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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN449

KEY

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41. C	42. B	43. D	44. B	45. C	46. B	47. A	48. B	49. D	50. C, D
51. A	52. B	53. C	54. C	55. B	56. C	57. C	58. A	59. D	60. D

SOLUTIONS

MATHEMATICS

1. **(A)** Given number = 18x + 21y

= 3 (6x + 7y)

'3' is a factor of 2025

$\therefore$ 2025 is the required number

[$\because$ 2025 = 18 × 4 + 21 × 93]

2. **(A)** $S = \frac{P}{2} = 12$ cm

Area of $\Delta = rs = 12\text{ cm} \times 2\text{ cm} = 24\text{ cm}^2$

3. **(B)** From C, draw CL $\perp$ AB and from D, drawn DM $\perp$ AB

Then CL = DM

In ΔACB, since $\angle B$ is an acute angle,

$\therefore AC^2 = AB^2 + BC^2 - 2AB \cdot BL$ .... (1)

Similarly, In ΔABD, Since $\angle A$ is an acute angle,

$\therefore BD^2 = AD^2 + AB^2 - 2AB \cdot AM$ ..... (2)

Adding (1) and (2), we get

$AC^2 + BD^2 = AD^2 + BC^2 + 2AB^2 - 2AB$.

BL – 2AB . AM

= $AD^2 + BC^2 + 2AB\,(AB - BL - AM)$

= $AD^2 + BC^2 + 2AB\,(AL - AM)$

= $AD^2 + BC^2 + 2AB$. ML

= $AD^2 + BC^2 + 2AB$. CD

4. **(D)** DC = AD & DC = BD

$\therefore$ AB = AD + DB = DC + DC = 2DC = 2 × 6 cm = 12 cm

5. **(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)

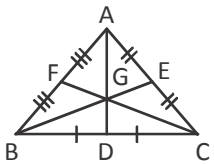
we get x = – 2

$\therefore$ (–2, 1) lies on kx + 4y + 2 = 0

$-2k + 4 + 2 = 0$

k = 3

6. **(B)**



In ΔABC, $AB^2 + AC^2 = 2AD^2 + 2BD^2$

$\Rightarrow AB^2 + AC^2 = 2\left(\frac{3}{2}AG\right)^2 + 2\left(\frac{BC}{2}\right)^2$

$AB^2 + AC^2 = \cancel{2} \times 9\,\frac{AG^2}{\cancel{4}_2} + \cancel{2} \times \frac{BC^2}{\cancel{4}_2}$

$2(AB^2 + AC^2) = 9AG^2 + BC^2$

$2AB^2 + 2AC^2 - BC^2 = 9AG^2 \rightarrow (1)$

Similarly $2BC^2 + 2AB^2 - AC^2 = 9\,BG^2 \rightarrow (2)$

$2BC^2 + 2AC^2 - AB^2 = 9CG^2 \rightarrow (3)$

Add eq (1) + (2) + (3)

$3AB^2 + 3BC^2 + 3CA^2 = 9AG^2 + 9BG^2 + 9CG^2$

$3(AB^2 + BC^2 + CA^2) = 9(AG^2 + BG^2 + CG^2)$

$\frac{\cancel{3}^1}{\cancel{9}_3} = \frac{AG^2 + BG^2 + CG^2}{AB^2 + BC^2 + CA^2}$

7. **(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

8. **(C)** Given AC = 2 BM [$\because \angle B = 90°$]

AC = 8.5 cm

Given AB + BC = 11.5 cm

squaring on both sides

$AB^2 + BC^2 + 2AB \times BC = 132.25\ cm^2$

$AC^2 + 2AB \times BC = 132.25\ cm^2$

$(8.5)^2 + 2AB \times BC = 132.25\ cm^2$

$72.25\ cm^2 + 2AB \times BC = 132.25\ cm^2$

$2AB \times BC = 60\ cm^2$

$AB \times BC = 30\ cm^2$

Area of $\Delta ABC = \frac{1}{2} \times AB \times BC = \frac{1}{2} \times 30$

$cm^2 = 15\ cm^2$

9. **(D)** $m^2 - n^2 = (\tan\theta + \sin\theta)^2 - (\tan\theta - \sin\theta)^2$

