When you sit, Leave space between your neighbors
No Phone or Internet Use during the Exam
Use only a Calculator and a pen or pencil
You may tear the first page.

PHYS 201 Test #2 Name: Answer Key

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: $F = G\frac{m_1 m_2}{r^2}; G = 6.673\times10^{-11}(SI)$.

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: $\boldsymbol{p} = m \times \boldsymbol{v}$.
Impulse is defined as the product of the force and time, $\boldsymbol{J} = \boldsymbol{F} \times t$.

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

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

PHYS 201-001 Test #2 F 2019 Name: KEY

A. Select the correct answer for the following multiple choice questions and write your answer in the line next to the question number.

C 1. Which one of the following is Newton's first law motion?
b 2. Which one of the following is Newton's law of universal gravitation?

Answers for 1-2

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.

C 3. Which one of the following is also the newton, N?
d 4. Which one of the following is also the watt, W?

Answers for 3-4

a. $kg.m^2/s^2$ b. $kg/(m.s^2)$ c. $kg.m/s^2$ d. $kg.m^2/s^3$ e. $kg.m/s^3$ f. kg.m/s

C 5. Which one of the following is a contact force?

a. electric force b. magnetic force
c. kinetic frictional force d. gravitational force

b 6. Which one of the following is an example for a non-conservative force?

a. electric force b. frictional force
c. magnetic force d. gravitational force

a 7. Which one of the following is a vector?

a. Impulse b. Work c. Energy d. Density e. Power

e 8. Which one of the following is a scalar?

a. Impulse b. Momentum c. Force d. Velocity e. Power

c 9. What provides the centripetal force for a toy airplane, tied to a rope and moving in a horizontal circle?
d 10. What provides the centripetal force for a satellite circling the Earth?

Answers for 9-10

a. Normal force b. Kinetic frictional force c. Static frictional force
d. Gravitational force e. Tension

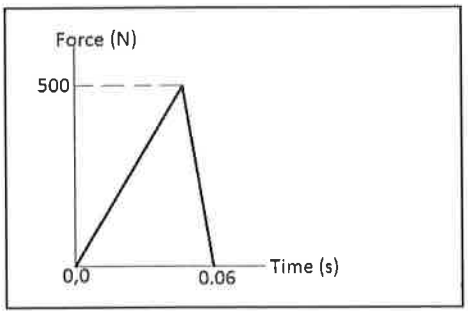
a 11. Which one of the following terms is used to indicate the natural tendency of an object to remain at rest or in motion at a constant speed along a straight line?

a. Inertia b. Velocity c. Speed d. Force e. Acceleration

__b__ 12. What is represented by the slope of the Velocity *versus* Time, graph?
a. Displacement b. Acceleration c. Speed d. Force e. Impulse

__d__ 13. What is represented by the area under a Force *versus* Time, graph?
a. Velocity b. Acceleration c. Work d. Impulse e. Displacement

__C__ 14. The force applied to a tennis ball during a serve is shown as a function of time. What is the impulse applied to the ball?
a. 5 N.s b. 10 N.s c. 15 N.s d. 30 N.s

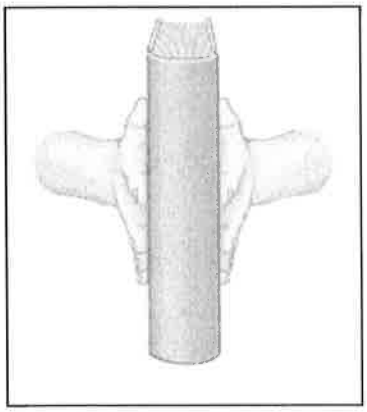


__b__ 15. Which one of the following energy transformation takes place in an electric motor?
a. Radiant energy is converted into electrical energy
b. Electrical energy is converted into mechanical energy
c. Radiant energy is converted into thermal energy
d. Mechanical energy is converted into electrical energy
e. Electrical energy is converted into radiant energy

__E__ 16. Estimate the cost of electricity for operating a 60-W incandescent light bulb for 4 hours a day for 20 days a month for one year. Assume a cost of 9 cents per kWh.
A. $ 57.6 B. $ 51.8 C. $ 1.29 D. 52 cents E. $ 5.18

