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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN470

KEY

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

SOLUTIONS

MATHEMATICS

01. (B) Given $3x + 5y = 3$ and $9x + ky = 8$ are having 'NO' solution

$a_1 = 3, b_1 = 5, c_1 = 3, a_2 = 9, b_2 = k, c_2 = 8$

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

$\therefore \quad \frac{\cancel{3}^{1}}{\cancel{9}_{3}} = \frac{5}{k} \neq \frac{3}{8}$

$\therefore \quad \frac{1}{3} = \frac{5}{k} \Rightarrow k = 15$

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

squaring on both sides

$x+1+x-2+2\sqrt{(x+1)(x-2)} = x+3$

$2\sqrt{(x^2-x-2)} = (4-x)$

squaring on both sides

$4(x^2 - x - 2) = 16 - 8x + x^2$

$4x^2 - x^2 - 4x + 8x - 8 - 16 = 0$

$3x^2 + 4x - 24 = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-4 \pm \sqrt{16 + 288}}{2 \times 3}$$

$$= \frac{-4 \pm \sqrt{304}}{6}$$

$$= \frac{-4 \pm \sqrt{4 \times 4 \times 19}}{6}$$

$$= \frac{-4 \pm 4\sqrt{19}}{6}$$

$$x = \frac{2\left(-2 \pm 2\sqrt{19}\right)}{6_3}$$

03. (C) Given f(–1) = 4

$\Rightarrow (-1)^2 - (-1) + C = 4$

1 + 1 + C = 4

C = 4 – 2 = 2

04. (A) $x^2 + y^2 + z^2 = 16\cos^2 A\cos^2 B + 16\cos^2 A\sin^2 B + 16\sin^2 A$

$= 16\cos^2 A(\cos^2 B + \sin^2 B) + 16\sin^2 A$

$= 16(\cos^2 A + \sin^2 A)$

= 16

05. (B) 105, 112 ..... 994 are in AP which are '3' digit numbers divisible by 7

$\therefore$ $a_n = 994$

105 + (n – 1)(7) = 994

(n –1)(7) = 994 – 105 = 889

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

n = 127 + 1 = 128

(OR)

upto 994 there are 142 numbers which arre divisible by 7 upto 98 there are 14 numbers which are divisible by 7

$\therefore$ No. of 3 digit numbers which are divisible by

7 = 142 – 14 = 128

06. (D) For option 'D' a = 5, b = – 3 & c = – 2

$\Delta = b^2 - 4ac = (-3)^2 - 4 \times 5(-2)$

= 9 + 40

= 49

$\therefore$ $\Delta > 0 \Rightarrow$ The roots real and different

07. (A) Co-ordinate of N are (12 + 9, 13) = (21, 13)

08. (C) Area of circle A = 3.14 × 10 × 10 cm^2

= 314 cm^2

Area of circle B = 3.14 × 8 × 8 cm^2

= 200.96 cm^2

Area of square = 7 × 7 cm^2 = 49 cm^2

Area of shaded regin Q

$$= \frac{1}{8} \times 3.14 \times 8 \times 8 = 25.12$$

$\therefore$ $4x = 25.12$

$\therefore$ $$x = \frac{25.12}{4}$$

Area of shaded region P = $5x$

$$= 5 \times \frac{25.12^{6.28}}{4_1}$$

= 31.4 cm^2

Area of unshaded part = Area of (circle A + circle B) + Area of square – 2 times area of P – 2 times area of Q

