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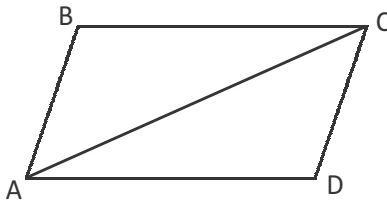
NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN 421

Solutions for Class : 9

Mathematics

1. (D)



Diagonals divide the parallelogram into two congruent Δ les.

In a Δ le the sum of any two sides must be greater than the third side.

So, the length of the diagonal must be less than $7\text{ cm} + 4\text{ cm} = 11\text{ cm}$.

2. (D)

Join OB, Then $\angle OBA = 90^\circ$

$$AB^2 + OB^2 = AO^2$$

$$\therefore OB = AB = 2\text{ cm}$$

$$\text{Hence } AO^2 = 2^2 + 2^2 \text{ or } AO = 2\sqrt{2}\text{ cm}$$

$$\therefore AC = AO + OC = (2\sqrt{2} + 2)\text{ cm}$$

3. (B)

$$\Delta ABC \cong \Delta PQR \Rightarrow CA = RP$$

4. (A)

From ΔABC and ΔDEF ,

$$\angle A + \angle B + \angle C = 180^\circ \text{ and}$$

$$\angle D + \angle E + \angle F = 180^\circ .$$

$$\therefore \angle A + \angle B + \angle C + \angle D + \angle E + \angle F = 360^\circ$$

5. (A)

$$x + \frac{1}{x} = a + b \text{ and } x - \frac{1}{x} = a - b$$

$$\Rightarrow 2x = 2a \Rightarrow x = a$$

$$\text{Similarly, } \frac{2}{x} = 2b \Rightarrow \frac{1}{x} = b$$

$$\therefore x \times \frac{1}{x} = a \times b \Rightarrow ab = 1$$

6. (A)

A median divides the triangle into two triangles of equal area.

7. (A)

Rationalizing factor of $\sqrt[n]{a^p}$ is $\sqrt[n]{a^{n-p}}$ or $a^{1-\frac{p}{n}}$ where $n > p$.

$$\therefore \text{R.F. of } \sqrt[5]{a^2b^3c^4} = \sqrt[5]{a^3b^2c}$$

8. (B)

I and IV quadrants have a positive abscissa.

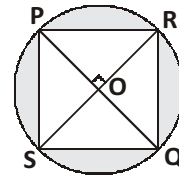
9. (C)

The points of the form $(p, p) \forall p \neq 0$ always lies on the line $y = x$.

e.g., $(5, 5)$ $(16, 16)$ etc., have their x and y coordinates same. So, they lie on the line $y = x$.

10. (C)

Let the diagonals meet at O as shown in the figure.



$$\angle POS = \angle ROQ = 90^\circ$$

Also $OP = OQ = OS = OR$, i.e., the diagonals are equal and bisect at right angles. Clearly, PQRS is a **square**.

11. (C)

By equating the given sides of the equilateral triangle, we get $a = 3$, $b = 4$.

