(b) What is sharpness of resonance? Explain the effect of damping on the sharpness of resonance.
A particle is moving with simple harmonic motion in a straight line. When the distance of the particle from the equilibrium position has the values x_1 and x_2, the corresponding values of velocity are u_1 and u_2. Show that time period is

$$2\pi\left[x_2^2 - x_1^2 / u_1^2 - u_2^2\right]^{1/2}.$$ 1+2+2=5

(c) Write down the Limitations of Poiseuille's formula for the rate of flow of liquid through a capillary tube. Calculate the rate at which water flows through a capillary tube of length 0.5 m with an internal diameter of 1 mm. Coefficient of viscosity is 1.3×10^{-3} kg/m-sec. The pressure head is 20 cm of water. 2+3=5

(d) Derive an expression of deflection of a freely falling body by the coriolis force due to rotation of the earth. 5

(e) Show that the motion of one projectile as seen from other projectile will always be a straight line. 5

4. Answer **any three** questions : 10×3=30

(a) (i) Show that the areal velocity $\dfrac{dA}{dt}$ of a particle moving in central force is half of the angular momentum per unit mass. Find the force field associated with the potential energy $V = Ae^{\alpha(x+y+z)}$, where A and α are constant. 2+2=4

(ii) Derive an expression for the gravitational field inside a sphere of radius R, when the mass density at a point is $\rho = a + br^2$, where 'r' is the distance of the point from the centre of the sphere. 6

(b) A 6000 kg rocket is set for vertical firing. If the gas exhaust speed is 1000 m/sec, how much gas must be ejected each second to supply the thrust needed

(i) to overcome the weight of the rocket