

1. 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)  $\frac{Mg(L_1 - L)}{AL}$

(2)  $\frac{MgL}{AL_1}$

(3)  $\frac{MgL}{A(L_1 - L)}$

(4)  $\frac{MgL_1}{AL}$

2. A cylinder contains hydrogen gas at pressure of 249 kPa and temperature  $27^\circ\text{C}$ .

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

(1)  $0.2 \text{ kg/m}^3$

(2)  $0.1 \text{ kg/m}^3$

(3)  $0.02 \text{ kg/m}^3$

(4)  $0.5 \text{ kg/m}^3$

3. Light with an average flux of  $20 \text{ W/cm}^2$  falls on a non-reflecting surface at normal incidence having surface area  $20 \text{ cm}^2$ . The energy received by the surface during time span of 1 minute is :

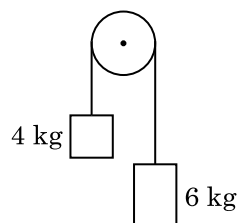
(1)  $12 \times 10^3 \text{ J}$

(2)  $24 \times 10^3 \text{ J}$

(3)  $48 \times 10^3 \text{ J}$

(4)  $10 \times 10^3 \text{ J}$

4. 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)  $g/2$

(2)  $g/5$

(3)  $g/10$

(4)  $g$

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

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

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

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

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

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

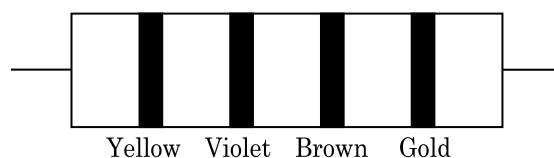
(1) 340 m

(2) 320 m

(3) 300 m

(4) 360 m

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



The values of resistance and tolerance, respectively, are :

(1)  $47 \text{ k}\Omega$ , 10%

(2)  $4.7 \text{ k}\Omega$ , 5%

(3)  $470 \Omega$ , 5%

(4)  $470 \text{ k}\Omega$ , 5%

8. When a uranium isotope  ${}_{92}^{235}\text{U}$  is bombarded with a neutron, it generates  ${}_{36}^{89}\text{Kr}$ , three neutrons and :

(1)  ${}_{40}^{91}\text{Zr}$

(2)  ${}_{36}^{101}\text{Kr}$

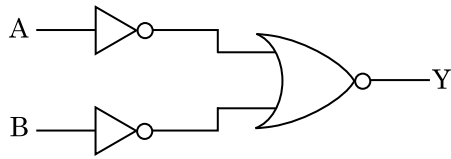
(3)  ${}_{36}^{103}\text{Kr}$

(4)  ${}_{56}^{144}\text{Ba}$

9. A spherical conductor of radius 10 cm has a charge of  $3.2 \times 10^{-7}$  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)  $1.28 \times 10^5$  N/C  
 (2)  $1.28 \times 10^6$  N/C  
 (3)  $1.28 \times 10^7$  N/C  
 (4)  $1.28 \times 10^4$  N/C
10. 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  $\mu$ , then the angle of incidence is nearly equal to :
- (1)  $\frac{2A}{\mu}$   
 (2)  $\mu A$   
 (3)  $\frac{\mu A}{2}$   
 (4)  $\frac{A}{2\mu}$
11. 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) adiabatic  
 (2) isochoric  
 (3) isobaric  
 (4) isothermal
12. An iron rod of susceptibility 599 is subjected to a magnetising field of  $1200 \text{ A m}^{-1}$ . The permeability of the material of the rod is :
- $$(\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1})$$
- (1)  $8.0 \times 10^{-5} \text{ T m A}^{-1}$   
 (2)  $2.4\pi \times 10^{-5} \text{ T m A}^{-1}$   
 (3)  $2.4\pi \times 10^{-7} \text{ T m A}^{-1}$   
 (4)  $2.4\pi \times 10^{-4} \text{ T m A}^{-1}$
13. The energy equivalent of 0.5 g of a substance is :
- (1)  $4.5 \times 10^{13}$  J  
 (2)  $1.5 \times 10^{13}$  J  
 (3)  $0.5 \times 10^{13}$  J  
 (4)  $4.5 \times 10^{16}$  J
14. 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) 2.05 A  
 (2) 2.5 A  
 (3) 25.1 A  
 (4) 1.7 A
15. 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 : 1  
 (2) 1 :  $c$   
 (3) 1 :  $c^2$   
 (4)  $c$  : 1
16. 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) 50 cm  
 (2) 67 cm  
 (3) 80 cm  
 (4) 33 cm
17. A resistance wire connected in the left gap of a metre bridge balances a  $10 \Omega$  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  $1 \Omega$  of the resistance wire is :
- (1)  $1.0 \times 10^{-1}$  m  
 (2)  $1.5 \times 10^{-1}$  m  
 (3)  $1.5 \times 10^{-2}$  m  
 (4)  $1.0 \times 10^{-2}$  m
18. 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) half  
 (2) four times  
 (3) one-fourth  
 (4) double

