



PHYSICS

JEE main - Physics

Time Allowed: 1 hour

Maximum Marks: 100

General Instructions:

- All questions are compulsory.
- There are 25 questions where the first 20 questions are MCQs and the next 5 are numerical.
- You will get 4 marks for each correct response and 1 mark will be deducted for an incorrect answer.

PHYSICS (Section-A)

- Given that the amplitude A of scattered light is: [4]
 - directly proportional to the amplitude (A_0) of the incident light.
 - directly proportional to the volume (V) of the scattering particle.
 - inversely proportional to the distance (r) from the scattered particle.
 - depend upon the wavelength (λ) of the scattered light.Then:
 - $A \propto \frac{1}{\lambda^3}$
 - $A \propto \frac{1}{\lambda^2}$
 - $A \propto \frac{1}{\lambda}$
 - $A \propto \frac{1}{\lambda^4}$
- A car moves a distance of 200 m. It covers first half of the distance at speed 60 km h^{-1} and the second half at speed v . If the average speed is 40 km h^{-1} , the value of v is: [4]
 - 30 km h^{-1}
 - 60 km h^{-1}
 - 13 km h^{-1}
 - 40 km h^{-1}
- A vector of length l is turned through the angle θ about its tail. What is the change in the position vector of its head? [4]
 - $l \sin \left(\frac{\theta}{2}\right)$
 - $l \cos \left(\frac{\theta}{2}\right)$
 - $2l \cos \left(\frac{\theta}{2}\right)$
 - $2l \sin \left(\frac{\theta}{2}\right)$
- A block moves down a smooth inclined plane of inclination θ . Its velocity on reaching the bottom is v . If it slides down a rough inclined plane of same inclination, its velocity on reaching the bottom is $\frac{v}{n}$, where n is a number greater than zero. The coefficient of friction μ is given by: [4]
 - $\mu = \tan \theta \left(1 - \frac{1}{n^2}\right)$
 - $\mu = \cot \theta \sqrt{1 - \frac{1}{n^2}}$
 - $\mu = \cot \theta \left(1 - \frac{1}{n^2}\right)$
 - $\mu = \tan \theta \sqrt{1 - \frac{1}{n^2}}$
- A $100 \text{ m} \times 50 \text{ m} \times 50 \text{ m}$ container containing 1000 kg of water is fixed at the top of the building to supply water. When a hole is made 90 m below the surface of water, water gains an acceleration of 36 m/s^2 and starts [4]

draining at the rate of 96 kg/s. The velocity of water will be:

- a) 375 m/s
- b) 275 m/s
- c) 475 m/s
- d) 575 m/s

6. A wheel has angular acceleration of 3.0 rad/s^2 and an initial angular speed of 2.00 rad/s . In a time of 2 s it has rotated through an angle (in radian) of: [4]

- a) 4
- b) 6
- c) 12
- d) 10

7. If A denotes the area of the free surface of a liquid and h the depth of an orifice of the area of cross-section a , below the liquid surface, then the velocity v of flow through the orifice is given by: [4]

- a) $v = \sqrt{(2gh)} \sqrt{\left(\frac{A^2}{A^2 - a^2}\right)}$
- b) $v = \sqrt{(2gh)}$
- c) $x = \sqrt{2gh} \sqrt{\left(\frac{A^2 - a^2}{A^2}\right)}$
- d) $x = \sqrt{2gh} \sqrt{\left(\frac{A}{A - a}\right)}$

8. The coefficient of linear expansion of crystal in one direction is α_1 and that in every direction perpendicular to it α_2 . The coefficient of cubical expansion is: [4]

- a) $\alpha_1 + \alpha_2$
- b) $\alpha_1 + 3\alpha_2$
- c) $\alpha_1 + 2\alpha_2$
- d) $2\alpha_1 + \alpha_2$

9. One gm mole of an ideal gas expands adiabatically from an initial temperature T_I to a final temperature T_F ($T_I > T_F$); then the work done is: [4]

- a) $C_V (T_I - T_F)$
- b) $C_P (T_I - T_F)$
- c) $R (T_I - T_F)$
- d) Zero

10. The earth rotates from west to east. A wind mass begins moving due north from the equator, along the earth's surface. Neglect all effects other than the rotation of the earth. The wind mass will: [4]

- a) move along a loop and returns to its starting point on the equator
- b) shift a little to the east as it moves to higher latitudes
- c) shift a little to the west as it moves to higher latitudes
- d) always move due north