= $\tan^2\theta + \sin^2\theta + 2\tan\theta\sin\theta - \tan^2\theta - \sin^2\theta + 2\tan\theta\sin\theta$

= $4\tan\theta\sin\theta$

= $4\sqrt{\tan^2\theta\sin^2\theta}$

= $4\sqrt{\frac{\sin^2\theta}{\cos^2\theta} \times \sin^2\theta}$

$= 4\sqrt{\frac{1-\cos^2\theta}{\cos^2\theta} \times \sin^2\theta}$

$= 4\sqrt{\left(\frac{1}{\cos^2\theta} - 1\right)\sin^2\theta}$

$= 4\sqrt{\left(\tan^2\theta - \sin^2\theta\right)}$

$= 4\sqrt{\left(\tan\theta + \sin\theta\right)\left(\tan\theta - \sin\theta\right)}$

$= 4\sqrt{mn}$

10. **(B)** $\text{LHS} = \frac{4}{3}\left(\sqrt{3}\right)^2 + 3\times\left(\frac{\sqrt{3}}{2}\right)^2 - 2\left(\frac{2}{\sqrt{3}}\right)^2 - \frac{4}{3}\left(\frac{1}{\sqrt{3}}\right)^2$

$= 4 + \frac{9}{4} - \frac{8}{3} - \frac{4}{9}$

$= \frac{144 + 81 - 96 - 16}{36}$

$= \frac{113}{36}$

11. **(B)** In $\Delta ABC \quad \tan 30° = \frac{AB}{BC}$

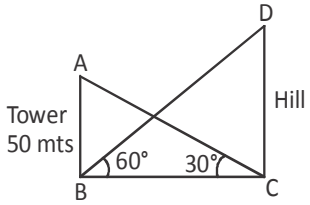
$\frac{1}{\sqrt{3}} = \frac{50 \text{ mts}}{BC}$

$BC = 50\sqrt{3}$ mts

In $\Delta BCD \tan 60° = \frac{DC}{BC}$

$\sqrt{3} = \frac{DC}{50\sqrt{3} \text{ mts}}$

Height of hill (DC) = 150 mts



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

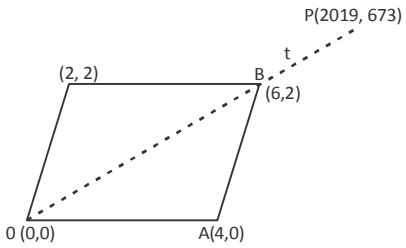
$BC = \sqrt{25 + 81} = \sqrt{106}$

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

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

Given vertices form right angled isosceles triangle.

13. **(A)**



0 (0, 0) B (6,2)

Slope or OB$= \frac{2}{6} = \frac{1}{3}$

B(6, 2) P(2019, 673)

Slope of BP $= \frac{673-2}{2019-6} = \frac{671}{2013} = \frac{1}{3}$

$\overleftrightarrow{OP}$ divides the parallogram into two regions of equal area and slope of OP

$= \frac{673}{2019} = \frac{1}{3}$.

14. **(C)** Given $a_1, a_2, a_3, \ldots\ldots a_n$ are there between a and b

$\therefore$ a, $a_1, a_2, a_3, \ldots\ldots a_n$, b are in AP

Total terms = n + 2

$\therefore$ Sum of (n + 2) term $= \frac{(n+2)}{2}(a+b)$

15. **(D)** DBDG $\sim$ DFEC

[$\because$ A.A similarity]

$\therefore \frac{12cm}{x} = \frac{x}{27cm}$

$x^2 = 12 \text{ cm} \times 27 \text{ cm}$

Side of sqaure = x = 18 cm

16. **(B)** Let present age of father & son be x and y

Given (x–2) = 5 (y–2)

$x - 5y = -8 \quad \rightarrow (1)$

Given x + 2 = 3(y+2) + 8

x + 2 = 3y + 14

$x - 3y = 12 \quad \rightarrow (2)$

Solving (1) & (2) y = 10 & x = 42

$\therefore$ x + y = 42 + 10 = 52

17. **(D)** LHS = $\sin^2 1° + \sin^2 2° + \sin^2 3° + ... + \sin^2 + \sin^2 90°$

