PHYS 201 Test #2 F2022 You may tear this page.

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

Conversion factors:
1 H = 3600 s, 1 Mile = 1608 m, 1 inch = 2.54 cm, 1 foot = 12 inch, 1 m = 3.281 ft.
1 m = 100 cm, 1 cm = 10 mm, 1 m = 1000 mm, 1 km = 1000 m

Force of friction: $F_{fr} = \mu\, F_N$. Acceleration due to gravity = g = 9.8 m/s^2, down.

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, $KE = \frac{1}{2}mv^2$. Gravitational Potential Energy = $PE = mgh$.

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

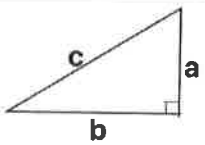
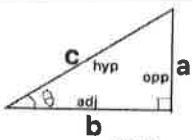
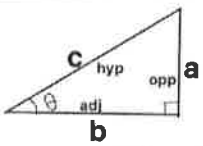
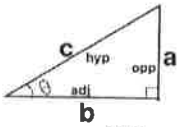
Work-Energy Theorem: $Work = \frac{1}{2}mv_f^{\,2} - \frac{1}{2}mv_i^{\,2}$

Linear momentum of an object of mass, m and velocity, v is given by: $\boldsymbol{p} = m$ x $\boldsymbol{v}$.

Impulse is defined as the product of the force and time, $\boldsymbol{J} = \boldsymbol{F}$ x t.

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

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

Pythagorean Theorem	*sin θ*	*cos θ*	*tan θ*	Components of a vector:
 $c^2 = b^2 + a^2$	 $Sin\,\theta = \frac{opp}{hyp} = \frac{a}{c}$	 $Cos\,\theta = \frac{adj}{hyp} = \frac{b}{c}$	 $Tan\,\theta = \frac{opp}{adj} = \frac{a}{b}$	Adjacent component = Cos Opposite component = Sin

2pt/Q
42

PHYS 201 Test #2 Fall 2022 Name: Answer Key

A. For the MC questions write your answers in the line next to the question number.

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

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. Which one of the following is Newton's second law motion?
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 mass of the object divided by the acceleration of the object.
e. The net force acting on an object is equals to the mass of the object multiplied by the acceleration of the object.
f. 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.
g. Frictional forces are in the opposite direction of motion.

d 4. 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 after the force is 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

$F = \frac{GMm}{r^2}$

d 5. Which one of the following is also the unit watt, W?
f 6. Which one of the following is a unit for momentum?
b 7. Which one of the following is a unit for the gravitational constant, G?

$G = \frac{F \cdot r^2}{Mm} = \frac{N \cdot m^2}{kg^2} = \frac{kg \cdot m/s^2 \cdot m^2}{kg^2} = \frac{m^3}{kg \cdot s^2}$

Answers for 5-7
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

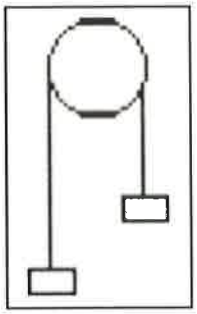
b 8. Which one of the following is an example for a non-contact force?
a. pushing b. gravitational force c. Tension
d. kinetic frictional force e. normal force f. static frictional force

e 9. Which one of the following is a fundamental force?
a. tension b. normal force c. elastic spring force
d. frictional force e. strong nuclear force

c 10. 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

e 11. A stack of books whose true weight is 165 N is placed on a scale in an elevator. The scale reads 160 N. What can be said about the motion of the elevator?
a. It is at rest
b. It is moving with a constant velocity upward
c. It is moving with a constant velocity downward
d. It is accelerating upward
e. It is accelerating downward

c 12. A person with a black belt in karate has a fist that has a mass of 0.70 kg. Starting from rest, this fist attains a velocity of 6.0 m/s in 0.15 s. What is the magnitude of the net force applied to the fist to achieve this? $v_0 = 0$, $v = 6$ m/s, $t = 0.15$ $v = v_0 + at \rightarrow a = \frac{v}{t}$ $\frac{6}{.15} = a$ $F = ma$ $f = 0.7 \times \frac{6}{0.15}$ $= 28$ N
a. 6.9 N b. 4.2 N c. 28 N d. 5.6 N e. 40 N