$$\text{Each side of the triangle} = 2a - b + 5 = 7$$

Area of an equilateral triangle

$$= \frac{\sqrt{3}}{4} (\text{side})^2$$

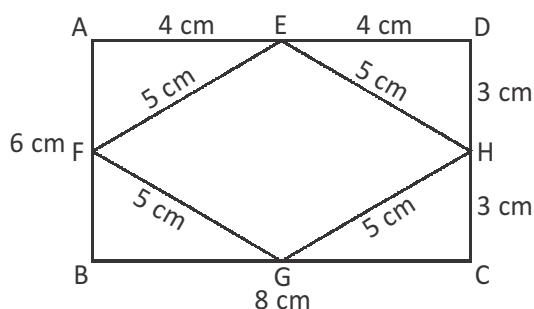
$$= \frac{\sqrt{3}}{4} (7)^2$$

$$= \frac{\sqrt{3}}{4} (49)$$

∴ The required area of the triangle

$$= \frac{\sqrt{3}}{4} \times 49.$$

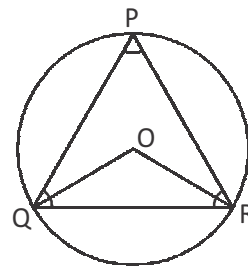
12. (C) Given, $AD \perp BC \Rightarrow BD = DC$
 In $\triangle ABD$ and $\triangle ACD$
 $BD = DC$ (Given)
 $AD = AD$ (Common side)
 $\angle ADB = \angle ADC = 90^\circ$
 $\triangle ABD \cong \triangle ADC$ [S.A.S. congruence]
 $\Rightarrow AB = AC$
13. (D) Here $p - 10^\circ + p - 5^\circ + p - 15^\circ + p - 30^\circ = 180^\circ$
 $\Rightarrow p = \frac{240^\circ}{4} = 60^\circ$
14. (A) Given $(x - 2)$ is a factor of $x^2 + ax - 6$ and $x^2 - 9x + b = 0$
 $x^2 + ax - 6 = 0$
 $\Rightarrow (2)^2 + a(2) - 6 = 0$
 $\Rightarrow 2a = 2$
 $\Rightarrow a = 1$
 $x^2 - 9x + b = 0$
 $\Rightarrow (2)^2 + 9(2) + b = 0$
 $\Rightarrow b = -14$
 $\therefore a + b = 1 - 14 = -13$
15. (D) The given equation $px + qy + r = 0$ is a linear equation in two variables if $p \neq 0$ and $q \neq 0$.
16. (D) Let ABCD be the rectangle with sides 8 cm and 6 cm.



The midpoints of the adjacent sides of ABCD are joined forming a Rhombus EFGH.

$$\begin{aligned} \text{Area of Rhombus} &= \left(\frac{1}{2} \times 6 \times 8 \right) \text{cm}^2 \\ &= 24 \text{ cm}^2 \end{aligned}$$

17. (B)



$\triangle PQR$ is an equilateral triangle.

$$\Rightarrow \angle PQR = \angle QRP = \angle QPR = 60^\circ$$

and $\angle QOR = 2\angle QPR = 2(60^\circ) = 120^\circ$

$$\therefore \angle QOR = 120^\circ$$

18. (C)

$$10^x = 64$$

$$10^{\frac{x}{2}+1} = 10^{\frac{x}{2}} \times 10^1$$

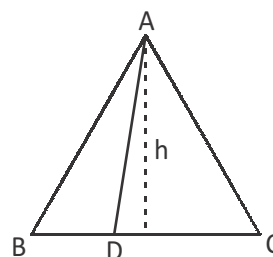
$$= \sqrt{10^x} \times 10$$

$$= \sqrt{64} \times 10 = 80$$

19. (D)

A line segment has two end points, so it cannot be produced indefinitely on either side. It has a fixed length.

20. (D)



'D' divides BC in ratio 3 : 5

$$\text{Area of } \triangle ABC = \frac{1}{2} \times BC \times h$$

$$\text{and } BD = \frac{3}{8} (BC)$$

$$\text{Area of } \triangle ABC = \frac{1}{2} \times \left(\frac{3}{8} BC \right) \times h$$

$$= \frac{3}{8} (\text{ar}(\triangle ABC))$$

$$\therefore \text{Area of } \triangle ABC = \frac{8}{3} \times \text{ar}(\triangle ABC)$$

21. (B) Sum of first 2016 positive odd integers
 $= 1 + (1 + 2) + (2 + 3) + (3 + 4) + \dots + (2014 + 2015) + (2015 + 2016)$

In the above sequence, the sum of 1st and last term, 2nd and 2nd last term and so on are equal. Thus, we get 1008 (i.e., $2016 \div 2$) terms having value $(2016 + 2016)$

$$\Rightarrow \text{Sum} = 1008 (2016 + 2016)$$

$$= 1008 \times 2016 (1 + 1)$$

$$= 1008 \times (2 \times 1008) \times 2$$

$$= 2^2 \times 1008^2$$

\therefore The sum of 1st 2016 positive odd integers is $2^2 \times 1008^2$.

