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1st Semester Practice Multiple Choice (Topics 1-6)

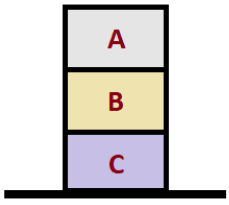
**For this exam, use Earth's gravitational field strength g = 9.8 N/kg.*

1. A car drives a certain length to the East. The car then turns around and drives half of that length back to the West. Let D represent the distance traveled by the car, and let X represent the displacement of the car. How do the values D and X compare?
   a. D = X b. D = 2X c. 2D = X d. D = 3X e. 3D = X

2. A car of mass 2,000 kg accelerates forward from rest as it pulls a trailer of mass 500 kg along a horizontal stretch of road. The car pulls the trailer with force F_1. And the trailer pulls back on the car with force F_2. How do the magnitudes of F_1 and F_2 compare?
   a. $F_1 > F_2$
   b. $F_1 < F_2$
   c. $F_1 = F_2$
   d. Cannot answer without knowing the acceleration value

3. A car of mass M wishes to complete a turn without slipping on a flat road. The road has a turning radius of 50 m and a known coefficient of static friction equal to 0.20. What is the maximum velocity the car can have without slipping around the curve?
   a) 10 m/s
   b) 25 m/s
   c) 100 m/s
   d) 250 m/s
   e) Impossible to answer without knowing mass M

4. Three boxes are stacked vertically and remain at rest, as shown to the right. Which of the following statements is true?
   a. The force box A exerts on B is greater than the force B exerts on C
   b. The force box A exerts on B is less than the force B exerts on C
   c. The force box A exerts on B is equal to the force B exerts on C
   d. This cannot be answered without knowing the masses of each box



5. Two objects are released from the same height and at the same time. Object A has twice the mass of Object B. Assume air resistance to be negligible. Which object will reach the ground first?
   a) Object A
   b) Object B
   c) Both will reach at the same time
   d) Impossible to answer without exact masses
   e) Impossible to answer without exact height

6. A box of mass 2 kg is released from rest at the top of a frictionless, curved track, as shown below. Height H is known to be 0.5 m. At the bottom of the curved track, the box travels onto a horizontal surface with a known coefficient of kinetic friction equal to 0.10. What is the distance D that the box will slide along the horizontal surface before coming to rest?
    a. 1.0 m
    b. 2.5 m
    c. 5.0 m
    d. 7.5 m
    e. 10.0 m

7. A sphere of mass 1 kg is tied to the end of a string of length 0.5 m and spun in a vertical circle with uniform circular motion. The sphere's speed is 4 m/s at all points throughout its motion. What is the ratio of the tension in the rope at the top of the sphere's path to the tension at the bottom of its path (T_T / T_B)?
    a. 0.13 b. 0.53 c. 1.0 d. 1.91 e. 4.32

Use the following scenario for questions 8 and 9.

Three objects are launched from ground-level with the same initial velocity and from the same position. Assume no effects of air resistance. Object A is launched at a 60° angle. Object B is launched at a 45° angle. Object C is launched at a 30° angle. All objects return to ground level at the end of their flight.

8. How would the time t in the air compare for each object?
    a. $t_a = t_b = t_c$ b. $t_a > t_b > t_c$ c. $t_c > t_b = t_a$ d. $t_b > t_a = t_c$ e. $t_a = t_c > t_b$

9. How would the horizontal distance d compare for each object?
    a. $d_a = d_b = d_c$ b. $d_a > d_b > d_c$ c. $d_c > d_b = d_a$ d. $d_b > d_a = d_c$ e. $d_a = d_c > d_b$

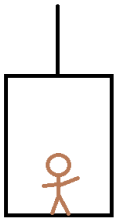
10. A car drives 180 m North in a time of 20 seconds. The car then stops at a red light for 30 seconds. When the light turns green, the car turns left, and drives 300 m West in a time of 25 seconds. Which choice below is closest to the magnitude of average velocity for the car over its entire trip?
    a. 1.6 m/s b. 4.7 m/s c. 6.4 m/s d. 7.8 m/s e. 8.4 m/s

11. A ball is launched upward from ground-level with velocity V. The ball reaches a maximum height H above the ground before falling back downward. If the same ball were launched upward instead with velocity 2V from ground-level, what new height would be reached (in terms of H)?

    a. 16H b. 4H c. 2H d. $\sqrt{2}$ H e. Still H

12. A person of mass 80 kg stands in an elevator that is initially at rest. After the person selects a destination floor the elevator begins to accelerate upwards, reaching a speed of 3 m/s when 8 meters above its resting location. Which answer choice most nearly represents the magnitude of the normal force acting on the person by the elevator floor while the elevator is accelerating?

    a. 739 N
    b. 772 N
    c. 784 N
    d. 796 N
    e. 829 N



13. A car turns while driving on a frictionless, banked road that is inclined 30 degrees above horizontal. If the car can drive with a maximum speed of 20 m/s before slipping along the road, which answer choice is closest to the car's turning radius?