11. A capacitor is charged to store an energy U . The charging battery is disconnected. An identical capacitor is now connected to the first capacitor in parallel. The energy in each of the capacitors is [4]

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

12. A proton is moving in a uniform magnetic field B in a circular path of radius a in a direction perpendicular to the z -axis along which field B exists. Calculate the angular momentum, if the radius is a charge on proton is e : [4]

- a) eB^2a
- b) aeB
- c) $\frac{Be}{a^2}$
- d) a^2eB

13. The ratio of induced emf in a coil of 50 turns and area A oscillating at frequency 50 Hz to that in a coil of 100 [4]

turns and same area oscillating at frequency 100 Hz is:

- a) 0.75
- b) 0.25
- c) 0.50
- d) 1.00

14. 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: [4]

- a) -1.0
- b) 1.0
- c) 0.5
- d) Zero

15. The values of resistance and inductive reactance of a choke coil are 8Ω and 6Ω respectively. What is the power factor of the coil? [4]

- a) 0.3
- b) 0.6
- c) 0.4
- d) 0.8

16. If μ_0 is permeability of free space and ϵ_0 is permittivity of free space, the speed of light in vacuum is given by: [4]

- a) $\sqrt{\mu_0 \epsilon_0}$
- b) $\sqrt{\frac{1}{\mu_0 \epsilon_0}}$
- c) $\sqrt{\frac{\epsilon_0}{\mu_0}}$
- d) $\sqrt{\frac{\mu_0}{\epsilon_0}}$

17. Planck's constant is dimensionally equal to: [4]

- a) angular momentum
- b) linear momentum
- c) work
- d) energy

18. If λ_1 and λ_2 are the wavelengths of the first members of the Lyman and Paschen series respectively, then $\lambda_1 : \lambda_2$ is: [4]

- a) 1 : 30
- b) 7 : 50
- c) 7 : 108
- d) 1 : 3

19. The ratio of the surface area of the nuclei ${}_{52}\text{Te}^{125}$ to that of ${}_{13}\text{Al}^{27}$ is: [4]

- a) $\frac{1}{4}$
- b) $\frac{5}{3}$
- c) $\frac{125}{17}$
- d) $\frac{25}{9}$

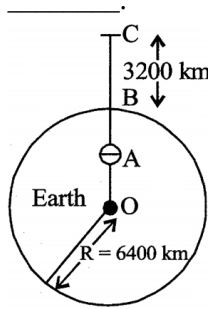
20. In a semiconductor: [4]

- a) the number of free electrons increases with pressure
- b) there are no free electrons at 0 K
- c) the number of free electrons is more than that in a conductor
- d) there are no free electrons at any temperature

PHYSICS (Section-B)

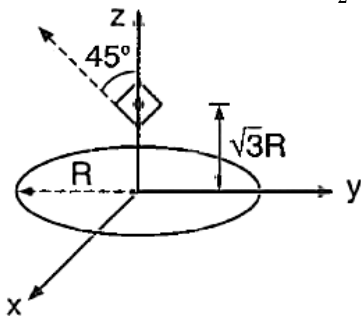
21. Two spherical conductors of radii r and $2r$ having surface charge densities $-\sigma$ and $+\sigma$ respectively are connected with each other. Final surface charge density of the smaller sphere is found to be K times that of σ . What is the value of K ? [4]

22. In the reported figure of earth, the value of acceleration due to gravity is same at point A and C but it is smaller than that of its value at point B (surface of the earth). The value of OA : AB will be $x : y$. The value of x is [4]



23. The general displacement of a simple harmonic oscillator is $x = A \sin \omega t$. Let T be its time period. The slope of its potential energy (U) - time (t) curve will be maximum when $t = \frac{T}{\beta}$. The value of β is _____ [4]

24. A circular wire loop of radius R is placed in the x - y plane centered at the origin O . A square loop of side a ($a \ll R$) having two turns is placed with its centre at $z = \sqrt{3}R$, along the axis of the circular wire loop, as shown in figure. The plane of the square loop makes an angle of 45° with respect to the z -axis. If the mutual inductance between the loop is given by $\frac{\mu_0 a^2}{2^{p/2} R}$ then the value of p is: [4]



25. A body cools from 60°C to 50°C in 10 minutes. If the room temperature is 25°C and assuming Newton's law of cooling to hold good, the temperature of the body at the end of the next 10 minutes will be _____ $^\circ\text{C}$. (round off to the nearest integer) [4]