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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN494

KEY

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

SOLUTIONS

MATHEMATICS

01. (A) Given $\alpha + \beta = -(-1)$ & $\alpha\beta = -12$

Cubing m both sides

$(\alpha + \beta)^3 = 1^3$

$\alpha^3 + \beta^3 + 3\alpha\beta(\alpha + \beta) = 1$

$\alpha^3 + \beta^3 + 3(-12)(1) = 1$

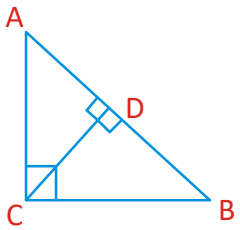
$\alpha^3 + \beta^3 = 1 + 36 = 37$

02. (B) HCF of 2, 12, 3 is 1

LCM of 15, 5, 4 is 60

$\therefore$ HCF of $\frac{2}{15}, \frac{12}{5}$, and $\frac{3}{4}$ is $\frac{1}{60}$

03. (C) $\Delta ADC \sim \Delta CDB \sim \Delta ACB$



[A. A similarity]

$\therefore \Delta ADC \sim \Delta ACB \Rightarrow \frac{AD}{AC} = \frac{AC}{AB} \Rightarrow AC^2 = AB \times AD \rightarrow 1$

$\therefore \Delta CDB \sim \Delta ACB \Rightarrow \frac{CD}{AC} = \frac{BD}{BC} = \frac{BC}{AB} \Rightarrow BC^2 = AB \times BD \rightarrow 2$

$\therefore \frac{BC^2}{AC^2} = \frac{\cancel{AB} \times DB}{\cancel{AB} \times AD} = \frac{DB}{AD}$

04. (D) We are given that AH is a straight line segment and C is a point on AH.

Since AD : DC = 2 : 1 , then AG : GH = 2 : 1

Since the length of AG is 6, the length of GH is 3.

The area of rectangle ABCD is 1 × 2 = 2

The area of square DEFG is $4^2 = 16$

The area of ΔAHG is $\frac{1}{2} \times 6 \times 3 = 9$

$\therefore$ The area of shaded region is

2 + 16 – 9 = 9

05. (D) $BD = \frac{1}{3}CD$ (Given)

$\Rightarrow BD = \frac{1}{4}BC = \frac{1}{4}a$ and $CD = \frac{3}{4}a$

$AD^2 = AB^2 - BD^2 = c^2 - \frac{1}{16}a^2$ ..... (1)

$AD^2 = AC^2 - CD^2 = b^2 - \frac{9}{16}a^2$ ..... (2)

$\therefore c^2 - \frac{1}{16}a^2 = b^2 - \frac{9}{16}a^2$

[From (1) and (2)]

$\Rightarrow 16c^2 - a^2 = 16b^2 - 9a^2$

$\Rightarrow 16b^2 = 16c^2 + 8a^2$

$\Rightarrow 2b^2 = a^2 + 2c^2$

06. (D) Let the three consecutive positive integers be x, $x + 1$, $x + 2$

Given $x^2 + (x + 1)^2 + (x + 2)^2 = 50$

$x^2 + x^2 + 2x + 1 + x^2 + 4x + 4 = 50$

$3x^2 + 6x - 45 = 0$

$3(x^2 + 2x - 15) = 0$

$x^2 + 5x - 3x - 15 = \frac{0}{3}$

$x(x + 5) - 3(x + 5) = 0$

$(x - 3)(x + 5) = 0$

$\therefore x = 3$ (or) -5

$x + 1 = 3 + 1 = 4$ [$\because$ $x = -5$ is rejected because it is negative integer]

$x + 2 = 3 + 2 = 5$

$\therefore x + x + 1 + x + 2 = 3 + 4 + 5 = 12$

07. (C) $m^3 - m = m(m^2 - 1) = (m - 1)(m)(m + 1)$

$\therefore$ Product of three consecutive natural numbers is divisible by 1 × 2 × 3 i.e., 6