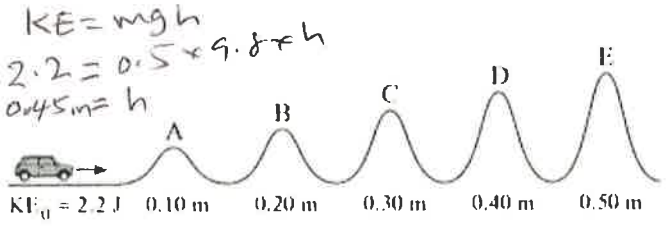
a 13. Two masses (3-kg and 5-kg) are attached by a massless cord passing over a massless, frictionless pulley of an Atwood's machine and released. What will be the acceleration of the masses? $a = \frac{\Sigma F}{m} = \frac{(5-3)9.8}{3+5} = 2.45$ m/s²
a. 2.45 m/s² b. 9.8 m/s²
c. 3.92 m/s² d. 6.53 m/s²

d 14. What is the centripetal force for ISS in orbit around the Earth?
a. Normal force b. Kinetic frictional force
c. Static frictional force d. Gravitational force

a 15. What is the angle between the centripetal acceleration and centripetal force?
d 16. What is the angle between the frictional force and displacement?
Answers for 15 & 16
a. 0 b. 30^0 c. 90^0 d. 180^0 e. 270^0

c 17. A box weighing 500N is at rest on the floor. A person pushes against it and it starts moving when 100N force is applied to it. What can be said about the coefficient of kinetic friction between the box and the floor?
a. $\mu_k = 0$ b. $\mu_k = 0.2$ c. $\mu_k < 0.2$ d. $\mu_k > 0.2$

d 18. A toy car (0.50 kg) runs on a frictionless track and has an initial kinetic energy of 2.2 J, as the drawing shows. The numbers beneath each hill give the heights of the hills. Over which of the hills will the car coast? $KE = mgh$ $2.2 = 0.5 \times 9.8 \times h$ $0.45\text{m} = h$



a. A
b. A and B
c. A, B, and C
d. A, B, C, and D
e. A, B, C, D, and E

a 19. In another solar system a planet has twice the earth's mass and twice the earth's radius. Your weight on this planet is _____ times your earth-weight.
a. 0.5 b. 1 c. 2 d. 4 e. 8 f. 10

Earth weight $= \frac{GMmg}{r^2}$ $\frac{GMm}{r^2} \rightarrow 2M$ $\rightarrow 2r$ $\frac{G(2M)m}{4r^2} = \frac{1}{2}\frac{GMm}{r^2} = 0.5\frac{GMm}{r^2}$ $= 0.5$ Earth weight

1.1 kW 0.5H

D 20. Estimate the cost of electricity for operating a 1100-W iron for 30 minutes a week for a year, 52 weeks. Assume a cost of 9 cents per kWh.
A. $28.6 B. $2.75 C. $154 D. $2.57 E. $257

1.1 × 0.5 × 52 KWH
Cost = 1.1 × 0.5 × 52 × 0.09
= $2.57

C 21. Which one of the following energy transformations takes place during photosynthesis?
a. Radiant energy is converted into electrical energy
b. Electrical energy is converted into mechanical energy
c. Radiant energy is converted into chemical energy
d. Mechanical energy is converted into thermal energy
e. Chemical energy is converted into radiant energy

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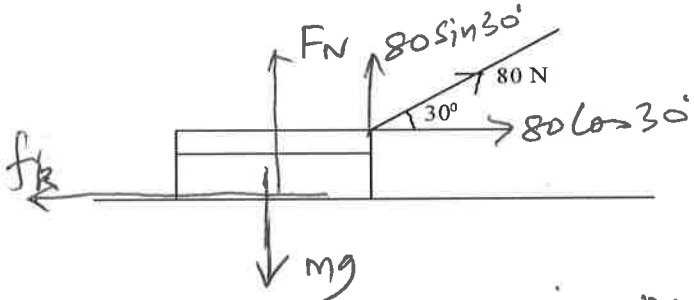
15 PTS B. A 25-kg box is pulled along a horizontal surface at a constant velocity. The pulling force has a magnitude of 80.0 N, which is applied at a 30^0 angle as shown below. Frictional force is also present.
a. Draw a free-body diagram for the box.
b. Resolve the 80-N force into horizontal and vertical components, in the diagram.
c. Determine the normal force.
d. Determine the frictional force.
e. Determine the coefficient of kinetic friction between the box and surface.



