Section ±A

1. a) Find the Radial and Transverse components of Velocity and Acceleration. 5
   b) A particle is moving along the parabola $a = x^2 - 4ay$ with constant speed V. Determine the tangential and the normal components of its acceleration when it reaches the point whose abscissa is $\sqrt{5}a$. 5

2. a) A particle moving along a straight line starts from rest and is accelerated uniformly till it attains velocity V. The motion then retarded and the particle comes to rest after travelling A total distance x. If the acceleration is f, find the retardation and the total time taken by the particle from rest to rest. 5
   b) The maximum velocity that a particle executing simple harmonic motion of amplitude a attains is V. If it is disturbed in such a way that its maximum velocity becomes nv, Find the change in amplitude and the time period of motion. 5

3. a) A projectile having horizontal range R, reaches a maximum height H. Prove that it must have been launched with
   i) An initial speed equal to $\sqrt{\frac{g(R^2 + 16H^2)}{8H}}$ And
   ii) At an angle with the horizontal given by $\mathrm{Sin}^{-1}\frac{4H}{\sqrt{R^2 + 16H^2}}$ 5
   b) The range of a rifle bullet LV \DUGV ZKHUH . LV tonKShow that if the rifle is fired with the same elevation from a car travelling at 10 miles per hours towards the target, the range will be increased by $220\sqrt{W}$ D feet. 5

4. a) Show that the least speed with which a particle must projected so that it passes through the points P and Q at heights h_p and h_Q respectively is $\sqrt{a(h_p + h_Q + p_Q)}$. 5
   b) The position vector of a moving particle of mass m at any time t is $\vec{r} = (a \cos nt)\hat{i} + (b \sin nt)\hat{j}$ where a,b, n are constant and a > b> 0. Show that the field of force acting on the particle is conservative. Find the work done in moving the particle from the point $a\hat{i}$ to $b\hat{j}$. 5

5. a) 7KH FRPSRQHQWV RI YHORFLW\ DORQJ DQG SHUSHQGLFXODU
   components of acceleration along and perpendicular to the radius vector. 5
   b) A particle is fired vertically upwards with a velocity u in a medium whose resistance is proportional to the square of the velocity. Show that the particle returns to the point of projection with a speed $\frac{uv}{\sqrt{u^2 + v^2}}$, where v is the limiting velocity of the particle in the medium. 5

Section ±B

6. a) Use Newton Raphson Method to evaluate a root of the equation near -0.5 of $e^x + 3x^2 = 0$. 5
   b) Solve the equation $2e^{-x} + \mathrm{Sin}x = 0$ by using Bisection Method 5

7. a) Solve the system of linear Equations 5

$$2x_1 + x_2 + 8x_3 = -15$$
$$x_1 + 7x_2 + x_3 = 10$$
$$6x_1 + 3x_2 + x_3 = -11$$

   Using Gauss Seidel Method with initial vector $X^{(0)} = (0, 0, 0)^T$
   b) Find to four decimal places the root near 3 of the equation $x \log_e x = 20$ using Simple Iteration. 5

8. a) Evaluate $\int_0^3 e^{x^2} \cos x$ Using i) Seven Points Trapezoidal Rule. 5
   b) Evaluate $\int_0^1 \frac{dx}{2 + x^2}$ % \ 6LPSVRQ¶V 5XOH ZLWK VHYHQ SRLQW
   with exact value 5