08. (B) Given equations are

$2x + 3y = 5$ ..... (1)

and $x - y = 10$ ..... (2)

Multiplying eq. (2) by 3 and adding eq. (1) and eq. (2), we get

$5x = 35$

$\Rightarrow x = 7$

and $y = -3$

$\therefore$ The point (x, y) at which the submarine can be destroyed is $(7, -3)$

09. (C) Given $x^2 + y = 10$ & $x + y = 10$

$\therefore$ $x^2 + y = x + y$

$x^2 = x$

$x^2 - x = 0$

$x(x - 1) = 0$

$x = 0$ or $x = 1$

If $x = 0$ then $y = 10$ (0,10)

If $x = 1$ then $y = 9$ (1, 9)

$\therefore$ Both meet at (0,10) & (1,9)

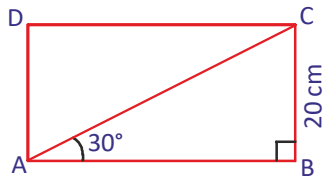
Distance between (0,10) & (1,9)

$= \sqrt{(1-0)^2 + (9-10)^2} = \sqrt{2}$

10. (C) In ΔABC, $\angle B = 90°$ & $\angle BAC = 30°$

$\therefore \tan 30° = \frac{BC}{AB}$

$\frac{1}{\sqrt{3}} = \frac{20 \text{ cm}}{AB}$



$AB = 20 \times \sqrt{3}$ cm = 20 × 1.73 cm = 34.6 cm

$\therefore$ Area of rectangle = $lb = 34.6 \times 20$ cm^2

= 692 cm^2

11. (D) Volume of cylinder

$= \pi R^2 H = \pi \times \frac{4.5}{2} \times \frac{4.5}{2} \times 10 cm^3$

$= \pi \times \frac{405}{8} cm^3 \rightarrow$ (1)

Volume of each coin

$= \pi r^2 h = \pi \times \frac{1.5}{2} \times \frac{1.5}{2} \times 0.2 cm^3$

$= \pi \times \frac{\cancel{15}^{3}}{20} \times \frac{\cancel{15}^{3}}{\cancel{20}_{4}} \times \frac{\cancel{2}}{\cancel{10}_{5}}$

$= \frac{9\pi}{80} \rightarrow$ (2)

$\therefore$ Number of Coins $= \frac{eq(1)}{eq(2)} = \frac{\cancel{\pi} \times \frac{405}{8} cm^3}{\frac{9\cancel{\pi}}{80} cm^3}$

$= \frac{\cancel{405}^{45}}{\cancel{8}_{1}} \times \frac{\cancel{80}^{10}}{\cancel{9}_{1}}$

= 450

12. (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]

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

Area of triangle = rs = 12 cm × 2 cm = 24 cm^2

14. (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 $\Delta ABC = \frac{1}{2} \times AB \times BC$

$= \frac{1}{2} \times 30 cm^2 = 15 cm^2$

15. (D) $X = \left(\frac{m_1 x_2 + m_2 x_1}{m_1 + m_2}, \frac{m_1 y_2 + m_2 y_1}{m_1 + m_2} \right)$

$= \left(\frac{(2 \times -3) + 3 \times 7}{5}, \frac{2 \times 6 + 4 \times 3}{5} \right)$

$= \left(\frac{-6 + 21}{5}, \frac{12 + 12}{5} \right)$

$= \left(\frac{\cancel{15}^{3}}{\cancel{5}}, \frac{24}{5} \right)$

$= \left(3, \frac{24}{5} \right)$

16. (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

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

17. (B) Given $\sqrt{x-2}$ = (8 – x)

squaring on both sides

$x - 2 = 64 - 16x + x^2$

$x^2 - 17x + 66 = 0$

$x^2 - 11x - 6x + 66 = 0$

$x = 11$ (OR) $x = 6$

But $x = 11$ doesn't satisfy the given equation

$\therefore$ $x = 6$

18. (B) $x^2 - y^2 = (a\sec\theta + b\tan\theta)^2 - (a\tan\theta + b\sec\theta)^2$

