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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN423

Solutions for Class : 9

Mathematics

1. **(B)** Let unit's digit be y and digit at ten's place be x.

Then x + y = 9 ...(i)

According to the question.

$(10y + x) - (10x + y) = 9$

$\Rightarrow$ $y - x = 1$ ...(ii)

From Eqs. (i) and (ii),

$y = 5,\ x = 4$

$\therefore$ Number = 45

Now, $y^3 - x^3 = 5^3 - 4^3$

$= 125 - 64$

$= 61$

2. **(A)** Given $l_1 \parallel l_2$

$\therefore\ y^\circ = z^\circ$ ..... (1)

[interior alternate angles] and $x^\circ + w^\circ = 180^\circ$ [interior angles on the same side of transversal]

$\Rightarrow\ x^\circ = 180^\circ - w^\circ$ ..... (2)

(1) + (2) $\Rightarrow\ x^\circ + y^\circ = 180^\circ - w^\circ + z^\circ$

3. **(C)** $x^2 + \frac{1}{x^2} + 2 - 2x - \frac{2}{x}$

$= \left(x + \frac{1}{x}\right)\left(x + \frac{1}{x} - 2\right)$

4. **(A)** $x + 1 = 0 \Rightarrow x = -1$

$\therefore$ The line $x = -1$ is parallel to y-axis.

5. **(B)** Given, a = 2 and b = 3

$\therefore\ a^a + b^b = 2^2 + 3^3$

$= 4 + 27 = 31$

and $a^b + b^a = 2^3 + 3^2$

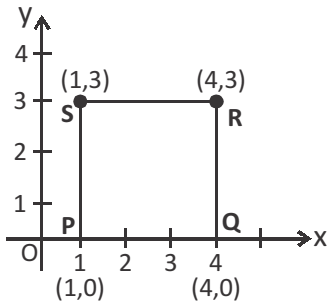
$= 8 + 9 = 17$

i.e., $(a^a + b^b) - (a^b + b^a) = 31 - 17 = 14$

6. **(B)** PQRS is a square, whose co-ordinates are P (1, 0), Q (4,0) and S (1,3)

Now, the x -coordinate of R will be equal to x-coordinate of Q, and the y-coordinate of R will be equal to y-coordinate of S.

$\therefore$ The coordinates of R is (4,3)



7. **(D)** According to the property,

$6 - 3 < x \Rightarrow 3 < x$

i.e. difference of two sides

is always less than

the third side.

and $x < 3 + 6$

$\Rightarrow\ x < 9$

i.e. Sum of two sides of a triangle is always greater than third side.

$\therefore\ 3 < x < 9$

8. **(C)** Curved surface area = $2\pi rh$

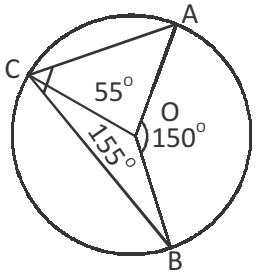
Radius is doubled (2r) height is halved $\left(\frac{h}{2}\right)$

Curved surface area = $2\ \pi\ (2r)\ \left(\frac{h}{2}\right)$

$= 2\pi rh$

$\therefore$ The C. S. A remains same.

9. **(B)**



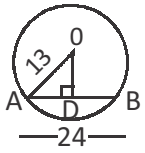
Measure of $\angle AOB = 360^o - 55^o - 155^o$

$= 150^o$

Measure of $\angle ACB = \frac{1}{2} \angle AOB$

$= \frac{1}{2}(150^o) = 75^o$

10. **(A)** As seen, ODB is a right angled triangle and by property, We know that perpendicular from the centre to the chord bisects the chord.



