

1. A circular area of radius 2 cm is placed in the xy -plane. A uniform magnetic field $B = 0.14$ T is applied along the $+z$ direction. The flux passing through the circular area is

(A) $\Phi = 1.76 \times 10^{-3}$ Wb

~~(B)~~ $\Phi = 1.76 \times 10^{-4}$ Wb

(C) $\Phi = 1.21 \times 10^{-5}$ Wb

(D) $\Phi = 2.76 \times 10^{-4}$ Wb

2. Three forces act on a body simultaneously. The body executes a rectilinear uniform motion with velocity $\vec{v} = (2\text{ms}^{-1})\hat{i} - (7\text{ms}^{-1})\hat{j}$ in the xy -plane. Two of the forces are

$(2N)\hat{i} + (3N)\hat{j} + (-2N)\hat{k}$ and

$(-5N)\hat{i} + (8N)\hat{j} + (-2N)\hat{k}$

The third force is

(A) zero

~~(B)~~ $(-3N)\hat{i} + (11N)\hat{j} + (-4N)\hat{k}$

(C) $(3N)\hat{i} + (-11N)\hat{j} + (-4N)\hat{k}$

(D) $(3N)\hat{i} + (-11N)\hat{j} + (4N)\hat{k}$

3. A constant electric field E along positive x -axis acts on a charged particle of mass $m = 3 \times 10^{-5}$ kg and charge $Q = 6$ C, which is initially at rest at the origin ($x = 0$). The distance covered by the particle after time t is

(A) $x = 3 \times 10^5 Et^2$

(B) $x = 10^5 Et^2$

~~(C)~~ $x = 2 \times 10^5 Et^2$

(D) $x = \frac{2}{3} \times 10^5 Et^2$

4. The working principle of a thermometer (a temperature measuring device) is based on

(A) equipartition of energy

(B) conservation of energy

~~(C)~~ zeroth law of thermodynamics

(D) first law of thermodynamics

5. Which of the following represents best of the law of constant composition?

(A) Elements exist in atomic form

~~(B)~~ Compounds always have fixed ratios

(C) Mixtures have variable composition

(D) Elements cannot be decomposed chemically

6. Which of the following is a metalloid?

- (A) Boron
- (B) Aluminum
- (C) Bismuth
- (D) Gallium

7. An experiment gives the following values of titrant in a titration experiment :

11.9 ml, 11.8 ml and 11.8 ml

The true value of the titrant should be 11.3 ml. The experimental data are

- (A) precise and accurate
- (B) precise but not accurate
- (C) accurate but not precise
- (D) neither precise nor accurate

8. What is the percentage of uncertainty in measuring 10.0 g of solid with ± 0.01 g error?

- (A) 0.01%
- (B) 1.0%
- (C) 10%
- (D) 0.1%

9. Express 0.0003141 in scientific notation with 4 significant figures.

- (A) 3.14×10^{-4}
- (B) 31.410×10^{-5}
- (C) 3.141×10^{-4}
- (D) 0.31410×10^{-3}

10. Calculate the pressure exerted by 12 g of helium gas when kept in a vessel of volume 1.0 dm^3 at 25°C assuming it behaves ideally.

- (A) 7436.45 atm
- (B) 83.00 atm
- (C) 24.48 atm
- (D) 73.29 atm

11. The density of Hg is 13.596 g per cc and acceleration due to gravity is 980.67 cm-s^{-2} . The pressure exerted by a column of 76 cm of Hg is

- (A) 101.33 Pa
- (B) 10.133 kPa
- (C) 101.33 kPa
- (D) 1.0133 kPa

12. The value of the ratio $\frac{P_c V_c}{RT_c}$ for the van der Waals equation is

(A) $\frac{8}{3}$

(B) $\frac{3}{8}$

(C) 1

(D) 0

13. The ratio between the Boyle's temperature and the critical temperature for a van der Waals gas is

(A) $\frac{27}{8}$

(B) $\frac{8}{27}$

(C) $\frac{a}{b}$

(D) $\frac{b}{a}$

14. In an experiment, a lower value of standard deviation indicates

(A) the result is accurate

(B) the result is accurate and precise

(C) the result is precise

(D) the result is neither accurate nor precise

15. An instrument with systematic error will affect

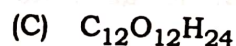
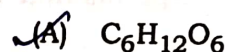
(A) accuracy