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

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

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

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

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

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

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

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

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

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

20. (D) Given Area of triangle = 20 units^2

$\frac{1}{2}bh = 20$ units^2

$\frac{1}{2} \times x \times b = 20$ units^2

$x = \frac{40}{b}$ unit

$\therefore$ $\left(\frac{40}{b}, 0\right)$ be the coordinates of 'C'

21. (B) In ABC, AD, BE, CF are the medians

$\therefore$ $3(AB^2 + BC^2 + CA^2) = 4(AD^2 + BE^2 + CF^2)$

$\therefore$ $4(AD^2 + BE^2 + CF^2) = 3(12^2 + 16^2 + 20^2)$

$4(AD^2 + BE^2 + CF^2) = 3(144 + 256 + 400)$

$AD^2 + BE^2 + CF^2 = \frac{3 \times 800}{4} = 600\,cm^2$

22. (A) Let the side of smaller square be x mts

$\therefore$ Let the side of larger square = $(x + 4)$ mts

Given $(x + 4)^2 + x^2 = 208$

$x^2 + 8x + 16 + x^2 = 208$

$\cancel{2}\left(x^2 + 4x + 8\right) = \cancel{208}^{104}$

$x^2 + 4x + 8 - 104 = 0$

$x^2 + 4x - 96 = 0$

$x^2 + 12x - 8x - 96 = 0$

$x(x + 12) - 8(x + 12) = 0$

$(x + 12)(x - 8) = 0$

$\therefore$ $x = 8$ m (or) $x = -12$ m which is rejected because lengh is never negative

$\therefore$ Side of larger square = $x + 4$ m = 12 mts

23. (D) Given OQ = 9 cm & PR = 4 cm

$\Rightarrow$ SQ = 4 cm

[$\because$ PRQS is a rectangle]

$\therefore$ SO = OQ – SQ = 9 cm – 4 cm = 5 cm

OP = 9 cm + 4 cm = 13 cm

In ΔOSP, $\angle S = 90° \Rightarrow OP^2 = OS^2 + SP^2$

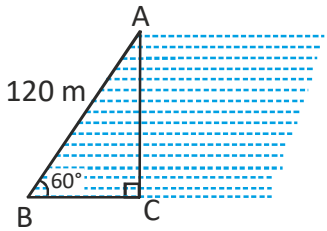
$(13\,cm)^2 = (5\,cm)^2 + sp^2$

$169\,cm^2 - 25\,cm^2 = sp^2$

$sp = \sqrt{144\,cm^2} = 12$ cm

$\therefore$ RQ = SP = 12 cm

24. (D) Construction : AC $\perp$ BC



In ΔABC, $\angle ABC = 60°$ and C = $\angle 90°$

$\therefore$ $\sin 60° = \frac{AC}{AB}$

$\frac{\sqrt{3}}{2} = \frac{AC}{120\,m}$

$AC = \cancel{120}^{60}\,m \times \frac{\sqrt{3}}{\cancel{2}}$

width of the river (AC) = $60\sqrt{3}$ mts

25. (C) Let the radius of the original sphere be 'r' units

$\therefore$ Original surface area = $4\pi r^2$

Given R = 2 r

New sphere surface area = $4\pi R^2$

= $4\pi(2r)^2$

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

= $4(4\pi r^2)$

= 4 times original surface area

PHYSICS

26. (B) As resistance is proportional to length, the second wire should have half the resistance of the first wire. As resistance is inversely proportional to cross-sectional area, the thicker second wire should have half the resistance of the first wire. Taking both the effects into account, the resistance of the second wire is now one-quarter that of the first. i.e., 2 Ω.

27. (B) To use a convex lens as a magnifying glass, the object is placed between the optical centre of lens and F. When the object is viewed through the lens, an image is seen which is upright, virtual and magnified. So, the optical instrument used in the given arrangement is of a magnifying glass.

28. (B) f = 5 cm, u = ?

