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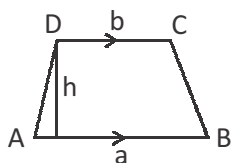
NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN415

Solutions for Class : 9

Mathematics

1. (C)



Given, area of ABCD = $a^2 - b^2$

$$\text{Area of ABCD} = \frac{1}{2}(a + b) \times h$$

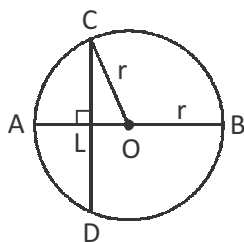
$$\Rightarrow a^2 - b^2 = \frac{1}{2}(a + b)h$$

$$\Rightarrow (a+b)(a-b) = \frac{1}{2}(a+b)h$$

$$\therefore h = 2(a - b)$$

Hence, the distance between the parallel lines is $2(a - b)$.

2. (D)



AL : LB = 1 : 2 and AB = 2r

$$\therefore x + 2x = 2r \text{ or } x = \frac{2}{3}r$$

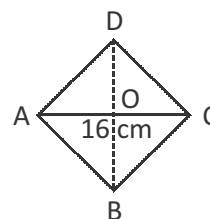
$$\Rightarrow LO = AO - AL = r - \frac{2}{3}r = \frac{1}{3}r$$

$$\text{In } \Delta CLO, OC^2 = CL^2 + LO^2$$

$$\text{or } CL^2 = OC^2 - LO^2 = r^2 - \frac{1}{9}r^2$$

$$\text{or } CL = \sqrt{\frac{8}{9}r^2} = \frac{2\sqrt{2}}{3}r \therefore CD = 2CL = \frac{4\sqrt{2}}{3}r$$

3. (C)



$$OA = OC = 8 \text{ cm}$$

Given, BC = 10 cm

$$\therefore OB = \sqrt{BC^2 - OC^2}$$

$$= \sqrt{100 - 64} = \sqrt{36} = 6 \text{ cm}$$

$$\Rightarrow OB = OD = 6 \text{ cm}$$

$$BD = OD + OB$$

$$= 6 \text{ cm} + 6 \text{ cm} = 12 \text{ cm}$$

\therefore The length of diagonal BD = 12 cm.

4. (A)

Sum of any two sides of a triangle is always greater than the third side.

Given length of side = 12 cm

$$(A) (4.8 + 8.2) \text{ cm} = 13 \text{ cm}$$

$$(B) (3.2 + 6.5) \text{ cm} = 9.7 \text{ cm}$$

$$(C) (29 + 7.2) \text{ cm} = 10.1 \text{ cm}$$

$$(D) (4.1 + 3.9) \text{ cm} = 8 \text{ cm}$$

Hence, the possible values of other two sides are 4.8 cm and 8.2 cm

5. (C)

It is evident that 6 lines can be drawn through three non-collinear points.

6. (D)

Given $x = 2, y = -2$

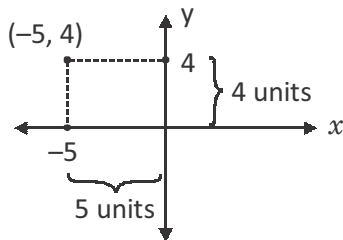
$$x - y^{x-y} = 2 - (-2)^{2-(-2)}$$

$$= 2 - (-2)^{(2+2)} = 2 - (-2)^4$$

$$= 2 - 16$$

$$= -14$$

7. (B)



The co-ordinates of the point are $(-5, 4)$.

8. (A)

$$6x + 1 > 7 - 4x$$

$$10x > 6$$

$$x > \frac{6}{10}$$

$$x > \frac{3}{5}$$

9. (B)

$$\angle PQS + \angle FSQ = 180^\circ$$

$$\Rightarrow \angle FSQ = 180^\circ - 60^\circ \quad \angle FSQ = 120^\circ$$

$$\text{and } \angle RFE = \angle FSQ = 120^\circ$$

[Corresponding angles since $EF \parallel QS$]

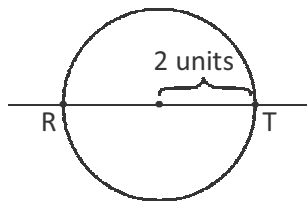
10. (C)

When the diagonals of a quadrilateral PQRS are perpendicular.

The quadrilateral, formed by joining the mid-points of its sides, is a rectangle.

11. (D)

The maximum distance between the points R and T is the length of the diameter of the circle.



