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FIRST SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2024

(CUFYUGP)

APH1MN101/PHY1MN101 – Mechanics and Optics

2024 Admission onwards

Maximum Time :2 Hours | **Maximum Marks :70**

Section A

All Questions can be answered. Each Question carries 3 marks (Ceiling : 24 Marks)

1	When a bus stops suddenly, the upper part of your body tends to move forward. Why?
2	To push a box up a ramp, which requires less force: pushing horizontally or pushing parallel to the ramp? Explain your answer.
3	When people feel cold, they rub their hands together to warm up. How does doing this produce heat? Where does the heat come from?
4	Does Newton's second law hold true for an observer in a van as it speeds up, slows down or rounds a corner? Explain
5	If there is a net non zero force on a moving object, can the total work done on the object be zero? Explain using an example.
6	The potential energy function for a force F is $U = \alpha x^3$, where α is a positive constant. What is the direction of F ?
7	Compare the intensity distribution patterns formed by Fraunhofer diffraction by a single slit and a double slit.
8	Explain the conditions to be satisfied by a source of light to be called as coherent? How can you realize a coherent source in practice?
9	Define Interference of light. Why do we need coherent beams of light to observe interference fringes?
10	The bottom of the passenger-side mirror on your car notes, “Objects in the mirror are closer than they appear”. Is this true? Explain.

Section B

All Questions can be answered. Each Question carries 6 marks (Ceiling : 36 Marks)

11	A ball falls under gravity from a height of 10 m with an initial downward velocity of u. It collides with the ground, losses 50 % of its energy in the collision and then rises back to the same height. Find the initial velocity u.
12	An ideal spring of negligible mass is 13 cm long when nothing is attached to it. When you hang a 3.30 Kg weight from it, you measure its length to be 14.4 cm. If you want to store 10 Joules of potential energy in this spring, what would be its total length? assume that it continues to obey Hooke’s law.

13	A heavy truck of mass 100 kg is moving on the Indian National Highway with an initial speed of 40 km/hr. The driver applies brakes to stop the truck. It comes to rest at a distance of 20 m after applying the break. What force does the brake exert on the truck?
14	Briefly explain the Work-energy theorem.
15	A ray of light is traveling in a glass cube that is totally immersed in water. You find that if the ray is incident on the glass water interface at an angle to the normal larger than 46 degrees , no light is refracted into the water. What is the refractive index of the glass?
16	Monochromatic light from a distant source is incident on a slit 0.765 mm wide. On a screen 2.05 m away, the distance from the central maximum of the diffraction pattern to the first minimum is measured to be 1.51 mm. Calculate the wavelength of the light.
17	In an interference pattern at a point, we observe the 12^{th} order maxima for λ = 600 nm. What order will be visible here if the source is replaced by light of wavelength 480 nm?
18	The image of a tree just covers the length of a plane mirror 3.70 cm tall when the mirror is held 34.0 cm from the eye. The tree is 20.0 m from the mirror. What is its height?
Section C	
Answer any ONE. Each Question carries 10 marks (1x10=10 Marks)	
19	Explain total internal reflection. Discuss the conditions to get total internal reflection. Explain a) the brilliance of diamond and b) the principle of optical fiber.
20	Explain the concept of real weight and apparent weight. Obtain expressions for apparent weight of a person in a lift which is a) Stationary b) Moving up or down with uniform velocity c) moving up with an acceleration d) moving down with an acceleration.