PHYS 201 Test #2 Name:______________________

1.	2.	3.	4.	5.	Newton's 2nd Law
$x = \bar{v}\, t$	$x = \frac{1}{2}(v_0 + v)t$	$v = v_0 + at$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$	$\sum \vec{F} = m\vec{a}$

Force of friction: $F_{fr} = \mu\ F_N$.

Acceleration due to gravity = g = 9.8 m/s^2.

Newton's law of gravitation is given by: $F = G\frac{m_1 m_2}{r^2}; G = 6.673 \times 10^{-11}(SI)$.

Centripetal force is given by, $F_c = m\frac{v^2}{r}$.

Kinetic Energy is given by, $KE = \frac{1}{2}mv^2$.

Potential Energy is given by, $PE = mgh$.

Work done by a Force, $W = (F \times Cos\theta) \times S$.

Power = Work/Time.

Work-Energy Theorem: $Work = \frac{1}{2}mv_f^{\ 2} - \frac{1}{2}mv_i^{\ 2}$

Linear momentum of an object of mass, *m* and velocity, ***v*** is given by: ***p*** = *m* x ***v***.

Impulse is defined as the product of the force and time, ***J*** = ***F*** x *t*.

Impulse-Momentum Theorem: $F \times t = mv_f - mv_i$

Area of a triangle = $\frac{1}{2} \times base \times height$.

PHYS 201 Test #2 Fall 2017 Name: KEY

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A. For the MC questions write your answers in the line next to the question number. Other questions/Problems provide your answers in the space below them.

a 1. Which one of the following objects has the largest inertia?
a. space shuttle b. book c. bicycle d. car e. truck

d 2. The push or pull on an object can be best described by what scientific term?
a. Friction b. motion c. gravity d. force e. mass

e 3. Newton's first law of motion states that a body in motion does what if it is not acted on by a net force?
a. Comes to rest
b. Changes direction
c. Maintains a constant speed
d. Increases inertia
e. Maintains a constant velocity

b/e 4. Which one of the following is Newton's law of gravitation?
a. Every particle in the universe exerts a repulsive force on every other particle
b. Every particle in the universe exerts an attractive force on every other particle
c. An object will remain in a state of rest or of uniform motion in a straight line unless acted on by an outside net force.
d. The net force acting on an object is equals to the product of the mass of the object and the acceleration of the object.
e. When one object exerts a force on a second object, the second object exerts a force on the first that has an equal magnitude but opposite direction.
f. Frictional forces are in the opposite direction of motion.

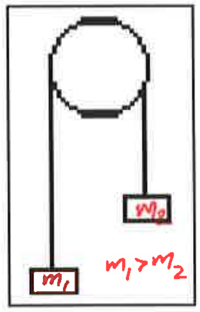
d 5. If a constant, nonzero force is applied to an object that is at rest, what can you say about the velocity and acceleration of the object while the force being applied?
a. velocity changes, acceleration changes
b. velocity remains constant, acceleration remains constant
c. velocity remains constant, acceleration changes
d. velocity changes, acceleration remains constant

c 6. Which one of the following is also the unit joule, J?
a. $kg.m/s^2$ b. $m^3/(kg.s^2)$ c. $kg.m^2/s^2$ d. $kg.m^2/s^3$ e. $kg.m/s^3$ f. $kg.m/s$

b 7. Which one of the following is an example for a non-conservative force?
a. elastic force
b. frictional force
c. electric force
d. gravitational force

d 8. Which one of the following is a fundamental force?
a. tension
b. normal force
c. frictional force
d. gravitational force

d 9. Two masses (4-kg and 6-kg) are attached by a massless cord passing over a massless, frictionless pulley of an Atwood's machine and released. What will be the acceleration of the masses?



