d are the sides of a right angled triangle

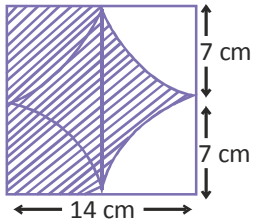
$\therefore$ 80 Unit is the side of a right angled triangle because 80 is multiple of 4 as well as 5

6: (A) If a circle inscribed in a quadrilateral then sum of opposite angles made at the centre are supplimantary

$\therefore$ $115° + \angle COD = 180°$

$\angle COD = 180° - 115° = 65°$

7: (C) Given shaded region becomes like this



Area of shaded region = Area of square – Area of two quarter circle

$$= (14\text{cm})^2 - \frac{1}{\cancel{4}_2} \times \cancel{2} \times \pi r^2$$

$$= 196\text{cm}^2 - \frac{1}{\cancel{2}} \times \frac{\cancel{22}^{11}}{\cancel{7}} \times \cancel{7} \times 7\text{cm}^2$$

$= (196 - 77)\text{ cm}^2 = 119\text{ cm}^2$

8: (A) Given $\alpha + \beta = m + n + n - m = 2n$

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

$\therefore$ Required quadratic equation is $x^2 - x(\alpha + \beta) + \alpha\beta = 0$

$\therefore$ $x^2 - 2nx + n^2 - m^2 = 0$

9: (D) Given $\text{Cos}\theta + \text{Sin}\theta = \sqrt{2}\,\text{Cos}\theta$

Squaring on both sides

$$\Rightarrow (\text{Cos}\theta + \text{Sin}\theta)^2 = \left(\sqrt{2}\,\text{Cos}\theta\right)^2$$

$\Rightarrow \text{Cos}^2\theta + \text{sin}^2\theta + 2\text{Sin}\theta\ \text{Cos}\theta = 2\text{Cos}^2\theta$

$2\ \text{Sin}\theta\ \text{Cos}\theta = 2\ \text{Cos}^2\theta - \text{Cos}^2\theta - \text{Sin}^2\theta$

$\therefore\ \text{Cos}^2\theta - \text{Sin}^2\theta = 2\ \text{Sin}\theta\ \text{Cos}\theta$

$(\text{Cos}\theta + \text{Sin}\theta)(\text{Cos}\theta - \text{Sin}\theta) = 2\ \text{Sin}\theta\ \text{Cos}\theta$

$$\left(\sqrt{2}\,\text{Cos}\theta\right)(\text{Cos}\theta - \text{Sin}\theta) = 2\sin\theta\,\text{Cos}\theta$$

$$\text{Cos}\theta - \text{Sin}\theta = \frac{2\text{Sin}\theta\ \text{Cos}\theta}{\sqrt{2}\ \text{Cos}\theta} = \sqrt{2}\ \text{Sin}\theta$$

10: (A) Given $\frac{1}{2}ab = 16$ squnits

$$\Rightarrow \frac{1}{2} \times 8 \times b = 16$$

$b = 4$

$\therefore$ $P = (0, 4)$

11: (B) $$\text{LCM of } \frac{3}{14}, \frac{1}{14} \text{ and } \frac{2}{7} = \frac{\text{LCM of numerators}}{\text{HCF of denominators}}$$

$$= \frac{6}{7}$$

12: (A) Given $2\cancel{\pi}r = 14\cancel{\pi}$ cm

$$r = \frac{14\,\text{cm}}{2} = 7\,\text{cm}$$

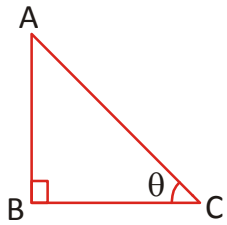
$\therefore$ Height = 2r = 14 cm

$$\text{Volume} = \pi r^2 h = \frac{22}{\cancel{7}} \times \cancel{7} \times 7 \times 14\,\text{cm}^3$$

$= 2156\ \text{cm}^3$

$$= \frac{2156}{1000}\text{Litres} = 2.156\ \text{Litres}$$

13: (C) Given AB = BC & $\angle B = 90°$



Let

$$\angle C = \theta \Rightarrow \tan\theta = \frac{AB}{BC} = \frac{\cancel{AB}}{\cancel{AB}} = 1 = \tan 45°$$

$\therefore$ $\theta = 45°$

14: (B) Given $\Delta ADE \sim \Delta ABC \Rightarrow \frac{AD}{AB} = \frac{DE}{BC} = \frac{AE}{AC}$

$$\Rightarrow \frac{1.2\,\text{cm}}{BC} = \frac{\cancel{3\,\text{cm}}^{2}}{\cancel{7.5\,\text{cm}}_{5}}$$

$$\Rightarrow BC = \frac{\cancel{1.2}^{0.6}\ \text{cm} \times 5}{\cancel{2}_{1}}$$

