PHYS 201 11AM Fall 2014 Test #2 Name: KEY

42

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

d 1. Which one of the following statements correctly states Newton's third law motion?
a. Every particle in the universe exerts an attractive force on every other particle
b. 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.
c. The net force acting on an object is equals to the product of the mass of the object and the acceleration of the object.
d. 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.
e. Frictional forces are in the opposite direction of motion.

e 2. Which one of the following objects has the greatest inertia?
a. Penny b. book c. bicycle d. car e. Supertanker

a 3. Which one of the following is also the unit joule, J?
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 4. A stack of books whose true weight is 165 N is placed on a scale in an elevator. The scale reads 175 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

5-6) Newton's Law of Gravitation is given below: $F = G\frac{M \times m}{r^2}; G = 6.67 \times 10^{-11}(SI).$

e 5. What are the SI units for G, gravitational constant?
a. $N.m^2/s^2$ b. $N.kg^2/m^2$ c. $kg.m^2/N^2$ d. $kg.m^2/s^2$ e. $N.m^2/kg^2$

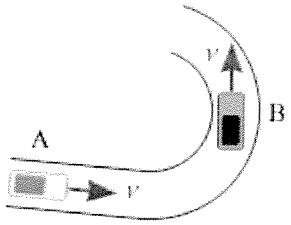
e 6. In another solar system a planet has twice the earth's mass and half the earth's radius. Your weight on this planet is ____ times your earth-weight. Assume that the masses of the earth and the other planet are uniformly distributed.
a. 1 b. 2 c. 3 d. 4 e. 8

$\frac{G(2M)\cdot m}{(r/2)^2}$

f 7. Which one of the following is a non-contact force?
a. Drag force b. static frictional force
c. kinetic frictional force d. normal force
e. tension f. gravitational force

c 8. A person is riding on a Ferris wheel. When the wheel makes one complete turn, the net work done on the person by the gravitational force is_____.
a. Positive b. Negative c. zero

C 9. Two cars are traveling at the same constant speed v. Car A is moving along a straight section of the road, while B is rounding a circular turn. Which statement is true about the acceleration of the cars?



a. The acceleration of both cars is zero, since they are traveling at a constant speed.

b. Car A is accelerating, but car B is not accelerating.

c. Car A is not accelerating, but car B is accelerating.

d. Both cars are accelerating.

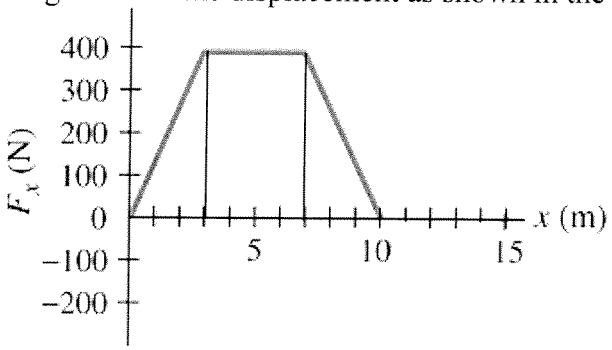
C 10. What is the centripetal force for a real plane when it turns in the air?

a. Tension b. Weight c. Component of the lift force
d. Frictional force e. Gravity

A 11. Which one of the following is a definition for conservative force?

a. A force is conservative when the work it does on a moving object is independent of the path between the object's initial and final positions.
b. A force is conservative when it does a net work on an object moving around a closed path, starting and finishing at the same point.
c. A force is conservative when the work it does on a moving object is dependent of the path between the object's initial and final positions.

12-14) A net external force is applied to a 55.0-kg object that is initially at rest by means of a motor. The net force component along the displacement of the object varies with the magnitude of the displacement as shown in the drawing.



E 12. What is the maximum net external force applied?

a. 0 N b. 10 N c. 200 N d. 300 N e. 400 N

E 13. How much work is done by the motor in moving the object from 0 to 10.0 m?

a. 4000 J b. 600 J c. 1200 J d. 1600 J e. 2800 J

D 14. What is the speed of the object after the above force is applied?

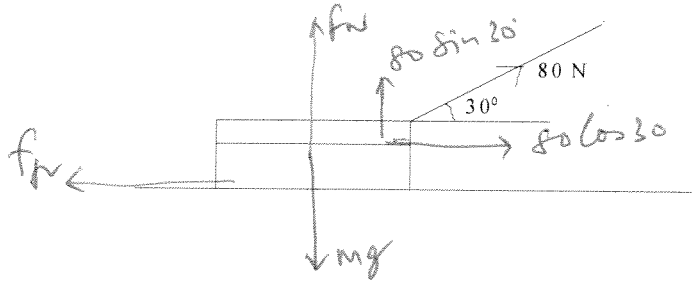
a. 102 m/s b. 58.2 m/s c. 12.1 m/s d. 10.1 m/s e. 7.63 m/s

(23)

B. A 35-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.

[6] 1. Show all the forces acting on the box.