(B) precision

(C) both accuracy and precision

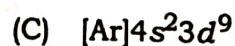
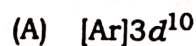
(D) None of the above

16. Glucose contains 6 carbon, 6 oxygen and 12 hydrogen atoms. The empirical formula of glucose is



(D) None of the above

17. The electronic configuration of Cu^+ is



18. Which of the following is **not** a d-block element?

(A) Hafnium

(B) Cerium

(C) Osmium

(D) Iridium

19. Which of the following is a homogeneous mixture?

(A) Air

(B) Concrete

(C) Oil and water mixture

(D) Soil

20. Froth flotation method is used for

(A) carbonate ores

(B) oxide ores

(C) halide ores

(D) sulphide ores

21. Which of the following metals is found in native state in nature?

(A) Sodium

(B) Iron

(C) Zinc

(D) Gold

22. In the extraction of iron, iron oxide is reduced by

(A) hydrogen

(B) carbon dioxide

(C) carbon monoxide

(D) None of the above

23. The alloy of copper and zinc is known as

(A) brass

(B) bronze

(C) bell metal

(D) constantan

24. The method by which aluminum is extracted from bauxite is

- (A) Down's process
- (B) Pidgeon process
- (C) Hall-Héroult process
- (D) Froth flotation process

27. In hematite ore, the major impurity is

- (A) silica
- (B) sulphide
- (C) gypsum
- (D) manganese

25. Identify the **false** statement.

- (A) Hematite is an ore of iron.
- (B) Calcination is done in presence of air.
- (C) Aluminum from bauxite is extracted by electrolytic reduction.
- (D) Amalgam is an alloy of mercury.

28. Among the following, which one is **not** an ore of zinc?

- (A) Hematite
- (B) Sphalerite
- (C) Calamine
- (D) Zincite

26. Which of the following is an amphoteric oxide?

- (A) CuO
- (B) PbO
- (C) MgO
- (D) FeO

29. If 2 g of H_2 contains 6.023×10^{23} molecules of hydrogen, then 32 g of O_2 has

- (A) 1.88×10^{22} molecules of oxygen
- (B) 3.76×10^{22} molecules of oxygen
- (C) 6.023×10^{23} molecules of oxygen
- (D) 9.64×10^{24} molecules of oxygen

30. The average of first 100 natural numbers is

(A) 50.5

(B) 50.0

(C) 55.5

(D) 55.0

31. If the average of m numbers is n^2 and that of n numbers is m^2 , then the average of $(m+n)$ numbers is

(A) $(m-n)$

(B) mn

(C) $(m+n)$

(D) $\frac{m}{n}$

32. If $16a + 16b = 48$, then what is the average of a and b ?

(A) 1.5

(B) 2.5

(C) 3

(D) 5

33. 3 litres of water is added to 15 litres of a mixture of 20% solution of alcohol in water. The strength of alcohol is now

(A) $12\frac{1}{2}\%$ (B) $16\frac{2}{3}\%$

(C) 24% (D) 16%

34. A reduction of 20% in the price of rice enables a person to buy 3.5 kg more rice for ₹ 385.00. The original price of rice was