$\therefore$ AD = BD = $\frac{24}{2}$ =12 cm

$\therefore$ $OD = \sqrt{13^2 - 12^2}$

[by pythagoras theorem]

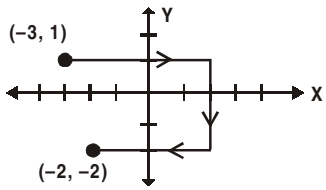
= $\sqrt{169-144} = \sqrt{25}\,cm = 5cm$

11. **(A)** Given AB = 5 cm, BC = 6 cm and CA = 7 cm

In a triangle, the angle opposite to the longest side is the greatest angle.

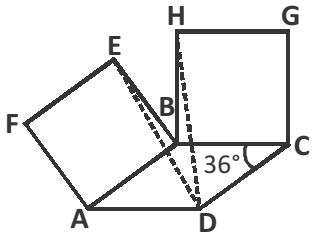
$\therefore$ $\angle B > \angle A > \angle C$ is the relation between the angles.

12. **(A)**



Hence, Reshma's starting point is (– 3, 1).

13. **(C)**



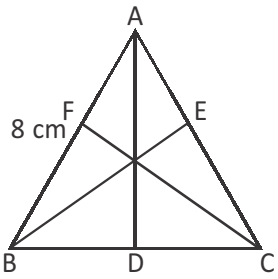
$\angle ABC = 180 - 36 = 144$

$\angle EDH + \angle DHB + \angle DEB$

=360 – [144+90+90]

= 36°

14. **(A)** In ΔABC, AB = 8 (Given)



Here AD = 5 cm, CF = 4 cm

$\frac{1}{2} \times BC \times AD = \frac{1}{2} AB \times CF$

$\Rightarrow \frac{1}{2} \times BC \times 5 = \frac{1}{2} \times 8 \times 4$

$\frac{5}{\not 2} BC = \frac{32}{\not 2}$

5 BC = 32

BC = $\frac{32}{5}$

BC = 6.4 cm

15. **(D)**

16. **(B)** Given, perimeter of triangle = 30 cm [given]

Sum of two equal sides =24 cm

$\therefore$ Third side = 30 – 24 = 6 cm

$s = \frac{a+b+c}{2}$

$s = \frac{30}{2} = 15\,cm$

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

$\sqrt{15(15-12)(15-12)(15-6)}$

= $\sqrt{15 \times 3 \times 3 \times 9}$

= $9\sqrt{15}cm^2$

17. **(D)**

From the figure,

CF + FN = CN ..... (1)

and MC + CF + FN = MN

$\therefore$ MC + CN = MN (From eq. 1)

Since, C is the mid-point of MF, MC = MF.

$\therefore$ CF + CN = MN

18. **(C)**

$$\frac{\sqrt{a}+\frac{1}{\sqrt{a}}}{1-a}+\frac{1-\frac{1}{\sqrt{a}}}{1+\sqrt{a}}$$

$$=\frac{a+1}{\sqrt{a}(1-a)}+\frac{\sqrt{a}-1}{\sqrt{a}(1+\sqrt{a})}$$

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

19. **(B)** Statements I and II are correct, while statement III,if n = 2 then

$\sqrt{n-1}=\sqrt{2-1}=\sqrt{1}=1$ and 1 is not irrational.

20. **(C)** It is evident that 6 lines can be drawn through three non-collinear points.

21. **(A)** We have,

$3x^2 + 2x + 1 = 2x^2 + 1 + 3x + 6$

[exterior angle = sum of non-adjacent interior angles]

$x^2 - x - 6 = 0$

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

$x = 3, -2$

We take x = 3 [+ve value]

$3x^2 + 2x + 1 = 3 \times 3^2 + 2 \times 3 + 1$

$= 27 + 6 + 1 = 34°$

$\therefore \angle ABC = 180° - 34° = 146°$

22. **(A)** $5x + 3x + 7x = 180°$

$\Rightarrow 15x = 180°$

$\Rightarrow x = 12$

$\therefore$ Three angles of the triangle are

$5x = 5\ (12) = 60°$

$3x = 3\ (12) = 36°$

$7x = 7\ (12) = 84°$

Three angles are acute

Hence, the triangle is acute angled triangle.

