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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

CLASS - 9

Question Paper Code : 1P214

KEY

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SOLUTIONS

MATHEMATICS

01. (B) $\sqrt{29+\sqrt{720}} = \sqrt{29+\sqrt{4\times180}}$

$= \sqrt{29+2\sqrt{180}}$

$= \sqrt{20+9+2\sqrt{20}\times\sqrt{9}}$

$= \sqrt{(\sqrt{20})^2+(\sqrt{9})^2+2\sqrt{20}+\sqrt{9}}$

$= \sqrt{(\sqrt{20}+\sqrt{9})^2}$

$= (3+2\sqrt{5})$

02. (D) Given $x = \sqrt{6}+\sqrt{5}$

$x^2 = \left(\sqrt{6}+\sqrt{5}\right)^2$

$= 6 + 5 + 2\sqrt{30}$

$= 11 + 2\sqrt{30}$

Simplify $x^2 + \frac{1}{x^2} - 2$

$\left(11+2\sqrt{30}\right)+\left(11-2\sqrt{30}\right)-2 = 20$

03. (D) $\sqrt{(x-1)(x-2)(x-3)(x-4)+1}$

$=\sqrt{(x-1)(x-4)(x-2)(x-3)+1}$

$=\sqrt{(x^2-5x+4)(x^2-5x+6)+1}$

$=\sqrt{a(a+2)+1}$

where a = $x^2 - 5x + 4$

$=\sqrt{a^2+2a+1}$

$=\sqrt{(a+1)^2}$

= a + 1

= $x^2 - 5x + 4 + 1$

= $(x^2 - 5x + 5)$

04. (B) $a^2 - b^2 = (a + b)(a - b)$

= (1234567 + 1234566) (1234567 – 1234566)

= 2469133 × 1

= 24,69,133

05. (C) If the supplement of an angle is two-third of itself. Determine the angle.

Let angle = x

Supplement = $180 - x$

Given: $180 - x = (2/3)x$

Multiply both sides by 3:

$540 - 3x = 2x$

$5x = 540$

$x = 108°$

06. (A) Given equations

$29x + 37y = 103$ ..... (1)

$37x + 29y = 95$ ..... (2)

Step 1: Add (1) and (2)

$66x + 66y = 198$

$x + y = 3$ ..... (3)

Step 2 : Subtract (1) from (2)

$8x - 8y = -8$

$x - y = -1$ ..... (4)

Step 3: Solve (3) and (4)

$x + y = 3$, $x - y = -1$

Add

$2x = 2$

$x = 1$

Substitute $x = 1$ into (3)

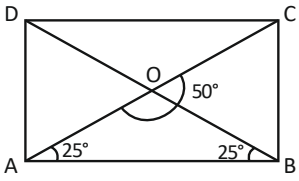
$1 + y = 3$

$y = 2$

07. (B) Quadrant II : a < 0, b > 0

So, –a > 0, –b < 0 (Quadrant IV)

08. (B) In a rectangle diagonals are equal and diagonals bisect each other.



$\therefore$ OA = OB $\Rightarrow$ $\angle$OBA = $\angle$OAB = 25° [$\because$ Given]

$\therefore$ $\angle$BOC = $\angle$OAB + $\angle$OBA = 25° + 25° = 50° is acute angle and $\angle$AOB = 180° – $\angle$BOC = 130° is obtuse angle.

09. (B) Given a = 9 cm, b = 8 cm and c = 13 cm

$s = \frac{a + b + c}{2} = \frac{9\text{ cm} + 8\text{ cm} + 13\text{ cm}}{2} = \frac{30\text{ cm}}{2}$

s = 15 cm

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

$=\sqrt{15 \times (15-9)(15-8)\times(15-13)}$

$=\sqrt{15\times6\times7\times2}$

$=\sqrt{3\times5\times3\times2\times7\times2}$

$=6\sqrt{35}$ cm^2

Area of the parallelogram ABCD = 2 × area of DABC = $12\sqrt{35}$ cm^2

10. (B) Given $\frac{1}{3}\pi r^2 h = 3696 m^3$

$\frac{1}{3} \times \frac{22}{7} \times r^2 \times 8 \text{ m} = 3696 m^3$

$r^2 = \cancel{3696}^{462} \times 3 \times \frac{7}{\cancel{22}_1} \times \frac{1}{\cancel{8}_1}$