= 3 cm

15: (C) Given $3x + y = 1$ and $(2K - 1)n + (k - 1)y = (2k + 1)$ are inconsistent lines

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

$$\therefore\ \frac{3}{2k-1} = \frac{1}{k-1} \neq \frac{1}{2k+1}$$

$\therefore$ $3(k - 1) = 2k - 1$

$3k - 3 = 2k - 1$

$3k - 2k = -1 + 3$

$k = 2$

If k = 2 then $\frac{3}{3} = \frac{1}{1} \neq \frac{1}{4}$

16: (D) Degree of $(x^2 + 1)^3$ is 6

Degree of $(x^3 + 1)^4$ is 12

$\therefore$ Degree of $(x^2 + 1)^3 (x^3 + 1)^4 = 6 + 12 = 18$

17: (A) Given $\sqrt{\frac{81}{49}} = \frac{6.3\,cm}{x}$

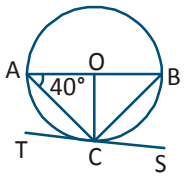
$\frac{9}{7} = \frac{6.3\,cm}{x}$

$x = \frac{7 \times \cancel{6.3}^{0.7}\ cm}{\cancel{9}_{1}}$

= 4.9 cm

18: (C) Construction :- Join $\overline{OC}$

In ΔAOC, $\angle OAC = 40°$ [$\because$ given]



$\therefore \angle OCA = 40°$

But $\angle TCO = 90°$

$\therefore 40° + \angle ACT = 90°$

$\angle ACT = 90° - 40° = 50°$

19: (B) Diagonal of a Cube = Diameter of a sphere

$\therefore \sqrt{3}a = 3\,cm$

$a = \frac{3}{\sqrt{3}}cm \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{3\sqrt{3}\,cm}{3} = \sqrt{3}\,cm$

$\therefore$ Volume of Cube

$= a^3 = \left(\sqrt{3}\,cm\right)^3 = 3\sqrt{3}\,cm^3$

20: (C) Given $a = 2b \Rightarrow x + 2y = 2(2b) - 6b = -2b$

$2bx + by = 2(2b)^2 - 3b^2$

$2bx + by = 8b^2 - 3b^2$

$\cancel{b}(2x + y) = \cancel{b}(8b - 3b) = 5b$

$\therefore a_1 = 1, b_1 = 2, c_1 = -2b,$

$a_2 = 2, b_2 = 1, c_2 = 5b$

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

This lines are intersecting having unique i.e one solution

21: (B) $x^2 - y^2 = (a\,Sec\theta + b\,tan\theta)^2 - (a\,tan\theta + b\,sec\theta)^2$

$= (a^2\,Sec\theta + b^2\,tan^2\theta + 2ab\,Sec\theta\,tan\theta) - (a^2\,tan^2\theta + b^2\,Sec^2\theta + 2ab\,Sec\theta\,tan\theta)$

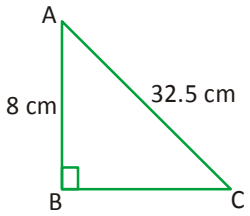
$= a^2\,Sec^2\theta + b^2\,tan^2\theta + \cancel{2ab\,Sec\theta\,tan\theta} - a^2\,tan^2\theta - b\,Sec^2\theta - \cancel{2ab\,Sec\theta\,tan\theta}$

$= a^2(Sec^2\theta - tan^2\theta) - b^2(Sec^2\theta - tan^2\theta)$

$x^2 - y^2 = a^2 - b^2$

22: (D) In ΔABC given $\angle B = 90°$

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



$(32.5)^2 = 8^2 + BC^2$

$BC = \sqrt{1056.25 - 64} = \sqrt{992.25} = 31.5$

Area of ΔABC

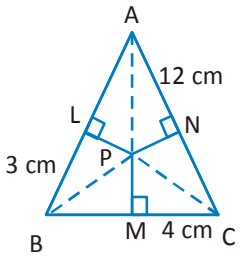
$= \frac{1}{2} \times AB \times BC = \frac{1}{\cancel{2}_{1}} \times \cancel{8}^{4}\ cm \times 31.5\,cm$

= 126 cm^2

23: (C) Construction :- Join PA, PS & PC

$AL^2 + BM^2 + CN^2 = AP^2 - PL^2 + BP^2 - PM^2 + CP^2 - PN^2$

$= BP^2 - PL^2 + CP^2 - PM^2 + AP^2 - PN^2$



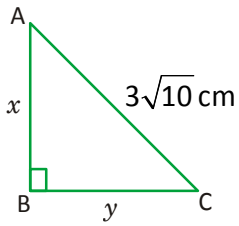
$= BL^2 + CM^2 + AN^2 = (3\ cm)^2 + (4\ cm)^2 + (12\ cm)^2$

