MSES 108 Engineering Physics

Candidates should attempt ANY FOUR Full Questions

Please read the Questions carefully
Q1 (a) A stone is dropped downwards. After 2 seconds another stone is dropped downwards from the same point. What is the Distance between the two stones 5 seconds after dropping the first stone?

(b) How Impulse is related to the Linear Momentum?

(c) A car is lifted by a hydraulic jack that consists of two pistons of different diameters. The large piston is 1.86m in diameter where the car is placed and the smaller piston is 22.4cm in diameter. If the weight of the car is 15,000N, how much is the Force needed on the smaller piston to lift the car?

(d) Name the physical quantity which is equal to the Rate of Change of Angular Momentum. Derive the relation between that physical quantity and Angular Momentum.

(e) Write any five characteristics of a Simple Harmonic Motion.

Q2 (a) Water flows through a horizontal pipe of radius 2.3cm at a speed of 4.1m/s. What should be the Diameter of the nozzle if the water is to come out at a speed of 22.1m/s?

(b) Calculate the Amount of Heat required for converting 2.5kg of ice at \(-18^\circ\text{C}\) into steam at 100\(^{\circ}\text{C}\) at normal pressure. Specific heat of ice =2100J/kg K, Latent heat of fusion of ice =3.36\times 10^5\text{J/kg}, Specific heat capacity of water = 4200J/kg K and Latent heat of vaporization of water = 2.25\times 10^6\text{J/kg}.

(c) (i) Distinguish between Periodic Motion and Oscillatory Motion.

(ii) A human heart is found to beat 75 times in a minute on an average. Calculate its Frequency and Period.

(d) State Inertia of Direction.
(b) Derive the equation for *Kinetic Energy* of a particle executing simple harmonic motion.

(c) The reading of a pressure meter attached with a closed horizontal water pipe is $6.1 \times 10^5$ N/m$^2$. On opening the valve of the pipe, the reading of the pressure meter is reduced to $4.22 \times 10^5$ N/m$^2$. Calculate the *Velocity* of the water flowing in the pipe. [Density of water=1000kg/m$^3$]

(d) State and explain *Zeroth Law of Thermodynamics*. 
Q4 (a) The force acting on an object in different time interval is measured and a graph is plotted between average force and time as in Figure Q4 (a). Calculate the Impulse in the first 10 seconds.

![Force vs Time Graph](image)

Figure Q4 (a)

(b) The motion of an object is characterized by the equation $x = 12t^3 - 6t + 7$; where $t$ is measured in seconds and $x$ is measured in meter. Calculate the

(i) Velocity of the object between 2 seconds and 4 seconds.

(ii) Acceleration of the object between 1 second and 4 seconds.

(c) What is an Isothermal Change? Write two essential conditions for a perfect isothermal change. Write two examples for an isothermal change.

(d) A man weighs 80kg. Calculate the Work done by gravity as he climbs a ladder of height 10m.
Q5 (a) 
(i) State the law, which gives a quantitative definition of Force.
(ii) A light body of mass $m_1$ is moving with a velocity $v_1$ and a heavy body of mass $m_2$ is moving with a velocity $v_2$. When both the bodies have same linear momentum, prove that $\frac{E_1}{E_2} = \frac{m_1}{m_2}$, Where $E_1$ is the kinetic energy of the lighter body and $E_2$ is the kinetic energy of the heavier body.

(b) A particle executes in simple harmonic motion with a period of 7s and amplitude 6.5cm. Assuming that the particle is at the mean position when $t=0$, calculate the

(i) Displacement after 0.38seconds.
(ii) Velocity after 1/8 seconds.
(iii) Acceleration after 1/6 seconds.

(c) An object of mass 4kg moving with a velocity of 18m/s collides with another object of unknown mass at rest. Both the objects are moving together in the original direction after collision.

(i) Calculate the Mass of the second object if both the objects are moving with a velocity equal to 1/6th of the initial velocity of the first object after collision.
(ii) Calculate the Common Velocity after collision, If the unknown mass is replaced by an object of mass 1kg,

(d) Define Specific Latent Heat of Fusion.
Q6 (a) A particle of mass 950g travels in a straight line with a velocity 
\[ v = kx^{5/2}, \text{ where } k = 3\text{m}^{-3/2}\text{s}^{-1}. \] What is the Work done by the net force during the displacement from \(x=0\) to \(x=4\text{m}\)?

(b) A fighter plane is pulling out for a drive at a speed of 600km/hr. Assuming its path to be a vertical circle of radius 1500m and its mass to be 10340kg, find the Force exerted by the air on it at the lowest point. [Take \(g=9.8\text{m/s}^2\)]

(c) A sample of gas at 120kPa pressure (\(y=1.35\)) is taken through an adiabatic process in which the volume is compressed from 1200cc to 350cc. Calculate the Final Pressure.

(d) Write a short note on the following.

(i) Specific Heat Capacity.
(ii) Radius of Gyration.
(iii) Buoyancy.

(e) (i) State the Bernoulli’s Equation and explain the background of each of the term.

(ii) A square plate of 0.3m sides moves parallel to another plate with a velocity of 0.2m/s. Both the plates being immersed in water. If the viscous force acting is \(3.4 \times 10^{-3}\text{N}\) and the viscosity of water is \(10^{-3}\text{decapoise}\), calculate the Separation between the plates.