ONLINE

PHYS 201 Test #2 V1 F 2025 **Name:** Answer key

A. Select the correct answer for the following multiple-choice questions and write your answer in the line next to the question number. For Q9 show your work in the diagram.

b 1. Which one of the following is also the Newton's first law?
a. law of action-reaction b. law of inertia c. law of force

a 2. Which one of the following is a non-contact force?
a. gravitational force b. frictional force c. normal force d. tension force

C 3. Which of the following is an example of Newton's Third Law?
a. A ball rolling on the ground eventually stops.
b. A book resting on a table.
c. A swimmer pushing water backward to move forward.
d. A car accelerating on a highway.

4-5) Newton's law of gravitation is given: $F = G\frac{m_1 m_2}{r^2}; G = 6.673\times10^{-11}(SI)$.

a 4. What is the SI unit for G, gravitational constant?
a. $\frac{m^3}{kg.s^2}$ b. $\frac{m^3}{kg.s^3}$ c. kg.m/s^2 d. kg.m^2/s^3 e. $\frac{m^4}{kg.s^2}$ f. $\frac{m^2}{kg.s^2}$

C 5. In another solar system a planet has twice the earth's mass. Its radius is same as that of 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

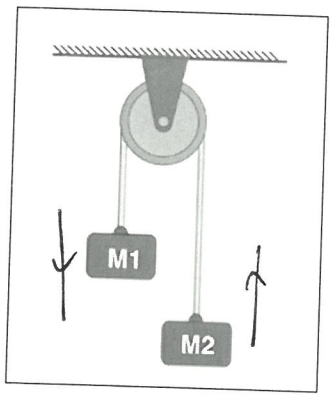
$W = \frac{GMm}{R^2}$
$= \frac{G2M \cdot m}{R^2}$
$= 2.\frac{GMm}{R^2}$

a 6. Which one of the following is a vector?
a. Impulse b. Mass c. Distance d. Work e. Power

C 7. What is the centripetal force for a vehicle turning along a flat curve?
a. Normal force b. Kinetic frictional force
c. Static frictional force d. Gravitational force

C 8. What is represented by the area under a Force VS. Displacement, graph?
a. Velocity b. Acceleration c. Work d. Impulse e. Power

9-10) Two masses (M1 = 3.5-kg and M2 = 1.5-kg) are attached by a massless cord passing over a massless, frictionless pulley of an Atwood's machine and released.



9. Show the motion of each of the masses in the diagram.
b 10. Calculate the magnitude of the acceleration of the masses?
a. 0.40 m/s^2 b. 3.9 m/s^2 c. 5.6 m/s^2
d. 13 m/s^2 e. 9.8 m/s^2 f. 3.3 m/s^2

e 11. A stack of books whose true weight is 165 N is placed on a scale in an elevator. The scale reads 170 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 downward
e. It is accelerating upward

d 12. 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

b 13. Which one of the following energy transformations takes place in a photovoltaic solar cell?

a. Electrical energy is converted into mechanical energy
b. Solar energy is converted into electrical energy
c. Mechanical energy is converted into electrical energy
d. Solar energy is converted into thermal energy
e. Chemical energy is converted into electrical energy
f. Electrical energy is converted into thermal energy

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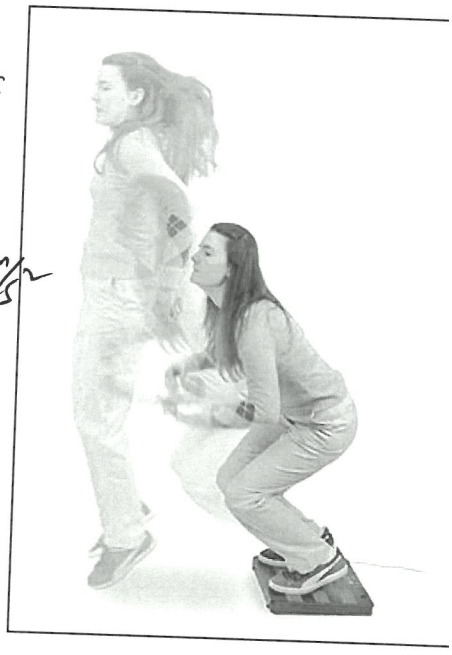
B. Starting from rest, a student of mass 45 kg, is jumping off a platform and gaining a vertical jump velocity of 5.5 m/s. During this jump her center of mass moves through a vertical distance of 0.65 m.



1. How long she is in contact with the platform?

$V_0 = 0,\ V = 5.5\ m/s,\ y = 0.65\ m$

$y = \frac{1}{2}(V_0 + V)t,\quad 0.65 = \frac{1}{2} \times 5.5 \times t$

$t = \frac{2 \times 0.65}{5.5} = 0.236\ s \approx 0.24\ s$

2. What is her acceleration during the jump?

$V = V_0 + at$

$5.5 = 0 + a \times 0.236 \rightarrow a = \frac{5.5}{0.236} = 23.27\ m/s^2$

3. What is the magnitude and direction of the force exerted on her?

$F = ma \uparrow = 45 \times 23.27 = 1050\ N \uparrow$

4. What is the impulse exerted on her?

$I = F \times t = 1050 \times 0.236 = 250\ N.s$

5. What is the magnitude and direction of the force is exerted on the platform?

$\downarrow$ 1050N

6 C. A large household air conditioner may consume 15.0 kW of power. What is the cost of operating this air conditioner 3.00 h per day for 30.0 d if the cost of electricity is \$0.110 per kW · h ?