\therefore Maximum distance between R & T

$$= 2(r)$$

$$= 2 \times 2 \text{ units}$$

$$= 4 \text{ units}$$

12. (B)

Given perimeter of a rhombus is 52 cm, each side of the rhombus $= \frac{52}{4} = 13 \text{ cm}$.

Area of rhombus

$$= 2\sqrt{25(25-24)(25-13)(25-13)}$$

$$= 120 \text{ sq.cm.}$$

$$\text{Area} = \frac{1}{2} \times \text{product of diagonals}$$

$$\Rightarrow 120 = \frac{1}{2} \times 24 \times d \Rightarrow d = 10 \text{ cm}$$

\therefore The other diagonal is 10 cm.

13. (B)

Given, $\triangle ABC \cong \triangle DEF$ by S.S.S.

Congruence $\Rightarrow \angle A = \angle D$

$$\angle B = \angle E$$

$\angle C = \angle F$ [Corresponding parts of congruent triangles.]

14. (A)

$$\text{Let } p(x) = x^{2015} + 2015$$

$$\Rightarrow p(-1) = (-1)^{2015} + 2015$$

$$= (-1) + 2015 = 2014$$

15. (C)

$$x^{x\sqrt{x}} = (x\sqrt{x})^x$$

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

$$\Rightarrow x^{x^{\frac{3}{2}}} = x^{\frac{3x}{2}}$$

Since, the bases are equal powers are also equal.

$$x^{\frac{3}{2}} = \frac{3x}{2}$$

$$\Rightarrow x \cdot (x)^{\frac{1}{2}} = \frac{3x}{2}$$

$$\Rightarrow x = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

16. (A)

Height of triangle = 9 units

PQ = 4 units

$$\text{Area of } \triangle PQR = \frac{1}{2} \times 9 \times 4$$

$$= 18 \text{ sq. units}$$

17. (A)

Exterior angle of a triangle is equal to sum of interior opposite angles.

Let x & y be the other two angles.

$$\Rightarrow 35^\circ + x = 115^\circ$$

$$\Rightarrow x = 80^\circ$$

$x + y + 35^\circ = 180^\circ$ (Sum of angles in a triangle)

$$\Rightarrow y = 180^\circ - 35^\circ - 80^\circ = 65^\circ$$

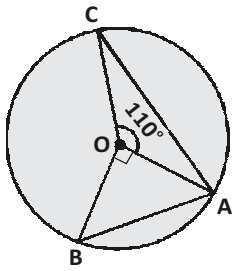
\therefore The other two angles are $80^\circ, 65^\circ$.

18. (C)

The area of parallelogram ABCD

$$= DC \times DL.$$

19. (B)



$$\angle OAC = \frac{180^\circ - 110^\circ}{2} = 35^\circ$$

$$\angle OAB = \frac{180^\circ - 90^\circ}{2} = 45^\circ$$

$$\angle BAC = 35^\circ + 45^\circ = 80^\circ$$

20. (C)

$$x^3 + y^3 + z^3 - 3xyz = K(x + y + z)[(x - y)^2 + (y - z)^2 + (z - x)^2]$$

$$= K(x + y + z)[x^2 + y^2 - 2xy + y^2 + z^2 - 2yz + z^2 + x^2 - 2xz]$$

$$= K(x + y + z)[2x^2 + 2y^2 + 2z^2 - 2xy - 2yz - 2xz]$$

$$= 2K(x + y + z)(x^2 + y^2 + z^2 - xy - yz - xz)$$

Hence, K must be equal to $\frac{1}{2}$.

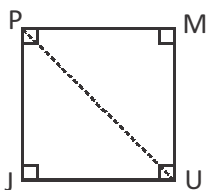
21. (D)

$$3x - 5 + p = qx + 1 \Rightarrow (3 - q)x + p = 6$$

Comparing the coefficients on both the sides $3 - q = 0$ and $p = 6 \Rightarrow q = 3$

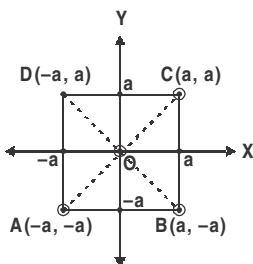
\therefore If $q = 3$, the coefficient of x will be cancelled on both the sides, i.e., x will vanish. Thus, for unique solution $q \neq 3$.

22. (A)



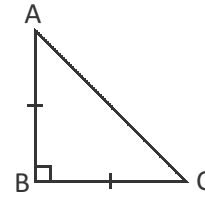
$$\angle JUP = \frac{1}{2}(90^\circ) = 45^\circ = \angle PUM$$

23. (D) Given points are $A(-a, -a)$, $B(a, -a)$, $C(a, a)$ and $D(-a, a)$



Hence, it is clear that the given points form a square and the origin lies at the point where the diagonals of the square intersect.

