Physics 10154 - Exam #6B

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. Two cars of equal mass have a collision. Car A is travelling East at 23 m/s. Car B is travelling 65° North of East at an unknown speed. The two cars collide and stick together. The combined mass moves off from the collision point at an angle of 28° North of East. What was the initial speed of car B?

x: $m(23) + mv_{2i}\cos 65 = 2m v_f \cos 28°$

$23 + v_{2i}\cos 65 = 2 v_f \cos 28°$

y: $m(0) + mv_{2i}\sin 65 = 2mv_f \sin 28°$

$v_{2i}\sin 65 = 2 v_f \sin 28°$

$v_{2i} = \frac{2\sin 28°}{\sin 65} v_f$

$= 1.04 v_f$

$23 + (1.04) v_f \cos 65 = 2 v_f \cos 28$

$23 = v_f (2\cos 28 - 1.04\cos 65)$

$23 = v_f (1.766 - .440)$

$v_f = 17.3$ $\boxed{v_{2i} = 18\ m/s}$

2. A 15-gram bullet is fired into a 225-gram block initially at rest. After the bullet passes through the block, it has a speed of 140 m/s. After the collision, the block slides 3.2 meters across a rough surface (coefficient of kinetic friction = 0.23) before coming to rest. What was the initial speed of the bullet?

Collision

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(.015) v_{1i} + 0 = (.015)(140) + m_2 v_{2f}$$

Sliding

$$\Sigma W_f = W_{KE} = 0 - \tfrac{1}{2} m v_0^2$$

$$-\mu_k m g \Delta s = -\tfrac{1}{2} m v_0^2$$

$$v_0 = \sqrt{2 \mu_k g \Delta s}$$

$$= 3.8 \text{ m/s} = v_f \text{ for pt 1}$$

$$.015 v_{1i} = 2.1 + (.225)(3.8)$$

$$.015 v_{1i} = 2.955$$

$$\boxed{v_{1i} = 197 \text{ m/s}}$$