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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN497

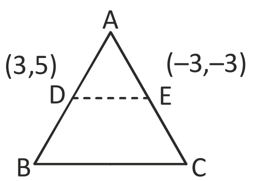
KEY

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

SOLUTIONS

MATHEMATICS

01. (B) Length of BC = 2(length of DE)



$\Rightarrow$ BC = $2\sqrt{(-3-3)^2+(-3-5)^2}$

= $2\sqrt{36+64} = 2\sqrt{100}$

= 2 (10) = 20

$\therefore$ The length of BC is 20

02. (C) a_{18} = a + (18 – 1)d = a + 17d and a_{11} = a + 10d

Given, $\frac{a_{18}}{a_{11}} = \frac{3}{2}$

$\Rightarrow \frac{a+17d}{a+10d} = \frac{3}{2}$

$\Rightarrow$ 2a + 34d = 3a + 30d

$\Rightarrow$ 4d = a ...... (i)

Now,

$\frac{a_{29}}{a_5} = \frac{a+28d}{a+4d} = \frac{3}{2}$

$\frac{4d+28d}{4d+4d}$ [from Eq. (i)]

$\frac{32d}{8d} = \frac{4}{1}$

03. (B) a = a_1 = 5, a_2 = 9, a_3 = 13 ...... l = 4n + 1

$s_n = \frac{n}{2}[a + l]$

$= \frac{n}{2}[5 + 4n + 1]$

$= \frac{n}{2}[4n + 6]$

= n(2n + 3)

= $2n^2 + 3n$

04. (D) Let the quotient when the given number is divided by 143 be 'q'. Given that the remainder is 31, the number

= 143q + 31

= 11 × 13q + 11 × 2 + 9

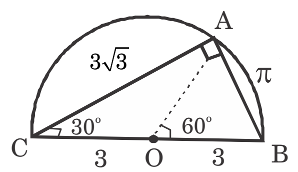
= 11(13q + 2) + 9

Hence the remainder when the same number is divided by 11 is 9.

05. (B) The intercepted arc

$\widehat{AB} = \frac{1}{6}$ of the circle = π

Length of AC = $3\sqrt{3}$



and given radius = 3 ⇒ diameter = 6 cm

∴ Perimeter = $6 + 3\sqrt{3} + \pi$

≈ 14.34 cm

06. (A) Given A(–1, –1) B(2, 3) and C(8, 11)

∴ Area of ABC =

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

$= \frac{1}{2}|-1(3-11) + 2(11+1) + 8(-1-3)|$

$= \frac{1}{2}|8 + 24 - 32|$

$= \frac{1}{2}|32 - 32|$

$= \frac{1}{2} \times 0$

= 0

07. (C) LHS = $(\sqrt{3})^2 + (\sqrt{3})^2 - \frac{3}{4} \times \frac{1}{2} + 4$

$= 6 - \frac{3}{8} + 4 = 10 - \frac{3}{8} = \frac{77}{8}$

08. (B) G = $\left(\frac{2 \times 5 + 2}{3}, \frac{2 \times 0 + 3}{3}\right)$

= (4, 1)

09. (B) Mid point of KL =

$\left(\frac{0+0}{2}, \frac{-4+12}{2}\right) = (0, 4)$

Mid point of MN =

$\left(\frac{-3+11}{2}, \frac{0+0}{2}\right) = (4, 0)$

Both perpendicular through mid points meet at (4, 4)

10. (C) Given (–1) is the zero of p(x) = $x^3 + ax^2 + bx + c$

p(–1) = $(-1)^3 + a(-1)^2 + b(-1) + c = 0$

–1 + a – b + c = 0

c = (b – a + 1)

But $\alpha\beta\gamma = \frac{-c}{a}$

⇒ $-1 \times \beta r = \frac{-(b-a+1)}{1}$

∴ $\beta r = (b - a + 1)$

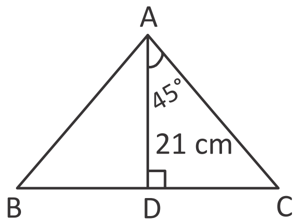
11. (D) LHS = $\cos^2 0° + \cos^2 1° + \cos^2 89° + \cos^2 2° + \cos^2 88° + ... + \cos^2 44° + \cos^2 46° + \cos^2 45°$