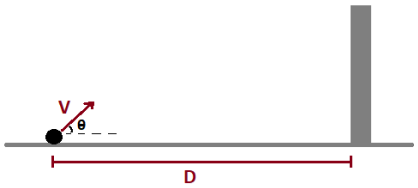
    a. 41 m b. 47 m c. 71 md. 82 m e. 1600 m

14. Object A moves East with constant velocity V. Object B starts a distance D behind object A, but moves in the same direction with constant velocity 3V. In terms of the given variables, how long will it take Object B to catch up to Object A?

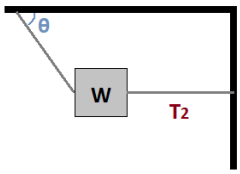
    a. V / 4D b. D / 4V c. 4V / D d. 2V / D e. D / 2V

15. A projectile is fired from ground level with velocity V = 30 m/s, as shown below. The projectile is aimed $\Theta = 40^{o}$ above horizontal. A distance D away from the launch point exists a vertical wall. Which height below best represents where the projectile will strike the wall?

    a. 0 m (will hit at ground level)
    b. 6 m
    c. 19 m
    d. 36 m
    e. The projectile will land short of the wall

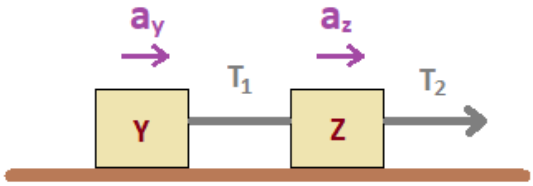


16. An object of weight W is suspended by two ropes, as shown in the image below. The slanted rope makes an angle of Θ = 45° with the ceiling. The second rope is horizontally aligned and the tension in the rope is described as T_2. How does weight W compare to tension T_2?
    a. $W > T_2$
    b. $W < T_2$
    c. $W = T_2$
    d. Cannot answer without knowing mass of object
    e. Cannot answer without knowing length of ropes



**Use the following scenario for questions 17-19.*

Blocks Y and Z are tied together and initially rest on a horizontal, frictionless surface. Block Y is twice as massive as Block Z. When Tension T_2 is applied to the right side of Block Y, the entire system accelerates. Let a_y represent the acceleration of Block Y, a_z represent the acceleration of Block Z, and T_1 represent the tension in the connecting string.



17. How does acceleration a_y compare to acceleration a_z?
    a. $a_y > a_z$
    b. $a_y < a_z$
    c. $a_y = a_z$
    d. Cannot conclude with information provided

18. How does Tension T_1 compare to Tension T_2?
    a. $T_1 > T_2$
    b. $T_1 < T_2$
    c. $T_1 = T_2$
    d. Cannot conclude with information provided

19. How does the net force acting on each block compare?
    a. Net Force on Y > Net Force on Z
    b. Net Force on Y > Net Force on Z
    c. Net Force on Y > Net Force on Z
    d. Cannot conclude with information provided

20. An object of mass M moves with velocity V and its kinetic energy is recorded as K. If a new object of mass 2M moves with velocity V/2, what would be the new object's kinetic energy (in terms of K)?

    a. 4K b. 2K c. Still K d. ½ K e. ¼ K

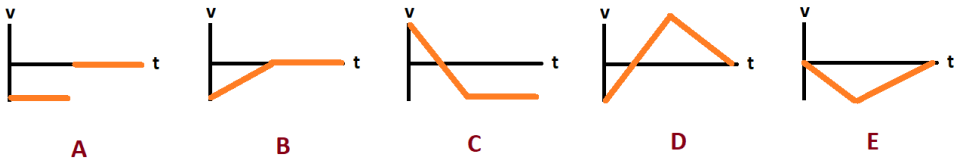
21. An object is thrown vertically upward from ground-level with speed V. When the object returns to ground-level on its way back down, how will its speed compare to initial speed V? Ignore any effects from air resistance.

    a. Downward speed > V
    b. Downward speed < V
    c. Downward speed = V
    d. Cannot answer with information provided.

