SP211 Exam 4

Name:

1) Do not open this exam until instructed to do so.

2) This exam consists of 14 multiple choice questions. Clearly circle your answers.

3) You have 50 minutes to complete this exam.

4) Do not interact with anyone except Dr. Rittenhouse during the exam.

5) Do not discuss this exam with any other students who have not taken the exam.

6) When you have completed the entire exam, write your final answers on the answer sheet provided. Be sure to write your name at the top of the answer sheet and hand it in. These will be the answers you are graded on. Take the rest of the exam packet with you for use in exam corrections.
1. A particle’s velocity along \( x \) for \( t \geq 0 \) is described by the function
\[
v_x = 7.0 + 4.0e^{-t}
\]
where \( v_x \) is in meters and \( t \) is in seconds. What is the particle’s acceleration at time \( t = 1.0 \) s?

a) \( a_x = +5.1 \) m/s\(^2\)

b) \( a_x = +8.5 \) m/s\(^2\)

c) \( a_x = -2.5 \) m/s\(^2\)

d) \( a_x = -1.5 \) m/s\(^2\)

e) \( a_x = +1.5 \) m/s\(^2\)

2. An object takes a turn with initial and final velocities shown. Which of the following best represents the direction of the object’s average acceleration vector through the turn?

a) ▲

b) ▼

c) ◄

d) ►

e) None of these

3. A projectile is launched with velocity of 17 m/s directed 33° above the horizontal from the edge of a vertical cliff that is 21 m high.

How far from the base of the cliff does it land?

a) 37 m

b) 75 m

c) 58 m

d) 63 m

e) 46 m

4. A 58 kg person stands in an elevator that is rising upward at 4.0 m/s. The elevator then steadily comes to rest over 1.6 s. As the elevator slows, the magnitude of the normal force exerted by the floor on the person is

a) 680 N

b) 360 N

c) 710 N

d) 420 N

e) 570 N
5. An 8.0 kg block is lowered down a frictionless 70° incline by a rope. The block speeds up as it descends. The tension in the rope is 54 N. The magnitude of the block’s acceleration is

a) 6.8 m/s²
b) 2.5 m/s²
c) 1.7 m/s²
d) 9.2 m/s²
e) 9.8 m/s²

6. A horizontal force is applied to the bottom block. The stacked blocks accelerate as one due to static friction $f_s$ between the blocks where $\mu_s = 0.32$. The maximum possible acceleration allowed for these blocks to slide as one is,

a) 9.8 m/s²
b) 6.7 m/s²
c) 1.8 m/s²
d) 4.3 m/s²
e) 3.1 m/s²

7. Beginning at $x = 0$ with $v_x = 1.2$ m/s, a 7.0 kg block experiences a net force $F_{\text{net,}x} = 8.0 - x^3$ for positions $x \geq 0$ where $F_{\text{net,}x}$ is in Newtons and $x$ is in meters. What is the largest positive velocity reached by the block?

a) 2.5 m/s
b) 1.9 m/s
c) 2.2 m/s
d) 2.8 m/s
e) 1.6 m/s
8. A 3.0 kg block starting from rest slides down a frictionless ramp that is 2.5 m high and then along a horizontal floor where the block-floor coefficient of kinetic friction is $\mu_k = 0.43$. The distance the block slides along the floor before coming to rest is

a) 2.5 m
b) 5.8 m
c) 7.3 m
d) 8.2 m
e) 4.3 m

9. On a flat frictionless plane of ice, a heavy puck and a light puck collide. Which of the following best describes the center-of-mass (COM) trajectory of this 2-puck system?

a) How the COM trajectory changes due to the collision depends on the relative masses of the pucks and the initial speed of the heavy puck.
b) How the COM trajectory changes depends on the extent to which the collision is inelastic (meaning the extent to which kinetic energy is not conserved).
c) The COM moves with a constant velocity showing no evidence of the collision.
d) How the COM trajectory changes depends on the degree to which the collision is more glancing or more head on.
e) At least two of the above are true.

10. These pieces of clay collide forming a single clay blob. The final speed of this blob is

a) 13 m/s
b) 6.7 m/s
c) 11 m/s
d) 9.1 m/s
e) 10 m/s

11. The pulley has rotational inertia $I = 0.0035 \text{ kg m}^2$ and radius $r = 0.060 \text{ m}$. The 0.50 kg block is released and it descends as the cord unwinds without slipping. The speed of the block after descending 0.80 m is

a) 3.4 m/s
b) 3.2 m/s
c) 4.0 m/s
d) 2.8 m/s
e) 2.3 m/s
12. A ramp 1.7 m long is inclined at 25° above the horizontal. A solid cylinder \((I = \frac{1}{2}MR^2)\) is released from the top. It rolls without slipping. What is the speed of its center of mass when it reaches the bottom?

   a) 4.5 m/s
   b) 4.7 m/s
   c) 3.5 m/s
   d) 3.1 m/s
   e) 4.0 m/s

13. A spinning star collapses due to a change in the internal dynamics of the star and in the process its rotational inertia shrinks to \(1/9\) of its initial value. How does the angular frequency after collapse compare to before collapse?

   a) It is 3 times greater.
   b) It is 9 times greater.
   c) The answer depends on unspecified details.
   d) It is the same.
   e) It is 81 times greater.

14. Comparing masses and radii: \(M_{\text{Mars}} = 0.107\ M_{\text{Earth}}\) and \(R_{\text{Mars}} = 0.533\ R_{\text{Earth}}\). The magnitude of the acceleration of an object in free fall near the surface of Mars is

   a) 2.0 m/s\(^2\)
   b) 3.7 m/s\(^2\)
   c) 4.2 m/s\(^2\)
   d) 6.0 m/s\(^2\)
   e) 9.3 m/s\(^2\)
Name:

Write your answers on this sheet and hand it in when you have completed the exam.

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