General Physics (PHYC 251) – Test #2

Multiple Choice (60 points). Circle the one best answer for each question.

1. Which is not a statement of one of Newton’s Three Laws of Mechanics?
   (a) If there is no net force acting on a body, then the body’s velocity cannot change.
   (b) The net force on a body is equal to the mass of the body times the acceleration.
   (c) The natural state of every body is to be at rest; if a body is disturbed from rest, it seeks to return to that state.
   (d) When two bodies interact, the forces on the bodies from each other are always in opposite directions and equal in magnitude

The following diagram applies to Questions 2 and 3. It shows four blocks, connected by three cords, being pulled to the right by a force $F$ along a frictionless horizontal surface.

2. Which set below lists the tension in the three cords from greatest to least?
   (a) C, B, A  (b) A, B, C  (c) A, C, B  (d) C, A, B  (e) all are equal

3. If the tension in C is 36 N, what is the acceleration of the 4.0-kg mass?
   (a) 18 m/s²  (b) 9.0 m/s²  (c) 6.0 m/s²  (d) 5.1 m/s²  (e) 3.5 m/s²

4. The diagram is an overhead view of two forces acting on block that lies on a frictionless surface. To be sure, we are looking straight down onto the surface; it is parallel to the plane of the paper. There are no other forces acting on the block except gravity and the normal force, but these are not factors in this question since they cancel each other, and we are not considering friction between the block and the surface on which it rests. If the magnitudes of force are appropriately chosen, is it possible that the block moves with constant velocity?

   (a) yes  (b) no

The following diagram applies to Questions 5 and 6. It shows a force $F$ applied to a block with mass $m$.

5. Given that the block remains stationary even with the applied force, what is the value of the opposing frictional force?
   (a) $mg$  (b) $N - mg$  (c) $\mu mg$
   (d) $F$  (e) $F_x$, i.e., the $x$-component of $F$
6. Suppose the magnitude $F$ does not change, but angle $\theta$ decreases a little. During this decrease in $\theta$, the block still does not move. Which among $F_x, f_s, N, f_{s,max}$ will increase when angle $\theta$ is decreased?
(a) $F_x$, $f_s$, $N$ only  
(b) $N, f_{s,max}$ only  
(c) $F_x$, $f_s$ only  
(d) $F_x$, $f_{s,max}$ only  
(e) $F_x$, $f_s$, $N$, $f_{s,max}$

7. In the figure below, a horizontal force $F$ of magnitude 80 N is applied to a 20-kg box on a floor. What is the magnitude of the frictional force opposing $F$? The coefficients of static and sliding friction, $\mu_s$ and $\mu_k$, respectively, are 0.30 and 0.10 for the surface between the box and floor.

(a) 20 N  
(b) 30 N  
(c) 59 N  
(d) 80 N  
(e) 98 N

8. A force $P$ is applied to a block that rests on an inclined surface. There is frictional force between the inclined surface and the block. The magnitude of $P$ is just less than what is needed to start the block moving up the incline. Then, force $P$ is removed, but the block still does not move. Which statement correctly describes the directions of the frictional force when $P$ is being applied and when it is removed?
(a) With $P$ applied, the friction force is up the incline; when $P$ is removed, friction is down the incline  
(b) With $P$ applied, the friction force is up the incline; when $P$ is removed, friction is up the incline  
(c) With $P$ applied, the friction force is down the incline; when $P$ is removed, friction is up the incline  
(d) With $P$ applied, the friction force is down the incline; when $P$ is removed, friction is down the incline

9. The roller coaster is going down the hill at the far left. At the position shown, it has a speed of 5.0 m/s. Will it make it to the other side of the 5.0-m hill?

(a) yes  
(b) no  
(c) depends on the mass
10. A group of park rangers are trying to return a reindeer stranded on a small cliff to a safe place on the ground below. They have three ramps that could be placed near the reindeer to allow it to slide down from the cliff. For which ramp would gravity do the most positive work on the descending reindeer?

(a) A  
(b) B  
(c) C
(d) all are the same  
(e) gravity does not do positive work

For Questions 11-14 consider the following force-distance graph of a 10.0 kg cart that is confined to move along the x axis. At x = 0 m, the speed is 0.0 m/s.

