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1 SEM TDC PHYH (CBCS) C 2

2022

(Nov/Dec)

PHYSICS

(Core)

Paper : C-2

(**Mechanics**)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : 1×5=5

(a) The curl for conservative force is

(i) one

(ii) zero

(iii) infinite

(iv) None of the above

(b) The moment of inertia of a body rotating about an axis is

(i) $\frac{2K}{\omega^2}$

(ii) $\frac{K}{\omega^2}$

(iii) $\frac{MK}{\omega^2}$

(iv) $\frac{\omega^2}{2K}$

(c) The couple required to twist a rod through ϕ radians is

(i) $\frac{\pi\eta r^4}{2l}$

(ii) $\frac{\pi\eta^2 r^2}{2}$

(iii) $\frac{\pi\eta^2 r^2}{4l}$

(iv) $\frac{\pi\eta}{2l}$

(d) The velocity profile of a liquid flowing through a capillary tube is

(i) straight line

(ii) parabolic

(iii) hyperbolic

(iv) circular arc

(e) The phase difference between driving force and velocity of forced oscillator is

(i) φ

(ii) $\frac{\pi}{2} + \varphi$

(iii) $\varphi - \frac{\pi}{2}$

(iv) $\frac{\pi}{2} - \varphi$

2. (a) What is meant by inertial frame of reference? Can you regard earth as an inertial frame? Explain. 1+1=2

- (b) Establish the relation between torque and angular momentum. 2

Or

Derive the law of conservation of linear momentum from Newton's laws of motion.

- (c) Calculate the angular momentum and rotational KE of earth about its own axis. The mass of earth is 6×10^{24} kg and the radius is 6.4×10^3 km. 2

- (d) Calculate Poisson's ratio for silver. Given Young's modulus = 7.25×10^{10} N/m² and Bulk modulus = 11×10^{10} N/m². 2

- (e) Why was the apparatus of Michelson-Morley experiment rotated through 90°? 2

3. What is Galilean transformation? Derive Galilean transformation equation for two inertial frames. 1+3=4

4. (a) Explain the concept of potential energy. Show that potential energy may be defined as a function of position whose negative gradient gives the intrinsic force. 1+2=3

Or

A constant force of 5 N acts for 10 sec on a body whose mass is 2 kg. The body was initially at rest. Calculate the work done by the force and the final kinetic energy. $1\frac{1}{2}+1\frac{1}{2}=3$

- (b) Show that in a head on collision between two particles the transfer of energy is maximum when their mass ratio is unity. 3

- (c) Define moment of inertia and radius of gyration of a body rotating about an axis, hence explain their physical meaning. $1\frac{1}{2}+1\frac{1}{2}=3$

5. (a) Deduce an expression for the gravitational potential and attraction due to this spherical shell at a point outside the shell. 4

- (b) Show how by introducing the concept of reduced mass, a two-body problem under central forces can be reduced to a one-body problem. 3

Or

When a particle moves under central force, prove that the angular momentum of a particle is constant.

- (c) Mention the limitations of Poiseuille's formula. 2
6. (a) A particle is oscillating under a damping force. Show that power dissipation is $P = \frac{E}{\tau}$, where E is average energy and τ is relaxation time. 4

Or

What is sharpness of resonance?
Explain the effect of damping on sharpness and resonance. 1+3=4

- (b) A particle executes simple harmonically as

$$y = 0.1 \sin(100\pi t + \frac{\pi}{4}) \text{ m}$$

Find maximum amplitude and angular frequency of oscillation.

2

7. Discuss the effects of the centrifugal force due to earth rotation.

5

8. What is relativistic Doppler effect? Derive relation for longitudinal Doppler effect. 1+4=5

Or

Derive transformation formulae for relativistic momentum.

5