$= \sin^2 1° + \sin^2 2° + \sin^2 3° + ... + \sin^2 45° + ... \sin^2 (90° - 1°) + \sin^2 90°$

$= \sin^2 1° + \sin^2 2° + ... + \left(\frac{1}{\sqrt{2}}\right)^2 + ...$

$+ \cos^2 2° + \cos^2 1° + \sin^2 90°$

$= 44 + \frac{1}{2} + 1$

$= 45 + \frac{1}{2} = \frac{91}{2}$

18. **(A)** $\alpha + \beta = \frac{-b}{a} = \frac{-8}{7}$ & $\alpha\beta = \frac{-2}{7}$

$\alpha + 2 + \beta + 2 = \alpha + \beta + 4 = \frac{-8}{7} + 4 = \frac{-8+28}{7} = \frac{20}{7}$

$(\alpha + 2)(\beta + 2) = \alpha\beta + 2(\alpha + \beta) + 4 = \frac{-2}{7} - \frac{16}{7} + 4$

$= \frac{10}{7}$

Q.E whose roots are $\alpha+2, \beta+2$ is

$k\left[x^2 - x(\alpha + 2 + \beta + 2) + (\alpha + 2)(\beta + 2)\right]$

$K\left[x^2 - x\left(\frac{20}{7}\right) + \frac{10}{7}\right]$

$k\left[\frac{7x^2 - 20x + 10}{7}\right] = 7x^2 - 20x + 10$

where k = 7

19. **(B)** a, a+d, a+2d ..... *l* are in AP

a, a+d, a+2d, ... *l* –2d, *l* –d, *l* are in AP

last term from the end = *l*

Second term from the end = *l*– d

Third term from the end = *l* – (2) d

nth term from the end = *l* – (n–1) d

20. **(A)** If n = 0 then $\frac{a^{n+1} + b^{n+1}}{a^n + b^n} = \frac{a+b}{2}$ which is Am of a & b.

21. **(C)** Given vertices form a right angled triangle In a right angled triangle the vertex of right angle is orthocentre.

$\therefore$ Ortho centre = (0, 0)

22. **(A)** Given (3k+1) (2k–1) = 144

$6k^2 - k - 1 = 144$

$6k^2 - k - 145 = 0$

$6k^2 - 30k + 29k - 145 = 0$

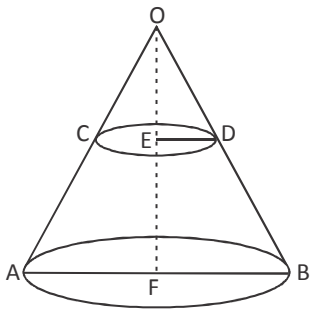
$6k(k-5) + 9(k-5) = 0$

$k = 5$ (or) $k = -\frac{9}{6}$

If k = 5 then *l* = 16 cm & b = 9 cm

Perimeter = 2 (*l* + b) = 50 cm.

23. **(A)** Let OAB be the given cone cut off by a plane CD parallel to the base AB such that a small cone OCD is left.



For the cone OAB :

Height H = 30 cm

Let the radius of the base be R.

Then, Volume of the cone OAB

$= \frac{1}{3}\pi R^2 h$

$= \left[\frac{1}{3}\pi R^2 \times 30\right] cm^2 = \left(10\pi R^2\right) cm^3$

For the cone OCD :

Let the height be h and radius of the base be r.

Then, the volume of the cone OCD

$= \frac{1}{3}\pi R^2 h.$

New, $\frac{1}{3}\pi r^2 h = \frac{1}{27}\left(10\pi R^2\right)$ [given]

$\Rightarrow \left(\frac{R}{r}\right)^2 = \frac{9h}{10}$ ... (i)

Also, $\Delta OED \sim \Delta OFB$ [$\because$ OF = H = 30 cm]

$$\therefore \frac{OE}{OF} = \frac{ED}{FB} \Rightarrow \frac{h}{30} = \frac{r}{R} \Rightarrow \frac{R}{r} = \frac{30}{h} \ldots \text{(ii)}$$

From (i) and (ii) we get :

$$\left(\frac{30}{h}\right)^2 = \frac{9h}{10} \Rightarrow h^3 = 1000 \Rightarrow h = 10 \text{ cm.}$$

Thus, the height of the smaller cone OCD = 10 cm.

