Practice Test 2

1. A highway curve has a radius of 0.14 km and is unbanked. A car weighing 12 kN goes around the curve at a speed of 24 m/s without slipping. What is the magnitude of the horizontal force of the road on the car?
   a. 12 kN
   b. 17 kN
   c. 13 kN
   d. 5.0 kN
   e. 49 kN

2. A stunt pilot weighing 0.70 kN performs a vertical circular dive of radius 0.80 km. At the bottom of the dive, the pilot has a speed of 0.20 km/s which at that instant is not changing. What force does the plane exert on the pilot?
   a. 3.6 kN up
   b. 4.3 kN up
   c. 2.9 kN down
   d. 2.9 kN up
   e. 5.8 kN down

3. A 0.50-kg mass attached to the end of a string swings in a vertical circle (radius = 2.0 m). When the mass is at the lowest point on the circle, the speed of the mass is 12 m/s. What is the magnitude of the force of the string on the mass at this position?
   a. 31 N
   b. 36 N
   c. 41 N
   d. 46 N
   e. 23 N

4. A 0.20-kg object attached to the end of a string swings in a vertical circle (radius = 80 cm). At the top of the circle the speed of the object is 4.5 m/s. What is the magnitude of the tension in the string at this position?
   a. 7.0 N
   b. 2.0 N
   c. 3.1 N
   d. 5.1 N
   e. 6.6 N
5. A 0.30-kg mass attached to the end of a string swings in a vertical circle \((R = 1.6 \text{ m})\), as shown. At an instant when \(\theta = 50^\circ\), the tension in the string is 8.0 N. What is the magnitude of the resultant force on the mass at this instant?

\[ mg \cos \theta + T \sin \theta = \frac{mv^2}{R} \]

\[ 5.6 \text{ N} \]

\[ 6.0 \text{ N} \]

\[ 6.5 \text{ N} \]

\[ 5.1 \text{ N} \]

\[ 2.2 \text{ N} \]

6. A 0.40-kg mass attached to the end of a string swings in a vertical circle having a radius of 1.8 m. At an instant when the string makes an angle of 40 degrees below the horizontal, the speed of the mass is 5.0 m/s. What is the magnitude of the tension in the string at this instant?

\[ mg \cos \theta + T \sin \theta = \frac{mv^2}{R} \]

\[ 9.5 \text{ N} \]

\[ 3.0 \text{ N} \]

\[ 8.1 \text{ N} \]

\[ 5.6 \text{ N} \]

\[ 4.7 \text{ N} \]

7. A race car traveling at 100 m/s enters an unbanked turn of 400 m radius. The coefficient of (static) friction between the tires and the track is 1.1. The track has both an inner and an outer wall. Which statement is correct?

\[ \mu = \frac{mg}{N} \]

\[ \mu = \frac{mv^2}{R} \]

\[ a. \text{ The race car will crash into the outer wall.} \]

\[ b. \text{ The race car will crash into the inner wall.} \]

\[ c. \text{ The car will stay in the center of the track.} \]

\[ d. \text{ The car will stay in the center of the track if the driver speeds up.} \]

\[ e. \text{ The car would stay in the center of the track if the radius were reduced to 200 m.} \]

\[ a \]
8. For a plane to be able to fly clockwise in a horizontal circle as seen from above, in addition to exerting a force downwards on the air
   a. it must be increasing its speed.
   b. it must exert a force on the air that is directed to the plane’s left side.
   c. it must exert a force on the air that is directed to the plane’s right side.
   d. it does not need to exert a force: it must only move the wing flaps out.
   e. it only needs to deflect the air without exerting any additional force on the air.

9. An iceboat is traveling in a circle on the ice. Halfway around the circle the sail and the steering mechanism fall off the boat. Which statement is correct?
   a. The boat will continue traveling in the circle because there is no friction.
   b. The boat will continue to travel in the circle because its velocity exerts a force on it.
   c. The boat will move off on a line tangent to the circle because there is no force on it.
   d. The boat will move off tangent to the circle because there is a force on it perpendicular to the boat directed to the outside of the circle.
   e. The boat will move off to the outside perpendicular to the tangent line since a force directed to the outside of the circle always acts on the boat.

10. A rock attached to a string swings in a vertical circle. Which free body diagram could correctly describe the force(s) on the rock when the string is in one possible horizontal position?

