MNS Department
Fall Semester, 2023
Midterm Examination
Course No: PHY 111(02)
Course Title: Principles of Physics I

Time: 1.5 hours | Total Marks: 30 | Date: November 08, 2023

Answer all the questions. Marks are as indicated.

1. The two vectors $\vec{a}$ and $\vec{b}$ in Fig. 1 have equal magnitudes of 8.0 m and the angles are $\Theta_1 = 23°$ and $\Theta_2 = 102°$.
   (a) (3.5 marks) Calculate the magnitude and direction of $\vec{R}$ where $(\vec{b} - 2\,\vec{a} + \vec{R}) = 0$.
   (b) (3.5 marks) Find the angle between $\vec{c}$ and $\vec{R}$, where $\vec{c}$ is a position vector which has the coordinate (3, -2, 5) from origin O.
   (c) (3 marks) Calculate the value of $(\vec{c} \times \vec{a}) \bullet \vec{b}$.

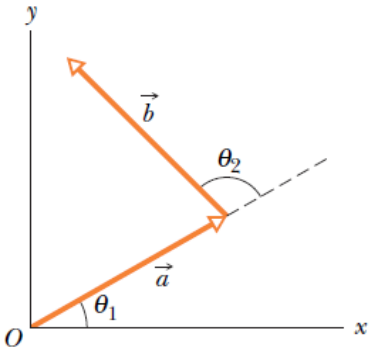

Fig. 1

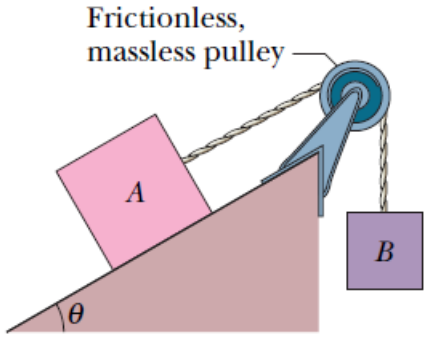

Fig. 2

2. A ball is thrown toward a wall at speed 29.0 m/s and at angle 30.0° above the horizontal. The wall is at a distance of 20 m from the release point of the ball.
   (a) (3 marks) How far above the release point does the ball hit the wall?
   (b) (3 marks) Find the velocity as it hits the wall?
   (c) (4 marks) Calculate the horizontal range and maximum height of the projectile in the absence of the wall?

3. Body A in Fig. 2 weighs 102 N, and body B weighs 32 N. The coefficients of friction between A and the incline are $\mu_s = 0.4$ and $\mu_k = 0.25$. Angle Θ is 40°. Body A is moving down the incline.
   (a) (3 marks) Draw a complete force free body diagram of body A and body B.
   (b) (5 marks) Calculate the acceleration of each body.
   (c) (2 marks) If the incline is frictionless, what is the required mass of body B to move the system at constant speed.