

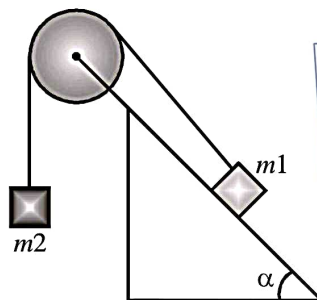


**FUTURE OF PHYSICS**  
**IIT JAM 2022 MOCK TEST AIJ22**  
**FULL MARKS:- 25×2 MARKS= 50 MARKS**  
**CEO:- DR. DIPESH SATPATI**  
**ASSOCIATE SPACE SCIENTIST**  
**INDIAN SPACE RESEARCH ORGANIZATION**

1. In a collision between two particles  
 (a) linear momentum is conserved, but kinetic energy is not necessarily conserved  
 (b) kinetic energy is conserved, but linear momentum is not necessarily conserved  
 (c) either linear momentum or kinetic energy, but not necessarily both are conserved.  
 (d) both linear momentum and kinetic energy are conserved.
2. The moment of inertia of a thin rectangular plate of length  $a$ , width  $b$ , mass  $m$  about an axis passing through the centre and perpendicular to the plate is  
 (a)  $\frac{1}{12}m(a^2 + b^2)$  (b)  $\frac{1}{6}m(a^2 + b^2)$  (c)  $\frac{1}{12}mab$  (d)  $\frac{1}{6}mab$
3. A smooth sphere rests on a horizontal plane. A point particle slides without friction down the sphere, starting at the top. If  $R$  be the radius of the sphere, the velocity of the particle when it leaves the surface would be given by ( $g$  is the acceleration due to gravity)  
 (a)  $\sqrt{\frac{2gR}{3}}$  (b)  $\sqrt{\frac{3gR}{2}}$  (c)  $\sqrt{\frac{3gR}{4}}$  (d)  $\sqrt{\frac{4gR}{3}}$
4. A mass  $m$  is suspended from a frictionless pulley and hangs over an inextensible string attached to the ceiling on one side and a force  $F$  is exerted upwards at the other end as shown in the figure below. The force  $F$  for the condition of static equilibrium is



- (a)  $1\text{ mg}$  (b)  $2\text{ mg}$  (c)  $4\text{ mg}$  (d)  $0.5\text{ mg}$
5. Two masses  $m_1$  and  $m_2$  are attached to an inextensible string passing over a massless and frictionless pulley. Mass  $m_1$  slides on an inclined plane whereas mass  $m_2$  hangs freely as shown in figure below. The acceleration of  $m_1$  down the plane would be



DR. DIPESH SATPATI, ISRO  
 ASSOCIATE SPACE SCIENTIST  
 INDIAN SPACE RESEARCH ORG  
 POST DOCTORAL RESEARCHER, ISCA

- (a)  $\frac{m_1 - m_2}{m_1 + m_2} g$  (b)  $\frac{m_1 \sin \alpha + m_2}{m_1 + m_2} g$  (c)  $\frac{m_2 - m_1 \sin \alpha}{m_1 + m_2} g$  (d)  $\frac{m_1 \sin \alpha - m_2}{m_1 + m_2} g$