(A) ₹ 20.00 per kg

(B) ₹ 22.50 per kg

(C) ₹ 25.00 per kg

(D) ₹ 27.50 per kg

35. If the side of a square is increased by 25%, its area increases by

(A) 25%

(B) 55%

(C) 40.5%

(D) 56.25%

36. If $\sin 42^\circ = x$, then what is $\cos 48^\circ$?

(A) $-x$

(B) x

(C) $x+1$

(D) $\frac{1}{x}$

37. If $(\tan \theta + \cot \theta) = 5$, then what is $(\tan^2 \theta + \cot^2 \theta)$?

(A) 25

(B) 27

(C) 23

(D) 24

38. If a vertical pole of 6 m has a shadow of length $2\sqrt{3}$ m, then what is the angle of elevation of the sun?

- (A) 30°
- (B) 45°
- (C) 60°
- (D) 65°

39. If $4 \cot \theta = 3$, then $\frac{\sin \theta - \cos \theta}{\sin \theta + \cos \theta}$ is

- (A) $\frac{1}{7}$
- (B) 7
- (C) $\frac{3}{7}$
- (D) None of the above

40. If $\sin A : \cos A = 4 : 7$, then

$$\frac{7 \sin A - 3 \cos A}{7 \sin A + 2 \cos A}$$

is

- (A) $\frac{1}{6}$
- (B) $\frac{1}{3}$
- (C) $\frac{3}{14}$
- (D) $\frac{3}{2}$

41. The length of a rectangular plot is 4.5 times that of its breadth. If the area of the plot is 200 square metres, then its length is

- (A) 25 m
- (B) 62 m
- (C) 27 m
- (D) None of the above

42. If the diagonal of a cube is $4\sqrt{3}$ cm, then its volume is

- (A) 64 cc
- (B) 69 cc
- (C) 36 cc
- (D) None of the above

43. The product of the areas of three adjacent faces of a rectangular box is equal to

- (A) the volume of the box
- (B) twice the volume of the box
- (C) the square of the volume of the box
- (D) the cube root of the volume of the box

44. If the variance of 5 values is 0.64, then its standard deviation is

- (A) 5.64
- (B) 0.128
- (C) 3.2
- (D) 0.8

45. If the mean is 25 and the standard deviation is 5, then the coefficient of variation is

- (A) 20%
- (B) 48%
- (C) 60%
- (D) 27%

46. The variance of the seven observations 6, 7, 10, 12, 13, 8, 14 is

- (A) 9
- (B) 9.25
- (C) 8.50
- (D) 8.29

47. If all the values in a data set are the same, the standard deviation is

- (A) 0
- (B) 1
- (C) equal to the mean
- (D) undefined

48. The square of the standard deviation is called

- (A) mode
- (B) mean
- (C) median
- (D) variance

49. The area enclosed between one arch of the cycloid

$$x = a(\theta - \sin \theta), y = a(1 - \cos \theta)$$

and its base is

- (A) $3\pi a^2$
- (B) $\frac{3}{2}\pi a^2$
- (C) $\frac{2}{3}\pi a^2$
- (D) None of the above

50. The area of the cardioid

$$r = a(1 - \cos \theta) \text{ is}$$

- (A) $3\pi a^2$
- (B) $6\pi a^2$
- (C) πa^2
- (D) $\frac{3}{2}\pi a^2$

51. The length of the arc of the parabola $x^2 = 4ay$ measured from the vertex to one extremity of the latus rectum is
- (A) $\log(1 + \sqrt{2})$
~~(B) $\log \sqrt{2}$~~
 (C) $\log 2$
 (D) None of the above
52. The volume of the solid generated by the revolution of the cardioid $r = a(1 + \cos \theta)$ about the initial line is
- (A) $\frac{8}{3} \pi a^2$
~~(B) $\frac{3}{8} \pi a^2$~~
 (C) $3\pi a^2$
 (D) $8\pi a^2$
53. The surface area of the solid generated by the revolution of the astroid $x = a \cos^3 t$, $y = a \sin^3 t$ about the y -axis is
- (A) $12\pi a^2$
 (B) $\frac{12}{5} \pi a^2$
~~(C) $\frac{5}{12} \pi a^2$~~
 (D) $5\pi a^2$
54. Which of the following statements is correct in respect of frictional force?
- (A) Frictional force does not obey Newton's second law of motion.
 (B) Frictional force does not depend on normal force.
~~(C) Frictional force is directly proportional to normal force.~~
 (D) Frictional force is a conservative force.
55. A torque of 30 N-m applied on a wheel causes it to suffer an angular displacement $\theta - \theta_0 = 5t^2$, where θ_0 is a constant. Which of the following quantities can be directly derived from the above data?
- (A) Linear acceleration of the wheel
 (B) Linear momentum of the wheel
~~(C) Angular momentum of the wheel~~
 (D) Moment of inertia of the wheel
56. A big asteroid of mass M breaks into two parts of masses m and $M - m$, which are separated by a distance of 200 km. The ratio m/M which gives the maximum value of the gravitational force between the two parts is
- (A) 1 (B) 2
 (C) $\frac{1}{2}$ ~~(D) $\frac{1}{4}$~~