$r^2 = (21 \text{ m})^2$

$r = 21 \text{ m}$

$l = \sqrt{b^2 \times r^2}$

$= \sqrt{8^2 + 21^2}$

$= 505$

$= 22.47 \text{ m}$

CSA of a cone

$= \pi \times l = \frac{22}{\cancel{7}_1} \times \cancel{21}^3 \text{ m} \times 22.47 \text{ m}^2$

$= 66 \times 22.47 \text{ m}^2$

$= 1483.02 \text{ m}^2$

11. (D) In ΔAOB, $OA = OB \Rightarrow \angle OBA = \angle OAB = 20°$

$\therefore$ $20° + 20° + \angle AOB = 180°$

$\angle AOB = 140°$

In ΔBOC, $OC = OB \Rightarrow \angle CBO = \angle C = 50°$

$\therefore$ $50° + 50° + \angle BOC = 180°$

$\angle BOC = 80°$

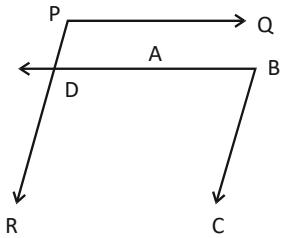
$\angle AOB = \angle AOC + \angle COB$

$140° = \angle AOC + 80°$

$140° - 80° = \angle AOC$

$\therefore$ $\angle AOC = 60°$

12. (A) Construction:– Extend BA upto 'D' such that BA intersects PR at D.



PR || BC $\Rightarrow \angle ABC + \angle BDR = 180°$

$\therefore$ $74° + \angle BDR = 180°$

$\angle BDR = 180° - 74° = 106°$

$\therefore$ $\angle QPR = \angle BDR = 106°$

[$\because$ corresponding angles

13. (C) Given $\angle A = 3\angle C$ and $\angle B = 2\angle C$

But $\angle A + \angle B + \angle C = 180°$

$3\angle C + 2\angle C + \angle C = 180°$

$6\angle C = 180°$

$\angle C = 30°$

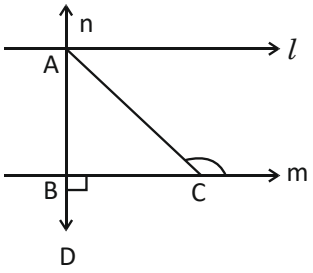
$\angle A = 3\angle C = 90°$

ABC is a right angled triangle.

14. (A) $\angle ABC + \angle CBD = 180°$

$\angle ABC + 90° = 180°$

$\angle ABC = 90°$



In ΔABC

$\angle ABC + \angle BAC = 125°$

$90° + \angle BAC = 125°$

$\angle BAC = 125° - 90° = 35°$

15. (A) From the second equation

$y = 3x - 7$

Substitute into the first equation

$2x + 3(3x - 7) = 1$

$2x + 9x - 21 = 1$

$11x = 22$

$x = 2$

Then, $y = 3(2) - 7 = -1$

16. (B) Sphere radius = half of cube side = 3 cm

Sphere volume = $\frac{4}{3}\pi(3)^3 = 36\pi \text{ cm}^3$

17. (D) $\sqrt{448} - \sqrt{1008} - \sqrt{567} + \sqrt{700}$

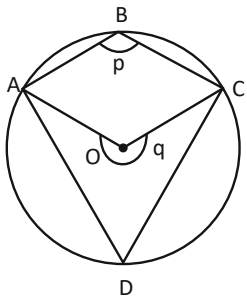
$= \sqrt{64 \times 7} - \sqrt{144 \times 7} - \sqrt{81 \times 7} + \sqrt{100 \times 7}$

$= 8\sqrt{7} - 12\sqrt{7} - 9\sqrt{7} + 10\sqrt{7}$

$= -3\sqrt{7}$

$= -\sqrt{3 \times 3 \times 7} = -\sqrt{63}$

18. (A) Construction: Take a point 'D' on the major arc and join AD & CD



ABCD is a cyclic quadrilateral

$\therefore$ $P + \angle D = 180°$

$\angle D = 180° - P$

But $\angle AOC = 2\angle D$

But $q + \angle AOC = 360°$

$q + 2(180° - P) = 360°$

$q + 360° - 2P = 360°$

$q = 360° - 360° + 2p$

$2p = q$

19. (A) Given $\frac{4}{3}\pi(R^3 - r^3) = \frac{1}{3}\pi \times r^2 \times h$

$\Rightarrow \frac{4}{3}\pi(4^3 - 2^3) = \frac{1}{3} \times \pi r_1^2 \times 14 cm^3$