__a__ 17. What is the angle between the centripetal acceleration and centripetal force?
__d__ 18. What is the angle between the frictional force and displacement?
Answers for 17 & 18
a. 0 b. 30^0 c. 90^0 d. 180^0 e. 270^0

__C__ 19. A student presses a book between his hands, as the drawing indicates. The forces that he exerts on the front and back covers of the book are perpendicular to the book and are horizontal. The book's mass is 3.40 kg. Determine the static frictional force on one side.
a. 1.70 N b. 3.40 N c. 16.7 N d. 33.3 N



__C__ 20. The kinetic energy of a car is 8×10^6 J as it travels along a horizontal road. How much power is required to stop the car in 10 s?
a. 8×10^7 W b. 8×10^6 W c. 8×10^5 W d. 8×10^4 W e. 8×10^3 W f. 8×10^2 W

B. Newton's law of gravitation is given: $F = G\frac{m_1 m_2}{r^2}; G = 6.673\times10^{-11}(SI)$.

3 1. Express the SI unit of G in terms of kg, m, s.

$$\frac{N\cdot m^2}{kg^2} = \frac{kg\cdot m\cdot m^2}{s^2 kg^2} = m^3/kg\,s^2$$

$$\frac{m^3}{kg\,s^2}$$

3 2. Define weight and derive the following expression for the surface gravity, g for a planet of mass, M and radius R. $g = G\frac{M}{R^2}$

Weight = Force of gravity

$$mg = \frac{GmM}{R^2}$$

$$g = \frac{GM}{R^2}$$

4 3. Calculate the surface gravity for an unknown planet whose mass = 3.78 x 10^{24}Kg, and radius = 5152 km.

$$g = \frac{GM}{R^2} = \frac{6.673\times10^{-11}\times 3.78\times10^{24}}{(5152\times10^3)^2} = 9.5$$

$$g = 9.5\ m/s^2$$

10 C. A child-buggy (total mass = 35-kg) is pulled along a horizontal surface at a constant velocity. The pulling force has a magnitude, F = 50 N, which is applied at a 30^0 angle as shown below. Frictional force is also present.

1. Draw a free-body diagram for the child-buggy system.
2. Resolve the 50-N force into horizontal and vertical components, in the diagram.
3. Determine the frictional force.
4. Determine the normal force.
5. Determine the coefficient of kinetic friction between the wheels and surface.

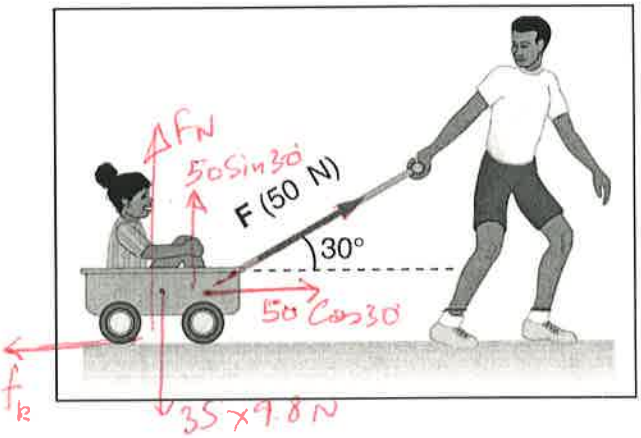
Constant velocity $\Rightarrow \Sigma F = 0$

