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 201-002 Test #2 F 2019 Name:_____

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

d 1. Which one of the following is Newton's second 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.

a 3. Which one of the following is also the joule, J?
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

d 5. Which one of the following is a non-contact force?

a. normal force b. tension
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

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

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

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

a. Impulse b. Momentum c. Force d. Work e. Acceleration

d 9. What provides the centripetal force for a toy airplane, tied to a rope and moving in a horizontal circle?
e 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. Tension e. Gravitational force

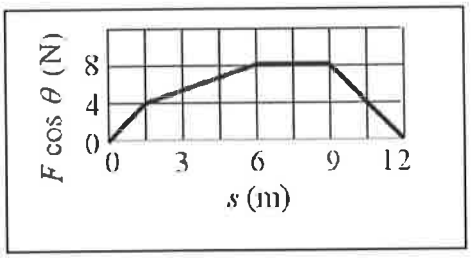
e 11. Which one of the following terms is used to indicate the natural tendency of an object to remain at rest or in motion at a constant speed along a straight line?

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

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

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

b 14. The force component acting on an object along the displacement varies with the displacement s as shown in the graph. Determine the work done on the object as it travels from s= 0.0 to 12 m.
a. 81 J b. 66 J c. 72 J
d. 57 J e. 48 J f. 96 J

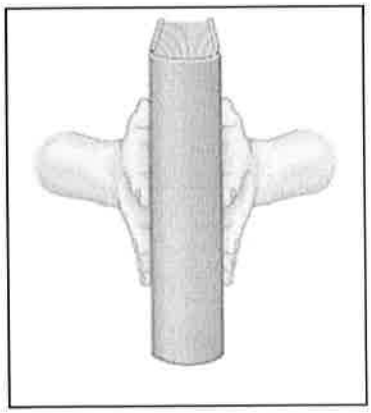


b or e 15. Which one of the following energy transformation takes place in an electric heater?
a. Radiant energy is converted into electrical energy
b. Electrical energy is converted into mechanical energy
c. Radiant energy is converted into thermal energy
d. Mechanical energy is converted into electrical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

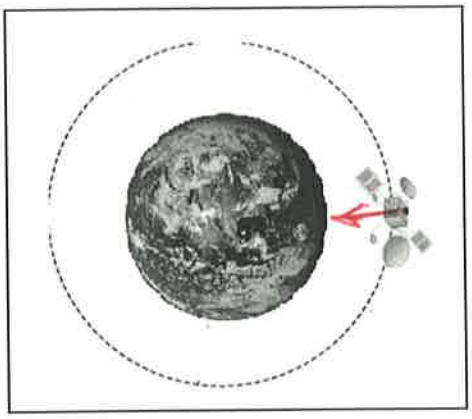
C 19. A student presses a book between his hands, as the drawing indicates. The forces that he exerts on the front and back covers of the book are perpendicular to the book and are horizontal. The book's mass is 3.40 kg. Determine the static frictional force on one side.
a. 1.70 N b. 3.40 N c. 16.7 N 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: $F = G\frac{m_1 m_2}{r^2}; G = 6.673\times10^{-11}(SI)$.

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



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

$G = \frac{F \cdot r^2}{m_1 m_2} \rightarrow \frac{N \cdot m^2}{kg^2} = \frac{kg \cdot m^3}{s^2 \cdot kg^2} = \frac{m^3}{kg \cdot s^2}$

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

3 2. Draw a free-body diagram for a satellite orbiting, radius r, the Earth (mass M) and derive the following expression for the speed of the satellite: $v = \sqrt{\frac{GM}{r}}$

$\frac{mv^2}{r} = \frac{G m M}{r^2}$

$v^2 = \frac{GM}{r} \rightarrow \boxed{V = \sqrt{\frac{GM}{r}}}$

4 3. Calculate the speed of a satellite orbiting the Earth at an altitude of 650 km.

Mass of Earth = 5.98 x 10^{24}kg and Mean Radius of Earth = 6380 km.

$r = 6380 + 650 = 7030\ km = 7.03\times10^6\ m$

$V = \sqrt{\frac{6.673\times10^{-11}\times5.98\times10^{24}}{7.03\times10^6}} = 7.53\times10^3\ m/s$

$\boxed{V = 7530\ m/s}$

10 C. A wooden crate (total mass = 32-kg) is pushed along a horizontal surface at a constant velocity. The pulling force has a magnitude, F = 50 N, which is applied at a 21^0 angle as shown below. Frictional force is also present.