23. **(A)** ΔAFE and ΔDBC,

AB = CF

$\Rightarrow$ AB + BF = BF + CF

$\Rightarrow$ AF = CB

EF = BD and $\angle AFE = \angle DBC$

$\therefore \Delta AFE \cong \Delta CBD$ [by SAS criterion]

24. **Deleted**

25. **(D)** $(x - a)^3 + (x - b)^3 + (x - c)^3 - 3(x - a)(x - b)(x - c)$

As $a^3 + b^3 + c^3 - 3abc$

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

$= (x - a + x - b + x - c)((x - a)^2 + (x - b)^2 + (x - c)^2 - (x - a)(x - b) - (x - b)(x - c) - (x - c)(x - a))$

$\Rightarrow (3x - (a + b + c))((x - a)^2 + (x - b)^2 + (x - c)^2 - (x - a)(x - b) - (x - b)(x - c) - (x - c)(x - a))$

$= (3x - 3x)((x - a)^2 + (x - b)^2 + (x - c)^2 - (x - a)(x - b) - (x - b)(x - c) - (x - c)(x - a))$

$= 0$

Physics

26. **(A)** Sound waves are reflected off the walls of the tube which makes the sound clearer. The other options are incorrect.

27. **(A)** When the mass to be pulled becomes twice and force supplied is same, acceleration 'a' becomes half (a = F/m) i.e., $2m/s^2$.

28. **(B)** Density of rectangular block =

$$\frac{\text{Mass of block}}{\text{Volume of block}}$$

$$= \frac{240\ g}{6x10x2cm} = \frac{240\ g}{120cm} = 2\ g\ cm^{-3}$$

29. **(C)** Mass of the car 'm' = 1000 kg

Initial velocity 'u' = 54 km/hr = 54 × 1000 ÷ 3600 = 15 m/s

Since the car comes to a stop, the final velocity 'v' = 0

Acceleration = $\frac{v-u}{t}$ ('t' is the time taken for the car to stop)

$$= \frac{0-15}{5} = -3m/s^2$$

(i.e., deceleration = 3 m/s^2)

Force exerted by the car on the tree = m × a = 1000 × (3) = 3000 N.

30. **(C)** The ascending order of the speed of sound is nitrogen, water and steel.

31. **(D)** In a circular track,

(i) Distance covered in 1/2 revolution

$$= \frac{2\pi r}{2} = \pi r$$

(ii) Displacement in half revolution = 2r.

We have r = 1, ∴ Ratio = π:2.

32. **(C)** Energy is measured in joules and power is measured in watts.

33. **(B)** If a = Area of cross section of fat hose pipe and v is the velocity of water flowing out through a constricting nozzle, then forward push is to be applied by fireman to hold the pipe = change in momentum per sec = Mass flowing out per sec × velocity. When the water is delivered at 2 litres/sec instead of 1 litre/sec, the speed is doubled. Therefore, forward push has to be made 4 times.

34. **(A)** Time = Distance / Speed

= 30 / 330

= 0.09 s

35. **(B)** Total time of motion on circular track = 2 × 60+20 = 140 s. Time period of revolution = 40 s. Therefore, displacement in time(= 3 × 40 = 120 s) = zero as athelete will be reaching at the starting point.

Thus, displacement in 140 seconds = displacement in 20 seconds = 2 R.

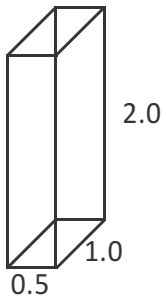
36. **(C)** Kinetic energy = $\frac{1}{2}mv^2$

As both the balls are falling through the same height, they possess same velocity.