57. A desperado fires a bullet horizontally into an open water tank creating a hole at a distance h below the surface of water. The pressure at the surface of water and the pressure at the exit hole is same as the atmospheric pressure. If the hole is taken as a reference level for the vertical height, h of the water surface, then which of the following is the correct answer for speed v of the water running out of the hole? (g = acceleration due to gravity)

(A) $v = \sqrt{\frac{gh}{2}}$ (B) $v = \sqrt{2gh}$

(C) $v = \sqrt{4gh}$ (D) $v = \sqrt{\frac{gh}{4}}$

58. Assume a first-order binomial expansion of

$$\left(1 + \frac{h}{R}\right)^{-2}$$

where $h + R$ is the distance to an object from the centre of the earth, R being the radius of the earth. The acceleration due to gravity experienced by the object at a height h is 5.8 m-s^{-2} . If M is the mass of the earth, then which one of the following is the correct expression for the height of the object from the surface of the earth? (G = universal constant of gravitation and $g = 9.8 \text{ m-s}^{-2}$).

(A) $h = \frac{2R^2}{GM}$ (B) $h = \frac{2R^3}{GM}$

(C) $h = \frac{R^2}{GM}$ (D) $h = \frac{R^3}{GM}$

59. In rotational motion, torque (τ) and angular velocity (ω) are analogous to force and linear velocity in linear motion. What is the correct expression for the power generated due to work done by a torque?

(A) $P = \tau\omega$

(B) $P = \frac{\omega}{\tau}$

(C) $P = \frac{\tau}{\omega}$

(D) $P = \frac{d\tau}{d\omega}$

60. A statue of mass m is completely immersed in seawater with a rope hoisting the statue. If B is the buoyant force on the statue and the statue is at rest, then which one of the following is the correct expression for the tension in the rope?

(A) $T = mg + B$

(B) $T = mg$

(C) $T = mg - B$

(D) $T = B$

61. The density of a material is $8.0 \times 10^3 \text{ kg/m}^3$. The volume of water that has the same mass as one cubic metre of that material is to be placed inside a cubical container of side L such that water completely fills the container. The value of L that is chosen is (density of water = 10^3 kg/m^3)

- (A) 1.78 m
- (B) 2.00 m
- (C) 3.00 m
- (D) 3.78 m

62. Bodies when heated undergo thermal expansion because

- (A) volume of atoms/molecules inside the bodies increases with temperature

(B) amplitude of vibration of atoms/molecules increases and hence the average distance among them increases

- (C) atoms/molecules start repelling one another at higher temperatures

(D) None of the above

63. The magnitude of electric field E produced by a uniformly charged sphere varies with distance r from its centre as

(A) $\frac{1}{r^2}$

(B) $\frac{1}{r^3}$

(C) $\frac{1}{r^4}$

(D) $\frac{1}{\sqrt{r}}$

64. Electric field of a dipole measured at a distant point varies as $\frac{1}{r^3}$, whereas that of a single point charge varies as $\frac{1}{r^2}$. It means that the electric field of a dipole decreases more rapidly with distance. What is the reason?