Hence, the height of the section from the base = EF = OF – OE = H – h = (30 – 10) cm = 20 cm.

24. **(D)** BD = $2\sqrt{2}$

Area of Circle = $\pi\left(\sqrt{2}\right)^2 = 2\pi$

Area of square $= 2^2 = 4$

Area of circle - Area of square $= 2\pi - 4$

Area between circle and square on each side = $\frac{2\pi - 4}{4}$

Area of shaded regions

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

$$= 4\left[\frac{\pi - \pi + 2}{2}\right] = 4$$

25. **(A)** Volume 8000 cubes = 50 cm × 50 cm × 50 cm

$8000 \times a^3 = 50 \times 50 \times 50 \text{ cm}^3$

$$a^3 = \frac{50 \times 50 \times 50}{20 \times 20 \times 20}$$

$$= \left(\frac{5}{2}\right)^3$$

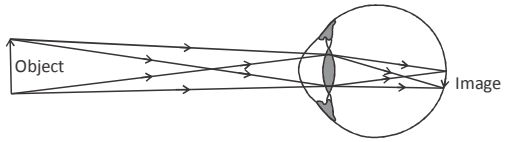
a = 2.5 cm

PHYSICS

26. **(C)** The plastic casing of hair dryer is an insulator. The earth wire is redundant or not necessary in such appliance.

27. **(C)** The object distance is the distance between the object and the optical centre. The object distance does not affect the focal length which is a property of the lens.

28. **(B)** When human eyes view a distant object, a real, inverted and diminished image of the object is formed on the retina, as shown below.



29. **(A)** f = –50 cm = – 0.5 m

Power of a lens = $\frac{1}{\text{focal length (m)}}$

$$= \frac{1}{-0.5} = -2\text{D}$$

Focal length is negative, therefore it is a concave lens and the power is 2 D.

30. **(B)** A straight current carrying conductor produces a circular magnetic field pattern.

31. **(D)** Even in absolutely clear water, a diver cannot see very clearly because the focal length of the eye lens in water gets changed and the image is no longer focussed sharply on the retina. In the case of diffused reflection, light rays fall on irregular surface and get reflected in different directions and does not allow the diver to see the object clearly.

32. **(D)** The resistance of a conductor is inversely proportional to its area of cross-section, $R \propto \frac{1}{A}$. If the area of cross-section of a copper wire/rod is doubled, its resistance gets halved and if the area of cross-section of a copper wire/rod is halved, then its resistance will get doubled. A thick copper rod has more area of cross-section than a thin copper wire. So, a copper rod has less resistance and copper wire has more resistance.

33. **(C)** As loop X carries current which increases with time, there will be change of magnetic flux in coil Y that will induce current in loop Y. The direction of induced current in loop Y

will be opposite to the direction of current in loop X. If two loops carry current in opposite direction, they repel each other. So, loop Y is repelled by loop X.

34. **(C)** Object distance = u = 20 cm

Image distance = v = 40 cm

I = size of the image

O = size of the object

$$m = \frac{I}{O} = \frac{v}{u}$$

$$m = \frac{40\ cm}{20\ cm} = 2$$

$$\frac{I}{O} = m = 2$$

The ratio between the image and object size is 2:1.

35. **(B)** Potential difference across 2 W resistance from left side is 6 V. Therefore, potential difference across 2 W resistance from right side should also be 6 V. This is possible only if E = 6 V as the current passing through 1W resistance is zero.

CHEMISTRY

36. **(D)** Copper metal displaces silver ions in the aqueous solution as shown below.

$Cu \rightarrow Cu^{2+} + 2e^-$

$Ag^+ + e^- \rightarrow Ag$

When 1 mole of copper is oxidised, it will produce sufficient electrons to reduce 2 moles of silver ions into silver, the shiny material deposited on the coin.

37. **(A)** Concentrated aqueous H_2SO_4 is an acid. It is an oxidizing as well as a dehydrating agent. It is not a reducing agent.

38. **(C)** The break down of glucose to form carbon dioxide and water is a decomposition reaction, while the other three are combination reactions.