= (314 + 200.96 + 49 – 2 × 25.12 – 2 × 31.4) cm^2

= 450.92 cm^2

09. (B) Given in an AP a = 5 & $a_6 = 100$

$\therefore$ a + 5d = 100

5 + 5d = 100

5d = 95

$$d = \frac{95^{19}}{5_1} = 19$$

$\therefore$ $x = a + d = 24$

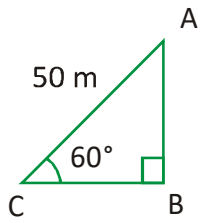
$y = x + d = 43$

$z = y + d = 62$

w = z + d = 81

$\therefore$ $x + y + z + w = 24 + 43 + 62 + 81 = 210$

10. (C) Given AC = 50 m & $\angle C = 60°$, $\angle B = 90°$



$$\sin 60° = \frac{AB}{AC}$$

$$\frac{\sqrt{3}}{2} = \frac{AB}{50\,m}$$

$$AB = 50\,m \times \frac{\sqrt{3}}{2} = 25\sqrt{3}\,m$$

11. (A) Given volume of cone = volume of cuboid

$$\Rightarrow \frac{1}{3}\pi r^2 H = l b h$$

$$\Rightarrow \frac{1}{3} \times \frac{22}{\cancel{7}_1} \times r^2 \times \cancel{28}^4\ cm^3 = 64 \times 44 \times 24\ cm^3$$

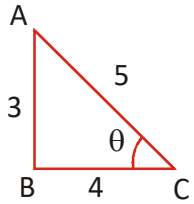
$$64 \times 44 \times 24 \times 3 \times \frac{1}{22} \times \frac{1}{4}$$

$$r^2 = 2304\ cm^2$$

$\therefore$ r = 48 cm

12. (C) HCF of 624 & 32 = 16.

13. (D) Given $\frac{\sin\theta}{\cos\theta} = \frac{3}{4}$



$$\Rightarrow \tan\theta = \frac{3}{4} = \frac{\text{opposite side to } \angle\theta}{\text{adjacent side to } \angle\theta}$$

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

$= 3^2 + 4^2 = 9 + 16 = 25$

$AC = \sqrt{25} = 5$

$$\therefore \frac{\cos ec^2\theta}{25\left(1-\cot^2\theta\right)} = \frac{\left(\frac{5}{3}\right)^2}{25\left(1-\left(\frac{4}{3}\right)^2\right)} = \frac{\left(\frac{25}{9}\right)}{25\left(1-\frac{16}{9}\right)}$$

$$= \frac{\cancel{25}^1}{\cancel{9}_1} \times \frac{1}{\cancel{25}_1} \times \frac{\cancel{9}^1}{(9-16)}$$

$$= -\frac{1}{7}$$

14. (C) Area of rectangle ABCD = 42 × 14 cm^2 = 588 cm^2

Area of 3 circles = $3\pi r^2$

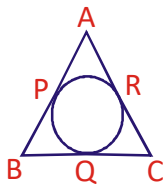
$$= 3 \times \frac{22}{\cancel{7}} \times \cancel{7} \times 7 cm^2 = 462\ cm^2$$

$\therefore$ Area of shaded regim = 588 cm^2 – 462 cm^2

= 126 cm^2

15. (B) AP = AR

[$\therefore$ length of tangent drawn from an external point to a circle are equal]



Similarly BP = BQ & CQ = CR

$\therefore$ AB + BC + CA = AP + PB + BQ + QL + CR + RA

= AP + BQ + BQ + CR + CR + AP

= 2 AP + 2 BQ + 2 CR

$\therefore$ AP + BQ + CR = $\frac{1}{2}$(AB + BC + CA)

16. (D) Given a = 27 & $d = a_2 - a_1 = 23 - 27 = -4$

Given $s_n = -126$

$$\Rightarrow \frac{n}{2}\left[2(27) + (n-1)(-4)\right] = -126$$

$$\Rightarrow \frac{n}{\cancel{2}} \times \cancel{2}\left[27 - 2(n-1)\right] = -126$$

$n[27 - 2n + 2] = -126$

$-2n^2 + 29n = -126$

$\Rightarrow 2n^2 - 29n - 126 = 0$

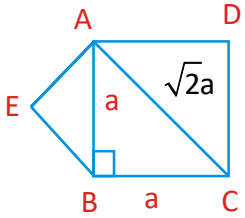
$2n^2 - 36n + 7n - 126 = 0$

$2n(n - 18) + 7(n - 18) = 0$

$(n - 18)(2n + 7) = 0$

$\therefore$ $n = 18$ (or) $n = -\frac{7}{2}$ is rejected

17. (B) Given AB = BC = a & $\angle ABC = 90°$



$\therefore$ $AC = \sqrt{AB^2 + BC^2}$

$= \sqrt{a^2 + a^2}$

$= \sqrt{2}a$

Given $\Delta ABE \sim \Delta ACD$

$$\Rightarrow \frac{Ar(\Delta ABE)}{Ar(\Delta ACD)} = \frac{a^2}{\left(\sqrt{2}a\right)^2} = \frac{a^2}{2a^2} = \frac{1}{2}$$