- (A) Coulomb's law is not applicable for charges of an electric dipole

(B) From a large distance, the dipole looks like a combination of two equal and opposite charges which almost coincide, thus reducing the strength of the field

- (C) Permittivity ϵ_0 of free space increases linearly with distance in presence of an electric dipole

(D) None of the above

65. An insulating sphere of radius R is uniformly charged with total electric charge Q . Consider a concentric spherical surface of radius r inside the sphere. Which of the following expresses Gauss' law for electric field E at r ?

(A) $4\pi r^2 E = \frac{Qr^2}{\epsilon_0 R^3}$

(B) $4\pi r^2 E = \frac{Q}{4\pi \epsilon_0 r}$

(C) $4\pi r^2 E = \frac{Qr}{4\pi \epsilon_0 R}$

(D) $4\pi r^2 E = \frac{Qr^3}{\epsilon_0 R^3}$

66. When a dielectric material of dielectric constant K is inserted between the plates of a parallel-plate capacitor, which one of the following represents a correct physical process?

(A) The capacitance of the capacitor is reduced by a factor K .

~~(B)~~ The potential difference between the plates increases by a factor K .

(C) The electric field strength between the plates is increased by a factor K .

(D) The electric field strength between the plates is reduced by a factor K .

67. A copper wire is carrying a current on account of the applied electric field E . The electric field required to generate a current density J in the wire is directly proportional to J . The proportionality factor is known as

(A) resistance

(B) dielectric constant

~~(C)~~ resistivity

(D) conductivity

68. Magnetic field lines always form closed loops because

(A) magnetic field is produced by current-carrying loops

(B) there is no magnetic monopole

(C) magnetic field exerts force only on moving charges

(D) magnetic energy is always conserved

69. A charged particle of mass m and charge q is moving with a velocity v in a uniform magnetic field B and is describing a helical path with radius R . The time required to complete one revolution of the charged particle is

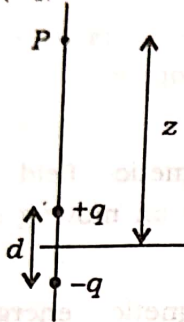
(A) $T = \frac{qB}{m}$

~~(B)~~ $T = \frac{m}{qB}$

(C) $T = \frac{2\pi m}{qB}$

(D) $T = \frac{m}{2\pi qB}$

70. The figure shows an electric dipole where charge separation is d and the point P is situated at a distance z from the centre of the dipole. P lies on the dipole axis. If $z = 50d$, then the electric field E of the positive charge $(+q)$ at P is



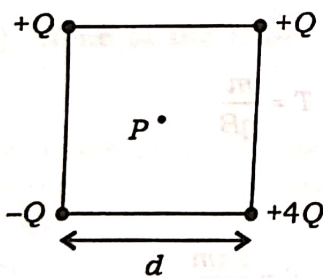
(A) $\frac{q}{4\pi\epsilon_0 d^2}$

(B) $\frac{q}{4\pi\epsilon_0 (40d)^2}$

(C) $\frac{q}{\pi\epsilon_0 (99d)^2}$

(D) $\frac{q}{\pi\epsilon_0 (100d)^2}$

71. The electric potential at the centre P of the square of side length d whose four corners are occupied by charges $+Q, +Q, -Q, +4Q$ is



(A) $\frac{3\sqrt{2}Q}{4\pi\epsilon_0 d}$

(B) $\frac{10Q}{4\pi\epsilon_0 d}$

(C) $\frac{6Q}{4\pi\epsilon_0 d}$

(D) $\frac{5\sqrt{2}Q}{4\pi\epsilon_0 d}$

72. Four statements are given below. Which two of the statements are simultaneously true about the electric field lines?

(i) Electric field lines are always closed loops.

(ii) Electric field lines are always parallel to each other.

(iii) Electric field lines can begin or end inside a region space only when there is charge within the region.

(iv) The number of electric field lines per unit area is proportional to the electric field.