$4^2 \times \frac{(64-8)}{14_7} = r_1^2$

$2 \times \frac{56^8}{7_1} = r_1^2$

$r_1 = \sqrt{16} cm = 4cm$

$\therefore$ Diameter $= 2r_1 = 8cm$

20. (C) Given $\pi r^2 = 38.5 \times \frac{2}{2}\ cm^2$

$\frac{22}{7} \times r^2 = \frac{77}{2}$

$r^2 = \frac{77^7}{2} \times \frac{7}{22_2}$

$r = \sqrt{\frac{49}{4}} = \frac{7}{2}$

Given $2\pi rh = 176\ cm^2$

$2 \times \frac{22}{7} \times \frac{7}{2} \times h = 176\ cm^2$

$h = \frac{176^8\ cm^2}{22_1\ cm} = 8\ cm$

Volume of the cylinder $= \pi r^2 h$

$= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 8^4\ cm^3$

$= 308\ cm^3$

21. (B) $12x^2 - 5x - 28 = 0$

$12x^2 - 21x + 16x - 28 = 0$

$3x(4x - 7) + 4(4x - 7) = 0$

$(4x - 7)(3x + 4) = 0$

$\therefore$ $4x = 7$ and $3x = -4$

$x = \frac{7}{4}$ $\quad$ $x = -\frac{4}{3}$

$\therefore$ sum of the zeros $= \frac{7}{4} + \frac{(-4)}{3}$

$= \frac{21-16}{12}$

$= \frac{5}{12}$

22. (B) $64^2 + 31^2 + 32^2 - 2 \times 64 \times 31 + 2 \times 31 \times 32 - 2 \times 64 \times 32$

$= (-64 + 31 + 32)^2$

$= (-1)^2$

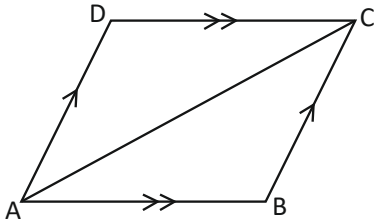
$= 1$

23. (B) In ΔABC and ΔCDA

$\angle CAB = \angle ACD$ ($\because$ alternative angles)

$AC = AC$ ($\because$ side and common)

$\angle ACB = \angle CAD$ ($\because$ alternative angles)



$\therefore$ $\Delta ABC \cong \Delta CDA$ [$\because$ ASA congruences]

$\therefore$ Area of CDA = area of ΔABC

$\therefore$ Area of the quadrilateral ABCD = Area of ABC + Area of ΔADC

$= (25 + 25)\ cm^2$

$= 50\ cm^2$

24. (C) $\angle BCD = \angle BAD = 44°$

[$\because$ angles in the same segment]

In ΔCDE, $\angle E = 90$ & $\angle ECD = 44°$

$\therefore$ $90° + 44° + x = 180°$

$\Rightarrow x = 180° - 134° = 46°$

25. (B) Given a = 8 cm, b = 31.5 cm and c = 32.5 cm

$$s = \frac{a + b + c}{2} = \frac{(8 + 31.5 + 32.5)\ cm}{2}$$

$$= \frac{72\ cm}{2} = 36\ cm$$

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

$= \sqrt{36\ cm \times 28\ cm \times 4.5\ cm \times 3.5\ cm}$

$= \sqrt{36 \times 7 \times 2 \times 2 \times 4.5 \times 3.5}\ cm^2$

$= 7 \times 3 \times 6\ cm^2$

$= 126\ cm^2$

PHYSICS

26. (B) KE = 20 J, U = 0 J

At the top: Total = PE = 25 J

Energy lost to friction = 5 J

Remaining mechanical energy = 25 – 5 = 20 J

At the bottom, PE = 0 $\rightarrow$ KE = 20 J

27. (A) From 4 to 6 s, the velocity remains constant $\rightarrow$ acceleration = 0. So, the claim of uniform acceleration is incorrect.