18. (D) Area of shaded region = Area of a semicircle AECO –area of semicircle ODCB – area of sector AOE + Area of sector BCF

$$= \frac{1}{2_1} \times \frac{\cancel{22}^{11}}{\cancel{7}_1} \times \cancel{14}^{2} \times 14\text{cm}^2 - \frac{1}{2_1} \times \frac{\cancel{22}^{11}}{\cancel{7}} \times \cancel{7} \times 7\text{cm}^2$$

$$- \frac{\cancel{60°}^{1}}{\cancel{360°}_{6_3}} \times \frac{22}{\cancel{7}_1} \times \cancel{14}^{2^1} \times 14\,\text{cm}^2 + \frac{\cancel{60°}}{\cancel{360°}_{6_3}} \times \frac{\cancel{22}^{11}}{\cancel{7}} \times \cancel{7} \times 7\,\text{cm}^2$$

$= 308\ cm^2 - 77\ cm^2 - 102.67\ cm^2 + 25.67\ cm^2$

$= 154\ cm^2$

19. (A) Given $\pi r^2 = 616\ cm^2$

$\frac{22}{7} \times r^2 = 616\ cm^2$

$r^2 = 616\ cm^2 \times \frac{7}{22}$

$r^2 = (7 \times 7 \times 2 \times 2)^2$

$r = 14$ cm

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

$= 2 \times \frac{22}{7} \times 14(25 + 14)\ cm^2$

$= 3432\ cm^2$

20. (C) $\sqrt{\frac{1+\sin\theta}{1-\sin\theta}} - \sqrt{\frac{1-\sin\theta}{1+\sin\theta}} =$

$$\frac{\left(\sqrt{1+\sin\theta}\right)^2 - \left(\sqrt{1-\sin\theta}\right)^2}{\sqrt{1-\sin\theta} \times \sqrt{1+\sin\theta}}$$

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

$$= \frac{\cancel{1} + \sin\theta - \cancel{1} + \sin\theta}{\cos\theta}$$

$$= 2\frac{\sin\theta}{\cos\theta}$$

$= 2\tan\theta$

21. (B) Given a = 1 b = 4 m c = $4m^2 + m + 1$

$\therefore$ given $\Delta \geq 0$

$\Rightarrow$ $(4m)^2 - 4 \times 1(4m^2 + m + 1) \geq 0$

$\cancel{16m^2} - \cancel{16m^2} - 4m - 4 \geq 0$

$\cancel{-4m} \geq \cancel{4}^{1}$

$m \leq -1$

22. (A) Given a = 1, b = –6 & c = 4

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-6) \pm \sqrt{(-6)^2 - 4 \times 1 \times 4}}{2 \times 1}$$

$$= \frac{6 \pm \sqrt{36 - 16}}{2}$$

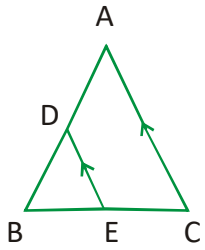
$$= \frac{6 \pm 2\sqrt{5}}{2}$$

$$= 3 \pm \sqrt{5}$$

23. (B) Given

$DE \Rightarrow AC \; \Delta BDE \sim \Delta BAC$

[$\because$ A.A similarity]



$\therefore \frac{BD}{BA} = \frac{DE}{AC} = \frac{BE}{BC}$

Given area of $\Delta BDE = \frac{1}{2}$ area of ΔABC

$\therefore \frac{\text{Area of } \Delta BDE}{\text{Area of } \Delta BAC} = \frac{1}{2} = \left(\frac{BD}{AB}\right)^2$