(A) (i) and (ii)

(B) (ii) and (iii)

(C) (i) and (iv)

(D) (iii) and (iv)

73. Magnetic flux through a solenoid of 100 turns changes from 1.44×10^{-5} Wb to zero within 25 ms. The induced emf in the solenoid is

(A) 5.76 mV

(B) 57.6 mV

(C) 576 mV

(D) 5760 mV

74. A source emf e is connected to a resistor of resistance R and an inductor of inductance L . The current flowing in the circuit is I . The energy conservation in the circuit implies the following equation :

$$eI = RI^2 + L \frac{dI}{dt} I$$

The second term in the right-hand side represents

- (A) thermal energy dissipated in the circuit
- (B) the rate at which thermal energy is dissipated
- (C) the rate at which thermal energy is stored in the circuit
- (D) the rate at which magnetic energy is stored in the inductor

75. Identify the correct statement about electromagnetic induction.

- (A) Induced electric field \vec{E} is related to induced emf e as

$$e = \iint \vec{E} \cdot d\vec{S}$$

where S is the surface area.

- (B) Induced emf is produced by static electric charges.
- (C) Lenz's law of electromagnetic induction gives the magnitude of the induced emf.
- (D) Induced emf is produced by a changing magnetic field.

76. Which one of the following is an **incorrect** statement about electro-magnetic induction?

- (A) A current is induced in a loop of conducting wire when a bar magnet is moved towards it.
- (B) A current is induced in a loop of conducting wire when the loop is moved towards a bar magnet.
- (C) The magnitude of the induced current does not depend on the size of the loop.
- (D) A current is induced in the loop whenever the number of magnetic field lines passing through it changes.

77. A proton has to gain an amount of energy 120 eV when accelerated by a potential difference. The potential difference required is

- (A) 60 V
- (B) 120 V
- (C) 240 V
- (D) 480 V

78. An object is freely falling under gravity with acceleration due to gravity, $g = 9.8 \text{ m/s}^2$. Which one of the following is a correct statement about the motion?

- (A) The speed of the object increases but the force on the object remains constant.
- (B) The speed of the object remains constant as the acceleration is constant.
- (C) The speed of the object increases as the force of gravity increases towards the ground.
- (D) There is no relation between the speed and the acceleration of a freely falling object.

79. While loosening or tightening a screw, a screwdriver of large radius handle is required. The reason is

(A) it causes large angular acceleration with a small torque

(B) it causes large angular acceleration with a large torque

(C) it causes large moment of inertia of the screw and hence a large angular acceleration

(D) it causes a large force on the screw

80. Given 1 atomic mass unit as $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$, the number of carbon atoms that is to be assembled to make 1 kg mass is

(A) 5.02×10^{25}

(B) 5.02×10^{27}

(C) 6.02×10^{26}

(D) 6.02×10^{27}

81. A piston with a small cross-sectional area A_1 exerts a force F_1 on a confined incompressible fluid. The pressure is transmitted through the fluid undiminished in magnitude to a large area of cross-section A_2 , where F_2 is the force. Which one of the following relations is true?

(A) $F_2 = \frac{A_1}{A_2} F_1$ (B) $F_2 = \frac{A_2}{A_1} F_1$

(C) $F_2 = \frac{A_1 A_2}{F_1}$ (D) $F_2 = \frac{A_2}{A_1 F_1}$

82. An object of mass m is initially at rest. It is acted upon by a varying force $\vec{F} = k_1 \hat{i} + k_2 t^3 \hat{j}$, t is in second and k_1 and k_2 are constants. The velocity of the object at $t = 1 \text{ s}$ is

(A) $k_1 \hat{i} + \frac{k_2}{4} \hat{j}$

(B) $\frac{k_1}{m} \hat{i} + \frac{4k_2}{m} \hat{j}$

(C) $\frac{k_1}{m} \hat{i} + \frac{k_2}{m} \hat{j}$

(D) $\frac{k_1}{m} \hat{i} + \frac{k_2}{4m} \hat{j}$

83. Which one of the following is the correct expression for temperature at which a gas escapes the earth? Given M and R are the mass and the radius of the earth, m is the mass of one molecule of the gas, k_B is the Boltzmann constant and G is the universal constant of gravitation.