28. (B) The knife, because the contact area is extremely small.

Pressure depends on both force and contact area. Although the elephant has a very large weight, its large foot area spreads out the force, reducing the pressure. The knife applies a relatively smaller force over a tiny contact area, causing very high pressure, which can easily cut meat. The barefoot person or brick exert lower pressure as the forces are distributed over larger areas or softer surfaces. This tests careful evaluation of force and area rather than intuitive choice based on weight alone, making it challenging and suitable for Olympiad level.

29. (C) Straight line with positive slope

The image provided is an acceleration-time graph. The relationship between acceleration and velocity is that acceleration is the rate of change of velocity, or the slope of the velocity-time graph. During the time interval of 0 to 4 seconds, the acceleration is a constant positive value (2.0 m/s^2 from 0-2s and 0.0 m/s^2 from 2-4 s). A constant, non-zero acceleration means the velocity is changing at a steady rate, which corresponds to a straight line with a positive slope on a velocity-time graph.

30. (C) The egg floats in salt water because density of salt water > density of egg, so the buoyant force equals or exceeds its weight.

It sinks in fresh water (less dense) and is partly submerged in honey because although honey is highly viscous, its density may not be sufficient to fully float the egg.

31. (B) Work done

$$W = \Delta KE = \frac{1}{2}mv^2_{final} - \frac{1}{2}mv^2_{initial}$$

Since the robot starts and ends at rest,

$W = 0 - 0 = 0J$

Hence, net work done = 0 J, even though energy was expended internally to move.

32. (B) Pressure on the shoulder is $P = \frac{F}{A}$. A thin strap has smaller contact area A, so for the same force F(weight of bag), pressure increases $\rightarrow$ more pain. A wider strap distributes force over larger area $\rightarrow$ lower pressure $\rightarrow$ more comfort.

33. (C) Density $\rho = \frac{\text{mass}}{\text{volume}}$

Same weight crown but larger volume $\rightarrow$ average density lower than pure gold

This proves the crown was impure, containing metals of lower density.

34. (A) In free fall (neglecting air resistance), acceleration = g for all bodies regardless of mass or material. However, Momentum p=mv $\rightarrow$ differs since masses differ.

Potential energy mgh $\rightarrow$ differs for unequal masses.

Kinetic energy $\frac{1}{2}$ $mv^2 \rightarrow$ also differs.

Thus, only acceleration remains the same for both spheres.

35. (B) The correct answer is: (B) Newton's Second Law – the force experienced depends on the change in momentum over time.

When an athlete lands on a cushioned bed, the stopping time is increased. According to Newton's Second Law ($F=\Delta p/\Delta t$), increasing the time over which momentum changes reduces the force experienced by the athlete. This smaller force helps prevent injuries.

CHEMISTRY

36. (B) Formula of glucose = $C_6H_{12}O_6$

Molecular weight = 180 a.m.u.

One mole gram glucose = 180 g

180 g of glucose contains

1 mole of glucose

540 g of glucose contains

$$= \frac{1}{180\text{ g}} \times 540\text{ g} = 3\text{ moles}$$

37. (D) $Rf = \frac{\text{distance travelled by the solute (dye)}}{\text{distance travelled by the solvent front}} = \frac{40}{50}$

38. (C) Gases do not have any definite volume. Their volume is equal to the volume of the container.

39. (D) $C + O_2 \rightarrow CO_2$

12 g + 32 g = 44 g

1.5 g = ?

$\therefore$ Weight of oxygen needed

$$= \frac{32 \times 1.5}{12} = 4\text{ g}$$

40. (C) Fractional distillation is used for separating liquids in a mixture based on the difference in boiling points of the components. The one with a lower boiling point will be separated out first.

41. (A) The correct matching is 1-s, 2-p, 3-q, 4-r

(1) Evaporation - Liquid to gas at any temperature

(2) Boiling - Liquid to gas at a fixed temperature

(3) Sublimation - Solid to gas

(4) Hoar frost - Gas to solid

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

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

$K_2CO_3 = (39 \times 2) + 12 + (16 \times 3)$

$= 78 + 12 + 48 = 138$

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) $CO_2 = 12 + 16 \times 2 = 44$

$N_2O\ (14 \times 2) + 16 = 44$

43. (C) X exists as a solid at room temperature and is insoluble in water. It is best separated from water by filtration where X remains as the residue while water is collected as the filtrate.