$\therefore \frac{BD}{AB} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$

$\therefore 1 - \frac{BD}{AB} = 1 - \frac{1}{\sqrt{2}}$

$\frac{AB - BD}{AB} = \frac{\sqrt{2} - 1}{\sqrt{2}}$

$\frac{AD + \cancel{DB} - \cancel{BD}}{AB} = \frac{\sqrt{2} - 1}{\sqrt{2}}$

24. (D) Area of ΔABC

$= \frac{1}{2}\left|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\right|$

$= \frac{1}{2}\left|0(6+6) + (-5)(-6+6) + (-5)(-6-6)\right|$

$= \frac{1}{\cancel{2}}\left|\cancel{60}^{30}\right|$ unit^2

(OR)

$AB = \sqrt{(-5)^2 + (6+6)^2} = 13$ units

$AC = \sqrt{(-5)^2 + (-6+6)^2} = 5$ units

$BC = \sqrt{(-5+5)^2 + (6+6)^2} = 12$ units

$\therefore \quad AC^2 + BC^2 = AB^2 \Rightarrow LC = 90°$

$\therefore \quad AC \perp BC \Rightarrow$ Area of $\Delta ABC = \frac{1}{2} \times AC \times BC$

$= \frac{1}{\cancel{2}} \times 5 \times \cancel{12}^{6}$ units^2

$= 30$ units^2

25. (C) Given $4\pi r^2 \times \frac{20p}{cm^2} = ₹\ 1108.8$

$\frac{88}{7} \times r^2 \times ₹\ \frac{1}{5\ cm^2} = ₹\ 1108.8$

$\therefore \quad r^2 = ₹\ 1108.8 \times 5\ cm^2 \times \frac{7}{88}$

$= ₹\ 5544 \times \frac{7}{88}$

$r = \sqrt{3 \times 3 \times 7 \times 7}$ cm

$r = 21$ cm

Volume $= \frac{4}{3}\pi r^2$

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

$= 38808$ cm^3

PHYSICS

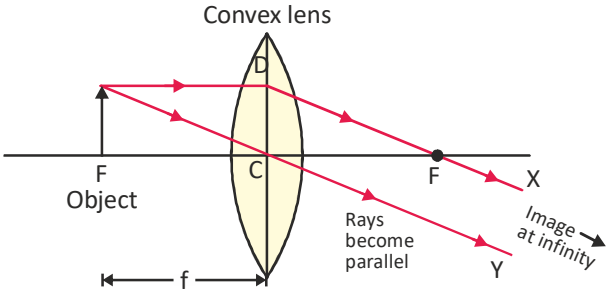
26. (C) $V = \frac{E}{Q}$

$I = \frac{Q}{t}$

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

28. (D) When an incident light ray (PQ) falls on a glass prism, it undergoes refraction inside the prism (QR) and comes out as emergent ray (RS) towards the base of the prism.

29. (B) When a real object is placed infront of a convex lens of focal length 'f' at its focus, then the image is formed at infinity.



30. (D) According to Fleming's left hand rule, the force on P acts downwards and the force on Q acts upwards.

31. (B) Light travels at different speeds in different media. When light from a far off star in vacuum comes down towards the earth in denser medium, the light rays bend towards the normal due to change in media.

32. (B) $f = \frac{R}{2} = \frac{30}{2}\text{cm} = +15\ \text{cm}$
(for convex mirror f is positive)

v = + 10 cm, [For convex mirror image is always virtual, so v is + ve]

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}, \frac{1}{u} = \frac{1}{f} - \frac{1}{v}, u = \frac{fv}{f - v}, = \frac{15 \times 10}{10 - 15} = -30\ \text{cm}$$

u is negative. So, the object position is in front of the mirror.

$$\text{Magnification} = m = -\frac{v}{u} = -\frac{10}{(-30)} = \frac{1}{3}$$

The image is diminished.

33. (D) The value of the magnetic field at a distance x from a long straight current – carrying conductor is proportional to 1/x

$\therefore B = \frac{\mu_0 i}{2\pi x}$, $B \propto \frac{1}{x}$

34. (D) We can see the sun about 2 minutes before the actual sunrise and 2 minutes after the actual sunset because the earth has atmosphere. Due to this reason, the day is longer on the earth by about 4 minutes.

