

W-GP Chapter 5 - 9 Pre-Test

1.) (5 pts) Briefly explain all three Newton's Laws of Motion.

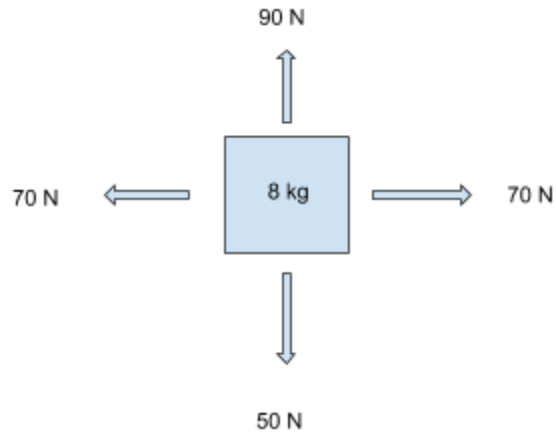
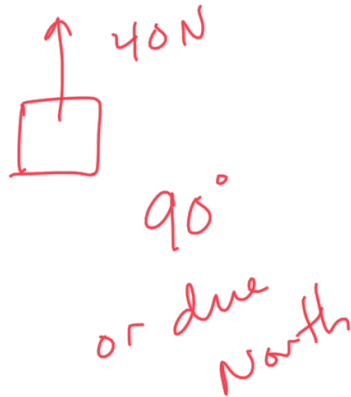
2.) (10 pts total, 5 pts each) **Draw each of the following free body diagrams.** Use the diagram to answer the question.

a) An airplane weighing 25,000 kg is flying at a relatively low altitude at a constant velocity. What is the net force acting on the plane?

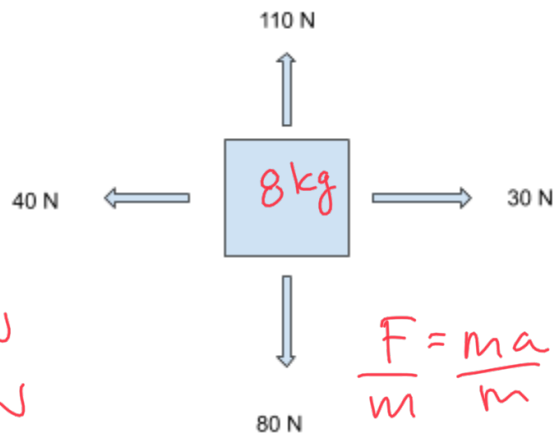
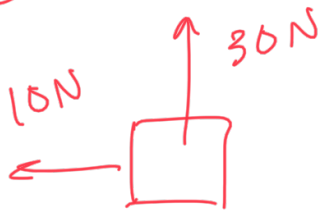
b) A block is being pushed along a surface with friction at constant speed. What must be true of the applied and frictional forces?

3.) (10 pts total, 5 pts each) Find the net force applied on each of the free body diagrams.
Please make sure to find the resultant and direction.

a) What is the F_{net} ?



b) What is the acceleration?



x component: -10 N
 y component: 30 N

$$\text{net force} = \sqrt{(-10)^2 + (30)^2}$$

$$\sqrt{100 + 900}$$

$$\sqrt{1000} = \sqrt{100 \cdot 10}$$

$$10\sqrt{10}\text{ N}$$

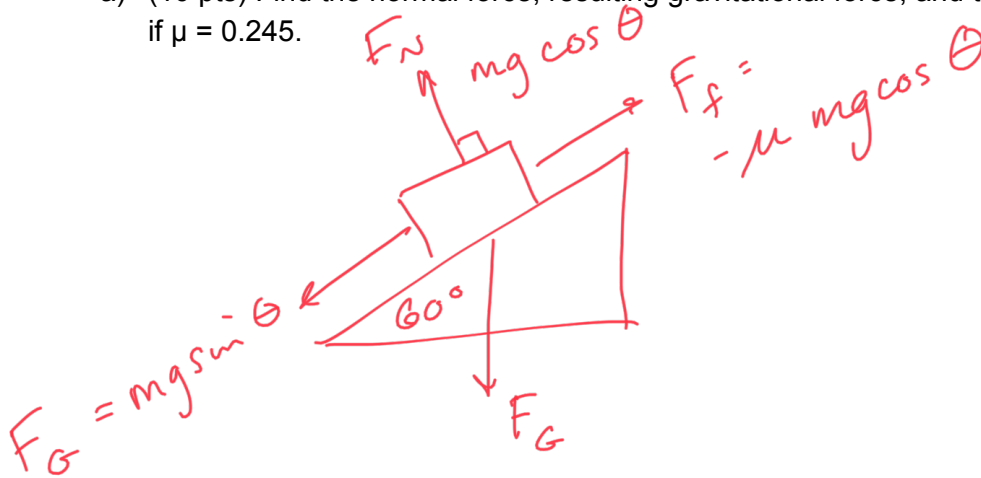
$$\frac{F}{m} = \frac{ma}{m}$$

$$\frac{10\sqrt{10}\text{ kg m/s}^2}{8\text{ kg}}$$

3.95 m/s^2

4.) (15 pts total) A 120 kg block is resting on a frictionless incline at an angle of 60° . Draw the corresponding free body diagram.