22. (B) Clearly, arc AB subtends $\angle ABC = 50^\circ$ at B and $\angle AOD$ at the centre.

$$\therefore \angle AOD = 2 \angle ABC = 100^\circ$$

Since, CD is a straight line. Therefore, $\angle AOC = 80^\circ$

23. (B) $(x + 1)(x - 2)(x + 3) \dots (x - 98)(x + 99)(x - 100) = 0$ has 100 roots.

Required sum $= -1 + 2 - 3 + 4 \dots -97 + 98 - 99 + 100$

$$= 2 - 1 + 4 - 3 + \dots + 98 - 97 + 100 - 99$$

$$= 1 + 1 + \dots + 1 + 1$$

$$= 50$$

24. (C) We know that centroid G divides median AD in the ratio 2 : 1

$$\text{Hence } G = \frac{2D + A}{3} = \frac{2(-3, 9) + (6, -3)}{3}$$

$$= \left(\frac{-6 + 6}{3}, \frac{18 - 3}{3} \right)$$

$$= (0, 5)$$

25. (D) $AC^2 = 256 + 144 = 400$

$$\Rightarrow AC = \sqrt{400} = 20$$

Let $AF = x$

AFCE is a rhombus

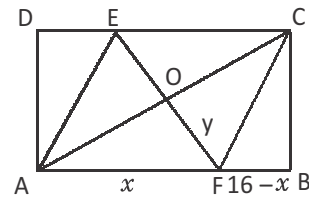
$$AF = EC = x$$

$$12^2 + (16 - x)^2 = x^2$$

$$32x = 256 + 144 = 400$$

$$4x = 50$$

$$x = \frac{50}{4} = \frac{25}{2}$$



AFCE is a rhombus.

\Rightarrow Diagonals are perpendicular

$$AC = 20 \Rightarrow AO = 10$$

(\therefore Diagonals are \perp r to each other.)

$$\text{Let } EF = 2y \Rightarrow OF = y$$

$$\Rightarrow x^2 = 100 + y^2$$

$$y^2 = x^2 - 100 = \left(\frac{25}{2} \right)^2 - 100$$

$$= \frac{625}{4} - 100$$

$$= \frac{625 - 400}{4}$$

$$y^2 = \frac{225}{4}$$

$$y = \sqrt{\frac{225}{4}} = \frac{15}{2}$$

$$\therefore \overline{EF} = 15$$

Physics

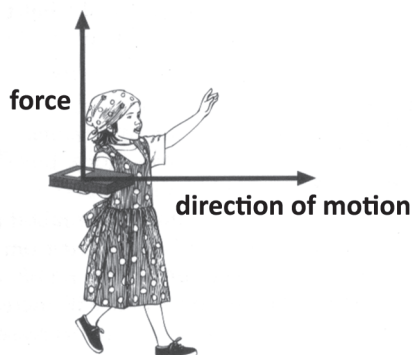
26. (D) We need the thickness of the block to calculate its volume. We need the exact density of steel as well as its thickness to calculate the mass of the block. We need the volume of the block as well as its coefficient of expansion to calculate the amount of expansion as the block is heated. The only information which can be determined from the given information is whether the block will sink in or float on water. As steel is denser than water, a steel block will sink in water.

27. (C) When a tuning fork is struck, the prongs vibrate. This causes the air molecules around the prongs to vibrate too, producing a sound. Bringing the handle of the tuning fork into contact with a table surface causes the vibrations to pass from the prongs to the molecules of the table. Hence, the sound produced is louder.

28. (A) Mass is a measure of the inertia of a body or an object. If a body has more mass, it has more inertia. If it has less mass, it has less inertia. Pencil is lighter than school bag, book and table, so it has least/less inertia.

29. (B) A particle moving with constant speed covers equal distances in equal time intervals.

30. (A)



Work equals to force times displacement. The force here must be the force in the direction of motion. In this case, the girl applies upward force but the displacement is horizontal. Since the force is perpendicular to the displacement, we say that the work done is zero.

31. (C) From Newton's second law of motion,

$$F = ma, a = \frac{F}{M}$$

Since, F is constant, $a \propto \frac{1}{m}$

For a given magnitude of force, the acceleration produced is inversely proportional to the mass of the body.

32. (A) The gaps between two drips of petrol are constant. This shows that the car is travelling at constant speed.

