

**WRITTEN TEST FOR THE POST OF SCIENTIFIC ASSISTANT (PHYSICS) – 2020****Total Questions: 90**

1. A clock shows the time as 3 hours and 20 minutes. The angle between the hour hand and the minute hand of the clock is
  - (a)  $100^\circ$
  - (b)  $110^\circ$
  - (c)  $120^\circ$
  - (d)  $130^\circ$
  
2. Along the optic axis of a crystal,
  - (a) the velocity of an extra-ordinary ray is greater than that of an ordinary ray.
  - (b) the velocity of an extra-ordinary ray is less than that of an ordinary ray.
  - (c) the velocity of an extra-ordinary ray is equal to that of an ordinary ray.
  - (d) the velocity of an extra-ordinary ray is undefined.
  
3. A hydrogen atom absorbs 2.55 eV of energy from its 1<sup>st</sup> excited state. The principal quantum number corresponding to the higher energy state is
  - (a) 2
  - (b) 3
  - (c) 4
  - (d) 5
  
4. The number of atoms per unit cell in a face-centred cubic unit cell is
  - (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
  
5. A disc, a solid sphere and a spherical shell, all having same radii, are allowed to roll down an inclined plane simultaneously without slipping from the same height. The correct order in which they will reach the bottom of the inclined plane in terms of least to maximum time taken by them is
  - (a) solid sphere, spherical shell, disc.
  - (b) disc, spherical shell, solid sphere.
  - (c) spherical shell, disc, solid sphere.
  - (d) solid sphere, disc, spherical shell.

6. The function

$$f(x) = \begin{cases} x^2, & x \leq 1 \\ 16, & x > 1 \end{cases}$$

is

- (a) continuous at  $x = 1$ .
- (b) discontinuous at  $x = 0$ .
- (c) continuous at  $x = 3$ .
- (d) discontinuous at  $x = \frac{1}{2}$ .

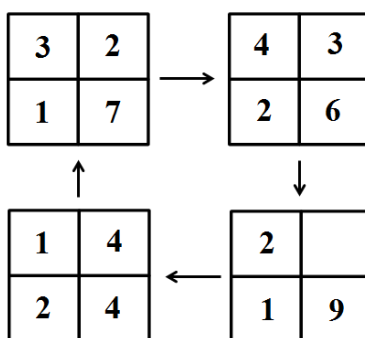
7. The number of hydrogen atoms in 8g of methane is

- (a)  $3.01 \times 10^{23}$
- (b)  $1.22 \times 10^{23}$
- (c)  $1.20 \times 10^{24}$
- (d)  $6.02 \times 10^{24}$

8. A particle is displaced by constant forces  $(3\hat{i} + 4\hat{j} - 3\hat{k})N$ ,  $(2\hat{i} - 3\hat{j} + 5\hat{k})N$ , and  $(\hat{i} + \hat{j} - \hat{k})N$  from  $(4\hat{j} - 5\hat{k})m$  to  $(2\hat{i} - 6\hat{k})m$ . The net work done by the forces on the particle is

- (a)  $-9$  J.
- (b)  $-5$  J.
- (c)  $3$  J.
- (d)  $8$  J.