44. (C) Solids have the given characteristics. Hence, they have definite shape and volume.

45. (B) 40 g of calcium constitutes one gram atom.

10 g of calcium accounts for gram atom

$$= \text{Gram atoms} = \frac{\text{Mass of the element in grams}}{\text{Atomic mass of the element}}$$

$$\frac{10}{40} = 0.25 \text{ gram atoms}$$

According to Avogadro's number, the number of atoms in 1 g of calcium = 6.023×10^{23}

The number of atoms in 0.25 gram atom

$= 0.25 \times 6.023 \times 10^{23} = 1.50 \times 10^{23}$ atoms.

BIOLOGY

46. (B) In metaphase, chromosomes align along the cell's equatorial plate (middle) before separation, a key visual characteristic of this stage.

47. (B) Collenchyma cells have thickened corners, provide flexible mechanical support, and are common in young stems and leaf stalks of climbing plants.

48. (C) Sclerenchyma cells have thick, lignified walls and are dead at maturity, providing rigid support in leaves/stems of plants in harsh conditions.

49. (B) Sprinkler and drip systems can irrigate uneven land efficiently, unlike traditional methods like moat or chain pump that require more uniform terrain.

50. (A) Tendons are tough, fibrous connective tissues that attach muscles to bones, enabling movement.

51. (B) Epithelial tissue

Skin appendages like hair, nails, feathers, and scales develops from epithelial tissues.

52. (B) Chondroblasts are cells that produce and secrete the cartilage matrix, aiding in the repair and maintenance of cartilage tissue.

53. (C) Xylem vessels and tracheids are dead cells that form hollow tubes, allowing upward movement of water and minerals via capillary action and transpiration pull.

54. (D) Connective tissue

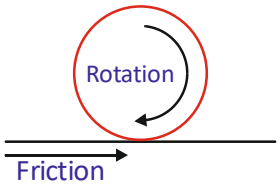
Blood and lymph are fluid connective tissues that transport nutrients, gases, and immune cells throughout the body.

55. (B) Recycling reduces waste, conserves natural resources, and minimizes pollution, helping to preserve the environment.

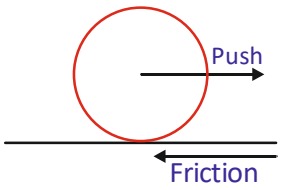
CRITICAL THINKING

56. (B) Squares are in no particular order within the frame. It is merely the number of squares that are important for this sequence. Shaded squares change from three to two with each turn. Unshaded squares change from two to three with each turn. Semi-circle moves from top left to top right, to bottom left to bottom right with each turn.

57. (B) The back wheel of the bicycle is connected to the pedals. It rotates and rubs against the floor to push itself to move forward. The friction opposes the motion for back wheel as shown.



The front wheel of the bicycle is a free wheel. It is being pushed forward at the centre of the wheel by the movement of the back wheels. The lower part of the wheel is being dragged towards the right and rubbing against the floor causes the rotation. The friction opposes the motion for front wheel as shown.



58. (B) Think of each pair: every time two cars swap relative order counts one overtake. Total overtakes between a pair equals number of times their relative order changes. Starting order Ramesh > Rajesh > Snehan.

R vs J swap 9 times → their final relative order is same as start if 9 is even? Actually odd swaps invert order. 9 odd ⇒ R and J end in opposite order (Rajesh ahead of Ramesh).

R vs S swap 11 times (odd) ⇒ their final order inverted (Snehan ahead of Ramesh).

J vs S swap 10 times (even) ⇒ their final order same as start (Rajesh ahead of Snehan).

Combine: From J vs S same as start: Rajesh ahead of Snehan.

From R vs J inverted: Rajesh ahead of Ramesh.

From R vs S inverted: Snehan ahead of Ramesh.

So final order: Rajesh (1st), Snehan (2nd), Ramesh (3rd).

Answer: (B) Rajesh, Snehan, Ramesh.

59. (B) As the awareness about health in the society is increasing particularly among middle-aged group of people, the importance of Yoga and exercise is being realized by all sections of the society.

60. (A)