33. (B) Bats can fly in pitch darkness because they hear ultrasonic sounds to produce echoes and detect the surroundings.

34. (A) When a ball is thrown up, it converts its kinetic energy to potential energy. The conversion is done by gravity. The moment it starts to fall down again, potential energy is converted back to kinetic energy, which is also done by gravity. Gravity acts throughout the journey, and not only when the ball reaches its maximum height.

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

$$E_p = mgh \text{ or P.E.} = mgh$$

m = mass of an object

g = acceleration due to gravity

h = height of an object above the surface of earth

36. (A) The ball gets slower as it increases in height due to the effect of gravity. The ball reaches its maximum height when its speed is zero (cannot move up any more).

37. (D) Work done = force \times distance moved in the direction of the force = $10 \times 6 = 60 \text{ J}$

38. (B) The mass of an object is independent of its location. The mass of an object is the same everywhere. It does not change from place to place. It is constant. A body or an object contains the same quantity of matter whether it is on the earth, the moon or anywhere in the universe.

39. (D) When a motorcar makes a sharp turn at a high speed, we tend to get thrown to one side because we tend to continue in our straight line motion and an unbalanced force is applied by the engine of the motorcar that changes the direction of motion of the motorcar. So, we slip to one side of the seat due to the inertia of our body.

40. (D) Solar energy can be transformed into chemical, electrical, heat or mechanical energy by using suitable equipments.

41. (C) Material with lower density floats and material with higher density sinks. Since the iron floats on mercury (13600 kg m^{-3}) and sinks in water (1000 kg m^{-3}), its density must be 8000 kg m^{-3} (between 1000 kg m^{-3} and 13600 kg m^{-3}).

42. (D) Speed of sound decreases when we go from solid to gaseous state and increases with increase in temperature. It also depends upon properties of the medium through which it travels.

43. (C) Acceleration (a) = 4 m/s^2

Mass (m) = 6 kg

Force (F) = ?

By using the formula,

$F = m \times a$, we get

$$F = 6 \text{ kg} \times 4 \text{ m/s}^2$$

$$F = 24 \text{ kg m/s}^2$$

$$= 24 \text{ N}$$

So, a force of 24 N is required.

44. (B) Average speed = total distance travelled ÷ total time taken

$$\text{Average speed} = (10 + 20) \div (2 + 1) = 10 \text{ m s}^{-1}$$

45. (B) A particle with a value of 46.0 m s^{-1} represents the velocity of the particle.

46. (D) $1 \text{ kWh} = 3.6 \times 10^6 \text{ J}$; 1 kWh is the energy consumed in one hour at the rate of 1000 J s^{-1} . 1 kWh is commonly referred to as a unit of electrical energy.

47. (C) A recording studio needs to be soundproof so that sounds cannot escape or enter. Its walls must prevent the reflection of sounds so that echoes, which affect the recording of the song, do not form. Its walls do not have to contain a vacuum, they can contain materials that are able to absorb sound, such as rubber foam.

48. (B) The larger the surface area in contact, the lesser pressure is exerted.

49. (C) Power, $P = 500 \text{ W} = \frac{500}{1000} = 0.5 \text{ kW}$

$$\text{Time} = 5 \text{ hours}$$

$$\text{Days} = 30$$

$$\text{Energy consumed} = 0.5 \times 5 \times 30 = 75 \text{ kWh}$$

50. (C) Rockets are examples of Newton's third law of motion, i.e. the law of conservation of momentum.

Chemistry

51. (C) One molecule of CH_3COOH contains 2 oxygen atoms.

∴ One mole of CH_3COOH contains 2 moles of oxygen atoms.

52. (D) A gas has no definite shape or volume because its particles are constantly moving randomly in all directions.

53. (D) The number of protons in $\text{CH}_4 = 6p + 4(1p) = 10p$

$$\text{The number of protons in } \text{NH}_3 = 7p + 3(1p) = 10p$$

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

55. (D) In this experiment, you must keep constant, the initial volume of water, the initial temperature and the length of time for exposure. The final volume of water left in the beaker is the dependent variable.

56. (B) Phosphate ion PO_4^{3-} is a trivalent ion.

