

1. For transistor action, which of the following statements is **correct** ?

- (1) Both emitter junction as well as the collector junction are forward biased.
- (2) The base region must be very thin and lightly doped.
- (3) Base, emitter and collector regions should have same doping concentrations.
- (4) Base, emitter and collector regions should have same size.

2. A spherical conductor of radius 10 cm has a charge of 3.2×10^{-7} C distributed uniformly. What is the magnitude of electric field at a point 15 cm from the centre of the sphere ?

$$\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2 \right)$$

- (1) 1.28×10^6 N/C
- (2) 1.28×10^7 N/C
- (3) 1.28×10^4 N/C
- (4) 1.28×10^5 N/C

3. Assume that light of wavelength 600 nm is coming from a star. The limit of resolution of telescope whose objective has a diameter of 2 m is :

- (1) 7.32×10^{-7} rad
- (2) 6.00×10^{-7} rad
- (3) 3.66×10^{-7} rad
- (4) 1.83×10^{-7} rad

4. Dimensions of stress are :

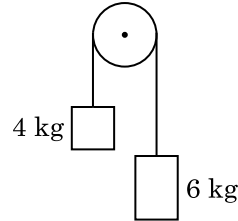
- (1) $[\text{ML}^0\text{T}^{-2}]$
- (2) $[\text{ML}^{-1}\text{T}^{-2}]$
- (3) $[\text{MLT}^{-2}]$
- (4) $[\text{ML}^2\text{T}^{-2}]$

5. A screw gauge has least count of 0.01 mm and there are 50 divisions in its circular scale.

The pitch of the screw gauge is :

- (1) 0.5 mm
- (2) 1.0 mm
- (3) 0.01 mm
- (4) 0.25 mm

6. Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity (g) is :



- (1) $g/5$
- (2) $g/10$
- (3) g
- (4) $g/2$

7. An electron is accelerated from rest through a potential difference of V volt. If the de Broglie wavelength of the electron is 1.227×10^{-2} nm, the potential difference is :

- (1) 10^3 V
- (2) 10^4 V
- (3) 10 V
- (4) 10^2 V

8. In a certain region of space with volume 0.2 m^3 , the electric potential is found to be 5 V throughout. The magnitude of electric field in this region is :

- (1) 1 N/C
- (2) 5 N/C
- (3) zero
- (4) 0.5 N/C

9. A cylinder contains hydrogen gas at pressure of 249 kPa and temperature 27°C .

Its density is : ($R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$)

- (1) 0.1 kg/m^3
- (2) 0.02 kg/m^3
- (3) 0.5 kg/m^3
- (4) 0.2 kg/m^3

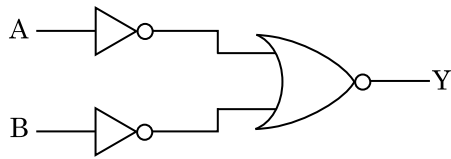
10. The mean free path for a gas, with molecular diameter d and number density n can be expressed as :

- (1) $\frac{1}{\sqrt{2} n^2 \pi d^2}$
- (2) $\frac{1}{\sqrt{2} n^2 \pi^2 d^2}$
- (3) $\frac{1}{\sqrt{2} n \pi d}$
- (4) $\frac{1}{\sqrt{2} n \pi d^2}$

11. A ball is thrown vertically downward with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of 80 m/s. The height of the tower is : ($g = 10 \text{ m/s}^2$)

- (1) 320 m
 (2) 300 m
 (3) 360 m
 (4) 340 m

12. For the logic circuit shown, the truth table is :



- (1) A B Y

0 0 1

0 1 1

1 0 1

1 1 0

- (2) A B Y

0 0 1

0 1 0

1 0 0

1 1 0

- (3) A B Y

0 0 0

0 1 0

1 0 0

1 1 1

- (4) A B Y

0 0 0

0 1 1

1 0 1

1 1 1

13. A short electric dipole has a dipole moment of $16 \times 10^{-9} \text{ C m}$. The electric potential due to the dipole at a point at a distance of 0.6 m from the centre of the dipole, situated on a line making an angle of 60° with the dipole axis is :

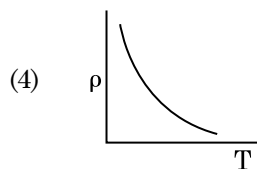
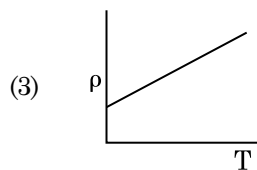
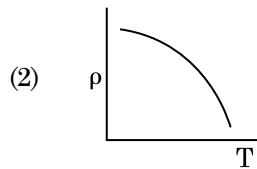
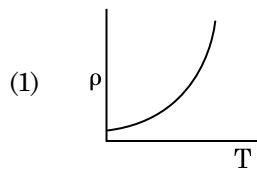
$$\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2 \right)$$