22. An object is placed at the bottom of an inclined ramp. It is then pushed up the ramp with initial speed V before sliding along the ramp's plane. When the object returns to the bottom of the ramp, how will its speed compare to initial speed V?

    a. Speed at bottom > V
    b. Speed at bottom < V
    c. Speed at bottom = V
    d. Cannot answer with information provided.

23. Which of the following velocity vs. time graphs below depict the same motion as what appears in the acceleration vs. time graph shown to the right?



24. A horizontally-aligned spring of constant k = 80 N/m is initially compressed 0.10 m from its equilibrium length. A person takes 2.0 seconds to compress the spring an additional 0.10 m - a total of 0.20 m from equilibrium. How much power was provided by the person to the spring?

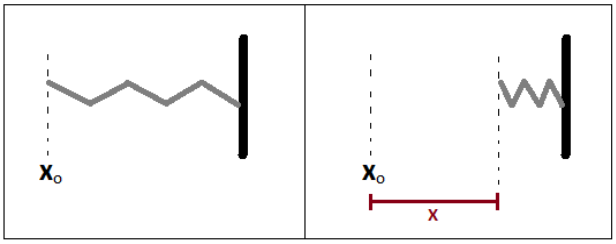
    a. 0.6 W b. 1.0 W c. 1.2 W d. 2.0 W e. 4.0 W

25. A skateboarder glides across a parking lot with a constant velocity of 2 m/s. After gliding like this for 3 seconds, the skateboarder pushes off the ground with her foot, and increases her speed to 3 m/s. If pushing off took 0.5 seconds to complete, what is the total displacement of the skateboarder during the entire 3.5 second time frame?

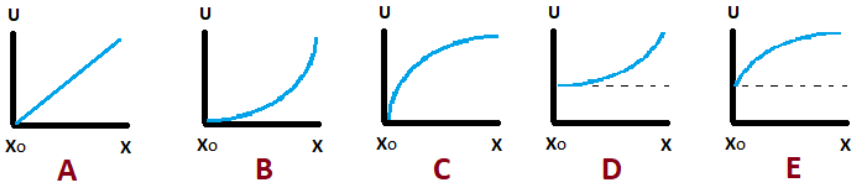
a. 1.25 m b. 6.00 m c. 6.25 m d. 7.25 m e. 19.25 m

26. A ball is tied to a string and revolved in a horizontal, circular path with uniform circular motion with period T. The ball's acceleration is recorded as A. If the ball is instead spun in the same circle with period 2T, what would be the new acceleration of the ball (in terms of T)?

a. 4T b. 2T c. Still T d. ½ T e. ¼ T



27. A horizontal spring is initially unstretched with its right edge connected to a vertical post, and its left edge resting at position Xo, as shown in the image above left. A moment later, the spring is compressed, and its left edge is now located a distance X measured to the right of Xo, as shown in the image above right. Which graph below correctly analyzes the potential energy stored in the spring U as a function of the position of the springs left edge?



28. A person standing on a bridge throws a rock straight downward towards a river below. If the rock is released 15 m above the water, and the rock was thrown with a speed of 6 m/s, which answer is closest to the time it takes the rock to reach the water? Assume no effects from air resistance.

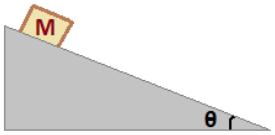
a. 1.24 s b. 1.53 s c. 1.75 s d. 1.85 s e. 2.46 s

29. An object slides with velocity V off a horizontal, frictionless table of height H. The object flies through the air and lands distance D from the edge of the table. If the same object were to slide with the same velocity across a new horizontal, frictionless table, now of height 2H, what would change about the landing distance? Ignore effects of air resistance in this problem.
    a. The landing distance would remain the same
    b. The landing distance would increase, but would be less than 2D
    c. The landing distance would increase to 2D
    d. The landing distance would increase and be between 2D and 4D
    e. The landing distance would increase to 4D

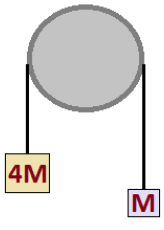
30. An object is moving with a constant speed. Which of the following statements must be true about the object?
    a. The object is accelerating
    b. The object is not accelerating
    c. The object has a constant velocity
    d. The object does not have a constant velocity
    e. None of these statements are true

31. A ball rests on a compressed, vertically-aligned spring. After the spring is released, the ball is shot upward, and is observed to have velocity V when reaching a height H above the spring's release point. Which of the following systems would see an *increase* of mechanical energy?
    a. Spring, Ball, Earth
    b. Spring, Ball
    c. Spring, Earth
    d. Ball, Earth
    e. Spring only