   ![Diagram]

   (a) (b) (c) (d) (e)
11. The equation below is the solution to a problem.
\[
\frac{(2.00 \text{ kg})(8.00 \text{ m})^2}{5.00 \text{ m}} = 6.00 \text{ N} - (2.00 \text{ kg})(9.80 \text{ m/s}^2)(\cos180^\circ).
\]
The best physical representation of this equation is
a. a sphere of 2.00 kg mass under a 6.00 N tension when at the bottom of a vertical circle.
b. a sphere of 2.00 kg mass under a 6.00 N tension when at the side of a vertical circle.
c. a sphere of 2.00 kg mass under a 6.00 N tension when at the top of a vertical circle.
d. a sphere of 2.00 kg mass at any point on a horizontal circle.
e. a 2.00 kg gecko running on the ceiling with a speed of 8.00 m/s.

c
12. The coefficient of static friction for the tires of a race car is 0.950 and the coefficient of kinetic friction is 0.800. The car is on a level circular track of 50.0 m radius on a planet where \(g = 2.45 \text{ m/s}^2\) compared to Earth’s \(g = 9.80 \text{ m/s}^2\). If the car is to be able to travel at the same speed on the planet as on Earth, the radius of the track on the planet must be ____ times as large as the radius of the track on Earth.

a. 0.25
b. 0.50
c. 1.00
d. 2.00
e. 4.00
e
13. An airplane flies in a horizontal circle of radius 500 m at a speed of 150 m/s. If the plane were to fly in the same 1000 m circle at a speed of 300 m/s, by what factor would its centripetal acceleration change?

a. 0.25
b. 0.50
c. 1.00
d. 2.00
e. 4.00
d
14. A single conservative force \( F_x = (6.0x - 12) \) N (\( x \) is in m) acts on a particle moving along the \( x \) axis. The potential energy associated with this force is assigned a value of +20 J at \( x = 0 \). What is the potential energy at \( x = 3.0 \) m?
   a. +11 J  
   b. +29 J  
   c. +9.0 J  
   d. −9.0 J  
   e. +20 J  

15. A 0.40-kg particle moves under the influence of a single conservative force. At point A where the particle has a speed of 10 m/s, the potential energy associated with the conservative force is +40 J. As the particle moves from A to B, the force does +25 J of work on the particle. What is the value of the potential energy at point B?
   a. +65 J  
   b. +15 J  
   c. +35 J  
   d. +45 J  
   e. −40 J  

16. A 12-kg block on a horizontal frictionless surface is attached to a light spring (force constant = 0.80 kN/m). The block is initially at rest at its equilibrium position when a force (magnitude \( P = 80 \) N) acting parallel to the surface is applied to the block, as shown. What is the speed of the block when it is 13 cm from its equilibrium position?
   a. 0.78 m/s  
   b. 0.81 m/s  
   c. 0.71 m/s  
   d. 0.58 m/s  
   e. 0.64 m/s
16. A 0.60-kg object is suspended from the ceiling at the end of a 2.0-m string. When pulled to the side and released, it has a speed of 4.0 m/s at the lowest point of its path. What maximum angle does the string make with the vertical as the object swings up?
   a. 61°
   b. 54°
   c. 69°
   d. 77°
   e. 47°

17. A 2.0-kg mass swings at the end of a light string (length = 3.0 m). Its speed at the lowest point on its circular path is 6.0 m/s. What is its kinetic energy at an instant when the string makes an angle of 50° with the vertical?
   a. 21 J
   b. 15 J
   c. 28 J
   d. 36 J
   e. 23 J

19. A certain pendulum consists of a 1.5-kg mass swinging at the end of a string (length = 2.0 m). At the lowest point in the swing the tension in the string is equal to 20 N. To what maximum height above this lowest point will the mass rise during its oscillation?
   a. 77 cm
   b. 50 cm
   c. 63 cm
   d. 36 cm
   e. 95 cm
20. A 0.04-kg ball is thrown from the top of a 30-m tall building (point A) at an unknown angle above the horizontal. As shown in the figure, the ball attains a maximum height of 10 m above the top of the building before striking the ground at point B. If air resistance is negligible, what is the value of the kinetic energy of the ball at B minus the kinetic energy of the ball at A ($K_B - K_A$)?