19. 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)  $2.5 \times 10^6$
  - (2)  $2.5 \times 10^{-6}$
  - (3)  $2.25 \times 10^{-15}$
  - (4)  $2.25 \times 10^{15}$
20. Dimensions of stress are :
- (1)  $[\text{ML}^2\text{T}^{-2}]$
  - (2)  $[\text{ML}^0\text{T}^{-2}]$
  - (3)  $[\text{ML}^{-1}\text{T}^{-2}]$
  - (4)  $[\text{MLT}^{-2}]$
21. For which one of the following, Bohr model is **not** valid ?
- (1) Singly ionised helium atom ( $\text{He}^+$ )
  - (2) Deuteron atom
  - (3) Singly ionised neon atom ( $\text{Ne}^+$ )
  - (4) Hydrogen atom
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) 0.5
  - (2) 1.0
  - (3) -1.0
  - (4) zero
23. 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) 5.0 g
  - (2) 10.0 g
  - (3) 20.0 g
  - (4) 2.5 g
24. 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)  $1.83 \times 10^{-7} \text{ rad}$
  - (2)  $7.32 \times 10^{-7} \text{ rad}$
  - (3)  $6.00 \times 10^{-7} \text{ rad}$
  - (4)  $3.66 \times 10^{-7} \text{ rad}$
25. The solids which have the negative temperature coefficient of resistance are :
- (1) insulators only
  - (2) semiconductors only
  - (3) insulators and semiconductors
  - (4) metals
26. 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)  $1.77 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$
  - (2)  $0.44 \times 10^{-10} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$
  - (3)  $5.00 \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$
  - (4)  $0.44 \times 10^{-13} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$
27. The energy required to break one bond in DNA is  $10^{-20} \text{ J}$ . This value in eV is nearly :
- (1) 0.6
  - (2) 0.06
  - (3) 0.006
  - (4) 6
28. The increase in the width of the depletion region in a p-n junction diode is due to :
- (1) reverse bias only
  - (2) both forward bias and reverse bias
  - (3) increase in forward current
  - (4) forward bias only
29. 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)  $\frac{9}{4}$
  - (2)  $\frac{3}{2}$
  - (3)  $\frac{5}{3}$
  - (4)  $\frac{27}{8}$

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



(1)	A	B	Y
	0	0	0
	0	1	1
	1	0	1
	1	1	1
(2)	A	B	Y
	0	0	1
	0	1	1
	1	0	1
	1	1	0
(3)	A	B	Y
	0	0	1
	0	1	0
	1	0	0
	1	1	0
(4)	A	B	Y
	0	0	0
	0	1	0
	1	0	0
	1	1	1