- (1) 400 V
 (2) zero
 (3) 50 V
 (4) 200 V

14. A capillary tube of radius r is immersed in water and water rises in it to a height h . The mass of the water in the capillary is 5 g. Another capillary tube of radius $2r$ is immersed in water. The mass of water that will rise in this tube is :

- (1) 10.0 g
 (2) 20.0 g
 (3) 2.5 g
 (4) 5.0 g

15. Which of the following graph represents the variation of resistivity (ρ) with temperature (T) for copper ?



16. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is : (c = speed of electromagnetic waves)

- (1) 1 : c
 (2) 1 : c^2
 (3) c : 1
 (4) 1 : 1

17. A long solenoid of 50 cm length having 100 turns carries a current of 2.5 A. The magnetic field at the centre of the solenoid is :

$$(\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1})$$

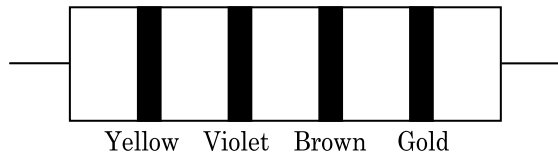
- (1) $6.28 \times 10^{-5} \text{ T}$
 (2) $3.14 \times 10^{-5} \text{ T}$
 (3) $6.28 \times 10^{-4} \text{ T}$
 (4) $3.14 \times 10^{-4} \text{ T}$

18. For which one of the following, Bohr model is **not** valid ?
- (1) Deuteron atom
 - (2) Singly ionised neon atom (Ne^+)
 - (3) Hydrogen atom
 - (4) Singly ionised helium atom (He^+)
19. The energy equivalent of 0.5 g of a substance is :
- (1) 1.5×10^{13} J
 - (2) 0.5×10^{13} J
 - (3) 4.5×10^{16} J
 - (4) 4.5×10^{13} J
20. Taking into account of the significant figures, what is the value of $9.99 \text{ m} - 0.0099 \text{ m}$?
- (1) 9.980 m
 - (2) 9.9 m
 - (3) 9.9801 m
 - (4) 9.98 m
21. In a guitar, two strings A and B made of same material are slightly out of tune and produce beats of frequency 6 Hz. When tension in B is slightly decreased, the beat frequency increases to 7 Hz. If the frequency of A is 530 Hz, the original frequency of B will be :
- (1) 536 Hz
 - (2) 537 Hz
 - (3) 523 Hz
 - (4) 524 Hz
22. A series LCR circuit is connected to an ac voltage source. When L is removed from the circuit, the phase difference between current and voltage is $\frac{\pi}{3}$. If instead C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$ between current and voltage. The power factor of the circuit is :
- (1) 1.0
 - (2) -1.0
 - (3) zero
 - (4) 0.5
23. The quantities of heat required to raise the temperature of two solid copper spheres of radii r_1 and r_2 ($r_1 = 1.5 r_2$) through 1 K are in the ratio :
- (1) $\frac{3}{2}$
 - (2) $\frac{5}{3}$
 - (3) $\frac{27}{8}$
 - (4) $\frac{9}{4}$
24. The Brewsters angle i_b for an interface should be :
- (1) $45^\circ < i_b < 90^\circ$
 - (2) $i_b = 90^\circ$
 - (3) $0^\circ < i_b < 30^\circ$
 - (4) $30^\circ < i_b < 45^\circ$
25. Two cylinders A and B of equal capacity are connected to each other via a stop cock. A contains an ideal gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stop cock is suddenly opened. The process is :
- (1) isochoric
 - (2) isobaric
 - (3) isothermal
 - (4) adiabatic
26. An iron rod of susceptibility 599 is subjected to a magnetising field of 1200 A m^{-1} . The permeability of the material of the rod is : ($\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$)
- (1) $2.4\pi \times 10^{-5} \text{ T m A}^{-1}$
 - (2) $2.4\pi \times 10^{-7} \text{ T m A}^{-1}$
 - (3) $2.4\pi \times 10^{-4} \text{ T m A}^{-1}$
 - (4) $8.0 \times 10^{-5} \text{ T m A}^{-1}$
27. The capacitance of a parallel plate capacitor with air as medium is $6 \mu\text{F}$. With the introduction of a dielectric medium, the capacitance becomes $30 \mu\text{F}$. The permittivity of the medium is : ($\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$)
- (1) $0.44 \times 10^{-10} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$
 - (2) $5.00 \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$
 - (3) $0.44 \times 10^{-13} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$
 - (4) $1.77 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$

28. A charged particle having drift velocity of $7.5 \times 10^{-4} \text{ m s}^{-1}$ in an electric field of $3 \times 10^{-10} \text{ Vm}^{-1}$, has a mobility in $\text{m}^2 \text{ V}^{-1} \text{ s}^{-1}$ of :

- (1) 2.5×10^{-6}
- (2) 2.25×10^{-15}
- (3) 2.25×10^{15}
- (4) 2.5×10^6

29. The color code of a resistance is given below :



The values of resistance and tolerance, respectively, are :

