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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 9

Question Paper Code : UN499

KEY

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

SOLUTIONS

MATHEMATICS

01. (C)

02. (D) Given a + b + c = 10

squaring on both sides

$a^2 + b^2 + c^2 + 2(ab + bc + ca) = 100$

$38 + 2(ab + bc + ca) = 100$

$2(ab + bc + ca) = 100 - 38 = 62$

$ab + bc + ca = \frac{62}{2} = 31$

But $(a^3 + b^3 + c^3 - 3abc) = (a + b + c)$

$(a^2 + b^2 + c^2 - ab - bc - ca)$

$160 - 3abc = 10\,(38 - 31)$

$160 - 70 = 3abc$

$\therefore abc = \frac{90}{3} = 30$

03. (A) Given diagonal of a cube = diameter of a sphere

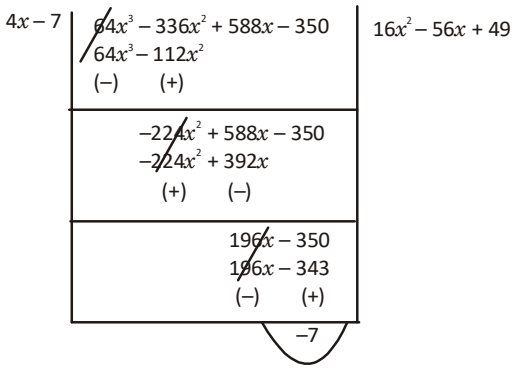
$\therefore \sqrt{3}a = 2$ cm

$\therefore a = \frac{2cm}{\sqrt{3}}$

Volume of cube = $a^3 = \left(\frac{2}{\sqrt{3}}cm\right)^3$

$= \frac{8}{3\sqrt{3}} cm^3$

04. (A)



Required remainder = – 7

05. (B) $s = \frac{91\ cm + 80\ cm + 109\ cm}{2}$

$= \frac{280\ cm}{2}$

= 140 cm

Area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{140\ cm \times 49\ cm \times 60\ cm \times 31\ cm}$

$= \sqrt{12759600}\ cm^2$

3	12759600 9	3572.0
65	375 325	
707	5096 4949	
7142	14500 14284	
71420	31600 0	
	31600	

= 3,572 cm^2

But $\frac{1}{2} \times h \times 109\ cm = 3,572\ cm^2$

$\therefore\ h = \frac{3,572\ cm^2 \times 2}{109\ cm}$

h = 65.54 cm

06. (C) Area of $\Delta PQS = \frac{1}{2} PQ \times QR = 32 cm^2$

Given area of $\Delta POQ = 12.8\ cm^2$

$\therefore$ Area of ΔPOS

= 32 cm^2 – 12.8cm^2 = 19.2cm^2

07. (B) $\left[\frac{1}{x-2} - \frac{4}{x^2-4}\right] =$

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

08. (C) If P(x) is divided by (x – 1), then the remainder is P(1)

$\therefore$ $P(1) = 1 + 1 + 1^2 + 1^3 + ... + 1^{2024}$

= 1 + 1 + ... + 1 = 2025

09. (A) P lies x = – 5 line & y = 1 line

$\therefore$ P = (–5, 1)

10. (C) Given AB + BC = BC + CD

$\therefore$ AB = CD

11. (B) Given $R = \frac{10\ cm}{2}$ = 5 cm

$\therefore$ r = R – w = 4 cm

Volume of the pipe = $\pi (R^2 - r^2)h$

$= \pi (5^2 - 4^2) \times 32\ cm^3$

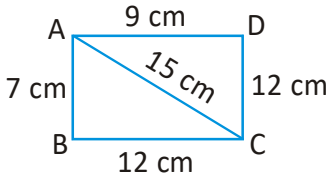
Given $\frac{4}{3} \pi r^3 = 9 \times 32\ \pi\ cm^3$

