2. If a bug and a truck windshield collide head-on, explain which one experiences a greater impact force.

Same force! Different accelerations. $ma = Ma$

3. You are a passenger in a car that is moving rapidly down a straight road. As the driver makes a sharp left turn, you are pressed against the right side of the car. Explain why this happens.

An object in motion will stay in motion @ a constant velocity (direction).

4. The block is initially moving at a speed of 5 m/s to the right. If no net force acts on it, what will be its subsequent motion?

a) The block moves to the right and slows down.
b) The block moves to the right at the same speed.
c) The block moves to the right and speeds up.
d) Its subsequent motion cannot be determined without more information.

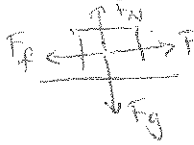
↳ no friction
no acceleration.

5. The block, initially moving to the right at 5 m/s, is acted upon by a net force to the left. How will it continue to move?

a) The block moves to the right at the same speed.
b) The block moves to the right and slows down. May stop & reverse.
c) The block moves to the right and speeds up.
d) The block moves to the left and slows down.

6. If a person gets a bookshelf sliding, and wants to keep it sliding at a constant velocity, they must:

a) Stop pushing and let inertia keep the shelves sliding.
b) Apply a force smaller than the kinetic friction.
c) Apply a force equal to the kinetic friction.
d) Apply a force greater than the kinetic friction.

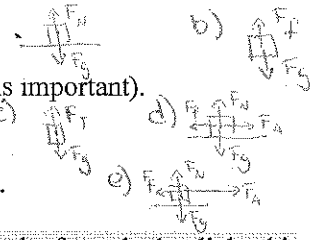


$F_A = F_f$

$F_{net_x} = 0N = F_A + F_f$

7. Draw free-body diagrams for the following problems. Be sure to draw all the forces with arrows that are of appropriate length to reflect the given descriptions.

a) Object slides across a horizontal surface at constant speed without friction.
b) A sky diver falls downward through the air at constant velocity (air resistance is important).
c) An object is suspended from the ceiling.
d) An object slides a horizontal surface at constant velocity. Friction is present.
e) An wagon accelerates from rest because of an applied force. Friction is present.



8. What is the gravitational force exerted by a large body, such as Earth called? What is the formula that links this answer to the mass of an object?

9. A 520-kg wrecking ball is suspended from a cable.

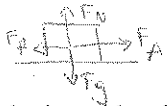
a) Draw a free-body diagram of this situation.
b) What the mass of the ball? $m = 520kg$
c) What is the tension exerted on the ball? $F_T = 5096N$

$F_g = mg = 520(9.8) = -5096N$

$F_{net} = 0N = F_T + F_g = F_T - 5096N$

$F_T = 5096N$

10. A 920-kg car is towed into the body shop with a force of 300 N. The friction between the car tires and the road surface is 115 N. What is the acceleration of the car?



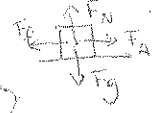
$F_{net_x} = F_A + F_f = 300N - 115N$

$= 185N = m \cdot a$

$185N = 920kg\,(a)$

$a = .20\ m/s^2$

11. A 55-kg person on a skateboard moves at a constant velocity with a force of 65N. What is the coefficient of friction between the skateboard and the pavement?



$F_g = 55(9.8) = -539$

$F_f = \mu \cdot F_N$

$65N = \mu\,(539N)$ $\mu = .121$

$0N = F_{net_y} = F_N + F_g = F_N - 539N$

$F_N = 539N$

$F_{net_x} = 0N = F_A + F_f$

$0N = 65N + F_f$

$F_f = -65N$

12. What is the momentum of a 0.185-kg softball traveling at 25.5 m/s?

$p = m \cdot v = .185kg\,(25.5\ m/s)$ $= 4.7\ kgm/s$

Unit 4 – Motion in 2D

Physics Classroom: Vectors – Motion & Force in 2 Dimensions

Key Vocab Words:

projectile, trajectory, uniform circular motion, centripetal acceleration, centripetal force

Problems:

1. A ball rolls with a speed of 2 m/s across a table top that is 1 meter above the floor. Upon reaching the edge of the table, it follows a parabolic path to its landing spot on the floor. How far along the floor is this spot from the table?