- (1) $4.7 \text{ k}\Omega$, 5%
 - (2) 470Ω , 5%
 - (3) $470 \text{ k}\Omega$, 5%
 - (4) $47 \text{ k}\Omega$, 10%
30. The solids which have the negative temperature coefficient of resistance are :
- (1) semiconductors only
 - (2) insulators and semiconductors
 - (3) metals
 - (4) insulators only
31. A body weighs 72 N on the surface of the earth. What is the gravitational force on it, at a height equal to half the radius of the earth ?
- (1) 30 N
 - (2) 24 N
 - (3) 48 N
 - (4) 32 N
32. A $40 \mu\text{F}$ capacitor is connected to a 200 V, 50 Hz ac supply. The rms value of the current in the circuit is, nearly :
- (1) 2.5 A
 - (2) 25.1 A
 - (3) 1.7 A
 - (4) 2.05 A

33. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is :

- (1) $\frac{\pi}{2}$ rad
- (2) zero
- (3) π rad
- (4) $\frac{3\pi}{2}$ rad

34. The average thermal energy for a mono-atomic gas is : (k_B is Boltzmann constant and T, absolute temperature)

- (1) $\frac{5}{2} k_B T$
- (2) $\frac{7}{2} k_B T$
- (3) $\frac{1}{2} k_B T$
- (4) $\frac{3}{2} k_B T$

35. Light of frequency 1.5 times the threshold frequency is incident on a photosensitive material. What will be the photoelectric current if the frequency is halved and intensity is doubled ?

- (1) one-fourth
- (2) zero
- (3) doubled
- (4) four times

36. A wire of length L, area of cross section A is hanging from a fixed support. The length of the wire changes to L_1 when mass M is suspended from its free end. The expression for Young's modulus is :

- (1) $\frac{MgL}{AL_1}$
- (2) $\frac{MgL}{A(L_1 - L)}$
- (3) $\frac{MgL_1}{AL}$
- (4) $\frac{Mg(L_1 - L)}{AL}$

37. A ray is incident at an angle of incidence i on one surface of a small angle prism (with angle of prism A) and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ , then the angle of incidence is nearly equal to :
- (1) μA
 - (2) $\frac{\mu A}{2}$
 - (3) $\frac{A}{2\mu}$
 - (4) $\frac{2A}{\mu}$
38. Find the torque about the origin when a force of $3\hat{j}$ N acts on a particle whose position vector is $2\hat{k}$ m .
- (1) $-6\hat{i}$ N m
 - (2) $6\hat{k}$ N m
 - (3) $6\hat{i}$ N m
 - (4) $6\hat{j}$ N m
39. In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent sources is doubled, then the fringe width becomes :
- (1) four times
 - (2) one-fourth
 - (3) double
 - (4) half
40. The energy required to break one bond in DNA is 10^{-20} J. This value in eV is nearly :
- (1) 0.06
 - (2) 0.006
 - (3) 6
 - (4) 0.6
41. When a uranium isotope ${}_{92}^{235}\text{U}$ is bombarded with a neutron, it generates ${}_{36}^{89}\text{Kr}$, three neutrons and :
- (1) ${}_{36}^{101}\text{Kr}$
 - (2) ${}_{36}^{103}\text{Kr}$
 - (3) ${}_{56}^{144}\text{Ba}$
 - (4) ${}_{40}^{91}\text{Zr}$
42. Two particles of mass 5 kg and 10 kg respectively are attached to the two ends of a rigid rod of length 1 m with negligible mass.
- The centre of mass of the system from the 5 kg particle is nearly at a distance of :
- (1) 67 cm
 - (2) 80 cm
 - (3) 33 cm
 - (4) 50 cm
43. Light with an average flux of 20 W/cm^2 falls on a non-reflecting surface at normal incidence having surface area 20 cm^2 . The energy received by the surface during time span of 1 minute is :
- (1) $24 \times 10^3 \text{ J}$
 - (2) $48 \times 10^3 \text{ J}$
 - (3) $10 \times 10^3 \text{ J}$
 - (4) $12 \times 10^3 \text{ J}$
44. The increase in the width of the depletion region in a p-n junction diode is due to :
- (1) both forward bias and reverse bias
 - (2) increase in forward current
 - (3) forward bias only
 - (4) reverse bias only
45. A resistance wire connected in the left gap of a metre bridge balances a 10Ω resistance in the right gap at a point which divides the bridge wire in the ratio 3 : 2. If the length of the resistance wire is 1.5 m, then the length of 1Ω of the resistance wire is :
- (1) $1.5 \times 10^{-1} \text{ m}$
 - (2) $1.5 \times 10^{-2} \text{ m}$
 - (3) $1.0 \times 10^{-2} \text{ m}$
 - (4) $1.0 \times 10^{-1} \text{ m}$