But KE ∝ m (If v = constant)

$$\therefore \frac{(KE)_1}{(KE)_2} = \frac{m_1}{m_2} = \frac{2}{4} = \frac{1}{2}$$

37. **(B)**



Weight of block=300 kg×10 N/kg = 3000 N

Force on ground = 3000 N

To exert minimum pressure, the block must be resting on the side with the biggest area i.e., the side measuring 2.0 m × 1.0 m.

Area = 2.0 m × 1.0 m = 2.0 m^2

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{3000}{2.0} = 1500\ Pa$$

Minimum pressure is 1500 Pa.

38. **(C)** Height of each step = 24 cm = 0.24 m

Total height of 15 steps =0.24 × 15 = 3.6 m

Gravitational potential energy gained = work done

∴ work done = mgh = 45×10×3.6 = 162 J.

Power required =

$$\frac{\text{Workdone}}{\text{time}} = \frac{1620}{30} = 54\ W$$

39. **(B)** Time taken = 60 h

= (60 × 60) min

= (60 × 60 × 60) s

= 216000

Average speed = 380000 / 216000

= 1.76 km/s

40. **(B)** When a particle moving at constant speed is being applied by a pair of equal and opposite forces, the resultant force is zero. Since, there is no resultant force, there will not be any acceleration. The particle will continue with its speed of 5 m s^{-1}.

41. **(D)** If the initial velocity of the body is zero or positive, then for an accelerating body, its speed may increase. If the initial velocity of the body is negative, then for an accelerating body, its speed may decrease. When a body is having a uniform circular motion, it is having centripetal acceleration and uniform speed.

42. **(C)** Weight = mass×gravitational field strength

i.e., weight = m × g

500 = m × 10

$$\therefore m = \frac{500}{100} = 50\ kg$$

Mass of the object will be same on the moon = 50 kg

Weight of the object on the moon = 50 x 1.6 = 80 N

43. **(C)** The speed of light (flash) is much greater than the speed of sound.

44. **(D)** The resultant force on the object shown in option (D) 80 N – 30 N = 50 N.

Option (A): The resultant force on the object is 20 N + 20 N = 40 N (add the two forces if they are applied in the same direction).

Option (B): The resultant force on the object is 30 N – 20 N = 10 N (subtract the two forces if they are applied in opposite directions).

Option (C): The resultant force on the object is 25 N – 5 N = 20 N (Subtract the two forces if they are applied in opposite directions).

45. **(B)** Density of the liquid = Mass / Volume

= 180 / 200

= 0.9 g/cm^3

The plastic foam and the cork have densities lower than 0.9 g/cm^3 and so they float on the liquid. Glass and copper sink as their densities are greater than 0.9 g/cm^3

46. **(B)** W = F S $\cos\theta$ = 100 × 10 cos 45°

$$= \frac{1000}{\sqrt{2}} = 707.1\ J.$$

47. **(C)** The range of hearing of the human ear is 20 Hz to 20kHz. Below or above this range sounds are inaudible (cannot be heard). The only sound in the human range is the hoot of an owl.

Options (A) and (B): The bat (30 kHz) and elephant sound (5 Hz) are outside the range of human hearing which is 20 Hz to 20 kHz.

48. **(C)** $S = ut + \frac{1}{2}at^2$

$$h = 0 + \frac{1}{2}at^2$$

$$x = 0 + \frac{1}{2}a\left(\frac{T}{2}\right)^2 = \left(\frac{1}{2}aT^2\right) \times \frac{1}{4}$$

$= \frac{h}{4}$ from top i.e., $\frac{3h}{4}$ metre from the ground.

49. **(D)** From v = u + at = 0 + 9·8×3 = 29·4 m/s

K.E. $= \frac{1}{2} m v^2 = \frac{1}{2} \times 3 \times (29 \cdot 4)^2 = 1296 \cdot 5$ J

50. **(A)** Total momentum of the balls before collision

= (0.3 × 4) + (0.2 × 2) kg m s^{-1}

= 1.2 + 0.4 kg m s^{-1}

1.6 kg m s^{-1}

Total momentum of the balls after collision

= (0.3 + 0.2) x *v* kg m s^{-1}

= 0.5*v* kg m s^{-1}

Based on the principle of conservation of momentum.