$= 9\ cm^2 + 16\ cm^2 + 144\ cm^2 = 169\ cm^2$

24: (D) Given in ΔABC

$\angle B = 90°$ & $AC = 3\sqrt{10}$ cm

Let AB = x & BC = y



$\therefore x^2 + y^2 = \left(3\sqrt{10}\right)^2 = 90 \rightarrow (1)$

Given $(3x)^2 + (2y)^2 = \left(9\sqrt{5}\right)^2$

$\Rightarrow 9x^2 + 4y^2 = 405 \rightarrow (2)$

eq (2) – eq (1) × 4 $\Rightarrow (9x^2 + 4y^2) - (4x^2 + 4y^2) = 405 - 4 \times 90$

$5x^2 = 45$

$x^2 = \frac{45}{5} = 9$

$x = \sqrt{9} = 3$

$9 + y^2 = 90 \rightarrow (1)$

$y^2 = 90 - 9 = 81$

$y = \sqrt{81} = 9$

$x + y = 3 + 9 = 12$ cm

25: (A) Given $S_n = (3n^2 + 5n)$

$\therefore$ $S_{n-1} = 3(n-1)^2 + 5(n-1) = 3(n^2 - 2n + 1) + 5n - 5$

$= 3n^2 - 6n + 3 + 5n - 5$

$s_{n-1} = 3n^2 - n - 2$

$\therefore$ $a_n = s_n - s_{(n-1)} = (3n^2 + 5n) - (3n^2 - n - 2)$

$= \cancel{3n^2} + 5n - \cancel{3n^2} + n + 2$

$= 6n + 2$

Given $a_n = 152$

$\therefore$ $6n + 2 = 152$

$6n = 152 - 2 = 150$

$n = \frac{150}{6} = 25$

PHYSICS

26: (C) Specific resistance $(\rho) = \frac{RA}{l}$ For $\rho = R$

A = 1 m^2 or 1 cm^2, l = 1 m ; 1 cm

$\therefore$ Specific resistance is numerically equal to resistance offered by 1 cm length of a conductor of 1 cm^2 of cross section.

27: (A, C) A convex mirror produces always only virtual and diminished image of an object.

A plane mirror does not form a magnified image of an object but it always forms the image same as that of the object.

i.e., object size = image size

28: (A) If μ be the refractive index of glass with respect to air, then according to Snell's law for the refraction of light,

$\mu = \frac{\sin i'}{\sin r'}$

(At the point of incidence)

Because, for minimum deviation

i = i', hence r = r'.

29: (D) All the three statements are true of principal focus.

30: (B) Magnetic field inside a current carrying solenoid is directly proportional to the flow of current.

31: (B, D) When white light passes through a dispersive medium it breaks up into various colours because velocity of light for different colours is different as they differ in wavelength. Secondly, velocity of light for violet is less than the velocity of light for red.

32: (B) $\mu = 1.54; c = 3 \times 10^8\ ms^{-1}$

$\mu = \frac{c}{v}$

$1.54 = \frac{3 \times 10^8}{v}$

$v = \frac{3 \times 10^8}{1.54} = 1.94 \times 10^8\ ms^{-1}$

33: (B) $\theta = 90°$, $\sin\theta = 1$, $\therefore F = Bil$

Maximum force is experienced by a conductor when it is placed perpendicular to a magnetic field.

34: (C) Human beings have a horizontal field of view of 150° with one eye open but with two eyes open, the field of view is 180°. With our two eyes open, we can see a much larger area in front of us.

35: (C) $R = 4.6\ \Omega$

Radius

$$= r = \frac{\text{Diameter}}{2} = \frac{0.642}{2} = 0.321 \text{ mm} = 0.321 \times 10^{-3} \text{m}$$

Area of cross-section = $A = \pi r^2$, Length = $l = 1$ m

Resistivity

$$= \rho = \frac{R\,A}{l} = \frac{R\pi r^2}{l} = \frac{4.6 \times 3.14 \times (0.321 \times 10^{-3})^2}{1}$$

$= 1.49 \times 10^{-6}\ \Omega$-m

CHEMISTRY

36: (B) X is sodium $Na^+(11)$. It loses an electron. Y is chlorine $Cl^-(17)$. It gains an electron from Na to form NaCl (Z), a solid ionic compound. Ionic compounds have high melting and boiling points. They conduct electricity in molten state. So, Z is a solid ionic compound. It does not have a low melting point.

37: (B) To balance the given equation the number of atoms of each element should be same on both the sides. Hence, the 'X' value should be 3.

$$2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$$

38: (C) A diamond-toothed saw is usually used for cutting marble slabs.