$= 1 + \cos^2 1° + \sin^2 1° + \cos^2 2° + \sin^2 2° + ... + \cos^2 44° + \sin^2 44° + \cos^2 45°$

$$= 1 + 1 \underbrace{+ .... +}_{44} 1 + \left(\frac{1}{\sqrt{2}}\right)^2 = 1 + 44 + \frac{1}{2} = 45.5$$

12. (B) ADC is an isosceles right angled triangle

$\therefore$ AD = DC = r = 21 cm



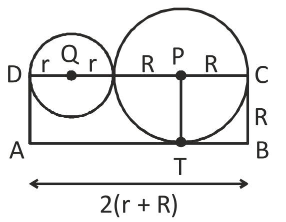
$\therefore$ Volume of the cone = $\frac{1}{3}\pi r^2 h$

$$= \frac{1}{3} \times \frac{22}{7} \times 21 \times 21 \times 21 \text{ cm}^3$$

$= 9702 \text{ cm}^3$

13. (B) Let the radius of small circle = r

The radius of big circle = R



Area of rectangle ABCD = AB $\times$ BC

$\Rightarrow$ 15 sq. cm = 2(r + R)R

$$\Rightarrow \frac{15}{2} = (r + R)R$$

Area of triangle QPT = $\frac{1}{2} \times QP \times PT$

$$= \frac{1}{2} \times (r + R)R$$

$$= \frac{1}{2} \times \frac{15}{2}$$

= 3.75 sq.cm

14. (A) Area of ΔABC = $\frac{1}{2} \times 6 \text{ cm} \times 8 \text{ cm}$

$= \frac{1}{2}$ AC $\times$ BD

$48 \text{ cm}^2 = 10 \text{ cm} \times BD$

BD = 4.8 cm

In ΔABD, $\angle D = 90°$

$\Rightarrow 6 \text{ cm}^2 = (4.8 \text{ cm})^2 + x^2$

$x^2 = 36 \text{ cm}^2 - 23.04 \text{ cm}^2$

$x = \sqrt{12.96 \text{ cm}^2}$

= 3.6 cm

15. (B) Given $2\pi R = 132$ cm

$$\Rightarrow 2 \times \frac{22}{7} \times R = 132 \text{ cm}$$

$$R = 132 \times \frac{7 \text{ cm}}{44} = 21 \text{ cm}$$

$$2\pi r = \frac{440}{7} \text{cm}$$

$$\frac{44}{7} r = \frac{440}{7} \text{ cm}$$

r = 10 cm

$$h = \sqrt{l^2 - (R - r)^2} = \sqrt{61^2 - (21 - 10)^2}$$

$$= \sqrt{3721 - 121}$$

$$= \sqrt{3600} = 60 \text{ cm}$$

Volume of the frustum of a cone

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

$$= \frac{22}{7} \times \frac{60}{3} \text{cm}(21^2 + 21 \times 10 + 10^2)$$

$$= \frac{440}{7}(441 + 210 + 100)$$

$$= \frac{440}{7} \times 751 \text{ cm}^3$$

$$= \frac{330440}{7} \text{ cm}^3 = 47{,}205\frac{5}{7} \text{ cm}^3$$

16. (C) Let $x = \sqrt{4+\sqrt{4+\sqrt{4+......\infty}}}$

$x = \sqrt{4+x}$

$x^2 = 4 + x$

$x^2 - x - 4 = 0$

$$x = \frac{-(-1) \pm \sqrt{1+16}}{2} = \frac{\sqrt{17}+1}{2} \text{ (or) } \frac{1-\sqrt{17}}{2}$$

$\therefore$ $x = \frac{1+\sqrt{17}}{2}$ is selected and $\frac{-\sqrt{17}+1}{2}$ is rejected, because it is negative.

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

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

$CD = \frac{3}{4}a$

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

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

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

[From (1) and (2).]

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

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

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

18. (D) $3748x + 5467y = 10085$

$1731x + 7484y = 4034$

(–) (–) (–)