$r^3 = 9 \times 32 \times \frac{3}{4}\ cm^3 = 216\ cm^3$

$r^3 = (6\ cm)^3$

r = 6 cm

12. (B) Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$



where $s = \frac{a+b+c}{2} = \frac{7cm+12cm+15cm}{2}$

$= \frac{34cm}{2} = 17$ cm

Area $(\Delta ABC) = \sqrt{17\times10\times5\times2}$ cm^2

$= 10\sqrt{17}$ cm^2

In ΔACD, $15^2 = 12^2 + 9^2 \Rightarrow \angle D = 90°$

$\therefore$ Area of $\Delta ACD = \frac{1}{2} \times AD \times DC$

$= \frac{1}{2_1} \times 9 \times \cancel{12}^{6}$ cm^2 $= 54$ cm^2

$\therefore$ Area of the quadrilateral ABCD

$= (10\sqrt{7} + 54)$ cm^2

13. (A) $y = 10$ is line is parallel to $y = 0$ line i.e., X-axis

14. (A) Given h = 4c

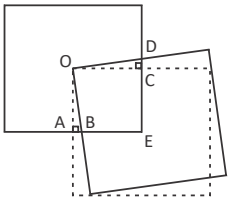
Given $c = 2\pi r \Rightarrow r = \frac{c}{2\pi}$

Volume $= \pi r^2 h = \pi \left(\frac{c}{2\pi}\right)^2 4c$

$= \pi \frac{c^2}{4\pi^2} \times 4c$

$= \frac{c^3}{\pi}$

15. (C)



In ΔAOB $\angle AOB = x$ then

$\angle BOC = 90° - x$

$\therefore$ $\angle COD = \angle BOD - \angle BOC$

$= 90° - (90° - x)$

$= 90° - 90° + x = x$

$\angle COD = \angle AOB \rightarrow (1)$

In ΔAOB & ΔCOD

$\angle A = \angle C = 90°$ (angle)

OA = OC (side)

$\angle AOB = \angle COD$

($\because$ angle & from eq (1)

$\therefore$ $\Delta AOB \cong \Delta COD$

[$\because$ ASA congruency]

$\therefore$ Area of ΔAOB = area of ΔCOD

Area of shaded region BEDO = area of quadrilateral BECO + are of ΔCOD

= Area of quadrilateral BECO + area of ΔAOB

= Arera of square OAEC = $\frac{1}{4}$ area of original square = 6 cm^2

16. (B) Const:- Extand GH Up to 5

$\angle AIH = 70°$

[$\because$ corresponding angles]

$\therefore$ $\angle AIJ = 180° - 70° = 110°$

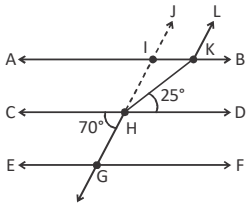
$\Rightarrow$ $\angle IKL = \angle AIJ = 110°$

[$\because$ corresponding angles]

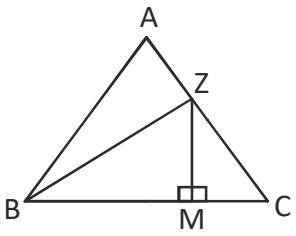
$\angle IKH = \angle KHD = 25°$

[$\because$ alternative angles]

$\therefore$ $\angle HKL = \angle HKI + \angle IKL = 25° + 110° = 135°$



17. (B)