24. (A)



Given area of $\Delta ABC = 8 \text{ cm}^2$

$$\Rightarrow \frac{1}{2} \times AB \times BC = 8 \text{ cm}^2$$

$$\Rightarrow (AB)^2 \times 16 \text{ cm}^2 (\because AB = BC)$$

$$\Rightarrow AB = 4 \text{ cm} = BC$$

$$AC^2 = AB^2 + BC^2$$

$$\Rightarrow AC^2 = (4)^2 + (4)^2$$

$$\Rightarrow AC^2 = (16 + 16) \text{ cm}^2$$

$$\Rightarrow AC = \sqrt{32} \text{ cm}$$

25. (D)

(Total area of square – sum of the areas of triangles ADE and DCF) will give the area of the quadrilateral.

$$9 - (2 \times \frac{1}{2} \times 3 \times 1.5) = 4.5 \text{ cm}^2$$

Physics

26. (B)

Among the four given substances, mercury being the densest will settle first at the bottom of the measuring cylinder followed by glycerine. Ice and wood being lighter float in the measuring cylinder.

27. (B)

Two sounds are heard as the sound travels through the railing and the air. It travels through the railing (solid) much faster than through the air (gas).

28. (A)

Mass is the measure of inertia. The greater the mass of the object (or the heavier is the object), the more is its inertia. As object P has more mass than object Q, object P has more inertia than Q.

29. (D)

The overall force on the object is $80 \text{ N} - 30 \text{ N} = 50 \text{ N}$.

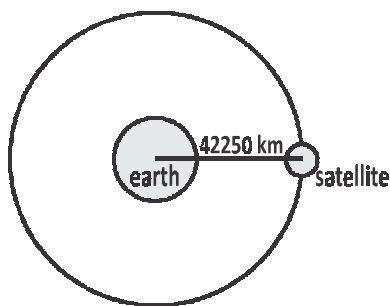
30. (C) At 8.30 am, the cyclist started from 0 km/h, i.e. from a stationary position. He accelerated until he reached a speed of 30 km/h at 9 am, then he travelled at a constant speed of 30 km/h from 9 am to 9.30 am. After that, he decelerated until he reached 0 km/h at 10 am. Constant speed is indicated by a horizontal line on the speed-time graph.

31. (A) Mass is different from weight. Weight depends on gravity. Even though the mass of the astronaut in option (A) is much bigger than the boy in options (B) and (C), but in outer space there is no gravity. Hence, the astronaut weighs the lightest.

32. (B) The tenth floor is at a distance of $10 \times 3 = 30$ metres from the ground floor. The lift travels this distance in 20 seconds. As

$$\text{speed} = \frac{\text{distance}}{\text{time}} = \frac{30\text{ m}}{20\text{ s}} = 1.5\text{ m/s.}$$

33. (B)



Radius of circular orbit (r) = 42250 km

\therefore Distance travelled in one revolution around the earth

$$= 2\pi r = 2 \times \frac{22}{7} \times 42250$$

= Time taken to revolve around the earth = 24 h

$$= 24 \times 60 \times 60\text{ s}$$

We know, Speed = $\frac{\text{Distance travelled}}{\text{Time taken}}$

$$= \frac{2 \times \frac{22}{7} \times 42250}{24 \times 60 \times 60} = 2 \times \frac{22}{7} \times \frac{42250}{24 \times 60 \times 60}$$

$$= 3.07\text{ km/s}$$

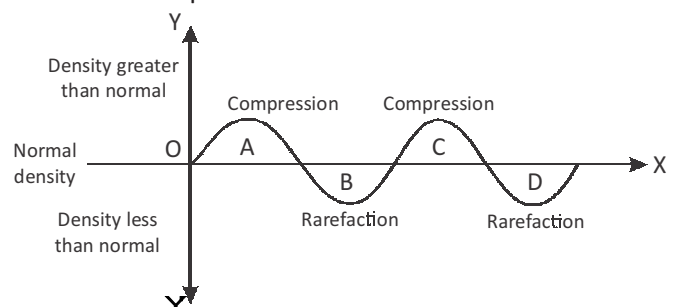
Thus, the speed of the artificial satellite revolving around the earth is 3.07 km/s.

34. (B) A guitar string stores potential energy. When a guitar string is plucked, potential energy is converted into kinetic energy (vibration) and sound energy.

35. (C) We cannot hear the sound on the moon because there is no material medium to propagate the sound. Sound travels through a medium that is continuous and elastic.