[4] 2. Resolve the 80-N force into horizontal and vertical components, in the diagram.



[5] 3. What is the magnitude of the normal force acting on the box?

$\Sigma \vec{F} = m\vec{a}$ ↑

$f_N + 80 \sin 30^\circ = mg = 35 \times 9.8$

$F_N = 35 \times 9.8 - 80 \sin 30^\circ$

$f_N = 303\ N$

[5] 4. What is the frictional force acting on the box?

$\Sigma \vec{F} = m\vec{a}$ →

$80 \cos 30^\circ - f_N = 0$

$f_N = 80 \cos 30^\circ = 69.3\ N$

[3] 5. What is the coefficient of kinetic friction between the box and surface?

$\mu_R = \frac{f_r}{f_N} = \frac{69.3}{303} = 0.23$

(9)

C. A volleyball is spiked so that its incoming velocity of +4.0 m/s is changed to an outgoing velocity of -17 m/s. The mass of the volleyball is 0.35 kg. If the ball is in contact with the hand for 0.20~~m~~ seconds, what is the magnitude of the average force the player applied to the ball?

Method 2:

$V_0 = 4\ m/s$

$V = -17\ m/s$

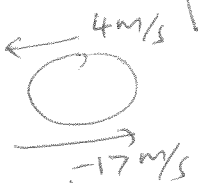
$t = 0.2\ s$

$a = \frac{V - V_0}{t} = \frac{-17 - 4}{0.2} = -105$

$F = ma = 0.35 \times (-105)$

$= -36.8\ N$

$|F| = 36.8 = 37\ N$



Method 1:

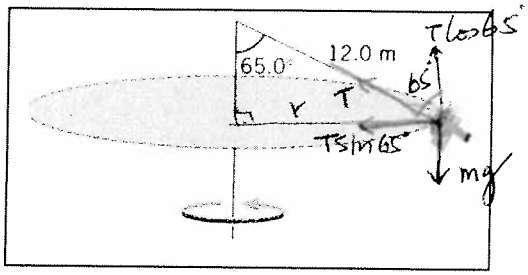
$F \times t = mV_f - mV_i$

$F \times 0.2 = 0.35(-17 - 4)$

$= 0.35(-21) = -7.35$

$|F| = 36.75\ N = 37\ N$

(13) D. A "swing" ride at a carnival consists of chairs that are swung in a circle by 12.0-m cables attached to a vertical rotating pole, as the drawing shows. Suppose the total mass of a chair and its occupant is m (= 65 kg) and the tension in the cable is T. Show the forces acting on the chair and its occupant.



1. Calculate the radius of the circle swung.
2. Determine the tension in the main cable.
3. Find the speed of the chair.

1. $r = 12 \sin 65^\circ = 10.9\ m$

2. $T \cos 65^\circ = mg = 65 \times 9.8$

$$T = \frac{65 \times 9.8}{\cos 65^\circ} = 1507\ N$$

3. $T \sin 65^\circ = \frac{mv^2}{r}$

$$v^2 = \frac{rT \sin 65^\circ}{m} = \frac{10.9 \times 1507 \times \sin 65^\circ}{65} = 229.07 \rightarrow v = 15.1\ m/s$$

(13) E. A car with a mass of 850-kg and a speed of 16 m/s approaches an intersection as shown. A 1200-kg minivan traveling at 21 m/s is heading for the same intersection. The car and minivan collide and stick together.

1. What type is this collision? Completely Inelastic
2. Using the conservation of momentum, find the speed (v_f) and direction (θ) of the wreckage just after the collision, assuming external forces can ignored.

Conservation of Momentum

$\rightarrow$ $850 \times 16 = (1200 + 850) v_f \cos\theta$ — (1)

$\uparrow$ $1200 \times 21 = (1200 + 850) v_f \sin\theta$ — (2)

(2)/(1) $\frac{1200 \times 21}{850 \times 16} = \tan\theta = 1.853$

$\theta = 61.6^\circ$

(2) $\rightarrow$ $v_f = \frac{1200 \times 21}{(1200 + 850) \sin 61.6}$

$v_f = 14\ m/s$