= 0.5*v* = 1.6

$$v = \frac{1.6}{0.5} = 3.2\ m\ s^{-1}$$

Chemistry

51. **(B)** The number of protons is always equal to the number of electrons in an atom. Only Option (B) shows a difference in the number of protons vs electons, which is incorrect.

52. **(C)** M_r of $H_2O = 2 \times 1 + 16 = 18$

Amount of H_2O in 72 g = $\frac{72}{18}$ = 4 moles

Therefore, there are 4 moles of oxygen atoms. Mass of oxygen = $4 \times 16 = 64$ g.

53. **(B)** The molecules from cooking have diffused from a region of higher concentration (the kitchen) to a region of lower concentration (the rest of the house).

54. **(C)** According to Avogadro's law, 1 mole of any substance contains 6×10^{23} particles. Therefore, 1 mole of ethanol contains 6×10^{23} ethanol molecules and 1 mole of ethane contains 6×10^{23} ethane molecules.

55. **(D)** Bronze is a mixture of elements. Sodium chloride is a compound. Air is a mixture of elements and compounds. A sports drink is a mixture of compounds in water, such as sugar, sodium chloride, citric acid and vitamin C.

56. **(D)** The number of air (gas) particles do not change on applying pressure. There is a lot of space between the particles of a gas. We can reduce the spaces (or distances) between the particles of a gas by enclosing it in a cylinder and compressing it by pushing the piston. If enough force (or pressure) is applied on the piston, the gas is highly compressed (into a small volume). The particles of air get close together. As volume decreases, density of air increases.

57. **(A)** Protons and neutrons have nearly the same mass so they are balanced on a beam balance.

Option (B): An electron is much lighter than the proton, so the beam balance will not remain horizontal.

Option (C): The total mass of neutron and the electron is greater than the mass of the proton. Therefore, the beam balance will not remain horizontal.

Option (D): An electron is much lighter than the neutron, so the beam balance will not remain horizontal.

58. **(C)** The presence of impurities in a pure substance can increase the boiling point of the substance and decrease its melting point. For example when a little salt is added to pure water, the water will boil at a temperature higher than 100° C and will freeze at a temperature lower than 0° C.

59. **(B)** All the three particles F^-, Ne and Na^+ have a total of 8 electrons i.e., a configuration of 2, 8.

60. **(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.

61. **(A)** Matter has mass and occupies space but non-matter has no mass and does not occupy space.

Thunder, shadow and music are non-matter.

Clouds consists of tiny droplets of water that are gathered together.

Snow is water in the solid state.

Wind is moving air. Air is a mixture of gases.

62. **(C)**

Elements	Nucleon number	No. of protons	No. of neutrons
^{31}P	31	15	16
^{32}S	32	16	16

63. **(A)** M_r of $CaO = 40 + 16 = 56$

M_r of $CaCO_3 = 40 + 12 + 3(16) = 100$

To form 56 g of CaO, 100 g of $CaCO_3$ is required. Therefore, to form 84 kg of CaO, mass of $CaCO_3$ required

$= \frac{84}{56} \times 100 = 150$ kg

64. **(B)** Air has no definite shape and no definite volume.

Air can spread out to occupy the whole space in a container. Air can also be compressed to occupy a smaller space.

The container with the smallest capacity will have the smallest volume of air in it, regardless of how much air is pumped into it.

65. **(B)** The number of sodium atoms/ions in the reactant should be the same as that in the product. The properties of the compound are usually different from those of its components. Sodium metal burns in air to form sodium oxide not sodium chloride. Sodium chloride can be broken down to form sodium and chlorine via electrolysis.