9. The missing number in the following arrangement is

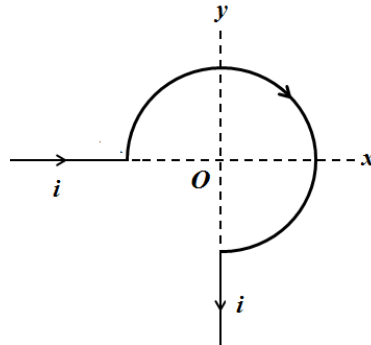


- (a) 7
- (b) 5
- (c) 3
- (d) 1

10. The voltage gain of an emitter follower is one if
- (a) the external ac emitter resistance is greater than the internal ac emitter resistance.
  - (b) the external ac emitter resistance is less than the internal ac emitter resistance.
  - (c) the external ac emitter resistance is equal to the internal ac emitter resistance.
  - (d) the product of external and internal ac emitter resistance is one.
11. Which of the following keyword is not used while writing a pseudocode in Python?
- (a) INPUT
  - (b) IF/ELSE
  - (c) PRINTOUT
  - (d) INCREMENT
12. A metallic solid sphere has a hollow cavity inside it which contains a charge  $+q$ . If another charge  $-q$  is brought nearer to the outer surface of the sphere, then
- (a) there will be a repulsive force between the two charges.
  - (b) there will be an attractive force between the two charges.
  - (c) the presence of  $-q$  will not affect  $+q$ .
  - (d) a positive charge will be induced in the inner surface of the sphere.
13. Which of the following is not an intensive thermodynamic state variable?
- (a) Density
  - (b) Internal energy
  - (c) Temperature
  - (d) Pressure
14. Choose the correct sentence.
- (a) A cow is a useful animal.
  - (b) The cow is a useful animal.
  - (c) Cows are useful animal.
  - (d) A cow is the useful animal.
15. Decimal number equivalent of  $(3B2)_{16}$  is
- (a)  $(71)_{10}$
  - (b)  $(311)_{10}$
  - (c)  $(848)_{10}$
  - (d)  $(946)_{10}$

16. The closed-loop voltage gain in a non-inverting amplifier is
- (a) always greater than one.
  - (b) always less than one but non-negative.
  - (c) always less than one but can be negative.
  - (d) always negative.
17. The orbital angular momentum of the electron in the hydrogen atom is approximately
- (a)  $1.05 \times 10^{-34}$  J-s
  - (b)  $2.25 \times 10^{-34}$  J-s
  - (c)  $2.95 \times 10^{-34}$  J-s
  - (d)  $3.15 \times 10^{-34}$  J-s
18. The location of a particle executing simple harmonic motion along  $x$ -axis at time  $t$  and  $2t$  is given by  $A \sin \omega t = 1$  cm and  $A \sin 2\omega t = \sqrt{3}$  cm where  $A$  is the amplitude of oscillation. The time period of oscillation of the particle is
- (a)  $4t$
  - (b)  $8t$
  - (c)  $12t$
  - (d)  $16t$
19. In a certain material,  $\sigma = 0$  and  $\vec{H} = A \sin \omega t \hat{i}$  Am<sup>-1</sup>. The corresponding displacement vector is
- (a)  $\frac{A}{\omega} \sin \omega t \hat{i}$  Cm<sup>-2</sup>
  - (b)  $-\frac{A}{\omega} \cos \omega t \hat{j}$  Cm<sup>-2</sup>
  - (c)  $-\frac{A}{\omega} \cos \omega t \hat{k}$  Cm<sup>-2</sup>
  - (d) 0
20. \_\_\_\_\_ is a clean source of energy.
- (a) Hydrogen.
  - (b) Sodium.
  - (c) Nitrogen.
  - (d) Oxygen.

21. The magnetic field at the centre  $O$  of the conducting loop of radius  $R$  and carrying a steady current  $i$  is (assume that the straight wires are very long)



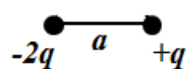
- (a) 0  
 (b)  $-\frac{\mu_0 i}{4R} \hat{k}$   
 (c)  $-\frac{3\mu_0 i}{8R} \hat{k}$   
 (d)  $-\frac{\mu_0 i}{4\pi R} \hat{k}$
22. If the wavelength of an electromagnetic wave in a conductor is  $6.28 \times 10^{-4}$  m, then the skin depth is approximately
- (a)  $1 \times 10^{-4}$  m  
 (b)  $2 \times 10^{-4}$  m  
 (c)  $3 \times 10^{-4}$  m  
 (d)  $4 \times 10^{-4}$  m
23. Which of the following is not a transition element?
- (a) Scandium ( $Z = 21$ )  
 (b) Zinc ( $Z = 30$ )  
 (c) Zirconium ( $Z = 40$ )  
 (d) Lanthanum ( $Z = 57$ )
24. A 4-bit word is called a
- (a) digit.  
 (b) bit.  
 (c) byte.  
 (d) nibble.

