

Physics 10154 - Exam #6C

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. A 3.5-kg block rests against a relaxed spring ($k = 850 \text{ N/m}$) on a frictionless surface. The block is struck by a 25-gram projectile that embeds itself in the block. The combined masses cause the spring to compress to a maximum amount of 54 cm. What was the initial speed of the projectile before the collision?

Collision

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

$$(0.025) v_{1i} + 0 = (3.525) v_f$$

Spring

$$\Sigma W_f = W_{\text{spr}} = 0 - \frac{1}{2} m v_0^2$$

$$-\frac{1}{2} k x^2 = -\frac{1}{2} m v_0^2$$

$$v_0^2 = \frac{k x^2}{m_{\text{tot}}} = \frac{(850)(.54)^2}{3.525}$$

$$v_0 = 8.39 \text{ m/s}$$

$$0.025 v_{1i} = (3.525)(8.39)$$

$$v_{1i} = 1200 \text{ m/s}$$

2. A 2100-kg car moving East at 33 m/s collides with a 2400-kg car moving 75° North of East at 27 m/s. The two cars stick together after the collision.

a) What is the magnitude and direction of the velocity of the combined mass of cars after the collision?

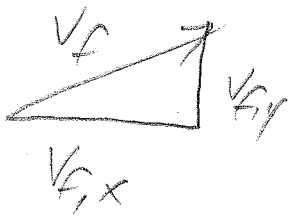
b) How much Kinetic Energy is lost during the collision?

$$x: (2100)(33) + (2400)(27 \cos 75) = 4500 v_{f,x}$$

$$v_{f,x} = 19.13 \text{ m/s}$$

$$y: (2100)(0) + 2400(27 \sin 75) = 4500 v_{f,y}$$

$$v_{f,y} = 13.91 \text{ m/s}$$



$$|v_f| = \sqrt{19.13^2 + 13.91^2} =$$

$$24 \text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{13.91}{19.13}\right) =$$

$$36^\circ \text{ N of E}$$

$$b) K_f = \frac{1}{2}(4500)24^2 = 1.296 \times 10^6 \text{ J}$$

$$K_i = \frac{1}{2}(2100)33^2 + \frac{1}{2}(2400)27^2 = 2.018 \times 10^6 \text{ J}$$

$$\Delta K = -720,000 \text{ J}$$