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

$F_N = 314 + 50\sin21^\circ = 314 + 18$

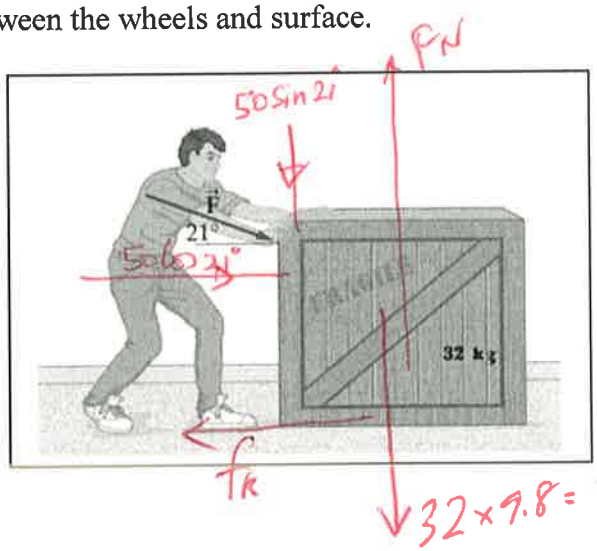
$\boxed{F_N = 332\ N}$

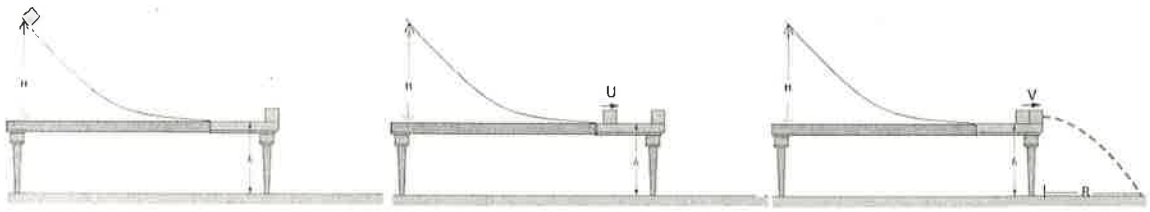
$\boxed{f_k = 50\cos21^\circ = 46.7\ N}$

$f_k = \mu_k \cdot F_N$

$\mu_k = \frac{f_k}{F_N} = \frac{46.7}{332} = 0.141$

$\boxed{\mu_k = 0.14}$





20

D. In the figure above, a 3.5 kg block slides down a frictionless track, height H = 0.75 m, and collides with a 2.5 kg block at rest on the edge of the table, height h = 0.45 m. The two blocks stick together after the collision, and travel, as shown above, and strikes the floor. (Acceleration due to gravity = 9.8 m/s^2, down)

1. Using the conservation of mechanical energy, find the velocity (U) of the 3.5 kg block, as it comes to the bottom of the track.

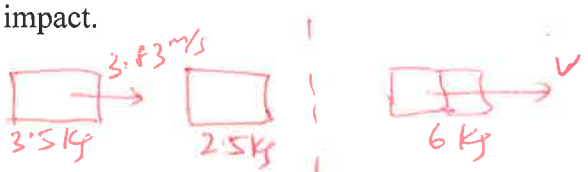
$mgh = \frac{1}{2}mu^2$

$gh = \frac{1}{2}u^2$

$u^2 = 2gh$, $u = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.75}$

$u = 3.83$ m/s

2. Using the conservation of momentum, find the speed of the combined blocks (V), just after the impact.



$3.5 \times 3.83 + 0 = 6V \rightarrow V = \frac{3.5 \times 3.83}{6} = 2.23$ m/s

3. Calculate the energy loss during the collision.

$\frac{1}{2} \times 3.5 \times 3.83^2 - \frac{1}{2} \times 6 \times 2.23^2$

$25.67 - 14.92 = 10.75$ J

$\simeq 10.85$

(Projectile Motion)

4. How long the blocks are in the air?

$V_{oy} = 0$

$y = 0.45$ m

$a_y = 9.8$ m/s^2

$y = V_{oy}t + \frac{1}{2}at^2$

$0.45 = \frac{1}{2} \times 9.8t^2$

$t^2 = 0.0918$

$t = 0.30$ sec

5. How far from the edge of the table (R), horizontally, the blocks will strike the floor?

$V_{ox} = 2.23$ m/s, $t = 0.30$ s, $a_x = 0$

$x = R = V_{ox}t + \frac{1}{2}a_x t^2$ ($a_x = 0$)

$R = 2.23 \times 0.3$

$R = 0.68$ m