$\Sigma F_y = 0$ $F_N + 80\sin 30^\circ = mg$

$F_N = mg - 80\sin 30^\circ$

$F_N = 25 \times 9.8 - 40$

$F_N = 205\ N$

$\Sigma F_x = 0$, $f_k = 80\cos 30^\circ = 69.3\ N$

$f_k = \mu_k \cdot F_N \rightarrow \mu_k = \frac{f_k}{F_N}$

$= \frac{69.3}{205} = 0.338$

$\mu_k = 0.34$

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

3 a. Define weight and obtain an expression for the surface gravity for a planet.

weight = force of gravity

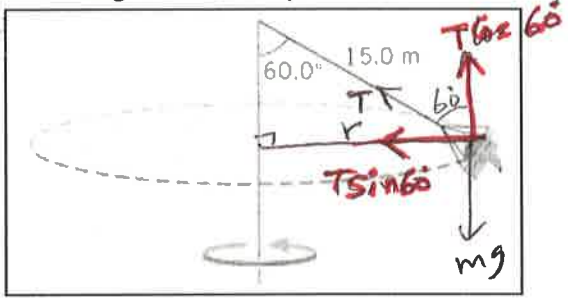
$mg = \frac{GMm}{R^2} \rightarrow g = \frac{GM}{R^2}$

5 b. Calculate the surface gravity for the planet Venus. (Mass of Venus = 4.87 x 10^{24}Kg, Radius of Venus = 6052 km)

$g = \frac{GM}{R^2} = \frac{6.673\times10^{-11} \times 4.87\times10^{24}}{(6052\times10^{3})^2}$

$g = 8.87\ m/s^2$

15 D. 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 drawi
of a chair and its occupant is m (= 179 kg).



a. Find the radius for the circular motion.

$r = 15\sin60^\circ = 12.99 = 13.0\ m$

b. Considering the chair and its occupant as the object of interest, show all the forces acting on it, in the diagram, a free-body diagram.

c. Resolve the tension into horizontal and vertical components, in the diagram.

d. Determine the tension in the main cable attached to the chair.

$T\cos60^\circ = mg$

$T = \frac{mg}{\cos60} = \frac{179\times9.8}{\cos60} = 3508.4$

$T = 3508\ N$

e. Find the speed of the chair.

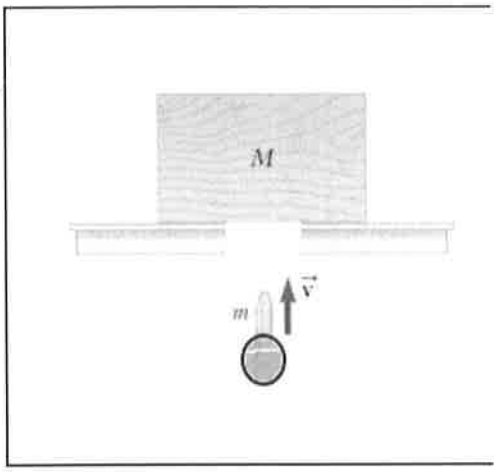
$T\sin60^\circ = \frac{mv^2}{r}$

$3508\sin60 = \frac{179\times v^2}{13.0}$

$v^2 = \frac{13\times3508\sin60}{179} = 220.64$

$v = 14.85\ m/s$

20 E. An object of mass, $m = 250$ g is fired vertically with a velocity, $\vec{V} = 8.50$ m/s into a (M =750 g) block of wood at rest directly above it, as shown below. The object becomes embedded in the block, and both move vertically up afterwards.



a. Using the conservation of momentum, find the velocity of the block-object system just after the object is embedded.

$$mV = (M+m)u$$

$$u = \frac{mV}{M+m} = \frac{250 \times 8.5}{750+250} = 2.125$$

$$u = 2.125 \text{ m/s}$$

b. Name the type of collision.

Completely inelastic

c. Calculate the energy loss during the collision.

$$\frac{1}{2}mV^2 - \frac{1}{2}(m+M)u^2$$

$$= \frac{1}{2} \times 0.25 \times 8.5^2 - \frac{1}{2} \times 1 \times 2.125^2$$

$$= 9.03125 - 2.2578 = 6.77 \text{ J}$$

d. What happened to the loss energy?

Transformed into heat.

e. How high will the block-object system will rise after the object becomes embedded in it?

$$(M+m)gh = \frac{1}{2}(M+m)u^2$$

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

$$h = \frac{u^2}{2g} = \frac{2.125^2}{2 \times 9.8} = 0.23 \text{ m}$$

$$h = 0.23 \text{m}$$