(A) $T = \frac{5GMm}{3k_B R}$

(B) $T = \frac{2GMm}{3k_B R}$

(C) $T = \frac{2GMm}{3k_B R^2}$

(D) $T = \frac{5GMm}{3k_B R^2}$

84. The depth in seawater where the gauge pressure is 1.00×10^5 Pa is (Given the density of seawater is 1.03×10^3 kg/m³ and $g = 9.8$ m-s⁻²)

(A) 12.91 m

~~(B)~~ 11.91 m

(C) 9.91 m

(D) 7.91 m

85. There are two particles of mass $m_1 = 1$ kg and $m_2 = 2$ kg on the xy -plane. Their position vectors are given as $2\hat{i} + 3\hat{j}$ and $5\hat{i} + 6\hat{j}$, where distances are in metres. The magnitude of x -component of the position vector of the centre of mass of the system is

(A) 4 m

(B) 5 m

~~(C)~~ 12 m

(D) 15 m

86. Which one of the following is the rotational equivalence of Newton's law $\vec{F} = \frac{d\vec{p}}{dt}$? (Symbols denote their usual meanings)

(A) $\vec{\tau} = \frac{d\vec{\alpha}}{dt}$ (B) $\vec{\tau} = \frac{d\vec{L}}{dt}$

(C) $\vec{L} = \frac{d\vec{\tau}}{dt}$ (D) $\vec{\tau} = \frac{d}{dt}(\vec{r} \cdot \vec{v})$

87. The dimension of torque is same as that of

(A) work

(B) angular momentum

(C) power

(D) force

88. A physicist tries to estimate the density of the earth by measuring the acceleration due to gravity. He knows the value of the earth's radius R . If he assumes that the earth is a uniform sphere, then which of the following represents a correct formula for the density of the earth? (Symbols denote their usual meanings)

(A) $\rho = \frac{g}{3\pi GR^3}$

(B) $\rho = \frac{3g}{4\pi GR^3}$

(C) $\rho = \frac{3g}{4\pi GR}$

(D) $\rho = \frac{g}{GR^3}$

89. A body of mass 0.3 kg is attached to one end of a spring of length 1 m. The string will break if the tension exceeds 120 N. The body is whirled in a horizontal circle, the other end of the string being fixed at the centre of the circle. The maximum speed the body attains without breaking the string is

- (A) 30 m/s
- (B) 20 m/s
- (C) 400 m/s
- (D) 200 m/s

90. A particle is acted by a conservative force. Its potential energy is given by

$$U = \frac{1}{2}(x^2 + y^2)$$

The magnitude of the force at the point $(x, y) = (3, 4)$ is

- (A) $F = 25 \text{ N}$ (B) $F = 16 \text{ N}$
- (C) $F = 9 \text{ N}$ (D) $F = 5 \text{ N}$

91. A ball of mass 1 kg hits a wall by moving towards the negative x -axis with a speed of 30 m/s. It then bounces back towards the positive x -axis with a speed of 20 m/s. If the collision time is 0.01 second, then what is the force experienced by the ball at the collision with wall?

- (A) 0.05 N
- (B) 0.5 N
- (C) 50 N
- (D) 5000 N

92. The moment of inertia of a cylinder of mass M and radius R about the axis of rotation is $\frac{1}{2}MR^2$.

A force of 9 N has been applied on the lever arm of the cylinder obtaining the maximum torque. The lever arm is equal to twice the radius of the cylinder, $R = 0.06 \text{ m}$. If the mass of the cylinder is 25 kg, then the angular acceleration of the cylinder due to the applied torque is

- (A) 12 rad/s²
- (B) 16 rad/s²
- (C) 24 rad/s²
- (D) 48 rad/s²

93. Which of the following statements is correct in respect of dew point?

(A) The dew point is the temperature at which the air becomes saturated with the water vapour present in the air.

(B) When the air is cooled down to its dew point, the relative humidity of the air becomes 100%.

(C) When the temperature drops below the dew point, condensation takes place.

(D) All of the above statements are true.