$2017x - 2017y = 6051$

$2017(x - y) = 6051$

$x - y = \frac{6051}{2017} = 3$

19. (C) Given a, b, c are in AP $\Rightarrow$ b = a+d & c = a + 2d

given $ax + by + c = 0$

$ax + (a + d)y + (a + 2d) = 0$

$ax + ay + dy + a + 2d = 0$

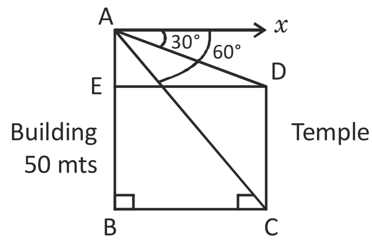
$a(x + y + 1) + d(y + 2) = 0$

If $y = -2$ and $x = 1$ then given expression is zero

$\therefore$ $ax + by + c = 0$ line passes through $(1, -2)$

20. (C) Given $\angle xAD = \angle ADE = 30°$

$\angle xAC = \angle ACB = 60°$



In ΔABC $\tan 60° = \frac{AB}{BC}$

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

$BC = \frac{50}{\sqrt{3}}$ mt = DE

In ΔADE $\tan 30° = \frac{AE}{DE}$

$\frac{1}{\sqrt{3}} = \frac{AE}{\left(\frac{50}{\sqrt{3}}\right)}$ mts

$\therefore$ $AE = \frac{50}{3}$ mts = 16.666 mts

$\therefore$ BE = AB – AE = 50 mts – 16.666 mts = 33.334 mts = 33.33 mts

21. (C) Given $\tan 4\theta \times \tan 5\theta = 1$

$\therefore$ $\tan 4\theta = \frac{1}{\tan 5\theta} = \cot 5\theta = \tan(90° - 5\theta)$

$\therefore$ $4\theta = 90° - 5\theta$

$9\theta = 90° \Rightarrow \theta = 10°$

22. (D) $\Delta BDG \sim \Delta FEC$

[$\because$ A.A similarity]

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

x^2 = 12 cm × 27 cm

Side of sqaure = x = 18 cm

23. (B) Equidistant chords are equal

$\therefore$ All tangents are same length.

24. (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]

$x + 2 = 3 + 2 = 5$

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

25. (A) In ΔABC, if $\angle A = 90°$ then $\angle B + \angle C = 90°$

$\therefore$ $\angle B = 90° - \angle C$

$\therefore$ sinB = sin(90 – C) = cosC

$\therefore$ $\sin^2A + \sin^2B + \sin^2C = \sin^2 90° + \cos^2C + \sin^2C = 1 + 1 = 2$

PHYSICS

26. (B) Copper is a metal with free electrons as charge carriers is a conductor. Plastic with no free electrons is an insulator.

27. (A) The lens is converging as the light rays from the top of the object converges after passing through the lens. Focal length is greater than 10 cm as the virtual image formed is enlarged.

28. (C) For reading purposes :

u = –25 cm v = –50 cm, f = ?

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = -\frac{1}{50} + \frac{1}{25} = \frac{1}{50}$;

$P = \frac{100}{f} = +2\,D$

For distant vision,

f' = distance of far point = –3 m

$P - \frac{1}{f'} = -\frac{1}{3}D = -\,0.33\,D$

29. (A) P is the angle of incidence and R is the angle of refraction. The angles of incidence and refraction are between the normal and incident and refracted light rays respectively.

30. (C) Current flowing in a straight wire will always produce a circular magnetic field around the wire.

31. (B) $P = -2D, F = \frac{100}{P} = \frac{100}{-2} = -\,50\,\text{cm}$

$\therefore$ Maximum distance of an object, which he can see without spectacle is 50 cm.

32. (D) Focal length (f) = –10 cm

Distance of the object (u) = –50 cm

Size of the object (O) = + 1 cm

Size of the image (I) = ?

As per the formula : $m = \frac{-I}{O}$ .....(i)

To calculate I, we will have to find out m and to calculate m, we must know v

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

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

Substituting the value of f and u, we get,

$$\frac{1}{v}=-\frac{1}{10}-\left(-\frac{1}{50}\right)$$

$$=-\frac{1}{10}+\frac{1}{50}$$

or $\frac{1}{v}=\frac{-5+1}{50}$

$$\Rightarrow v=\frac{-50}{4}=-12.5\text{ cm}$$

33. (D) Magnetic field does not change with change in diameter of a wire carrying current.

34. (D) The dispersed light refracts or bends towards the base with the violet light (V) deviated more than the red light (R).

35. (C) The electric circuit shown can be used to determine the resistance of the fixed resistor. The voltmeter reading gives the p.d. across the resistor and the ammeter reading gives the current flowing through the resistor. Using $R=\frac{V}{I}$, only

The correct resistance of $\frac{12}{0.5}=24\,\Omega$

CHEMISTRY

36. (B) In aluminothermic process, aluminium acts as a reducing agent. Aluminium being a more reactive metal has strong affinity to oxygen. It reduces some metal oxides like iron to respective metals that cannot be reduced by using carbon.