39. **(C)** All the four valence electrons are bonded with four other carbon atoms and carbon atom does not have any free electrons.

40. **(D)** The ionic equation for neutralization reaction is $H^+ + OH^- \rightarrow H_2O$. Two moles of hydrochloric acid supply two moles of hydrogen ions, which will thus require two moles of hydroxide ions for complete reaction. Hence, one mole of the alkali must supply two moles of the hydroxide ions for reaction.

$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$
($2H^+$ and $2OH^-$).

41. **(C)** Element Q is carbon and it has four valence electrons. To achieve stable configuration, carbon forms four single covalent bonds with four hydrogen atoms to form methane mole cule CH_4. The electronic structure of element Q i.e., carbon in 2, 4.

42. **(B)** Acetic acid reacts with ethanol to form ethyl ethanoate and water.

$$\underset{\text{Acetic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Ethyl Ethanoate}}{CH_3COOC_2H_5} + \underset{\text{Water}}{H_2O}$$

43. **(D)** Ethyl we can balance a chemical equation by adjusting the coefficients in front of the chemical formulae.

44. **(B)** The compound is Plaster of Paris. The chemical equation is

$$\underset{\text{Gypsum}}{CaSO_4.2H_2O} \xrightarrow[(373\ K)]{\text{Heat to } 100^\circ C} \underset{\text{Plaster of Paris}}{CaSO_4.\tfrac{1}{2}2H_2O} + 1\tfrac{1}{2}H_2O$$

Water

45. **(C)** The correct matching is a-5, b-4, c-3, d-2, e-1. The general formula of :alkanes is C_nH_{2n+2} The formula of Hexane-C_6H_{14}, Ethane-C_2H_6, Butane C_4H_{10}. Alkenes have general formula C_nH_{2n}. The formula of Pentene is C_5H_{10} and Hexene is C_6H_{12}.

BIOLOGY

46. **(B)** $Q \rightarrow S \rightarrow T \rightarrow P \rightarrow R$

47. **(A)** Reproduction is the act or process that produces young living things. Living things reproduce to ensure the continuity of their own kind.

The fusion of a sperm and an egg is called fertilization.

48. **(B)** Coronary arteries blood to the heart muscles.

49. **(D)** The mount of energy decreases as we go up the pyramid.

50. **(C, D)** The diagram given shows a human baby of 20 & 38 weaks.

51 **(A)** Hormones are destroyed in the liver.

52. **(B)** The sequence of events involve a sensory receptor, passage of impulses along a sensory neurone and the effector (muscle).

53. **(C)** Insulin stimulates the liver cells to take up excess glucose and store it as glycogen.

54. **(C)** The ciliated cells contain cilia, which can perform wave like movements to remove mucus containing dust and bacteria.

55. (B) Decomposers convert organic components into inorganic substances.

CRITICAL THINKING

56. **(C)** In 12 hours, they are at right angles 22 times

\In 24 hours, they are at right angles 44 times.

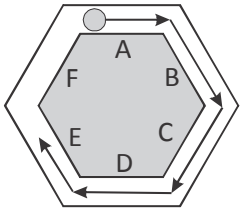
57. **(C)** The hexagonal track has 6 sides

Each side constitutes $\frac{1}{6}$ of the distance around the track.

$$\frac{3}{4} = \frac{9}{12} = \frac{9}{2} \times \frac{1}{6} = 4\frac{1}{2} \times \frac{1}{6}$$

The distance the ball will roll through is equal to $4\frac{1}{2}$ sides of the hexagon.

Therefore, the ball will roll to side E.



58. **(A)** All of the trees in the park are flowering trees. So, all dogwoods in the park are flowering trees.

59. **(D)** Knowledge is understanding through experience or study, so learning is the essential element. A school (choice a) is not necessary for learning or knowledge to takeplace, nor is a teacher or a textbook (choices b and c).

60. **(D)** Hapl means cloud; lesh means brust; srench means pin; och means ball; and resbo means nine. Leshsrench (choice a) doesn't contain any of the words needed for cloud nine. We know that och means ball, so that rules out choices b and c. When you combine hapl (cloud) with resbo (nine), you get the correct.

THE END