25. The full form of IT Act is
- (a) Information Technology Act.
  - (b) Information Technical Act.
  - (c) Indian Technology Act.
  - (d) Intellectual Technology Act.
26. A solid sphere of radius  $R$  carries a charge density  $\rho(r) = kr$ , where  $k$  is a positive constant and  $r$  is radial distance from the centre of sphere. The magnitude of electric field outside the sphere is
- (a) 0
  - (b)  $\frac{kR^4}{4\epsilon_0 r^2}$
  - (c)  $\frac{kR^5}{4\epsilon_0 r^3}$
  - (d)  $\frac{kR^2}{3\epsilon_0} \left(1 - \frac{r^3}{4R^3}\right)$
27. The energy absorbed by one mole of a substance at a frequency of  $6 \times 10^{14}$  Hz is around (Take  $h = 6.63 \times 10^{-34}$  J-s)
- (a)  $9.6 \times 10^5$  J.
  - (b)  $6.4 \times 10^5$  J.
  - (c)  $3.2 \times 10^5$  J.
  - (d)  $2.4 \times 10^5$  J.
28. The slew rate of an op amp is  $15 \text{ V}/\mu\text{s}$ . The power bandwidth for a peak output voltage of 50 V is around
- (a) 48 kHz
  - (b) 150 kHz
  - (c) 300 kHz
  - (d) 480 kHz
29. In Python, what is the role of the function: lower()?
- (a) Converts uppercase letters of a string to lowercase letters.
  - (b) Counts and returns the counted value of lowercase letters of a string.
  - (c) Returns TRUE if the string is in lowercase letters.
  - (d) Returns FALSE if the string is in uppercase letters.

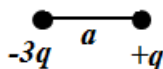
30. The value of  $\cot(22.5^\circ) - \tan(22.5^\circ)$  is

- (a) 1
- (b) 2
- (c)  $\sqrt{2} + 1$
- (d)  $\sqrt{2} - 1$

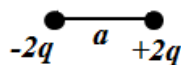
31. In the following configuration of charges, in which configuration is the dipole moment independent of the choice of origin?



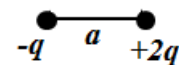
(a)



(b)



(c)



(d)

32. The magnetic susceptibility of

- (a) a paramagnetic material is negative and diamagnetic material is positive but both are less than one.
- (b) a paramagnetic material is positive and a ferromagnetic material is positive but both are less than one.
- (c) a diamagnetic material is negative and less than one and a ferromagnetic material is positive but much greater than one.
- (d) a diamagnetic material is negative and greater than one and a ferromagnetic material is positive and much greater than one.

33. A bus collectively includes

- (a) CPU and Memory.
- (b) CPU and Input/Output devices.
- (c) Memory and Input/Output devices.
- (d) CPU, Memory and Input/Output devices.

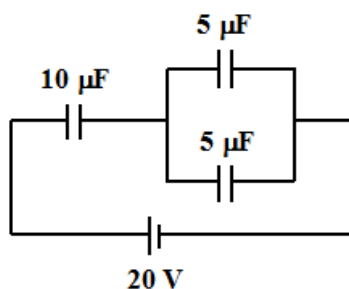
34. Choose the correct option.

- (a) In a good conductor, the electric field lags the magnetic field by  $45^\circ$ .
- (b) In a good conductor, the magnetic field lags the electric field by  $45^\circ$ .
- (c) In a bad conductor, the electric field lags the magnetic field by  $45^\circ$ .
- (d) In a bad conductor, the magnetic field lags the electric field by  $45^\circ$ .

35. Indian Space Research Organization was founded in the year

- (a) 1951
- (b) 1959
- (c) 1964
- (d) 1969

36. The charge stored in  $5\mu\text{F}$  capacitor in the given circuit is



- (a)  $25\ \mu\text{C}$
- (b)  $50\ \mu\text{C}$
- (c)  $75\ \mu\text{C}$
- (d)  $100\ \mu\text{C}$

37. The function of the flowchart symbol given below is



- (a) Process.
- (b) Input.
- (c) Decision.
- (d) End.

38. The components of the velocity of a gas molecule are  $v_x$ ,  $v_y$  and  $v_z$ , respectively. The value of  $\langle (v_x + 2v_y + 3v_z)^2 \rangle$  in terms of  $k$ ,  $T$  and  $m$  is

- (a)  $\frac{6kT}{m}$
- (b)  $\frac{14kT}{m}$
- (c)  $\frac{25kT}{m}$
- (d)  $\frac{36kT}{m}$



39. If  $\cot\theta - \tan\theta = 2$ , then the possible value of  $\theta$  is

- (a)  $\frac{n\pi}{2} + \frac{\pi}{4}$
- (b)  $\frac{n\pi}{2} + \frac{\pi}{6}$
- (c)  $\frac{n\pi}{2} + \frac{\pi}{8}$
- (d)  $\frac{n\pi}{2} + \frac{\pi}{10}$

40. Incorrect Maxwell's thermodynamic relation is

- (a)  $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$
- (b)  $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$
- (c)  $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$
- (d)  $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

41. Fill in the blank with a suitable adverb.

He is far and \_\_\_\_\_ the best athlete in our school.