BZ is a median

$\therefore$ Area of ΔBCZ =

$\frac{1}{2}$ of Area of $\Delta ABC = \frac{1}{2} \times 8\ cm^2 = 4\ cm^2$

Given BM = 2 MC

$\Rightarrow MC = \frac{1}{3}BC \Rightarrow BM = \frac{2}{3}BC$

$\therefore$ Area of $\Delta BZM = \frac{2}{3}$ of area of ΔBZC

$= \frac{2}{3} \times 4\ cm^2$

$= 2.67\ cm^2$

18. (C) Given ABC and equilateral triangle

$\therefore AD = \frac{\sqrt{3}}{2}AB$

$2AD = \sqrt{3}\,AB$

Squaring on both sides

$4\,AD^2 = 3\,AB^2$

19. (D) LHS

$$= \sqrt{11+3+2+2\sqrt{2}\times\sqrt{3}+2\sqrt{2}\times\sqrt{11}+\sqrt{11}\times\sqrt{3}}$$

$$= \sqrt{\left(\sqrt{11}\right)^2+\left(\sqrt{3}\right)^2+\left(\sqrt{2}\right)^2+2\sqrt{2}\times\sqrt{3}+2\sqrt{2}\times\sqrt{11}+2\sqrt{2}\times\sqrt{11}+2\sqrt{11}\times\sqrt{3}}$$

$$= \sqrt{\left(\sqrt{11}+\sqrt{3}+\sqrt{2}\right)^2}$$

$$= \sqrt{11}+\sqrt{3}+\sqrt{2}$$

20. (C) Substitute y = x + 3 in eq 3x + y = 11

3x + x + 3 = 11

4x = 8

x = 2

If x = 2 then y = 2 + 3 = 5

$\therefore$ (2, 5) lies on y = x + 3 and 3x + y = 11 line

21. (B) Volume of the pyramid

$$= \frac{1}{3}\times \text{base area} \times \text{height}$$

$$= \frac{1}{3}\times 8\times 8\times 12\ cm^3$$

$= 256\ cm^3$

22. (D) Given $\sqrt{l^2+b^2} = 2b$

Squaring on both sides

$l^2 + b^2 = 4b^2$

$l^2 = 4b^2 - b^2$

$l^2 = 3b^2$

$$l = \sqrt{3b^2} = \sqrt{3}b$$

$$\therefore \frac{l}{b} = \sqrt{3}$$

$$\therefore l : b = \sqrt{3} : 1$$

23. (D) Given $a + \frac{1}{a} = 4.25 = \frac{425}{100} = \frac{17}{4}$

Cubing on both sides

$$a^3 + \frac{1}{a^3} + 3a\times\frac{1}{a}\left(a+\frac{1}{a}\right) = \left(\frac{17}{4}\right)^3$$

$$a^3 + \frac{1}{a^3} + 3\left(\frac{17}{4}\right) = \frac{4913}{64}$$

$$a^3 + \frac{1}{a^3} = \frac{4913}{64} - \frac{51}{4} = \frac{4913-816}{64}$$

$$= \frac{\cancel{4097}^{64.015}}{\cancel{64}_{1}} = 64.015$$

24. (A) $\angle PRS = \angle PTS = 35°$

[$\because$ Angles in the same segment]

In ΔQRS, $\angle Q = 90°$

$\Rightarrow 35° + 90° + x = 180°$

$x = 180° - 125° = 55°$

25. (B) $$\frac{7-\sqrt{5+x}}{(x-44)}=\frac{7-\sqrt{5+x}}{(x-44)}\times\frac{7+\sqrt{5+x}}{7+\sqrt{5+x}}$$

$$=\frac{49-(5+x)}{(x-44)\left(7+\sqrt{5+x}\right)}$$

$$=\frac{49-5-x}{(x-44)\times\left(7+\sqrt{5+x}\right)}$$

$$=\frac{44-x}{(x-44)\left(7+\sqrt{5+x}\right)}$$

$$=\frac{-x+44}{(x-44)\left(7+\sqrt{5+x}\right)}$$

$$=\frac{-(\cancel{x-44})1}{(\cancel{x-44})\left(7+\sqrt{5+x}\right)}$$

PHYSICS

26. (D) The gravitational force between two objects depends upon (i) product of the masses, (ii) gravitational constant, (iii) distance between the masses.