39: (B) When concentrated solution of sodium chloride is electrolysed, chlorine and hydrogen gases are evolved along with sodium hydroxide. So, totally three products are formed in chlor-alkali process as given below :

$$\underset{\text{Sodium chloride (Brine)}}{2NaCl(aq)} + \underset{\text{Water}}{2H_2O(l)} \xrightarrow[\text{(Electrolysis)}]{\text{Electricity}}$$

$$\underset{\text{Sodium hydroxide (Caustic soda)}}{2NaOH(aq)} + \underset{\text{Chlorine}}{Cl_2(g)} + \underset{\text{Hydrogen}}{H_2(g)}$$

During electrolysis, chlorine gas is produced at the anode (positive electrode) and hydrogen gas is produced at the cathode (negative electrode). Sodium hydroxide solution is formed near the cathode. All the products of electrolysis of sodium chloride solution, chlorine, hydrogen and sodium hydroxide, are collected and stored separately.

The process of electrolysis of sodium chloride solution is called chlor-alkali process because of the products formed : chlor for chlorine and alkali for sodium hydroxide.

40: (C) Element X being a yellow coloured solid is Sulphur (S). The melting point and boiling point relate to the above element along with the given characteristic flame when it burns in the presence of oxygen to form sulphur dioxide gas (SO_2).

Sulphur dioxide being an acidic gas turns blue litmus paper red and finally becomes colourless. So, X is sulphur and Y is sulphur dioxide gas.

41: (C) Among the given equations, only $2KClO_3$ represents a decomposition reaction.

42: (B) The density of graphite is 2.3 g cm^{-3}.

43: (B) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ (Salt of a strong base and a strong acid)

$2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$ (Salt of a weak base and a strong acid)

$NH_4OH + CH_3COOH \rightarrow CH_3COONH_4 + H_2O$ (Salt of a weak base and a weak acid)

$2KOH + H_2CO_3 \rightarrow K_2CO_3 + 2H_2O$ (Salt of a strong base and a weak acid)

44: (C) Isomerism is possible only with hydrocarbons having 4 or more carbon atoms.

45: (C) As silver is less reactive than hydrogen, it will not displace hydrogen from dilute hydrochloric acid.

BIOLOGY

46. (B) 1 - Style; 2 - Anther; 3 - Sepal.

47. (D) In the given diagram S is ventricle. Blood reaches highest pressure at ventricle.

48. (B) In the given figure part labelled 2 is phloem. Phloem transports sugar to different parts of the plant.

49. (B) Fat emulsification is the process of increasing the surface area of fats in the small intestine by grouping them into small clusters. This is the responsibility of bile, a liquid created by the liver and stored in the gallbladder.

50. (D) Structure (D) is the alveoli (air sacs) and it has the largest surface area to increase the efficiency of exchange of gases.

51. (C) (i) - kidney; (ii) - ureter; (iii) - bladder; (iv) - urethra.

52. (D) None of the plants inherit the chewed leaf pattern.

53. (B, D) Insectivores or carnivores like frog and snake are secondary consumers.

54. (D) The neutrophils and lymphocytes are different types of white blood cells which help to fight infection. The antibodies are produced by white blood cells and they will recognise and bind to foreign particles.

55. (B) In the TS of the plant part labelled Q represents mesophyll tissue. Mesophyll tissue are rich in chloroplasts. Hence part Q contains most starch after the period of bright light.

CRITICAL THINKING

56: (B)

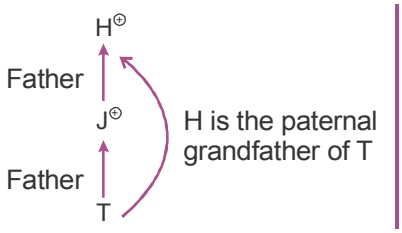
57: (D)

By decoding given information with symbols of family diagram, we get

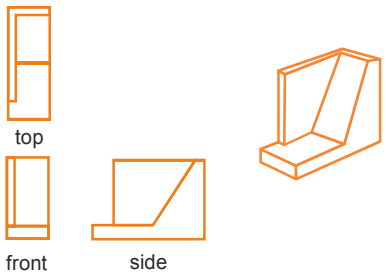
$$\left|(P+Q)=P^{\ominus}\underset{Q}{\uparrow}\text{Father}\right|\left|(P-Q)=P^{\ominus}\underset{Q}{\uparrow}\text{Mother}\right|\left|(P\times Q)=P^{\ominus}\xleftarrow{\text{Brother}}Q\right|\left|(P\div Q)=P^{\ominus}\xleftarrow{\text{Sister}}Q\right|$$

By applying above decoding method, we check all the options for the required relationship

(T + J + H)



58: (D)



59: (D) All information's are required to know the positions of all the students in row.

60: (C) Gear 2 and gear 4 are moved anticlockwise