a. 0.20 m/s^2 b. 9.8 m/s^2 c. 5.88 m/s^2
d. 1.96 m/s^2 e. 3.92 m/s^2

$a = \frac{(m_1 - m_2)g}{m_1 + m_2} = \frac{(6-2)\times 9.8}{6+4}$

d 10. What is the angle between the acceleration and velocity of an object in uniform circular motion?
a. 0 b. 30^0 c. 45^0 d. 90^0 e. 180^0

c 11. Which one of the following terms is used to indicate the natural tendency of an object to remain at rest or in motion at a constant speed along a straight line?
a. Velocity b. Speed c. Inertia d. Force e. Acceleration

a 12. Sally wants to push a box across the floor. She has a hard time getting the box to start moving, but finds it easy to push it the rest of the way. What can you infer from this example about the relationship between kinetic friction and static friction?

a. Kinetic friction is less than static friction.
b. Kinetic friction is equal to static friction.
c. Kinetic friction is greater than static friction.

b 13. Which one of the following is an example of a completely inelastic collision?
a. A hockey puck crashes into a wall and bounces backwards.
b. A bullet is shot and lodges into a wooden block.
c. Two bumper cars collide and split off in different directions.

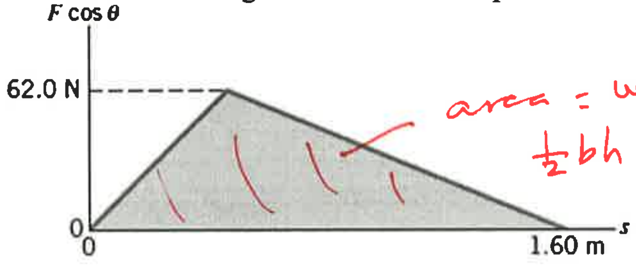
e 14. What is represented by the area under the Force VS. Time graph?
a. Displacement b. Work c. Acceleration d. Velocity e. Impulse (Force × time)

c 15. A volleyball of mass 0.35 kg is spiked so that its incoming velocity of -15 m/s is changed to an outgoing velocity of +12 m/s. What impulse does the player apply to the ball?

$Ft = mv_f - mv_i = 0.35\times(12) - 0.35\times(-15) = 0.35\times 12 + 0.35\times 15 = 9.45$

a. 4.2 kg.m/s b. -5.3 kg.m/s c. 9.5 kg.m/s d. -9.5 kg.m/s e. 1.1 kg.m/s f. -1.1 kg.m/s

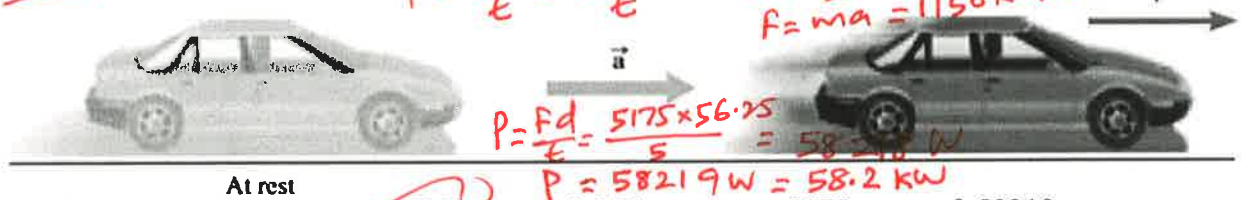
b 16. The graph shows how the force component $F \cos\theta$ along the displacement varies with the magnitude s of the displacement. Find the work done by the force.



area = work
$\frac{1}{2}bh = \frac{1}{2}\times 1.6 \times 62 = 49.6$

a. 24.8 J b. 49.6 J c. 62 J d. 99.2 J

C 17. A car, starting from rest, accelerates in the $+x$ direction as in the figure. It has a mass of 1150 kg and maintains an acceleration of +4.50 m/s^2 for 5.00 s. Assume that a single horizontal force (not shown) accelerates the vehicle. Determine the average power, in kW generated by this force.



a. 5.18 b. 56.3 c. 58.2 d. 291 e. 5175 f. 58219

D 18. Estimate the cost of electricity for operating a 6-W LED light bulb for 8 hours a day for 20 days a month for two years. Assume a cost of 9 cents per kWh.
A. $ 0.35 B. $ 1.04 C. $ 1.55 D. $ 2.07 E. $ 23

f 19. When you charge your smart phone, which one of the energy transformations take place?
a. Chemical energy is converted into electrical energy
b. Chemical energy is converted into thermal energy
c. Electrical energy is converted into sound energy
d. Electrical energy is converted into thermal energy
e. Chemical energy is converted into sound energy
f. Electrical energy is converted into chemical energy