$3FeO + 2Al \rightarrow 3Fe + Al_2O_3$

37. (B) Slaking of lime is an exothermic reaction. Dry lime (CaO) dissolves in water to form calcium hydroxide called Slaked lime $Ca(OH)_2$. As it is a base, the pH of solution will become more than seven (7).

38. (A) Complete combustion of methane, produces CO_2 and H_2O. When the combustion is incomplete, C(soot) and CO are formed.

39. (C) To change colour of universal indicator from yellow to red, pH need to be increased by 4 times i.e., [H^+} increases by 10^4 times.

40. (B) Statements (A), (C) and (D) are true.

Metals high in reactivity series are very reactive. They are obtained by electrolysis of their molten chlorides.

41. (C) pH paper will turn green colour which indicates that the solution is of neutral nature. It is an acid-base reaction resulting in neutralisation forming a neutral solution.

42. (A) Balanced equation for the given chemical reaction is in option(A).

43. (C) The total atoms of both the products must add up to C_8H_{18}.

44. (D) Na_2CO_3 is a salt of weak acid (H_2CO_3) and a strong base (NaOH)

45. (D) Metals react with acids and evolve hydrogen gas. Thus, X is a metal and bonding present in it is metallic.

As Cl is a non-metal, it forms ionic compound with the metal X. Hence, XCl_2 is an ionic compound and the bonding is ionic.

BIOLOGY

46. (D)

(i) Small intestine - Absorbs nutrients from digested food.

(ii) Appendix - Has no specific function in the body.

(iii) Rectum - Temporary storage of faeces, before being expelled out of the body.

47. (A) Renal cortex (X) is the outer most region, which is towards the convex surface of kidney. It is dark red in colour. It appears to be dark and dotted due to the presence of Malpighian corpuscles (Y).

48. (C) The group of organisms: Phytoplankton, man, and hawk or the wolf, grass, snake, and tiger doesn't have the primary consumers (herbivores) which acts as an intermediate trophic level between producers and the secondary consumers. Therefore, they cannot make a complete food chain.

49. (C) Development of placenta occurs in females during pregnancy and secretion of estrogen by the ovaries starts at puberty in females.

50. (B) The organ which is not vestigial in the body of humans is the nail. A nail is a claw-like keratinized plate found at the top of fingers and toes and is responsible for protecting those tips. Nails are found in most primates and are the equivalent of claws found in other animals.

51. (C) Antigens are specific protein molecules found on the surface of red blood cells. There are two antigens, A and B.

Blood Group A - Antigen A and antibodies Anti-B

Blood Group B - Antigen B and antibodies Anti-A

Blood Group AB - Antigen A and B but No antibodies

Blood Group O - No Antigens but antibodies A and B

52. (B) Colour blindness in humans is caused due to sex linked inheritance.

53. (C) The mid part of the brain contains optic lobes and crura ceribri. The optic lobe of each side is a large and complex extension of the brain, this is the analyzer of visual inputs from the eye as well as performs other "higher" functions related to memory and initiation and control of behaviour. Hence X is optic lobes.

54. (C) Gastric Juice has minimum pH.

	pH
Saliva	7 - 8 Neutral
Bile	6 - 7
Gastric juice	1 - 2, Acidic
Pancreatic juice	8, slightly alkaline

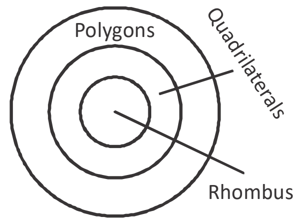
55. (A) The lungs are enclosed by a double-layered membrane which is called pleura. The two layers of pleura are the visceral pleura and the parietal pleura.

CRITICAL THINKING

56. (C) Wrench 2 as it is longer and provides more leverage.

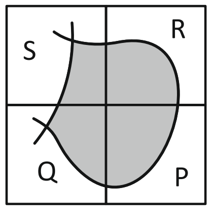
57. (A) All rhombuses are quadrilaterals.

All quadrilaterals are polygons.



58. (C) In front of the house.

59. (C)



60. (D) While both statements provide relevant information, they do not directly confirm whether Savrav actually bought a new car. Test driving a car does not guarantee a purchase, and receiving a bonus does not necessarily imply spending it on a car. Therefore, the answer cannot be determined based on the given information.