(i) For the closest distance, v = – 25 cm

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

$-\frac{1}{u}=\frac{1}{f}-\frac{1}{v}=\frac{1}{5}+\frac{1}{25}=\frac{6}{25}$,

$u=\frac{-25}{6}\text{cm}=-4.25\text{ cm}$

This is the closest distance at which he can read the book.

(ii) For the farthest distance, v' = ∞ , u' = ?

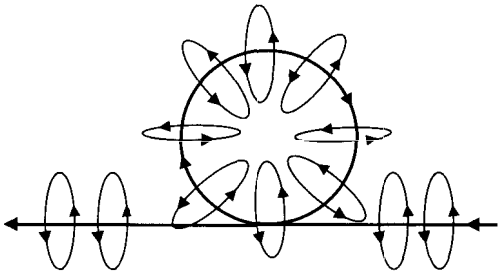
Again from $\frac{1}{v'}=\frac{1}{u'}=\frac{1}{f}$,

$-\frac{1}{u'}=\frac{1}{f}-\frac{1}{v'}=\frac{1}{5}-\frac{1}{\infty}=\frac{1}{5}, u'=-5\text{ cm}$

This is the farthest distance at which he can read the book.

29. (D) Angle of reflection is between the normal and incident rays. i.e., 70° as angle of incidence is equal to the angle of reflection.

30. (A) When the current-carrying wire is being coiled up, the circular magnetic field produced by a portion on the straight wire is being concentrated in the core of the coil. This will produce a stronger magnetic field strength as shown below.



31. (B) Here, i_1 = 60°, A = 30°, δ = 30°, i_2 = ?

As $i_1 + i_2 = A + \delta$

$\therefore$ $i_2 = A + \delta - i_1 = 30 + 30 - 60 = 0°$

Angle of emergent ray with second face of prism = 90° – 0° = 90°

32. (C) Distance of the object (u) = 10 cm

= – 10 cm (according to sign convention)

Distance of the image (v)

= 6 cm

= – 6 cm (according to sign convention)

Focal length (f) = ?

$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$

Substituting the given values,

$\frac{1}{f}=\frac{1}{-10}+\frac{1}{-6}$

$=\frac{-6-10}{60}=\frac{-16}{60}$

$\therefore$ f = – 3.75 cm

33. (C) The current flowing in the live wire and the neutral wire are both 0.5 A. The earth wire should not have any current flowing through it when the appliance is operating normally.

34. (C) In the given figure AB is incident ray, BC is refracted ray and CD is the emergent ray through the prism. $\angle p$ represents the angle of incidence, $\angle y$ represents the angle of emergence and $\angle z$ represents the angle of deviation.

35. (B) Current $I = \frac{Q}{t} = \frac{120\ C}{60\ s} = 2.0\ A$

Power, P = IV

$V = \frac{P}{I} = \frac{24\ W}{2.0\ A} = 12V$

CHEMISTRY

36. (C) Only Al and Zn are more reactive as compared to Cu and Fe, so, they undergo displacement reaction with the solution of $FeSO_4$ and thus, a black residue is formed in test tubes II and IV as given below.

$2\ Al(s) + 3\ FeSO_4(aq) \rightarrow Al_2(SO_4)_3\ (aq) + 3\ Fe\ (s)$ (Black residue)

$Zn(s) + FeSO_4(aq) \rightarrow ZnSO_4\ (aq) + Fe(s)$ (Black residue)

37. (A) $\underset{\text{Compound + Compound}}{H_2O + CaO} \longrightarrow \underset{\text{Compound}}{Ca(OH)_2}$

Hence, it is a compound - compound combination reaction.

38. (C) Soaps are the sodium salts of fatty acids with the ionic group [$-COO^-Na^+$].

39. (B) Statements (i), (ii) and (iii) are true about the gas. The gas evolved is carbon dioxide (CO_2). It turns lime water milky. CO_2 gas does not support burning and extinguishes the burning splinter. CO_2 gas dissolves in sodium hydroxide solution to form sodium carbonate as given below.