27. (C) As the aircraft gains speed, it is accelerating. Using Newton's 2nd law, there is a resultant horizontal force acting on the plane. Vertically, there is no acceleration because the aircraft is at a constant vertical height. Hence, the vertical forces are balanced.

28. (A) When a plane takes off, it needs to increase its speed to increase the lifting force below the wings. Both the speed and height of the plane will increase. As speed and height are factors of kinetic energy and gravitational potential energy respectively, both kinetic energy and gravitational potential energy increase during a plane's take off to the sky.

29. (C) $V_{avg} = \frac{2\times u\times v}{u+v}=\frac{2\times 40\times 60}{(40+60)} = 48 \text{ km h}^{-1}$

30. (D) The velocity of football changes four times. First, when a football player kicks to another player, second when that player kicks the football to the goalkeeper. Third when the goalkeeper stops the football. Fourth when the goalkeeper kicks the football towards a player of his own team. The velocity of football changes four times.

31. (C) Final kinetic energy of released object,

$$E_k=\frac{1}{2}mv^2$$

Where, m = mass of object in kg.

v = speed of object in m/s

Given m = 4 kg, v = 20 m/s

Alternatively, change in energy (to heat and sound) = mgh.

Given m = 4 kg, g = 10 N/kg, h = 20 m = 800 J

32. (D) As displacement is the shortest distance between the two positions, so, it is generally less than distance. But displacement can be equal to distance when path taken is a straight line. So, the numerical ratio of displacement to distance for a moving object is equal to or less than 1.

33. (A) $F = ma = m\left(\frac{v-u}{t}\right)$

$$0.6\times\left(\frac{6-5}{2}\right)=\frac{0.6\times 2}{1}m = 1.2 \text{ kg}$$

34. (B) Potential energy of an object at a height is given as

E_p = mgh or P.E. = mgh

m = mass of an object

g = acceleration due to gravity

h = height of an object above the surface of the earth

35. (B) When gravitational force becomes zero, then centripetal force on the satellite also becomes zero. Therefore, the satellite moves tangentially and escapes away from its orbit.

CHEMISTRY

36. (A) Molecular mass of $C_{11}H_{17}NO_3$ can be calculated as below:

(a) Number of carbon atoms = 11

Molecular mass of 1 carbon atom = 12

Molecular mass of 11 carbon atoms = 11 × 12 = 132

(b) Number of hydrogen atoms = 17

Molecular mass of 1 hydrogen atom = 1

Molecular mass of 17 hydrogen atoms = 17 × 1 = 17

(c) Number of Nitrogen atoms = 1

Molecular mass of 1 nitrogen atom = 14

(d) Number of oxygen atoms = 3

Molecular mass of 1 oxygen atom = 16

Molecular mass of 2 oxygen atoms = 3 × 16 = 48

By adding the molecular mass of all atoms (132 + 17 + 14 + 48), we get the molecular mass of compound $C_{11}H_{17}NO_3$ as 211.

37. (B) In the stomach, enzymes break down food into simpler substances. Option (B) shows the formation of a compound from two substances, Q and R. Options (C) and (D) show the breakdown of a compound by heating and electrolysis respectively.

38. (B) 12 × 98.9% = 1186.8 + 13 × 1.1% = 14.3

$$= 1186.8 + 14.3 = \frac{1201.1}{100} = 12.011 \text{ amu}$$

39. (C) Brinjals and apples become dark due to chemical change. Rest all options represent physical changes only.

40. (B) Helium and nitrogen have different molecular masses. Helium (M_r=4) is much lighter than nitrogen (M_r=28) and thus will diffuse faster out of the balloon. Over the same period of time, more of the lighter helium will have escaped from the balloon, compared to the heavier nitrogen, thus leaving behind a higher proportion of nitrogen.

Helium diffuses faster as it has a smaller molar mass.