- (a) far
- (b) away
- (c) wide
- (d) again

42. If  $PV$  vs  $V$  is plotted at different Boyle temperature, then

- (a) above Boyle temperature,  $PV$  decreases, attains a minimum value at a particular pressure and then increases.
- (b) below Boyle temperature,  $PV$  increases, attains a maximum value at a particular pressure and then decreases.
- (c) at Boyle temperature,  $PV$  increases linearly with  $V$ .
- (d) at Boyle temperature,  $PV$  is constant.

43. The number of modes of vibration per unit volume within the frequency interval  $6 \times 10^{14}$  to  $6.001 \times 10^{14}$  Hz for a blackbody radiation is around (Take  $c = 3 \times 10^8 \text{ ms}^{-1}$ )

- (a)  $1.2 \times 10^{16}$
- (b)  $3.4 \times 10^{16}$
- (c)  $6.8 \times 10^{16}$
- (d)  $9.6 \times 10^{16}$

44. The first Commander-in-Chief of the Indian army was
- (a) Field Marshal K. M. Cariappa.
  - (b) General K. S. Thimayya.
  - (c) Field Marshal Sam H. F. J. Manekshaw.
  - (d) General Jayanto Nath Chaudhuri.
45. Four concentric spherical shells of radii  $R$ ,  $2R$ ,  $3R$ , and  $4R$  carries surface charge densities  $2\sigma$ ,  $2\sigma$ ,  $-\sigma$ , and  $-3\sigma$ , respectively. The magnitude of the displacement vector  $\vec{D}$  at a point  $(\hat{i} + 2\hat{j} + 3\hat{k})R$  is
- (a)  $\frac{3\sigma}{4}$
  - (b)  $\frac{\sigma}{9}$
  - (c)  $\frac{3\sigma}{10}$
  - (d)  $\frac{\sigma}{14}$
46. The electric field due to a uniformly charged sphere of radius  $R$  is given by

$$\vec{E} = \begin{cases} kr\hat{r} & , r < R \\ \frac{kR^3}{r^2}\hat{r} & , r > R \end{cases}$$

where  $k$  is a positive constant and  $r$  is the radial distance measured with respect to the centre of sphere. The electrostatic energy of the sphere is

- (a)  $\frac{12\pi\epsilon_0 k^2 R^5}{5}$
  - (b)  $\frac{6\pi\epsilon_0 k^2 R^5}{5}$
  - (c)  $\frac{3\pi\epsilon_0 k^2 R^5}{5}$
  - (d)  $\frac{\pi\epsilon_0 k^2 R^5}{5}$
47. Out of the following softwares, one which does not come under FOSS is
- (a) Python.
  - (b) Mozilla Firefox.
  - (c) Skype.
  - (d) Openoffice.

48. A magnetic dipole is placed at the origin and is oriented along  $z$ -axis. Another magnetic dipole is placed at distance  $r$  on the  $x$ -axis and is oriented along  $x$ -axis. The force between the two magnetic dipoles is

- (a) zero.
- (b) repulsive and varies as  $r^{-4}$ .
- (c) attractive and varies as  $r^{-4}$ .
- (d) repulsive and varies as  $r^{-3}$ .

49. The radius of the cylinder of maximum volume that can be inscribed in a sphere of radius  $R$  is

- (a)  $\sqrt{\frac{3}{4}}R$
- (b)  $\sqrt{\frac{2}{3}}R$
- (c)  $\sqrt{\frac{1}{4}}R$
- (d)  $\sqrt{\frac{1}{3}}R$

50. First ever sports person to have won the badminton world championship is

- (a) P. Gopichand.
- (b) P. V. Sindhu.
- (c) Saina Nehwal.
- (d) Prakash Padukone.