6. Kirchoff's current law is valid for  
 (a) DC circuit only (b) AC circuit only  
 (c) Both DC and AC circuits (d) Circuits having active elements only
7. If  $\alpha = 0.98$ ,  $I_{CO} = 6 \mu A$  and  $I_B = 100 \mu A$  for a transistor based amplifier, then value of  $I_C$  is about  
 (a) 2.3 mA (b) 3.1 mA (c) 4.6 mA (d) 5.2 mA
8. The threshold voltage  $V_T$  is negative for  
 (a) an n-channel enhancement MOSFET (b) an n-channel depletion MOSFET  
 (c) a p-channel depletion MOSFET (d) all active unipolar devices
9. The 2's complement of the binary number 1101100 in BCD is  
 (a) 12 (b) 13 (c) 14 (d) 15
10. A master-slave flip-flop has the characteristic that  
 (a) change in the input at 'Master' is immediately reflected in the output of 'Slave'.  
 (b) input states of both the 'Master' and 'Slave' are affected at the same time.  
 (c) change in the output of "Slave" follows the change in output of 'Master'.  
 (d) output states of both the 'Master' and 'Slave' are affected at the same time.
11. Which of the following statements is NOT correct ?  
 (a) Acoustic branch of diatomic linear chain is similar to the monoatomic case  
 (b) Both group velocity and phase velocity are equal to the velocity of sound in the long wavelength limit  
 (c) Under the low wavelength limit, the lattice acts as a low pass filter  
 (d) Acoustic and optical modes in diatomic lattice cancel each other at the boundary of first Brillouin zone
12. According to Dulong-Petit's law, the specific heat of a solid  
 (a) is proportional to the temperature (b) does not depend on temperature  
 (c) depends on square of temperature (d) is inversely proportional to temperature
13. In the X-ray diffraction pattern of a sodium metal, which has a bcc structure, the missing reflection planes will be  
 (a) 101 (b) 011 (c) 020 (d) 100
14. For a paramagnetic material, the energy difference between spin magnetic dipole parallel and anti-parallel to an external field H is ( $\mu_B$  is the Bohr magnetron)  
 (a)  $\mu_0 H / 4\pi$  (b)  $\mu_B H$  (c)  $2\mu_B \mu_0 H$  (d)  $\mu_B \mu_0 H$
15. The Hall coefficient of a Si wafer was found to be  $-7.35 \times 10^{-5} m^3 C^{-1}$  in the temperature range from 100 to 400 K. The type of charge carrier and the approximate value of carrier density respectively are  
 (a) n-type;  $8.5 \times 10^{22} m^{-3}$  (b) p-type;  $8.5 \times 10^{22} m^{-3}$   
 (c) n-type;  $4.2 \times 10^{22} m^{-3}$  (d) p-type;  $4.2 \times 10^{22} m^{-3}$
16. Consider oxygen gas at 300K having the mass of its molecule as  $5.31 \times 10^{-26}$  kg. The root mean square speed of its molecules, is about  
 (a) 284 m/s (b) 248 m/s (c) 348 m/s (d) 484 m/s
17. One mole of a monoatomic perfect gas initially at temperature  $0^\circ C$  expands from volume  $V_0$  to  $2V_0$  at constant pressure. The specific heat at constant volume of the gas is  $20.8 J mol^{-1} K^{-1}$ . The amount of heat absorbed is nearly  
 (a) 1179 J (b) 1779 J (c) 1979 J (d) 7972 J
18. When 100 g ice at  $0^\circ C$  melts, the change in entropy in cal/K is about (Take latent heat of fusion (melting) as 80 cal/g.)  
 (a) zero (b) 0.34 (c) 29.3 (d) 39.2



19.  $N$  distinguishable particles are distributed among three states having energies  $0$ ,  $k_B T$  and  $2k_B T$  respectively. If the total equilibrium energy of the system is  $151.23 k_B T$ , the number of particles of the system is about  
 (a) 152 (b) 264 (c) 356 (d) 635
20. The power per unit area emitted by a surface of a blackbody (in  $\text{Wm}^{-2}$ ) at temperature  $230 \text{ K}$  is about  
 (a) 112.67 (b) 128.67 (c) 158.67 (d) 178.67
21. A Van der Waals gas is passed through a porous plug. Let  $\alpha = \frac{1}{V} \left[ \frac{\partial V}{\partial T} \right]_P$  be the volume coefficient and  $T$  is the temperature. The temperature of the gas will decrease when  
 (a)  $\alpha T = 0$  (b)  $\alpha T > 1$  (c)  $\alpha T = 1$  (d)  $\alpha T < 1$
22. Light from a point source located at the origin gets reflected parallel to the  $x$ -axis from a large concave mirror. For a constant,  $\alpha$ , the equation describing the shape of the mirror on the  $x$ - $y$  plane is  
 (a)  $y^2 = \alpha x + \alpha^2$  (b)  $y^2 = 2\alpha x + \alpha^2$  (c)  $x^2 = \alpha y + \alpha^2$  (d)  $x^2 = 2\alpha y + \alpha^2$
23. The dispersion relation for a wave is given by  $\omega^2 = pk + qk^3$ , where  $\omega$  is the angular frequency,  $k$  is the wave number,  $p$  and  $q$  are constants. The wave number for which both the group and phase velocities are same is  
 (a)  $\sqrt{\frac{p}{q}}$  (b)  $\sqrt{\frac{2p}{q}}$  (c)  $\sqrt{\frac{p}{2q}}$  (d)  $\frac{1}{2} \sqrt{\frac{2p}{q}}$
24. A thin film of oil of thickness  $t$  and refractive index  $n_0$  is covering a pool of water of refractive index  $n_w$ . A ray of light of wavelength  $\lambda$  is incident normally on the oil surface. The condition for constructive interference of the reflected light is ( $m$  has integer values)  
 (a)  $2tn_w = m\lambda$  (b)  $2tn_0 = m\lambda$   
 (c)  $2tn_0 = \left(m + \frac{1}{2}\right)\lambda$  (d)  $2tn_w = \left(m + \frac{1}{2}\right)\lambda$
25. A Newton's ring experiment uses a glass lens having radius of curvature  $1.0 \text{ m}$ . The apparatus is illuminated separately by light having two different wavelengths. Suppose that one of the wavelengths is  $550 \text{ nm}$ . The  $6^{\text{th}}$  bright ring of the  $550 \text{ nm}$  fringe system coincides with the  $5^{\text{th}}$  bright ring of the other. The value of second wavelength is about  
 (a)  $450 \text{ nm}$  (b)  $672 \text{ nm}$  (c)  $733 \text{ nm}$  (d)  $563 \text{ nm}$