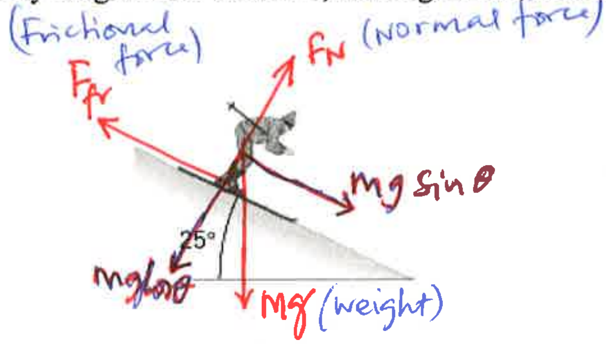
d 20. Two objects are involved in a completely inelastic one-dimensional collision. The net external force acting on them is zero. The table lists four possible sets of the initial momenta and kinetic energies of the two objects, as well as their final momenta and kinetic energies. Identify the set that violates the collision laws?

		Initial (Before Collision)		Final (After Collision)	
		Momentum	Kinetic Energy	Momentum	Kinetic Energy
a.	Object 1: Object 2:	+6 kg·m/s +2 kg·m/s	15 J 0 J	+8 kg·m/s	9 J
b.	Object 1: Object 2:	+8 kg·m/s -2 kg·m/s	5 J 7 J	+6 kg·m/s	7 J
c.	Object 1: Object 2:	-3 kg·m/s +4 kg·m/s	1 J 6 J	+1 kg·m/s	4 J
d.	Object 1: Object 2:	0 kg·m/s -8 kg·m/s	3 J 8 J	-7 kg·m/s	10 J

B. A skier is coasting down a 25° slope, at a constant velocity as shown below.

1. Draw a free-body diagram for the skier, naming all the forces.

6



2. Determine the coefficient of kinetic friction between the skis and snow.

4

$F_{fr} = mg \sin\theta$

$F_N = mg \cos\theta$

$\mu_k = \frac{F_{fr}}{F_N} = \frac{mg \sin\theta}{mg \cos\theta} = \tan\theta$

$\mu_k = \tan 25° = 0.47$

C. A 44-kg skater is moving due west at a speed of 3.2 m/s. A 67-kg skater is moving due south at a speed of 5.8 m/s. They collide and hold on to each other after the collision.

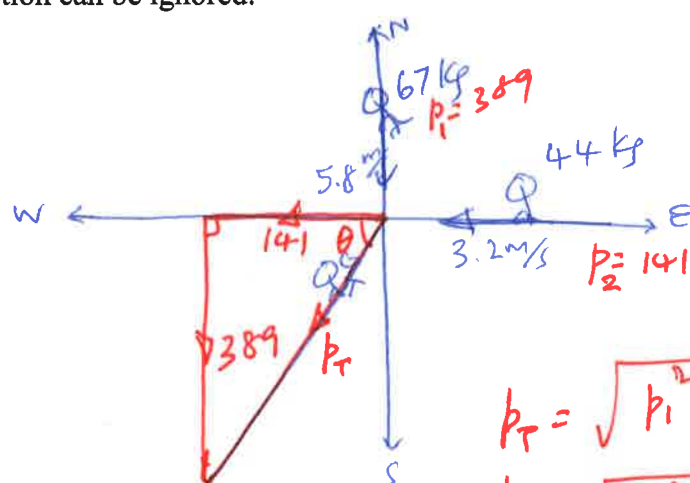
a. Sketch a diagram of the above situation, showing the skaters before and after the collision.

2 b. What type is this collision? Completely Inelastic

2 c. What quantity is conserved in this collision? Momentum

d. Find the velocity (speed and direction) of the skaters after the collision, assuming that friction can be ignored.