36. (A) When the girl is on the tree, she possesses gravitational potential energy. When she falls down due to the gravitational pull, her speed increases constantly. During the process, gravitational potential energy is converted into kinetic energy.

37. (B) Longitudinal wave is represented by density-distance graph as shown below. The horizontal line OX represents the normal density of air. All the points above this line represent greater density. In a compression of a longitudinal wave, the density of the particles is high. So, here A and C represent compressions. All the points below the line OX represent less density (than normal). In a rarefaction, the density of the particles is less than that in the normal. So, here B and D represent rarefactions.



38. (A) The mass, volume, and density of a matter will not change as they do not depend on gravity.

The relation between the mass, volume, and density, is given by:

$$\text{volume} = \text{mass} \div \text{density.}$$

$$\text{volume} = 79 \div 7.9$$

which gives us the volume of the rock to be 10 cm^3 .

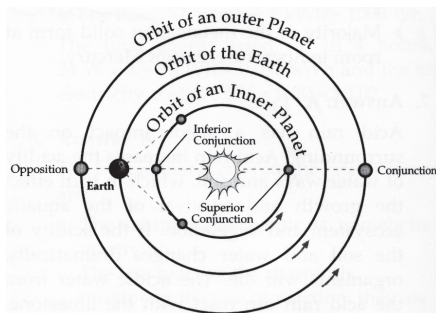
39. (C) When two equally strong forces act in opposite directions to each other (whether they are pulling or pushing), the total force is zero, and hence the box will not move. Option (D) is also impossible since the question has already stated that the two forces are equally strong, which implies that the total force is also zero.

Both of them can be weak forces, but as long as they do not act in opposite directions to each other, the box will move.

40. (B) Work done is the product of the applied force and the distance moved by the object in the direction of the force. When the object is at rest, there is no distance covered and therefore there is no work done.

41. (A) Being light, the momentum of the tennis ball is very small as compared to that of a cricket ball and a basket ball. Hence, the force required to catch the tennis ball is very small. So, it is easier to catch it in motion.

42. (A)



The motion of the planets in the solar system is governed by Kepler's laws. The third Kepler's law states that the time taken for a planet to orbit the Sun (which is called the period), depends on the distance between the planet and the Sun (or the radius); the longer the distance, the longer the period, and vice versa.

Since the outer planets have longer orbital radius, they have longer period as well. The period is not affected by the mass of the planet.

43. (D) Compression is the region of high pressure and rarefaction is the region of low pressure. Pressure is related to the number of particles of a medium in a given volume. More density of the particles in the medium gives more pressure and vice versa. Thus, propagation of sound is based on density or pressure variations in the medium.

44. (B) The smallest force needed will be equal to the weight of the cup of tea, which is $0.5 \text{ kg} \times 10 \text{ m/s}^2 = 5 \text{ Newton}$.

45. (C) The hands of a clock are in uniform motion and cover equal distances in equal intervals of time however small the time intervals may be.

46. (C) When the paper ball is being released in air, the paper has an initial speed of 0 m s^{-1} and an acceleration of 10 m s^{-2} . As it travels through air due to the gravitational acceleration, the air resistance will go against the paper ball and the acceleration decreases. Although the acceleration decreases, the paper ball is still increasing its speed but at a lower rate as before (decreasing acceleration)

47. (D) Work done by a man in holding a suitcase while waiting for a bus, i.e. he is in stationary position. As there is no displacement, no work is done by him.

48. (D) $0.05 \text{ kHz} = 50 \text{ Hz}$ and it is the lowest frequency and therefore has the lowest pitch. The other options have a higher pitch than this.

49. (B) The density of oil, icebergs and air bubbles is less than that of water having a density of 1 g cm^{-3} . Hence, they float. Pebbles have more density than water, so they sink in water.

50. (C) Work done = 30 J
Time taken = 5 s

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}} = \frac{30 \text{ J}}{5 \text{ s}} = 6 \text{ J/s} = 6 \text{ W}$$