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

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

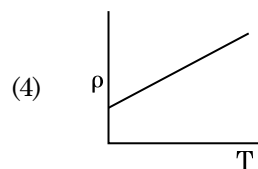
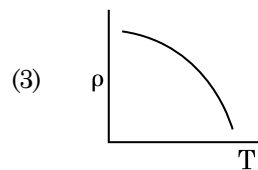
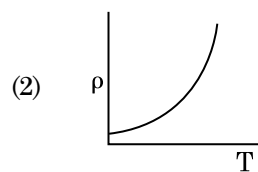
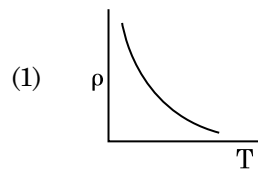
32. In a guitar, two strings A and B made of same material are slightly out of tune and produce beats of frequency 6 Hz. When tension in B is slightly decreased, the beat frequency increases to 7 Hz. If the frequency of A is 530 Hz, the original frequency of B will be :

- (1) 524 Hz
- (2) 536 Hz
- (3) 537 Hz
- (4) 523 Hz

33. 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  $60^\circ$  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) 200 V
  - (2) 400 V
  - (3) zero
  - (4) 50 V
34. 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) 32 N
  - (2) 30 N
  - (3) 24 N
  - (4) 48 N
35. Which of the following graph represents the variation of resistivity ( $\rho$ ) with temperature (T) for copper ?



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

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

37. The average thermal energy for a mono-atomic gas is : ( $k_B$  is Boltzmann constant and  $T$ , absolute temperature)
- (1)  $\frac{3}{2} k_B T$
  - (2)  $\frac{5}{2} k_B T$
  - (3)  $\frac{7}{2} k_B T$
  - (4)  $\frac{1}{2} k_B T$
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)  $6\hat{j}$  N m
  - (2)  $-6\hat{i}$  N m
  - (3)  $6\hat{k}$  N m
  - (4)  $6\hat{i}$  N m
39. 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) four times
  - (2) one-fourth
  - (3) zero
  - (4) doubled
40. 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)  $3.14 \times 10^{-4} \text{ T}$
  - (2)  $6.28 \times 10^{-5} \text{ T}$
  - (3)  $3.14 \times 10^{-5} \text{ T}$
  - (4)  $6.28 \times 10^{-4} \text{ T}$
41. The Brewsters angle  $i_b$  for an interface should be :
- (1)  $30^\circ < i_b < 45^\circ$
  - (2)  $45^\circ < i_b < 90^\circ$
  - (3)  $i_b = 90^\circ$
  - (4)  $0^\circ < i_b < 30^\circ$
42. An electron is accelerated from rest through a potential difference of  $V$  volt. If the de Broglie wavelength of the electron is  $1.227 \times 10^{-2} \text{ nm}$ , the potential difference is :
- (1)  $10^2 \text{ V}$
  - (2)  $10^3 \text{ V}$
  - (3)  $10^4 \text{ V}$
  - (4)  $10 \text{ V}$
43. Taking into account of the significant figures, what is the value of  $9.99 \text{ m} - 0.0099 \text{ m}$  ?
- (1)  $9.98 \text{ m}$
  - (2)  $9.980 \text{ m}$
  - (3)  $9.9 \text{ m}$
  - (4)  $9.9801 \text{ m}$
44. 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) 0.25 mm
  - (2) 0.5 mm
  - (3) 1.0 mm
  - (4) 0.01 mm
45. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is :
- (1)  $\frac{3\pi}{2}$  rad
  - (2)  $\frac{\pi}{2}$  rad
  - (3) zero
  - (4)  $\pi$  rad
46. Match the organism with its use in biotechnology.
- |                                      |  |
|--------------------------------------|--|
| (a) <i>Bacillus thuringiensis</i>    | (i) Cloning vector                       |
| (b) <i>Thermus aquaticus</i>         | (ii) Construction of first rDNA molecule |
| (c) <i>Agrobacterium tumefaciens</i> | (iii) DNA polymerase                     |
| (d) <i>Salmonella typhimurium</i>    | (iv) Cry proteins                        |
- Select the **correct** option from the following :
- |     | (a)   | (b)   | (c)   | (d)  |
|-----|-------|-------|-------|------|
| (1) | (iv)  | (iii) | (i)   | (ii) |
| (2) | (iii) | (ii)  | (iv)  | (i)  |
| (3) | (iii) | (iv)  | (i)   | (ii) |
| (4) | (ii)  | (iv)  | (iii) | (i)  |