57. (B) Water is a compound and has no odour. Oil is a saturated or unsaturated fatty acid with odour. Oil burns in air whereas water extinguishes fire.

58. (A) Protons present in the nucleus of an atom have positive charge. Though neutrons are present in the nucleus, they do not have any charge. So, the nucleus of an atom is positively charged.

59. (B) Salt (NaCl), Water (H_2O) and Hydrochloric acid (HCl) are compounds. Iron is an element.

60. (B) Maximum number of electrons occupying each orbital level is given as

$$1^{\text{st}} \text{ orbital} = 2 \text{ electrons}$$

$$2^{\text{nd}} \text{ orbital} = 8 \text{ electrons}$$

Total number of electrons in both 1^{st} and 2^{nd} orbitals is 10, since phosphorus has 15 electrons, its second orbital will be filled up by 8 electrons. There are 5 electrons in the 3^{rd} orbital in phosphorus.

61. (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 proportion.

62. (A) Apple juice is a liquid. A liquid has no definite shape as it takes the shape of the container it is kept in. However it does have a definite mass and volume.

63. (D) Atomic number 20 belongs to calcium and the number of electrons in

$$\text{K shell} = 2$$

$$\text{L shell} = 8$$

$$\text{M shell} = 8$$

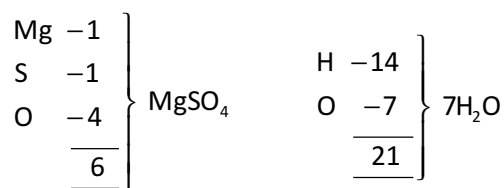
$$\text{N shell} = 2$$

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

65. (D) To condense below 80°C , the substance will need a boiling point above 80°C (83°C).

To freeze above 30°C, the substance will need a melting point above 30°C (34°C).

66. (C) The number of atoms present in hydrated magnesium sulphate $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ are 27 as given below



$$6 + 21 = 27$$

67. (A) Elements X and Y have same proton number, hence, they are the same elements. The number of neutrons of X, Y and Z are 21, 20, 20 respectively.
68. (B) Gases do not have definite shape and volume due to the absence of any significant interparticle forces. Gases have high compressibility due to the presence of large interparticle empty spaces.
69. (B) Chromatography process is used to separate drugs from the blood.
70. (B) Molecular weight of KClO_3
 $= 39 + 35.5 + (16 \times 3) = 122.5$
245 g of $\text{KClO}_3 = 2$ moles.
Ratio of number of atoms of
K : Cl : O are 1 : 1 : 3.

Biology

71. (C) Fungi causes ringworm disease.
72. (C) Lysosome reduces the number of old worn out cell organelles.
73. (D) Sponges reproduce by gemmules, planaria by regeneration and hydra by budding.
74. (A) Species is the basic unit of classification. The group of animals that can reproduce among themselves is called species

75. (A) Connective tissue like adipose stores fat and insulates the body against heat loss.
76. (D) Photosynthesis is the process of synthesising food in the presence of sunlight by green plants.
77. (B) Cell membrane, chromosomes, cytoplasm and mitochondrion are the cell organelles found in both plant and animal cells
78. (B) Angiosperms are also called flowering plants.
79. (A) Decomposers feed on dead organic matter and they breakdown the complex organic compounds into simpler substances through the decomposers the elements enter the soil again which in turn are again taken up by the plants
80. (C) Aschelminthes are mostly parasites hence they do not have separate respiratory or circulatory systems.
81. (D) Measles is a viral disease, cholera is a bacterial disease and sleeping sickness a protozoan disease.
82. (A) Axon is concerned with the conduction of impulse.
83. (C) Xylem and phloem are called complex conducting tissues.
84. (B) Chloroplasts trap light energy during photosynthesis.
85. (C) "P" is the contractile vacuole. It is responsible for osmoregulation.
86. (A) Guava, tomato and citrus fruits are protective food. They are rich in vitamins and minerals
87. (A) Lizard is a reptile
88. (D) Dicotyledons are flowering plants that have taproots and reticulate venation.
89. (B) Rearing of honeybees is called apiculture
90. (D) Pea are pulses.