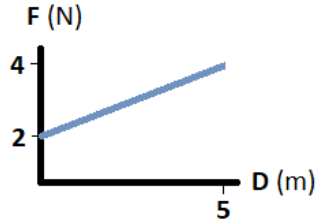
32. A box of mass M rests on rough, inclined ramp that is elevated Θ degrees above horizontal, as shown below. In terms of the given variables and fundamental constants, which expression below best represents the coefficient of static friction between box and incline?
    a. sinΘ b. cosΘ c. tanΘ
    d. MgsinΘ e. MgcosΘ



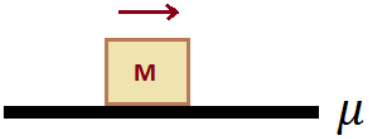
33. An object of mass 4M is connected to an object of mass M via light string, which is then draped over a frictionless pulley, as shown below. The system is then released from rest. Find the acceleration of the system in terms of earth's gravitational field strength g.
    a. 1/3 g b. 1/4 g c. 3/5 g
    d. 5/3 g e. 4g



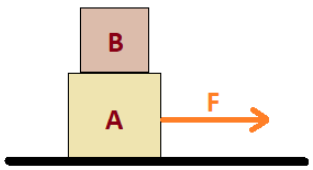
34. An object of mass 10 kg is acted on by a force that changes uniformly from 2 N to 4 N. The force is applied over a displacement D = 5 m, as shown in the Force vs Displacement graph below. Assume the force and displacement to be in the same direction. Find the work done by this force.
    a. 0.4 J
    b. 1.5 J
    c. 4.0 J
    d. 15 J
    e. 150 J



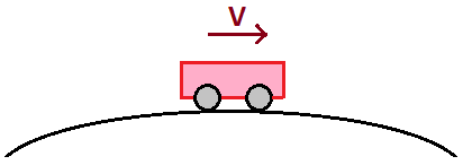
35. A box of mass M slides along a rough, horizontal surface with coefficient of kinetic friction μ, as shown in the image below. After a time T, the box comes to rest. In terms of the given variables and fundamental constants, find the magnitude of the initial velocity of the box.
    a. μMgT
    b. μgT
    c. μMg / T
    d. g / μT
    e. Mg / μT



36. Box B rests on top of Box A. Box A is then pulled to the right with force F, as shown below. The system begins to accelerate to the right, and the boxes do not slip relative to each other. What force is responsible for accelerating Box B to the right?
    a. Force F
    b. Gravitational Force
    c. Normal Force
    d. Kinetic Friction
    e. Static Friction

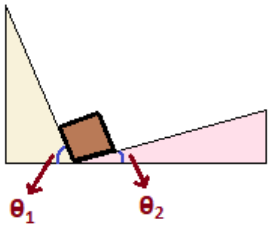


37. A car drives to the right over a curved section of roadway, as shown in the image below. When the car is at the position shown, how does the magnitude of the normal force acting on the car F_N compare to the gravitational force acting on the car Fg?
    a. $F_N > Fg$
    b. $F_N < Fg$
    c. $F_N = Fg$
    d. Cannot answer without knowing radius of curve
    e. Cannot answer without knowing velocity of car



38. If there is no net force acting on an object, then the object can be:
    a. Speeding Up
    b. Slowing Down
    c. Sitting Still
    d. Moving with Constant Velocity
    e. There is more than one correct answer.

39. A box rests motionless while wedged between two angled ramps, as shown in the image below. Angles Θ_1 and Θ_2 are both measured from horizontal, with Θ_1 being larger than Θ_2. Let F_1 represent the normal force provided on the box by the left ramp (Θ_1), and left F_2 represent the normal force provided on the box by the right ramp (Θ_2). How do the magnitudes of F_1 and F_2 compare?
    a. $F_1 > F_2$
    b. $F_1 < F_2$
    c. $F_1 = F_2$
    d. Cannot answer without knowing exact angles
    e. Cannot answer without knowing mass of box



40. An object slides with velocity V off a horizontal, frictionless table of height H. The object flies through the air and lands distance D from the edge of the table. If the same object were to slide with the same velocity across a new horizontal, frictionless table, now of height 2H, what would change about the landing distance? Ignore effects of air resistance in this problem.
    a. The landing distance would remain the same
    b. The landing distance would increase, but would be less than 2D
    c. The landing distance would increase to 2D
    d. The landing distance would increase and be between 2D and 4D
    e. The landing distance would increase to 4D