![](image)

a. 12 J  
b. -12 J  
c. 20 J  
d. -20 J  
e. 32 J

21. A 2.0-kg mass is projected from the edge of the top of a 20-m tall building with a velocity of 24 m/s at some unknown angle above the horizontal. Disregard air resistance and assume the ground is level. What is the kinetic energy of the mass just before it strikes the ground?

a. 0.18 kJ  
b. 0.97 kJ  
c. 0.89 kJ  
d. 0.26 kJ  
e. 0.40 kJ
22. A skier weighing 0.80 kN comes down a frictionless ski run that is circular \((R = 30 \text{ m})\) at the bottom, as shown. If her speed is 12 m/s at point A, what is her speed at the bottom of the hill (point B)?

- a. 17 m/s
- b. 19 m/s
- c. 18 m/s
- d. 20 m/s
- e. 12 m/s

23. A spring \((k = 200 \text{ N/m})\) is suspended with its upper end supported from a ceiling. With the spring hanging in its equilibrium configuration, an object \((\text{mass} = 2.0 \text{ kg})\) is attached to the lower end and released from rest. What is the speed of the object after it has fallen 4.0 cm?

- a. 90 cm/s
- b. 79 cm/s
- c. 96 cm/s
- d. 83 cm/s
- e. 57 cm/s

24. A block \((\text{mass} = 4.0 \text{ kg})\) sliding on a horizontal frictionless surface is attached to one end of a horizontal spring \((k = 100 \text{ N/m})\) which has its other end fixed. If the maximum distance the block slides from the equilibrium position is equal to 20 cm, what is the speed of the block at an instant when it is a distance of 16 cm from the equilibrium position?

- a. 71 cm/s
- b. 60 cm/s
- c. 80 cm/s
- d. 87 cm/s
- e. 57 cm/s
25. A 20-kg mass is fastened to a light spring \((k = 380 \text{ N/m})\) that passes over a pulley as shown. The pulley is frictionless, and the mass is released from rest when the spring is unstretched. After the mass has dropped 0.40 m, what is its speed?


\[\text{a. 2.2 m/s} \]
\[\text{b. 2.5 m/s} \]
\[\text{c. 1.9 m/s} \]
\[\text{d. 1.5 m/s} \]
\[\text{e. 3.6 m/s} \]

a

26. A spring \((k = 600 \text{ N/m})\) is placed in a vertical position with its lower end supported by a horizontal surface. A 2.0-kg block that is initially 0.40 m above the upper end of the spring is dropped from rest onto the spring. What is the kinetic energy of the block at the instant it has fallen 0.50 m (compressing the spring 0.10 m)?

\[\text{a. 5.3 J} \]
\[\text{b. 6.8 J} \]
\[\text{c. 6.3 J} \]
\[\text{d. 5.8 J} \]
\[\text{e. 6.5 J} \]

b
27. A 1.5-kg block sliding on a rough horizontal surface is attached to one end of a horizontal spring \((k = 200 \text{ N/m})\) which has its other end fixed. If this system is displaced 20 cm horizontally from the equilibrium position and released from rest, the block first reaches the equilibrium position with a speed of 2.0 m/s. What is the coefficient of kinetic friction between the block and the horizontal surface on which it slides?

a. 0.34  
b. 0.24  
c. 0.13  
d. 0.44  
e. 0.17

28. A 12-kg projectile is launched with an initial vertical speed of 20 m/s. It rises to a maximum height of 18 m above the launch point. How much work is done by the dissipative (air) resistive force on the projectile during this ascent?

a. −0.64 kJ  
b. −0.40 kJ  
c. −0.52 kJ  
d. −0.28 kJ  
e. −0.76 kJ

29. The block shown is released from rest when the spring is stretched a distance \(d\). If \(k = 50 \text{ N/m}, m = 0.50 \text{ kg}, d = 10 \text{ cm}\), and the coefficient of kinetic friction between the block and the horizontal surface is equal to 0.25, determine the speed of the block when it first passes through the position for which the spring is unstretched.

a. 92 cm/s  
b. 61 cm/s  
c. 71 cm/s  
d. 82 cm/s  
e. 53 cm/s
In a given displacement of a particle, its kinetic energy increases by 25 J while its potential energy decreases by 10 J. Determine the work of the nonconservative forces acting on the particle during this displacement.

a.  -15 J
b.  +35 J
c.  +15 J
d.  -35 J
e.  +55 J

c