$\longleftrightarrow$ $f_k = 50\cos30^\circ = 43.3\ N$

$\updownarrow$ $F_N + 50\sin30 = 35\times9.8$

$F_N + 25 = 343$

$F_N = 343 - 25 = 318\ N$



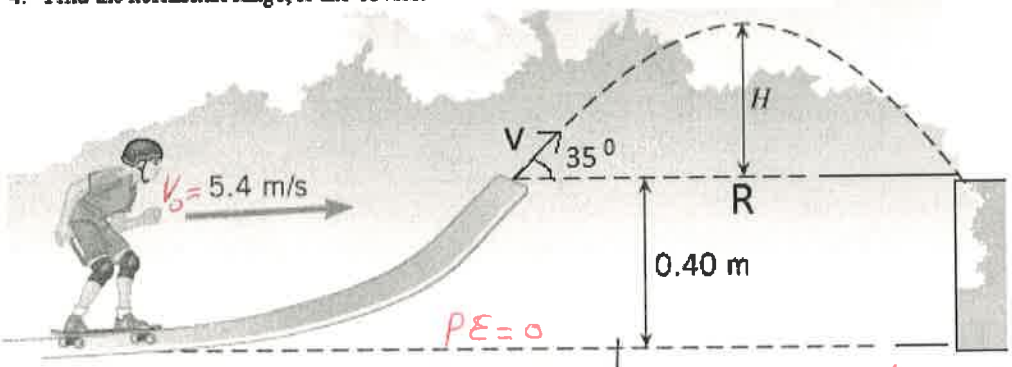
$f_k = \mu_k F_N$

$$\mu_k = \frac{f_k}{F_N} = \frac{43.3}{318} = 0.136$$

$$\mu_k = 0.14$$

12 D. The drawing shows a skateboarder moving at 5.4 m/s along a horizontal section of a track that is slanted upward by $\theta = 35.0°$ above the horizontal at its end, which is 0.40 m above the ground. When she leaves the track, she follows the characteristic path of projectile motion. Ignore friction and air resistance.

1. Using the conservation of mechanical energy, find her speed, V as she leaves the track.
2. Find the horizontal and vertical component of her speed as she leaves the track.
3. Find the maximum height H to which she rises above the end of the track.
4. Find the horizontal range, R she covers.



1. $\frac{1}{2}mV_0^2 = \frac{1}{2}mV^2 + mgh$

$V_0^2 = V^2 + 2gh$

$5.4^2 = V^2 + 2\times 9.8\times 0.4$

$V^2 = 5.4^2 - 2\times 9.8\times 0.4 = 21.32$

$V = \sqrt{21.32} = 4.62$ m/s

2. $V_{0x} = V\cos 35 = 4.62\cos 35 = 3.78$ m/s

$V_{0y} = V\sin 35 = 4.62\sin 35 = 2.65$ m/s

3. ↑ $V_y = 0$, $V_{0y} = 2.65$, $a = -9.8$

$V_y^2 = V_{0y}^2 + 2ay$

$0 = 2.65^2 - 2\times 9.8H$

$19.6H = 2.65^2 = 7.02$

$H = \frac{7.02}{19.6} = 0.36$ m

4. → $V_{0x} = 3.78$, $a_x = 0$

Need time.

↓ $y = V_{0y}t + \frac{1}{2}at^2$

$0 = 2.65t - \frac{1}{2}\times 9.8t^2$

$4.9t^2 = 2.65t$

$t = \frac{2.65}{4.9} = 0.54$ sec

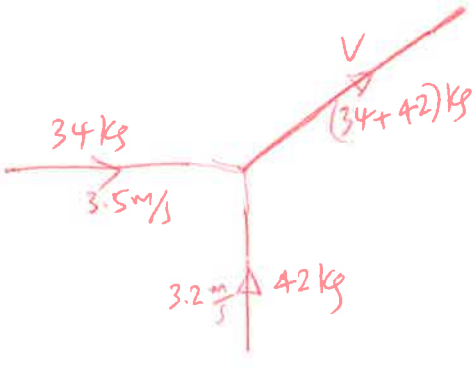
$R = V_{0x}t$

$R = 3.78\times 0.54$

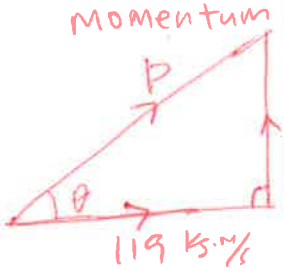
$R = 2.0$ m

8 E. A 34-kg skater is moving due east at a speed of 3.5 m/s. A 42-kg skater is moving due north at a speed of 3.2 m/s. They collide and hold on to each other after the collision.

1. Sketch a diagram of the above situation, showing the skaters before and after the collision.
2. Find the velocity (speed and direction) of the skaters after the collision, assuming that friction can be ignored.



Momentum conservation, vector diagram.



$\tan\theta = \frac{134.4}{119} = 1.129$

$\theta = 48.5°$

$p = \sqrt{119^2 + 134.4^2}$

$p = 179.5$ kg·m/s

$v = \frac{p}{m} = \frac{179.5}{76}$

$V = 2.36$ m/s