BRAC
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Inspiring Excellence

Department of Mathematics and Natural Sciences
PHY111 - Principles of Physics-I (Summer 2021)
Assignment-1
Total Marks: 20
Answer all questions.

1. Three vectors are given by: $\vec{a} = 2\hat{\imath} - 3\hat{\jmath} + 5\hat{k}$, $\vec{b} = -2\hat{\imath} + 7\hat{\jmath} - \hat{k}$ and $\vec{c} = \lambda\hat{\imath} + 2\hat{\jmath} - 4\hat{k}$.

   a. (3 marks): Find λ, so that $\left[\frac{\vec{a} \times \vec{b}}{8}\right] \cdot [2\vec{c}] = -4$.

   b. (2 marks): Calculate the angle between $\vec{b}$ and a position vector with coordinate (0, 0,-3).

2. Two vectors **A** and **B** with the magnitude 750 N and 900 N respectively, which create some angles with the Cartesian coordinate as shown in the Figure-1. Consider the unit vectors $\hat{e}_1$, $\hat{e}_2$ and $\hat{e}_3$ for the +x, +y and +z axis, respectively.
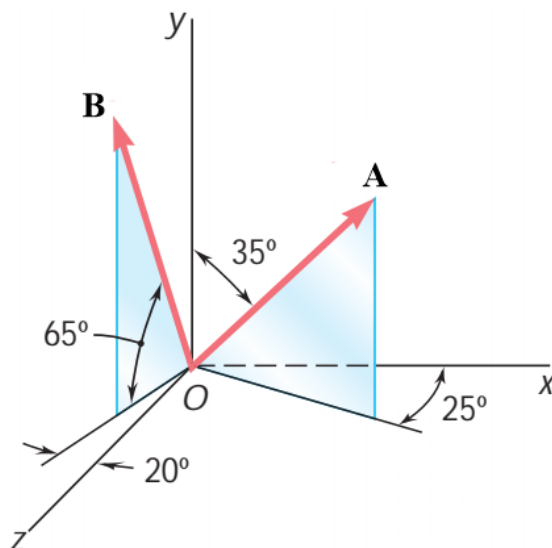

Figure-1

   a. (4 marks): Express the vectors **A** and **B** in terms of unit vectors $\hat{e}_1$, $\hat{e}_2$ and $\hat{e}_3$.
   b. (1 mark): Calculate the resultant vector **R** = **A**+**B**.

3. (5 marks): Pin **P** at the end of the telescoping rod as shown in Figure-2 slides along the fixed parabolic path, $y^2 = 40x$, where x and y are measured in millimeters. The y coordinate of **P** varies with time t (measured in seconds) according to $y = 4t^2 + 6t$ mm. When $y = 30$ mm, compute the velocity and the acceleration vector of **P**.
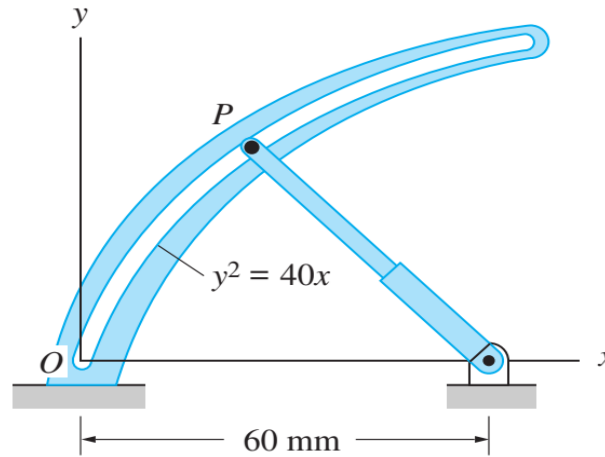

Figure-2

4. A team of engineering students designs a medium size catapult which launches 8 kg steel spheres. The launch speed is $v_0 = 45$ m/sec, the launch angle is $= 35°$ above the horizontal, and the launch position is 6 m above ground level as shown in Figure-3. The students use an athletic field with an adjoining slope topped by an 8 m fence as shown in the Figure, which is 130 m away from the releasing point of steel spheres. Neglect the air resistance for the following calculations.
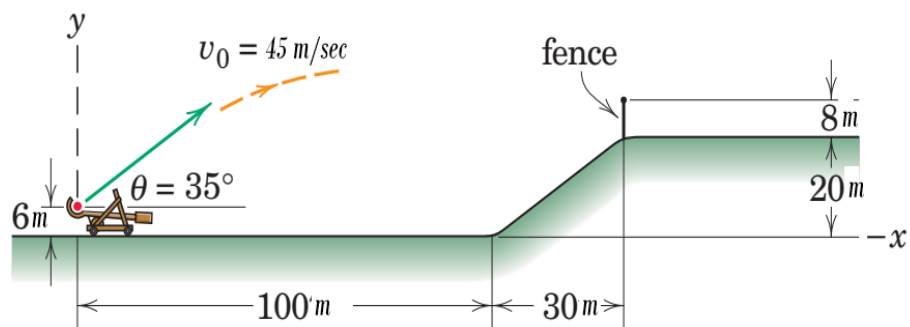

Figure-3

   a. (4 marks): Determine steel sphere's time duration t_f of the flight.
   b. (1 mark): Calculate the x-y coordinates of the point of first impact of the steel sphere.