(2) $\Delta x = v_0 t + \frac{1}{2} a t^2$
$\Delta x = 2(.45) + 0$
$\Delta x = .90\,m$

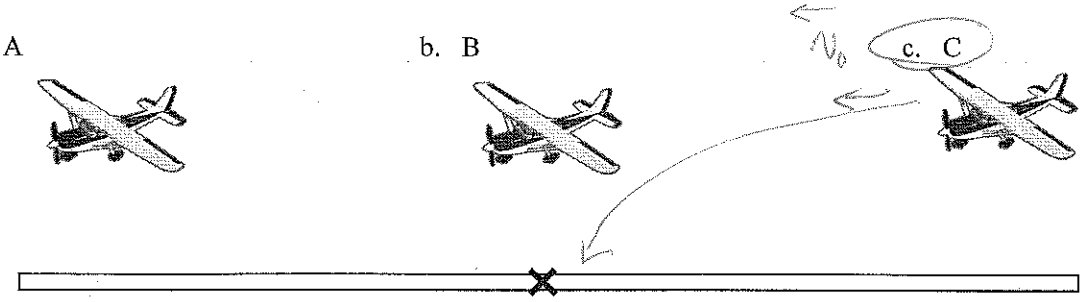
Horizontal v = k		Vertical a = k = a_g (free fall)	
v_{ix}	2 m/s	v_{iy}	0 m/s
v_{fx}	2 m/s	v_{fy}	
Δx (range)		Δy (height)	-1 m
a_x	0 m/s²	a_y	-9.8 m/s²
t	.45s	t	.45s

(1) $\Delta y = v_0 t + \frac{1}{2} a t^2$
$-1 = 0 - 4.9 t^2$
$t = .45\,s$

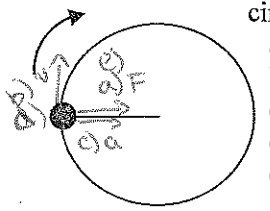
2. Two balls, one 1.0 kg, the other 3.0 kg, are rolled off the edge of a table at the same speed.
   a) Which ball, if either, travels farther out from the table? same Δx.
   b) Which ball, if either hits the ground first? same time

3. Which position should the airplane drop its cargo to hit the target? Draw the path the cargo would take as it moves toward the ground.

a. A b. B c. C



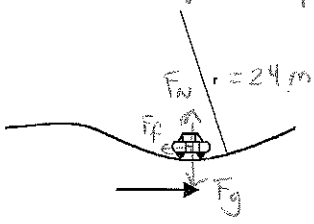
4. The following diagram represents an overhead view of a ball attached to a string that is being spun in a horizontal circle.



   a) Indicate the direction of the force acting on the ball.
   b) Indicate the direction of the velocity of the ball.
   c) Indicate the direction of the acceleration of the ball.
   d) If the ball was suddenly released at the point shown (the black dot), indicate which way the ball would travel.
   e) Indicate the direction of the centripetal force acting on the ball. (same as a)

(same as b) tangentially

5. While traveling at 13 m/s, a car hits a dip in the road of radius 24 m.
   a) Draw the free-body diagram for the driver.
   b) What is your centripetal acceleration? $a_c = \frac{v^2}{r} = \frac{13^2}{24} = 7.04\,m/s^2$
   c) What is the magnitude of the normal force acting on you if you are 60 kg? $F_{net} = ma_c = 60(7.04) = F_N + F_g$
   careful! $F_g = mg = (60)(9.8) = -588N$
   $422.5N = F_N - 588N$
   $F_N = 1010N$



Unit 5 – Work & Energy

Physics Classroom: Work, Energy & Power

Key Vocab Words:

energy, kinetic energy, work, gravitational potential energy, law of conservation of energy

Problems:

1. A student lifts a box of books that weighs 185 N. The box is lifted 0.800 m. How much work does the student do on the box? $W = F \cdot \Delta x = 185N(.8m) = 148\,J$

2. Differentiate the following terms: positive work, negative work, no work.

lifting (work against gravity) ↓ gaining weight

↘ F ⊥ Δx