94. Which of the following is a correct statement about buoyant force?

(A) Buoyant force does not depend on the acceleration due to gravity.

(B) Buoyant force is proportional to the density of the fluid.

(C) Buoyant force is equal to the weight of the body immersed in the fluid.

(D) Buoyant force does not depend on the volume of the immersed body.

95. Which one of the following is the definition of relative humidity?

(A) It is the ratio of the partial pressure of water vapour in the air to the saturation water vapour pressure at the same temperature, expressed as a percentage.

(B) It is the ratio of partial pressure of water vapour at room temperature to the pressure of air at the same temperature, expressed as a percentage.

(C) It is mass of the water vapour present in 1.0 m^3 of air, expressed as a percentage.

(D) It is the partial pressure of water vapour in the air, expressed as a percentage.

96. Absolute zero temperature ($0 \text{ K} = -273.15 \text{ }^\circ\text{C}$) refers to

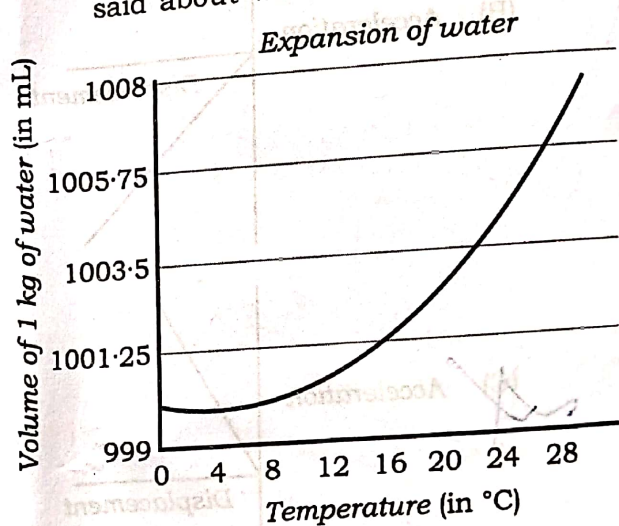
(A) temperature at which water freezes to solid state

(B) temperature at which absolute pressure of all gases becomes zero

(C) temperature at which all gases become solid

(D) temperature at which all liquids become solid

97. The volume of certain amount of water changes with temperature as shown in the figure. What can be said about water from the figure?



(A) Water contracts on freezing.

(B) Water has positive coefficient of volume expansion between $0 \text{ }^\circ\text{C}$ and $4 \text{ }^\circ\text{C}$.

(C) Water has negative coefficient of volume expansion between $0 \text{ }^\circ\text{C}$ and $4 \text{ }^\circ\text{C}$.

(D) The density of water is minimum at $4 \text{ }^\circ\text{C}$.

98. Consider Hooke's law for a particle oscillating along x -axis with a spring constant $k = 1$ (in unit). If the mass of the particle is 1 (in unit), then which of the following graphs of acceleration vs. displacement of the particle is correct?

(A) Acceleration

Displacement

(B) Acceleration

Displacement

(C) Acceleration

Displacement

(D) Acceleration

Displacement

99. Two parallel-plate capacitors have identical charge q and area of cross-section A . The plates of capacitor 1 are separated by twice the separation of the plates of capacitor 2. Which one of the following statements is correct?

(A) Capacitances of both the capacitors are same.

(B) Capacitance of the capacitor 1 is twice the capacitance of the capacitor 2.

(C) Energy stored in the capacitor 1 is 4 times the energy stored in the capacitor 2.

(D) Energy stored in the capacitor 1 is 2 times the energy stored in the capacitor 2.

100. In an experimental setup, an electric field E and a magnetic field B are kept perpendicular to each other. A charge q with mass m moves along the direction of the electric field and hence perpendicular to the magnetic field with a velocity v . The charge has been accelerated by a potential difference V . If the electric force and the magnetic force on the charged particle balance, and E , B and V are known, the experiment can be used to measure

(A) only the charge of the particle

(B) only the mass of the particle

(C) only the kinetic energy of the particle

(D) charge-to-mass ratio (q/m) of the particle