51. In an LCR circuit,  $C = 1$  nF and  $L = 0.1$  H. For the circuit to be oscillatory, the maximum value of  $R$  should be

- (a)  $10$  k $\Omega$
- (b)  $20$  k $\Omega$
- (c)  $40$  k $\Omega$
- (d)  $100$  k $\Omega$

52. The pure form of carbon is

- (a) Fullerene.
- (b) Carbon black.
- (c) Coke.
- (d) Charcoal.

53. Which of the following option is incorrect about the effect of a bias at a  $p$ - $n$  junction?
- (a) When reverse biased, the field at the junction is increased by the applied field.
  - (b) When forward biased, the field at the junction is decreased by the applied field.
  - (c) When reverse biased, the field at the junction is increased compared to the field due to unbiased junction.
  - (d) When forward biased, the field at the junction is increased compared to the field due to unbiased junction.
54. If  $z = 3 + 4i$ , then  $z^{-1}$  is
- (a)  $\frac{3-4i}{5}$
  - (b)  $\frac{3+4i}{5}$
  - (c)  $\frac{3-4i}{25}$
  - (d)  $\frac{3+4i}{25}$
55. A plane wave enters from the air medium into a region of dielectric constant of 2.25 at normal incidence. The reflection coefficient for the plane wave is
- (a) 0.04
  - (b) 0.15
  - (c) 0.38
  - (d) 0.60
56. A vector of magnitude  $\sqrt{62}$  perpendicular to both vectors  $\hat{i} + \hat{j} + \hat{k}$  and  $3\hat{i} - 2\hat{j} + 4\hat{k}$  is
- (a)  $6\hat{i} - \hat{j} - 5\hat{k}$
  - (b)  $\frac{6\hat{i} - \hat{j} - 5\hat{k}}{\sqrt{62}}$
  - (c)  $\sqrt{62}(6\hat{i} - \hat{j} - 5\hat{k})$
  - (d)  $\frac{6\hat{i} - \hat{j} - 5\hat{k}}{62}$
57. The sum of a two digit number to a number obtained by interchanging its digits is 66. If the ratio of the larger to the smaller digit is 2, then the product of the two digits is
- (a) 4
  - (b) 6
  - (c) 8
  - (d) 10

58. A thin uniform rod of mass  $M$  and length  $L$  is pivoted at one end and can rotate freely about it in a vertical plane. The pivoted end is located on the ground. The rod is released from rest from its vertical position. If  $g$  is the acceleration due to gravity, then the tangential acceleration of the rod at the instant it makes an angle of  $30^\circ$  with respect to the vertical is

- (a)  $\frac{3g}{4}$
- (b)  $\frac{2g}{3}$
- (c)  $\frac{g}{3}$
- (d)  $\frac{g}{4}$

59. A particle describes the curve  $r = a\cos\theta$  under a force  $F$  to the pole where  $a$  is a positive constant. The law of force is proportional to

- (a)  $r^{-2}$
- (b)  $r^{-3}$
- (c)  $r^{-4}$
- (d)  $r^{-5}$

60. For Python programming language, the incorrect option is

- (a) It is not case sensitive.
- (b) It is a high level language.
- (c) It is an interpreted language.
- (d) It is portable.

61. Viscosity is the property of gas describing the

- (a) transport of energy.
- (b) transport of atoms and molecules.
- (c) transport of momentum.
- (d) transport of pressure.

62.  $PV^n$  is a constant for expansion or compression of a perfect gas where  $n$  depends upon the nature of the gas. Which of the following option is incorrect about  $n$ ?

- (a)  $n = 0$  at constant pressure.
- (b)  $n = 1$  at constant volume.
- (c)  $n = 1$  at constant temperature.
- (d)  $n = C_p/C_v$  for adiabatic expansion.

63. If the radius of 6<sup>th</sup> zone in a zone plate is  $R$ , then the radius of 10<sup>th</sup> zone is

- (a)  $\frac{19}{11}R$
- (b)  $\frac{7}{5}R$
- (c)  $\sqrt{\frac{5}{3}}R$
- (d)  $\sqrt{\frac{21}{13}}R$

64. Full form of LIGO is

- (a) Laser Interferometer Gravitational-Wave Observatory.
- (b) Laser Interferometric Gravitational-Wave Observatory.
- (c) Laser Installed Gravitational-Wave Observatory.
- (d) Laser Infra-red Gravitational-Wave Observatory.