- a) (10 pts) Find the normal force, resulting gravitational force, and the frictional force if $\mu = 0.245$.



$$F_N = -mg \cos \theta = -(120 \text{ kg})(9.8 \text{ m/s}^2) \cos 60^\circ$$

$$\boxed{-588 \text{ N}}$$

$$F_G = mg \sin \theta = (120 \text{ kg})(9.8 \text{ m/s}^2) \sin 60^\circ$$

$$\boxed{1018 \text{ N}}$$

$$F_f = -\mu mg \cos \theta = -(0.245)(120 \text{ kg})(9.8 \text{ m/s}^2) \cos 60^\circ$$

$$\boxed{-144 \text{ N}}$$

- b) (5 pts) Based on your diagram, will the block move down the incline. If so, what is its acceleration?

yes

$$1018 \text{ N} + (-144 \text{ N})$$

$$874 \text{ N}$$

$$\frac{F}{m} = \frac{ma}{m}$$

$$a = \frac{874 \text{ N}}{120 \text{ kg}} = \boxed{7.29 \text{ m/s}^2}$$

- 5.) (10 pts) In a world without pain or injury, a 75 kg person is struck by a 4,350 kg automobile traveling 45 m/s. What is the resulting velocity of this cartoon person?

$$\frac{m_1 v_1}{m_1} = \frac{m_2 v_2}{m_1}$$

$$v_1 = \frac{(4350 \text{ kg})(45 \text{ m/s})}{75 \text{ kg}} = \boxed{2610 \text{ m/s}}$$

- 6.) (5 pts) What is the impulse of a puck when struck by a hockey stick exerting a constant force of 5,500 N for 0.04 s?

$$I = F \cdot t$$

$$(5500 \text{ kg m/s}^2)(0.04 \text{ s})$$

$$\boxed{220 \text{ kg m/s}}$$

- 7.) (5 pts) Define both elastic and perfectly inelastic collisions. Highlights the two major differences between the two.

Elastic - kinetic energy conserved
and momentum conserved

inelastic - momentum conserved,
mass combined.

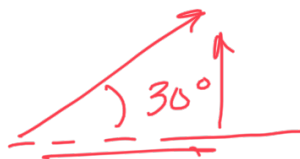
Elastic only possible at atomic level

- 8.) (10 pts) A 2,400 kg inflatable banana travelling at 96 m/s 30° above horizontal collides with a 3,500 kg Hello Kitty doll travelling 72 m/s 60° above horizontal. If the collision is perfectly inelastic, find the resulting velocity.

$$\frac{m_1 v_1 + m_2 v_2}{m_1 + m_2} = \frac{(m_1 + m_2) V}{m_1 + m_2}$$

$$V = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

banana



x direction

$$\begin{aligned} & (2400 \text{ kg})(96 \text{ m/s}) \cos 30^\circ \\ & - (3500 \text{ kg})(72 \text{ m/s}) \cos 60^\circ \\ & 199,532 - 126,000 \\ & \underline{73,532 \text{ kg m/s}} \end{aligned}$$

Hello Kitty



y direction

$$\begin{aligned} & (2400 \text{ kg})(96 \text{ m/s}) \sin 30^\circ \\ & + (3500 \text{ kg})(72 \text{ m/s}) \sin 60^\circ \\ & 115,200 + 218,238 \\ & \underline{333,438 \text{ kg m/s}} \end{aligned}$$

$$\sqrt{(73,532)^2 + (333,438)^2}$$

$$341,450 \text{ kg m/s}$$

$$\underline{341,450 \text{ kg m/s}}$$

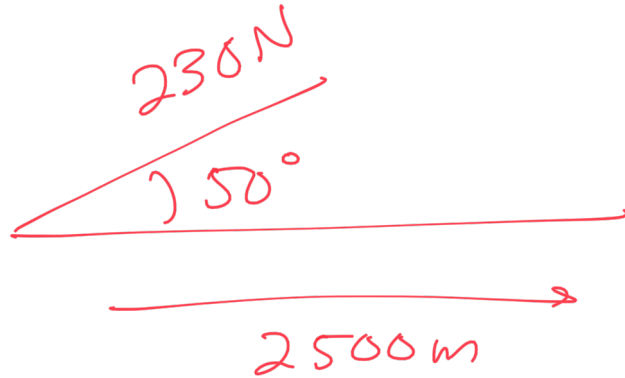
$$\tan^{-1}\left(\frac{333,438}{73,532}\right) = 77.6^\circ$$

$$(2400 + 3500) \text{ kg}$$

$$\boxed{49.5 \text{ m/s}, 77.6^\circ}$$

- 9.) (10 pts) Stewart is also dragging a motionless... ummm... everything bagel. The bagel is tied 50° from the horizontal (on level ground) and is being pulled with a force of 230 N. If Stewart pulls this tasty bagel 2500 meters, how much work is he doing on the object?

$$W = Fd$$



$$(230 \text{ N} \cos 50^\circ)(2500 \text{ m})$$

$$\boxed{\begin{array}{c} 369,603 \text{ J} \\ \text{or} \\ 369.6 \text{ kJ} \end{array}}$$

10.) (10 pts total, 5 pts each) A particle moving in the xy plane undergoes a displacement $\Delta \mathbf{r} = (4.0\mathbf{i} + 5.0\mathbf{j})$ m as a constant force $\mathbf{F} = (2.0\mathbf{i} + 3.0\mathbf{j})$ N acts on the particle.

a) (5 pts) Calculate the magnitudes of the displacement and the force.

b) (5 pts) Calculate the work done by \mathbf{F} .

- 11.) (10 pts) A 150 kg stuffed Tampo doll is pushed off of a 720 m building. Assuming no wind or air resistance, what is Tampo's velocity just prior to impact?

$$mgh = \frac{1}{2} mv^2$$

$$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$$

$$2(gh) = \left(\frac{1}{2}v^2\right)2$$

$$\sqrt{2gh} = \sqrt{v^2}$$

$$v = \sqrt{2gh}$$

$$= \sqrt{2(9.8 \text{ m/s}^2)(720 \text{ m})}$$

$$\boxed{118.8 \text{ m/s}}$$