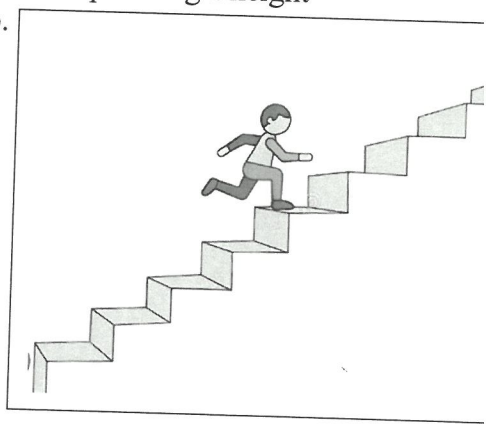
$15 kw \times 3 \times 30 \times \$0.110$

$\$ 148.50$

8 D. A person (mass = 75kg) is running up a total of 9 steps with each step having a height of 18 cm in 6.5 seconds and gaining a speed of 4.5 m/s at the top.

a. How much work is done by the person?

b. What is the power developed by the person to do this?



(a) $W = PE + KE$

$= mgh + \frac{1}{2}mv^2$ $\quad h = 18 \times 9\,cm$

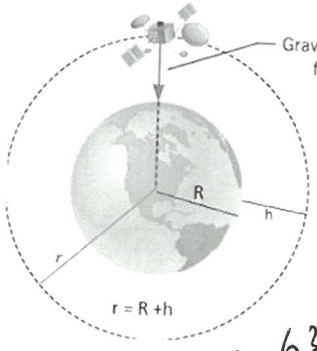
$h = 1.62\,m$

$W = 75 \times 9.8 \times 1.62 + \frac{1}{2} \times 75 \times 4.5^2$

$W = 1190 + 759 = 1950J$

(b) $P = \frac{W}{t} = \frac{1950}{6.5} = 300W$

6 E. A satellite circles the Earth in an orbit whose altitude is 645 km. Calculate the speed of the satellite. (Mass of Earth = M = 5.98 x 10^{24}Kg, Radius of Earth = R = 6380 km)



$r = 6380 + 645\,km$

$r = 7025\,km$

$\text{Gravitational force} = \frac{GMm}{r^2} = m\frac{v^2}{r}$

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

$v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{6.673 \times 10^{-11} \times 5.98 \times 10^{24}}{7025 \times 10^3}}$

$v = 7537\,m/s$

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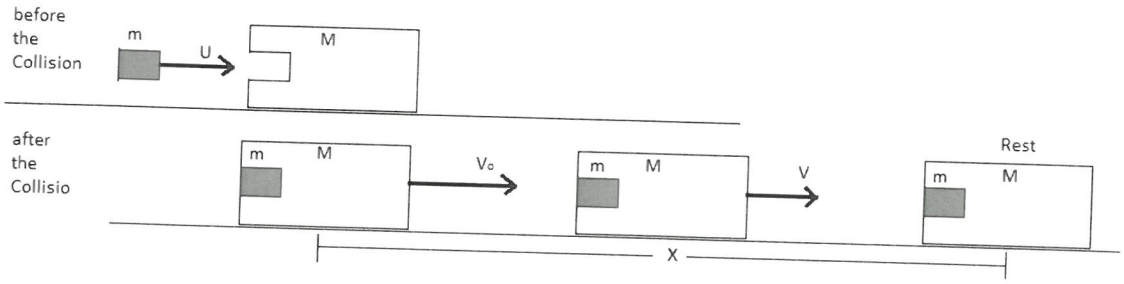
F. A metal block of mass, m = 50-gram, is fired (u= 15 m/s) into a wood block of mass, M = 250-gram, as shown. After the firing the wood block with the impeded metal block moves a distance, x = 1.2 m, and comes to rest due to the friction between the wood block and the surface.



a. Using the conservation of momentum find the velocity, V_0, of the blocks after the collision.

$$mu = (M+m)V_0$$

$$50 \times 15 = 300 \times V_0 \rightarrow V_0 = \frac{50 \times 5}{300} = 2.5\ m/s$$

b. Calculate the energy loss during the collision.

$$E_i - E_f = \frac{1}{2}mu^2 - \frac{1}{2}(M+m)V_0^2$$

$$= \frac{1}{2} \times 0.05 \times 15^2 - \frac{1}{2} \times 0.3 \times 2.5^2$$

$$= 5.625 - 0.9375 = 4.695$$

b. Find the deceleration of the blocks.

$V_0 = 2.5\ m/s$ $\quad V^2 = V_0^2 + 2ax$

$V = 0$ $\quad 0 = 2.5^2 + 2 \times a \times 1.2$

$x = 1.2m$ $\quad a = -2.5^2/(2 \times 1.2) = -2.60\ m/s^2$

c. Calculate the frictional force on the blocks.

$$f_k = Ma = 0.3 \times (-2.60) = -0.78\ N$$

$$f_k = 0.78N$$

d. Calculate the normal force on the blocks.

$$F_N = mg = 0.30 \times 9.8 = 2.94N$$

e. Calculate the coefficient of friction between the blocks and the surface.

$$\mu_k = \frac{f_k}{F_N} = \frac{0.78}{2.94} = 0.265$$