65. The displacement of a particle executing simple harmonic motion along  $x$  direction is given by  $x(t) = a\cos(kt) + b\sin(kt)$ , where  $a$ ,  $b$  and  $k$  are positive constants. The amplitude of oscillation is

- (a)  $\sqrt{a^2 + b^2}$
- (b)  $\sqrt{a^2 - b^2}$
- (c)  $(a + b)$
- (d)  $(a - b)$

66. Which of the following property is correct for a nonsingular matrix  $A$  of order  $n$ ?

- (a)  $|\text{adj}(A)| = |A|^{n+1}$
- (b)  $|\text{adj}(A)| = |A|^n$
- (c)  $|\text{adj}(A)| = |A|^{n-1}$
- (d)  $|\text{adj}(A)| = |A|^{n+2}$

67. The bulk modulus of air at STP is approximately (Take  $\gamma = 1.4$  for air)

- (a)  $1.42 \times 10^5 \text{ Nm}^{-2}$
- (b)  $1.01 \times 10^5 \text{ Nm}^{-2}$
- (c)  $0.90 \times 10^5 \text{ Nm}^{-2}$
- (d)  $0.14 \times 10^5 \text{ Nm}^{-2}$

68. A particle falls freely from infinity towards the earth. Given that the gravitational potential at a point inside the earth is given by  $V(r) = -\frac{GM}{2R^3}(3R^2 - r^2)$  where  $G$  is the gravitational constant,  $M$  is the mass and  $R$  is the radius of the earth, respectively.  $r$  is measured from the centre of the earth. If  $g$  is the acceleration due to gravity, then the velocity of the particle at the surface and at centre of the earth is

- (a)  $\sqrt{gR}, \sqrt{gR}$
- (b)  $\sqrt{gR}, \sqrt{2gR}$
- (c)  $\sqrt{gR}, \sqrt{3gR}$
- (d)  $\sqrt{2gR}, \sqrt{3gR}$

69. Synonym of Pinnacle is

- (a) Big.
- (b) Long.
- (c) High.
- (d) Peak.

70. The arithmetic mean between two numbers  $a$  and  $b$  is two times the geometric mean between them. The ratio  $a:b$  is

- (a)  $7 + 4\sqrt{3}$
- (b)  $2 + 4\sqrt{3}$
- (c)  $4 - 7\sqrt{3}$
- (d)  $4 + 2\sqrt{3}$

71. The area enclosed by the parabola  $2y = 5(4 - x^2)$  and the  $x$ -axis is (in sq. units)

- (a)  $\frac{80}{3}$
- (b)  $\frac{40}{3}$
- (c)  $\frac{20}{3}$
- (d)  $\frac{10}{3}$

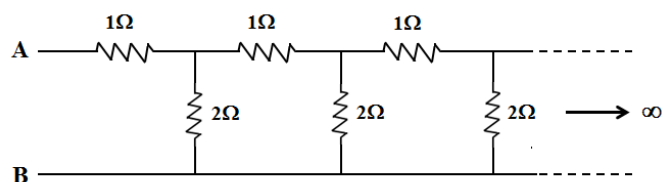
72. The equation of a plane waver is  $y = 10 \sin \frac{\pi}{6} \left( t + \frac{x}{4} \right)$ . At any given instance, the phase difference between two particles 12 cm apart is

- (a)  $0^\circ$
- (b)  $3^\circ$
- (c)  $45^\circ$
- (d)  $90^\circ$

73. The distance of a plane  $2x + 3y + z - 1 = 0$  from the origin is

- (a) 1
- (b)  $\frac{1}{\sqrt{6}}$
- (c)  $\frac{1}{\sqrt{14}}$
- (d)  $\frac{1}{\sqrt{15}}$

74. The equivalent resistance of the following network between A and B is



- (a)  $1 \Omega$
- (b)  $1.4 \Omega$
- (c)  $1.6 \Omega$
- (d)  $2 \Omega$

75. Michelson interferometer measures

- (a) Spatial coherence.
- (b) Temporal coherence.
- (c) Both spatial and temporal coherence.
- (d) None of these.

76. The force of attraction between two temporary dipoles is known as

- (a) London force.
- (b) Viscous force.
- (c) Drag force.
- (d) Elastic force.