66. **(C)** Sand is made up of silicon and oxygen.

67. **(B)** A pure substance has a fixed melting and boiling point at the same atmospheric pressure.

68. **(C)** The purple colour from the potassium permanganate would diffuse evenly throughout the whole beaker.

Options (A), (B) and (D): The purple colour from the potassium permanganate will diffuse evenly throughout the whole beaker and not divide themselves into two columns, or settle as two layers of liquids.

69. **(D)** 1 mole of hydrated copper (II) sulphate crystals dissolve in water to form 1 mole of copper (II) ions, 1 mole of sulphate ions and 5 moles of water molecules.

70. **(C)** X can be compressed, so it is a gas.

Y cannot be compressed, so it is not a gas. It can be a liquid or a solid.

Biology

71. **(D)** Plant cells are different from animal cells by the presence of a cell wall (P), a large vacuole (R) and chloroplasts (U). The other structures, cell membrane (Q), nucleus (S) and mitochondrion (T), are found in both plant and animal cells.

72. **(C)** Due to girdling, phloem is removed. Hence, sugar and other materials will not move downwards and roots die due to starvation.

73. **(B)** Plastids are semi-autonomous, double membrane bound organelles with pigments.

74. **(B)** Xylem and phloem are complex tissues.

75. **(D)** X - Bacterial cell, Y - Amoeba, Z - Sperm.

76. **(B)** Rhizobium is a symbiotic bacteria present in the root nodules of legumes.

77. **(C)** In arthropods echinoderms and molluscs pump blood into a hemocoel with the blood diffusing back to the circulatory system between cells.

78. **(B)** P is cytoplasm. It is the space present between the plasma membrane and the nucleus. It is filled by an amorphous, translucent, homogeneous, colloidal liquid.

It consists of 90% water, 7% proteins 2% carbohydrates and lipids and 1% inorganic materials, minerals, vitamins etc.

79. **(D)** In order for water molecules to move from X to Y, Y must have a lower water potential than X and will therefore be more concentrated than X.

80. **(C)** Hydra which belongs to phylum Coelenterata and is also called as coelenterate. It is mostly marine. Hydra is a freshwater coelenterate. Its body encloses a single central cavity called coelenteron or gastrovascular cavity that help in digestion and circulation.

They are radially symmetrical (animal that can be bisected in more or less any plane that passes through the centre) and diploblastic (body wall made of two layers) animals.

81. **(B)** Figure in option (B) is leucocyte.

82. **(C)** Option (C) is ciliated epithelium, the functions of ciliated epithelium cells is to move secretions and foreign bodies away with a certain rapid directions of speed.

83. **(C)** Pore bearing animals - Porifera

Diploblastic - Coelenterate

Metameric segmentation - Annelida

Jointed legs - Arthropoda

84. **(A)** Common cold is a viral disease. Amoebic dysentery is caused by a protozoan Entamoeba histolytica. Anthrax is a bacterial disease, atheletes foot is due to fungus.

85. **(A)** Fungus are a group of organisms with a definite cell wall. It lacks chlorophyll and build up of a single cell or many cells. The reserve food material is in the form of glycogen.

86. **(D)** In the given oxygen cycle X is photosynthesis and Y is respiration.

87. **(A)** S is ribosome. Ribosome is a single or one membrane bound organelle.

88. **(C)** Osmosis is the spontaneous movement of solvent molecules through a semi-permeable membrane into a region of high solute concentration to a region of solute concentration to equalize it.

89. **(C)** The technique used to obtain new variety with desirable characters is called hybridization.

90. **(D)** p - RBCs help in transport of oxygen.

q - WBCs help in the production of antibodies.

r - Platelets help in blood clotting.

91. **(D)**

92. **(A)**

93. **(D)**

94. **(B)**

95. **(B)**

96. **(B)**

97. **(C)**

98. **(C)**

99. **(A)**

100. **(C)**