Problem Sheet No. 2

1. A roofer tosses a small tool towards a coworker on the ground. What is the minimum horizontal velocity v_0 necessary so that the tool clears point B? Locate the point of impact by specifying the distance s shown in the figure.

   Ans. V_0 =6.64 m/s, s =2.49 m

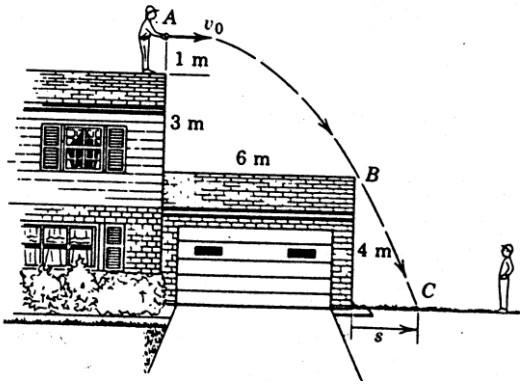

Figure - 1

2. The pilot of an airplane carrying a package of mail to a remote outpost wishes to release the package at the right moment to hit the recovery location A. What angle θ with the horizontal should the pilot's line of sight to the target make at the instant of release ? The airplane is flying horizontally at an altitude of 100 m with a velocity of 200 km/h.

   Ans. θ = 21.7^0

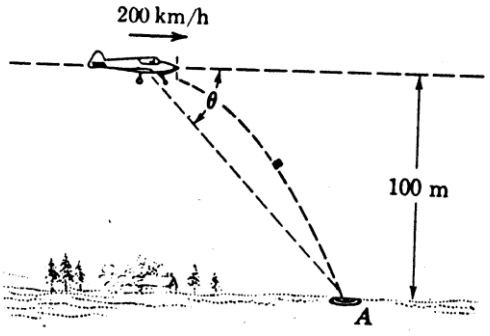

Figure - 2

3. For a certain interval of motion,the pin P is forced to move in the fixed parabolic slot by the vertical slotted guide, which moves in the *x*- direction at the constant rate of 20 mm/s. All measurements are in millimeters and seconds. Calculate the magnitudes of the velocity v and acceleration *a* of pin P when x =60 mm.

   Ans.*v* =25mm/s, *a* = 5 mm/s^2

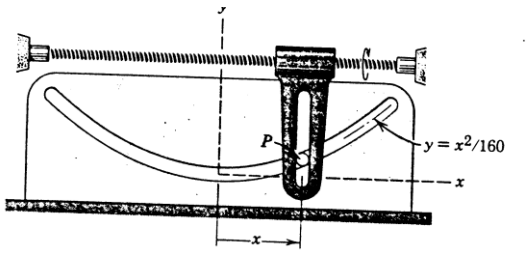

Figure - 3

4. A particle is ejected from a tube at A with a velocity *v* at an angle θ with the vertical *y*-axis. A strong horizontal wind gives the particle a constant horizontal acceleration a in the *x*-direction. If the particle strikes the ground at a point directly under its released position, determine the height *h* of the point A. The downward *y*-acceleration may be taken as constant *g*.

   Ans. $h=\frac{2v^2}{a}\sin\theta(\cos\theta+\frac{g}{a}\sin\theta)$

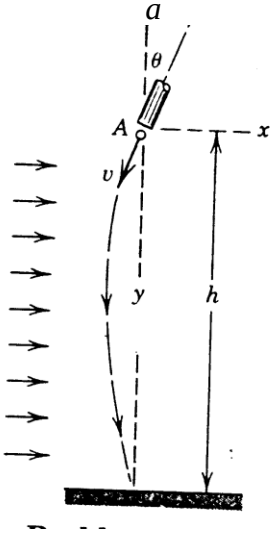

Figure - 4

5. In the cathode-ray tube, electrons traveling horizontally from their source with the velocity v_0 are deflected by an electric field E due to the voltage gradient across the plates P. The deflecting forces causes an acceleration in the vertical direction on the sketch equal to eE/m, where e is the electron charge and m is its mass. When clear of the plates, the electrons travel in straight lines. Determine the expression for the deflection δ for the tube and plate dimension shown.

Ans. $\delta = \dfrac{eEl}{mv_0^2}\left(\dfrac{l}{2}+b\right)$

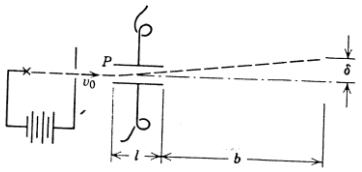

Figure - 5

6. A projectile is launched with speed v_0 from point A. Determine the launch angle θ that results in the maximum range R up the incline of angle α (where $0 \le \alpha \le 90°$). Evaluate your results for α = 0, 30°and 45°
Ans.

$$\theta = \frac{90° + a}{2}, \theta = 45°, 60°, 67.5°$$

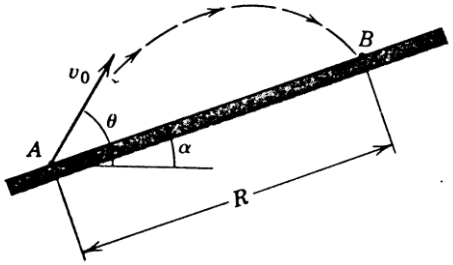

Figure - 6