$CO_2(g) + 2\ NaOH(l) \rightarrow Na_2CO_3(aq) + H_2O(l)$

40. (A) Generally non-metals are brittle and break easily when they are hit. Hence, non-metals cannot be shaped easily by beating them.

41. (D) The correct representation of reaction occurring during the chlor-alkali process is given in option (D).

42. (A) Potassium permanganate ($KMnO_4$) is an oxidising agent. It oxidises ferrous sulphate to ferric sulphate in the presence of dilute H_2SO_4.

43. (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}.

44. (C) Bleaching powder is used to remove colour from clothes etc., by decolourisation. Baking soda is used as an antacid to remove excess acid in the stomach. Aqua Regia, a mixture of two strong acids like HNO_3 and HCl is used to dissolve gold. Sodium chloride is used for the production of H_2 and Cl_2 gases respectively.

45. (B) Calcium pellets react with water and form $Ca(OH)_2$ [a base] and hydrogen gas is released as given below.

$Ca + 2\ H_2O \rightarrow Ca(OH)_2 + H_2\uparrow$

The solution being basic turns red litmus blue and the hydrogen gas released burns with a pop sound when tested with a burning splinter.

BIOLOGY

46. (A) In test tube B, a plant and a snail are kept. The plant in the test tube B has more concentration of CO_2, available because the snail releases CO_2 during respiration. This increases the rate of photosynthesis in the plant placed in the test tube B which leads to the release of more amount of oxygen.

47. (C) The leaves of a plant has tiny pores called stomata through which this exchange of respiratory gases takes place by diffusion. Oxygen from air diffuses into a leaf through stomata and reaches all the cells, where it is used for respiration and the carbon dioxide produced diffuses out from the leaf into the air through stomata. The correct order of steps of respiration in leaves is (r)→(p)→(s)→(q)

48. (B) There are 12 pairs of cranial nerves and 31 pairs of spinal nerves in human beings.

49. (C) Offsprings formed are not clones.

50. (B) According to Darwin's theory of evolution, nature selects the fittest. Fitness is based on characteristics which are inherited. Therefore, there must be a genetic basis for getting selected and to evolve. Some organisms are better adapted to survive in an otherwise hostile environment. Adaptive ability is inherited. Fitness is the end result of the ability to adapt and get selected by nature. Therefore, natural selection and branching descent are the two key concepts of Darwin's Theory.

51. (B) The respiratory system delivers oxygen (X) to the cells of the body's tissue and remove carbon dioxide (Y) as a cell waste product.

52. (A) If a plant Yy Rr is self pollinated, the ratio of phenotypes will be 9 : 3 : 3 : 1.

53. (D) Grass → Grasshopper → Frog → Snake → Eagle

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

55. (A) In the phenomenon of active absorption, the water is uptaken from roots to all parts. During this process there is expenditure of energy by the cell. This process usually happens against the osmotic gradient.

CRITICAL THINKING

56. (A) The dancer who is on one leg with the other lep up is more likely to rotate at high speed.

When a ballet dancer pulls their leg into the body or raises it, the moment of inertia is reduced allowing them to spin faster. This is similar to how a figure skates spins faster when they pull their arms in close to their body. The other two dancers, with both feet on the ground are not in a position conductive to spinning rapidly.

∴ Correct answer would be the ballet dancer who is on one leg with the other leg up.

57. (C) Statement I consists of two Particular Affirmative (I-type) Premises.

Statement II consists of two Universal Affirmative (A-type) Premises.

Some locks are numbers. All numbers are letters.

I + A ⇒ I-type of Conclusion "Some locks are letters".

This is Conclusion II.

All numbers are letters. All letters are words.

A + A ⇒ A-type of Conclusion "All numbers are words".

Conclusion I is Converse of it.

58. (B) Three person live between W and X.

Floor	Person
8	S
7	X
6	Z
5	T
4	V
3	W
2	U
1	Y

59. (A) 

60. (C) 

The End