6



$p_T = \sqrt{p_1^2 + p_2^2}$

$p_T = \sqrt{141^2 + 389^2} = \sqrt{171202}$

$p_T = 413.7$

$V_T = \frac{p_T}{m} = \frac{413.7}{(44+67)} = 3.73$ m/s

$\tan\theta = \frac{389}{141} = 2.76 \rightarrow \theta = 70°$

$V_T = 3.7$ m/s

$\theta = 70°$ South of West

D. While driving along a country lane with a constant speed of 15 m/s, one encounters a dip in the road. The dip can be approximated as a circular arc of radius 55 m.
1. Draw a free-body diagram for the car at the bottom of the dip.
2. Calculate the normal force on the car (mass = 1200-kg) when the car is at the bottom of the dip?

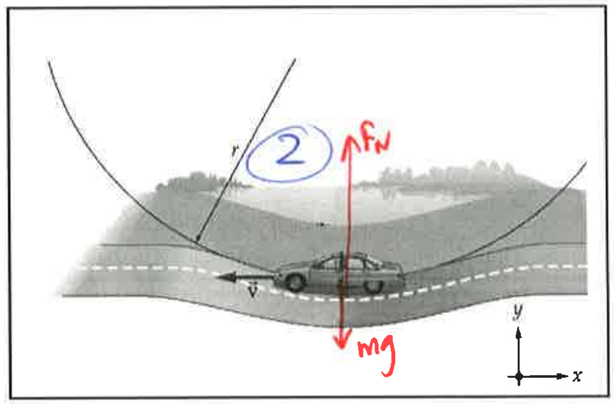
$F_N - mg = \frac{mv^2}{r}$

$F_N = mg + \frac{mv^2}{r}$

6 $F_N = 1200 \times 9.8 + 1200 \times \frac{15^2}{55}$

$F_N = 11760 + 4909$ (4)

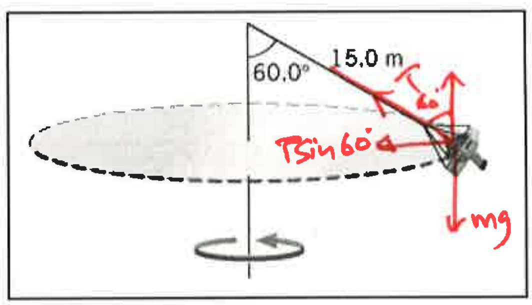
$F_N = 16,669$ N



E. A "swing" ride at a carnival consists of chairs that are swung in a circle by 15.0-m cables attached to a vertical rotating pole, as the drawing shows. Suppose the total mass of a chair and its occupant is m.

4 1. Draw a free-body diagram for the chair and its occupant.

2 2. Identify the centripetal force. $T\sin 60°$ or $T\cos 30°$



F. Newton's law of gravitation is given by: $F = G\frac{m_1 m_2}{r^2}; G = 6.673 \times 10^{-11}(SI)$.

2 1. Express the SI unit of the gravitational constant, G, in terms of kg, m, and s. $\frac{N m^2}{kg^2} = kg \cdot \frac{m}{s^2} \cdot \frac{m^2}{kg^2} = \frac{m^3}{kg \cdot s^2}$

2 2. In another solar system a planet has twice the earth's mass and twice the earth's radius. Your weight on this planet is ½ times your earth-weight. Assume that the masses of the earth and the other planet are uniformly distributed. → $\frac{GM}{R^2}$ NEW WEIGHT $= \frac{G2M}{(2R)^2} = \frac{1}{2}\frac{GM}{R^2}$

4 3. A satellite circles the Earth in an orbit whose altitude is equal to the radius of the Earth. Derive an expression for the speed of the satellite and calculate it.
(Mass of Earth = M = 5.98 x 10^{24}Kg, Radius of Earth = R = 6380 km)

$\frac{mv^2}{r} = \frac{GMm}{r^2}$ $r = 2R$

$v^2 = \frac{GM}{r}$

$v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{GM}{2R}} = \sqrt{\frac{6.673 \times 10^{-11} \times 5.98 \times 10^{24}}{2 \times 6380 \times 10^3}}$

$v = \sqrt{31270464} = 5592$ m/s

$v = 5592$ m/s