77. A stretched string between two rigid supports has a fundamental frequency of vibration at 420 Hz. If the same string is allowed to vibrate freely from one end with the other end fixed to a support, then the fundamental frequency of vibration, in Hz, is

- (a) 105
- (b) 210
- (c) 420
- (d) 840



78. A car emits a signal at 400 Hz. It passes through a stationary observer at a velocity of  $30 \text{ ms}^{-1}$ . If the velocity of sound is  $350 \text{ ms}^{-1}$ , then the change in frequency, in Hz, is approximately
- (a) 50
  - (b) 70
  - (c) 90
  - (d) 110
79. \_\_\_\_\_ is not a commonly used preservative.
- (a) Sugar
  - (b) Table salt
  - (c) Vegetable oil
  - (d) Sugarcane
80. The separation between two charges in vacuum is 20 cm. When immersed in a liquid of relative permittivity of 4, the force between the charges remains unchanged. The separation between the charges in the liquid, in cm, is
- (a) 40
  - (b) 25
  - (c) 15
  - (d) 10
81. Conversion of  $(120)_{10}$  to octal number is
- (a)  $(170)_8$
  - (b)  $(166)_8$
  - (c)  $(140)_8$
  - (d)  $(120)_8$
82. The mean free path between the atoms of two gases under the same condition of temperature and pressure is found to be in the ratio of 3:2. Assuming that the size of the atoms of two gases is same, the ratio of the number density of two gases is
- (a) 3:2
  - (b) 2:3
  - (c) 4:9
  - (d) 9:4

83. Two carnot engines P and Q are arranged in series. P receives heat at 850 K and rejects some heat to Q maintained at a temperature of  $T$  K. Q in turn rejects the heat to a reservoir maintained at 400 K. If the work output of P and Q is equal, then the value of  $T$ , in K, is
- (a) 225
  - (b) 425
  - (c) 525
  - (d) 625
84. The oxidation number of Mn in  $\text{KMnO}_4$  is
- (a) +3
  - (b) -1
  - (c) +7
  - (d) 0
85. Against which physical quantity is the dimensional formula incorrect?
- (a) Resistance:  $\text{ML}^2\text{T}^{-3}\text{A}^{-2}$
  - (b) Magnetic field:  $\text{MT}^{-2}\text{A}^{-1}$
  - (c) Capacitance:  $\text{M}^{-1}\text{L}^{-2}\text{T}^3\text{A}^2$
  - (d) Electric potential:  $\text{ML}^2\text{T}^{-3}\text{A}^{-1}$
86. An object is thrown horizontally with a velocity of  $\sqrt{4gh}$  from the top of a wall of height  $h$  where  $g$  is the acceleration due to gravity. The object hits the ground at a distance of
- (a)  $h$
  - (b)  $\sqrt{2}h$
  - (c)  $2h$
  - (d)  $2\sqrt{2}h$
87. An artificial satellite orbits very close to the surface of the earth. The orbital velocity (in  $\text{kms}^{-1}$ ) of the satellite is (Take  $g = 10 \text{ ms}^{-2}$  and radius of the earth =  $6.4 \times 10^6 \text{ m}$ )
- (a) 4
  - (b) 8
  - (c) 10
  - (d) 20

88. A particle projected from the origin moves in the x-y plane with a velocity of  $\vec{V} = \hat{i} + 3x\hat{j}$ . The trajectory of the particle is

(a)  $y = \frac{x^3}{3}$

(b)  $y = \frac{3x^2}{2}$

(c)  $x = \frac{y^3}{3}$

(d)  $x = \frac{3y^2}{2}$

89. Two identical drops of a liquid falls through the air medium with terminal velocities  $v$  each. If the two drops coalesce, then the terminal velocity of the drop is

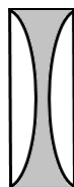
(a)  $2^{1/3} v$

(b)  $2^{2/3} v$

(c)  $4^{1/3} v$

(d)  $4^{2/3} v$

90. Two thin plano-convex lenses are placed together with a liquid of refractive index 2 filled between them as shown in the figure, with liquid as the shaded region. The radius of curvature of each lens is 100 cm and refractive index is 1.5. The focal length of the combination, in cm, is



(a) 100

(b) -100

(c) 50

(d) -20