Chemistry

51. (A) Atomic number: 12 (number of protons)
The number of protons of every atom is equal to the number of electrons. Therefore, initially, magnesium has 12 protons and 12 electrons. However, positively charged magnesium indicates the loss of electrons. The formation of ions only involves the releasing or gaining of electrons by the atom. To have a +2 charge, magnesium will need to lose two electrons. Positively charged magnesium ions will therefore have 10 electrons in total.
52. (B) At 80° C, Substance Z is at its liquid state as it has passed its freezing point.
At 600° C, Substance Z is at its gaseous state as it has passed its boiling point.
53. (D) It has 13 protons, i.e., its proton number is 13, indicating it is aluminium. There is a net charge of +3, hence it is an Al^{3+} ion.
54. (D) A mixture of starch and water is a colloidal solution.
55. (B) Potassium and chlorine react to form K^+ and Cl^- ions of 2.8.8 electronic configuration, which is similar to that of argon (proton number 18).
56. (A) Solubility of a solute (salt) with its solvent (water) varies with temperature. Generally, the higher the temperature the more soluble the salt is.
57. (D) There are spaces between the particles of water and alcohol. When they are mixed together, the water and alcohol particles move into these spaces. This causes the final volume to be less than 100 ml.
58. (A) Isotopes are atoms with the same atomic number (same atomic number means same element), but with different number of neutrons. X and Y have the same atomic number of 17, but their neutrons are $(35 - 17 =)$ 18 and $(37 - 17 =)$ 20 respectively.
59. (C) Distillation: To separate two soluble/miscible liquids with different boiling points. The liquid with lower boiling point distils over first and the liquid having higher boiling point distils later.
60. (B) 6.022×10^{23} molecules of CO_2 correspond to mass = 44 g
 3.011×10^{23} molecules of CO_2 correspond to mass = 22 g
61. (A) The lithium atom has 1 valence electron. The 3 electrons are arranged in 2 shells, indicating the two different energy levels they are in.
62. (C) When a mixture of salt, sand and ammonium chloride is heated in a china dish by covering an inverted glass funnel on it. Ammonium chloride changes into white vapours which rise up and on cooling get converted into solid ammonium chloride. Salt and sand are added to water. Salt is soluble and sand is insoluble. The salt solution is separated by filtration and sand is obtained as residue on the filter paper. The salt solution is evaporated in a china dish. Water evaporates leaving behind salt crystals.
63. (C) Charge of X = 0
Number of protons = 8
Number of electrons = number of protons = 8
Number of neutrons = atomic mass - number of protons = $17 - 8 = 9$
64. (D)
- | Ion | Electronic configuration | No. of shells occupied |
|------------------|--------------------------|------------------------|
| S^{2-} | 2, 8, 8 | 3 |
| Al^{3+} | 2, 8 | 2 |
| N^{3-} | 2, 8 | 2 |
| Be^{2+} | 2 | 1 |
65. (B) The number of neutrons is given by the difference between the nucleon number and the proton number. In this case, all of them have 20 neutrons.
66. (C) The correct relative mass of sulphur is 32, oxygen, 16, and carbon, 12.
67. (D) Fractional distillation cannot be used to test the purity of a substance.

68. (C) The bubbly texture of carbonated soda is due to presence of carbon dioxide dissolved in the drink. When the cap is still closed, the pressure inside the bottle is higher, keeping the carbon dioxide dissolved in the drink. However, when the cap is opened, the pressure in the bottle decreases, allowing the carbon dioxide to slowly escape from the drink.
69. (A) Eventhough a part of the ice-cube floats above the surface, the water level in the glass is exactly the same before and after the ice has melted. 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.
70. (A) The can is a solid. The 'fizz' of the fizzy (carbonated) drink is a gas. The drink is a liquid.
- Biology***
71. (C) Stomata is absent in Xerophytic plants.
72. (B) The number of chromosomes are fixed for a particular species.
73. (B) Earthworm belong to Annelida.
74. (B) Meristematic tissues of plants include stem and root tips, internodes of stem and cork cambium.
75. (D) Deforestation increases air pollution, destruction of habitats and mineral salts in the soil are washed away.
76. (D) P represents cytoplasm, Q - cell wall and R - nucleus.
77. (D) Lysosomes are concerned with the waste disposal system of the cell.
78. (A) Echinoderms have the water vascular system as a distinctive feature.
79. (A) Hepatitis is a communicable disease.
80. (C) The figure in option C is of bone cell.
81. (A) The movement of water from higher concentration of water molecules to lower concentration is called osmosis.
82. (A) Hen's egg is a single cell.
83. (C) Pteridophytes are the vascularised plants without seeds. Gymnosperm and angiosperm are the vascularised plants with seeds.
84. (C) Binomial system of nomenclature means that every organism has one scientific name and one species name.
85. (C) Earthworm contains nerve cell.
86. (B) In mitochondria cellular respiration takes place.
87. (B) Lock jaw or tetanus is a bacterial disease.
88. (C) Stomata helps in the exchange of gases.
89. (C) The association between fungi and roots of higher plants is called Mycorhiza
90. (C) The figure in option C represents the shape of a red blood cell. It is disc shaped. Due to its shape it is able to roll or move easily in blood vessels and help in exchange of gases.

