PHYS101 Tutorial 3 – PHYS101-21S2

These questions are to be started in your tutorial session and the answers to be submitted post-tutorial via LEARN.

1. There are two vectors A= $4\hat{\imath} + 6\hat{\jmath} - 12\hat{k}$ and B= $-3\hat{\imath} + 5\hat{\jmath} + 7\hat{k}$. Determine the following:
   a) A + B
   b) A · B
   c) A x B
   d) B x A

Handwritten:

$$\begin{array}{ccc} 4 & 6 & -12 \\ 3 & 5 & 7 \end{array}$$

a) $1\hat{\imath} + 11\hat{\jmath} - 5\hat{k}$

b) $-12 + 30 - 84 = -66$

c) $(102, 8, 38)$

$$\begin{array}{cc} 42 + 60 & 102 \\ -(28-36) & 8 \\ 20 + 18 & 38 \end{array}$$

d) $(-102, -8, -38)$

2. A tumbleweed is sliding through the desert without rolling due to kinetic energy imparted from the wind. The wind stops blowing and the tumbleweed is measured to be traveling at a velocity of 20 m/s. It is measured again after traveling 50m and found to be traveling at 10 m/s. Determine the coefficient of friction of the desert floor.

Handwritten: $F = \mu a = mg$ $a = 3$ $3 N_s = \dfrac{g}{3}$ μ

3. A stunt team is setting up to shoot an action scene with a car rolling down a hill. The car weighs 1000 kg and is sitting at rest atop a 50-meter high hill. You can assume the hill is frictionless.

Handwritten: $E_p = mgh = 1000 \times 9.81 \times 50 = 490500$

   A) When the cars brakes are released and it is left to roll down the hill, what speed does the car reach by the bottom of the hill?

Handwritten: $v = 31 \, ms^{-1}$ $E_k = \dfrac{1}{2}mv^2$

   B) A massive spring system is designed to bring the car to rest. The location of filming means that this system must be displaced by a maximum of 0.5 m to safely stop the car. Calculate the minimum spring coefficient required to do this.

Handwritten: $F = -\dfrac{R}{x}$ $v_f^2 = v_i^2 + 2ad$ $a = 261$ $R = 480500$

4. Two balls of equal mass collide and then bounce of in different directions. These balls have the initial velocities v $_{1,i}$ = $4\hat{\imath} + 7\hat{\jmath}$ and v $_{2,i}$ = $-11\hat{\imath} + 3\hat{\jmath}$. If one of the balls leaves with the velocity $v_{1,f}$ = $-6\hat{\imath} + 9\hat{\jmath}$, determine the final velocity of the other ball? Additionally, determine the impulse from this collision.

   Optional Challenge question: Determine the angle between the velocity vectors before and after the collision. Is it possible to use this information to determine if the collision is elastic?

Handwritten:

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

$$4\hat{\imath} + 7\hat{\jmath} + 3\hat{\jmath} - 11\hat{\imath} = -6\hat{\imath} + 9\hat{\jmath} + x\hat{\imath} + y\hat{\jmath}$$

$$-1\hat{\imath} - 1\hat{\jmath} = x\hat{\imath} + y\hat{\jmath} = v_{2f}$$