N_2 = 2 × 14 = 28 g/mole

He = 1 × 4 = 4 g/mole

Rate of diffusion

$$= \frac{He}{N_2} = \sqrt{\frac{28\,g/mole}{4\,g/mole}} = 2.6$$

41. (D) Carbon dioxide and nitrous oxide have the same formula unit mass.

Option (A) $CaCl_2$ = 40 + 71 = 111

K_2CO_3 = (39 × 2) + 12 + (16 × 3)

= 78 + 12 + 48 = 138

Option(B) CaO = 40 + 16 = 56

HCl = 1 + 35.5 = 36.5

Option (C) CO = 12 + 16 = 28

NH_3 = 14 + 3 = 17

Option (D) CO_2 = 12 + 16 × 2 = 44

N_2O (14 × 2) + 16 = 44

42. (A) Doesn't leave residue while boiling. This property suggests that the liquid is pure, but it doesn't confirm that it is water.

43. (B) All pure samples of water contain hydrogen and oxygen in fixed mass ratio of 1 : 8.

This is in agreement with the law of constant or definite proportion.

44. (C) Milky glass is a solid-in-solid colloid.

45. (A) Eventhough an ice-cube floats in a glass of water above its surface, the water level in the glass is exactly the same before and after the ice has melted i.e., exactly at the brim of the glass. This shows that when ice melts, the water formed takes up less space than the ice, and that is exactly the amount of space taken by the submerged ice.

BIOLOGY

46. (D) It is a common misconception that chloroplasts and mitochondria are interchangeable in their functions. Chloroplasts and mitochondria perform two distinct functions. Chloroplasts perform photosynthesis, the conversion of light energy into chemical energy stored in glucose. Mitochondria perform respiration, the oxidation of glucose to release stored chemical energy for metabolism. A plant cell that contains only chloroplasts would be able to produce glucose but would not be able to utilise the chemical energy stored in glucose.

47. (D) Seed coat of legumes, grit of guava and pear and fruit walls of nuts, all have sclereids.

48. (C) Mitochondria are strange organelles in the sense that they have their own DNA and ribosomes. Like the mitochondria. plastids also have their own DNA and ribosomes.

49. (D) Statements (A), (B) and (C) are not correct. A person doing work and running the skeletal muscles contract and pull the tendon to move the bones.

50. (B) The part labeled as X in the diagram is chromosome.

51. (A) The characteristics of meristematic tissue are:

    (i) Cells have dense cytoplasm with prominent nucleus

    (ii) Cells possess the ability to grow and divide

52. (D) A sperm cell is an animal cell. It has a long tail that helps it to swim or move. Nerve cell is the longest cell and sperm cell is the smallest.

53. (D) Muscle X is smooth muscle. Smooth muscles are spindle shaped, unbranched, uninucleated and involuntary.

54. (A) In the given figure 'N' is nucleus. Nucleus controls activities in a cell.

55. (C) Based on the given information R - cell, S - tissue, T - organ and U - system.

CRITICAL THINKING

56. (A)

57. (B) If statement 2 is the 'Cause' and statement 1 is the 'Effect'.

58. (C) When all cells are connected in parallel, the total emf of the combination is 1.5 V

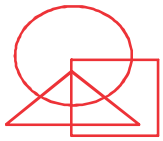
    When cells are connected two of then in series and one is parallel, then total emf of combination is 3V

    When all three cells are connected in series, then the total emf is 4.5 V.

59. (D) 1 rabbit is going towards the rives, not the 6 elephants and these 6 elephants saw 2 monkeys going towards the river. They also noticed that each monkey is holding 1 turtle.

    Hence total number of animals going towards the river are 1 rabbit, 2 monkeys and 2 turtles.

    $\therefore$ 1 + 2 + 2 = 5

60. (D) 

In the given figure one of the dots lies in the region common to the circle, square and triangle. The other dot lies in the region common to the square and triangle only. In options (A), (B) there is no region common to the triangle and square. In the same way in option (C) there is no region common to the circle, square and triangle. Only option (D) consists of both type of regions.