35. (C) Let R and 4 R be the values of two resistances.

$\text{Now, } R_p = \frac{R \times 4R}{R + 4R}$ or 20 = 0.8 R

or R = 25 Ω and 4 R = 4 × 25 = 100 Ω

CHEMISTRY

36. (D) Copper metal is more reactive than silver metal (Ag), so a displacement reaction will take place between $AgNO_3$ solution and copper metal.

(A) Copper metal is less reactive than sodium metal (Na), so no displacement reaction will occur between NaCl solution and copper metal.

(B) Aluminium metal is less reactive than magnesium metal (Mg), so no displacement reaction will take place between $MgCl_2$ solution and aluminium metal.

(C) Silver metal is less reactive than iron metal (Fe), so no displacement reaction will occur between $FeSO_4$ solution and silver metal.

37. (D) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$

The above reaction is a double displacement reaction as there is mutual exchange of radicals between the two compounds.

38. (C) Isomerism is not possible in methane, ethane and propane. It is possible only in hydrocarbons having 4 or more carbon atoms. Butane has two isomers, n-butane and iso-butane respectively.

39. (C) When black copper(II) oxide reacts with dilute HCl, it dissolves in the acid to form a blue-green solution of copper (II) chloride salt and water.

40. (B) Carbon tetrachloride is a covalent compound. Rest of them are all ionic compounds.

41. (A) The balanced chemical equation is $3\,Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$. So, a = 3, b = 4

42. (A) Carbon has electronic configuration of 2.4. It has four electrons in its outermost shell. Phosphorus has 5, Boron has 3 and Sulphur has 6 electrons respectively in their outermost shells.

43. (B) Acids change blue litmus paper red and bases change red litmus paper blue.

44. (B) Benzene (C_6H_6) has 6 carbon atoms and 6 hydrogen atoms

45. (C) Germanium is a metalloid. It exhibits the properties of both metals and non-metals.

BIOLOGY

46. (C) The most fertile stage occurs during the period that includes ovulation. A mature egg cell is released into the oviduct.

47. (A) Ovulation is inhibited and ovaries stop producing ova during menopause in women.

48. (B) Structure X is the lacteal/lymphatic capillary and these are structural adaptations for the absorption of dietary fat molecules.

49. (C) The kidney dialysis machine and kidneys are able to remove nitrogenous waste products such as urea and uric acid from the blood.

50. (C) (ii) is the stomach, which secretes pepsin and (iv) is the pancreas, which secretes trypsinogen. These enzymes help to break down proteins.

51. (A) Blood vessel 1 is vena cava and blood vessel 2 is pulmonary artery.

52. (B) As the flower shown has large petals, it is likely to be an insect-pollinated flower. I represents the ovules and III represents the anthers. These regions are involved in the production of gametes. II is the stigma and only pollination occurs there.

53. (D) Fertilisation take place in fallopian tube in female mammals.

54. (B) Structure X is the skin arteriole and it can undergo vasoconstriction or vasodilation in response to changes in the external temperature.

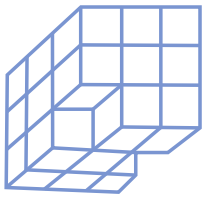
55. (C) Decomposers like bacteria decomposes dead organic matter into humus and make soil fertile.

CRITICAL THINKING

56. (B) The adhesive force between the water and glass is greatest in the narrow tube and the water will rise highest; this is called capillary rise.

57. (C) All parrots are birds, some parrots are pet.

58. (A) Information 1 is sufficient to answer the question.

59. (B) 

Removing blocks X and Y leaves the following: diagram Turned upside - down, this corre - sponds with B.

60. (A) Only I is implicit

Artificial money can be made. That is why the word 'natural' needs to be mentioned in the advertisement. So, I is implicit. No comparison is made of the prices of natural and artificial honey. So, II is not implicit. Nothing about the quality of honey of other companies can be deduced. So, III is also not implicit.