11. How much work is done between 0 and 10 m?
(a) 30 J  
(b) 60 J  
(c) 90 J
(d) 120 J  
(e) 150 J

12. What is the speed at 10 m?
(a) 3.5 m/s  
(b) 5.5 m/s  
(c) 12 m/s
(d) 21 m/s  
(e) 144 m/s

13. Where, other than 0 m, is the speed zero?
(a) 0-2 m only  
(b) 0-2 m and 4-6 m only  
(c) 0-2 m, 4-6 m, and 6-8 m
(d) at 9 m  
(e) no where

14. Where is the kinetic energy of the cart the greatest?
(a) from 8-10 m  
(b) at 10 m only  
(c) at both 4 m and 10 m
(d) from 0-2 m  
(e) from 2-4 m
For Question 15 - 16, consider a force $F = 10 - 4x$ acting on a 3.0-kg particle that moves along the $x$-axis, where SI units are implied. The particle has velocity of 2.0 m/s at $x = 0$.

15. The work done by this force from $x = 0$ to $x = 4.0$ m is:
   (a) 4.0 J  
   (b) 8.0 J  
   (c) 16.0 J  
   (d) 32.0 J  
   (e) -4.0 J

16. The velocity at $x = 2.0$ m is:
   (a) 3.5 m/s  
   (b) 6.0 m/s  
   (c) 8.0 m/s  
   (d) 12.0 m/s  
   (e) 16.5 m/s

For Question 17 - 20, consider the following situation that shows a block that will slide on a track starting at rest from A. The track is frictionless all along A to E, but has friction from E to F.

17. The mechanical energy of the sliding block will decrease from:
   (a) A-B only  
   (b) A-B and C-D  
   (c) E-F only  
   (d) B-C only  
   (e) B-C and D-E

18. The interval during which gravity does the most negative work is:
   (a) A-B only  
   (b) B-C  
   (c) C-D  
   (d) D-E  
   (e) E-F

19. Which statement is true regarding the speed half way between E and F compared to the speed at C?
   (a) The speed at C is greater than the speed halfway between E and F.  
   (b) The speed at C is less than the speed halfway between E and F.  
   (c) The speed at C equals the speed halfway between E and F.  
   (d) One cannot say for sure whether (a), (b), or (c) is correct.

20. Which statement is true regarding the speed halfway between E and F compared to the speed at D?
   (a) The speed at D is greater than the speed halfway between E and F.  
   (b) The speed at D is less than the speed halfway between E and F.  
   (c) The speed at D equals the speed halfway between E and F.  
   (d) One cannot say for sure whether (a), (b), or (c) is correct.

Extra Credit

21. A ball is thrown from the edge of a cliff. Below the cliff is a valley with a stream running through it. The ball is thrown with speed 10 m/s. Apply conservation of energy to determine which direction the ball should be thrown if it is to have the greatest speed when it reaches the stream. Assume air resistance is negligible.
   (a) straight downward  
   (b) horizontally outward  
   (c) 45° up from the horizontal  
   (d) straight upward  
   (e) any direction
Problem Solving (50 points). Solve each problem in the space provided.

1. Determine the acceleration of the masses and the tension in the string if \( m_1 = 40.0 \text{ kg} \), \( m_2 = 30.0 \text{ kg} \), and the incline is frictionless. Clearly state the direction that the masses accelerate.
2. Two blocks of mass 5.0 kg and 7.0 kg are attached to the 8.0 kg block as shown in the diagram. There is also a 4.0 kg block resting on top of the 8.0 kg block. The coefficients of static ($\mu_s$) and kinetic ($\mu_k$) friction between the 8.0 kg block and the table are 0.2 and 0.1, respectively. The pulley systems have negligible friction. A person is holding the system so that it cannot move.

(a) What is the acceleration (magnitude and direction) if the person quits holding the system so that it is free to move?

(b) What would be the acceleration of the system if the person lifted off the 4.0 kg block when she releases her hold on the system?
3. A skier, starting from rest, coasts down a slope that drops 3.5 m below his present position, and then rises 1.0 m from the bottom of the valley as shown in the diagram. There is essentially no friction from A to B because the snow conditions are extremely icy over that part. The snow surface changes at B so that the skier gradually coasts to a stop as he goes from B to C because of friction between the skies and the snow surface. What is the coefficient of kinetic friction between the skies and the snow from B to C?