MC.i) The box shown to the right is placed against the two supports as shown. If the supports can only exert a normal force but not a friction force, could the box remain stationary? (Where are you using as your pivot point?)
   a) yes
   b) no, but it could if the supports could have friction
   c) no, even if the supports could have friction

MC.ii) A box of weight 10 N sits on a frictionless surface. It is attached by a massless frictionless rope to a box of weight 20 N. What will the tension in the rope be as they accelerate?
   a) zero
   b) 10 N
   c) less than 20 N, but not necessarily 10 N
   d) 20 N
   e) more than 20 N

MC.iii) A refrigerator with a weight of 500 N sits on a floor. The coefficient of kinetic friction is 0.30 and the coefficient of static friction is 0.40. A force of 250 N is applied horizontally to the refrigerator. What is the magnitude of the friction force on the refrigerator? (Does the refrigerator move?)
   a) 0 N
   b) 150 N
   c) 200 N
   d) 250 N
   e) 500 N

MC.iv) The object shown to the right consists of three point masses (enlarged for clarity). What is the moment of inertia of the object if it rotates around the middle mass?
   a) 3 kg m²
   b) 4 kg m²
   c) 6 kg m²
   d) 8 kg m²
   e) 10 kg m²

MC.v) A car is towing a trailer, but not necessarily at constant velocity. The magnitude of the force that the car exerts on the trailer is equal to the magnitude of the force that …
   a) the road exerts on the trailer
   b) the trailer exerts on the road
   c) the road exerts on the car
   d) the trailer exerts on the car
   e) the earth exerts on the trailer
MC.vi) Which curve could represent the acceleration of an object thrown vertically upward (up is the positive direction).

- a)  
- b)  
- c)  
- d)  
- e)  

MC.vii) A 15 N box sits on top of a 25 N box. What is the weight of the 25 N box?
- a) 0 N  
- b) 5 N  
- c) 15 N  
- d) 25 N  
- e) 40 N  

MC.viii) A car makes a trip at 100 m/s and returns at 150 m/s. What is the average speed for the trip? (Do you really need to calculate this?)
- a) 0 m/s  
- b) 100 m/s  
- c) 120 m/s  
- d) 125 m/s  
- e) 134 m/s  

MC.ix) A boy pushes a sled with a force that is 32° below horizontal. The magnitude of the normal force of the ground on the sled is …
- a) zero  
- b) equal to the weight  
- c) less than the weight  
- d) greater than the weight  

MC.x) A baseball player stands at the base of the Washington Monument, which is 169 m high. He throws a baseball straight up with a speed of 50 m/s. What is the speed of the baseball when it reaches the top of the monument?
- a) 0 m/s  
- b) 30 m/s  
- c) 50 m/s  
- d) 76 m/s  
- e) the baseball won’t reach the top of the monument
MC.xi) A child of mass 40 kg stands on the end of a massless diving board. What is the force that the left hand support exerts on the diving board?

a) 392 N down  
   b) 784 N down  
   c) 784 N up  
   d) 1176 N down  
   e) 1176 N up

MC.xii) A 0.2 kg ball moving at 3 m/s bounces back from a wall at 2 m/s. What is the magnitude of the impulse that the wall puts on the ball?

a) 0  
   b) 0.2 N s  
   c) 0.4 N s  
   d) 0.6 N s  
   e) 1.0 N s

MC.xiii) A 1500 kg car moving at 14 m/s runs into a stationary 5000 kg truck. After the collision the two vehicles stick together. What is the work that the car does on the truck?

a) positive work  
   b) negative work  
   c) zero work

MC.xiv) Two spheres, one solid and one hollow, are allowed to roll down a ramp. Which one is moving faster at the end of the ramp? \( I_{\text{solid}} = \frac{2}{5} M R^2, I_{\text{hollow}} = \frac{2}{3} M R^2 \)

a) the solid sphere  
   b) the hollow sphere  
   c) they will have the same speed  
   d) the one with the greater radius, regardless of whether it is solid or hollow

MC.xv) A 0.2 kg object attached to a 80 cm long string swings in a vertical circle. At the top of the circle the speed of the object is 4.5 m/s. What is the tension in the string when the object is at the top of the circle?

a) 2.0 N  
   b) 3.1 N  
   c) 5.1 N  
   d) 6.6 N  
   e) 7.0 N

MC.xvi) A 0.2 kg object attached to a 80 cm long string swings in a vertical circle. At the top of the circle the speed of the object is 4.5 m/s. What is the speed of the object at the bottom of the circle?

a) 4.5 m/s  
   b) 6.0 m/s  
   c) 7.2 m/s  
   d) 8.5 m/s  
   e) it never gets there
MC.xvii) A ball of mass m is swinging in a vertical circle. At the position shown, which is the correct free body diagram?

\[ \begin{array}{cccc}
\text{T} & \text{Fc} \\
\downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
\text{mg} & \text{mg} & \text{mg} & \text{mg} & \text{Fc} & \text{Fc} \\
a) & b) & c) & d) & e) \\
\end{array} \]

MC.xviii) A car at rest accelerates to the right. What is the type and direction of friction force that the road exerts on the car? Assume that the car does not “smoke” the tires.

- a) kinetic friction to the left
- b) kinetic friction to the right
- c) static friction to the left
- d) static friction to the right

MC.xix) What is the direction of the vector $\mathbf{A-B}$?

- a) left
- b) right
- c) up
- d) down
- e) zero

MC.xx) A baseball is thrown up and to the right. At the highest point in its flight, the direction of the velocity is...

- a) left
- b) right
- c) up
- d) down
- e) zero

MC.xxx) A baseball is thrown up and to the right. At the highest point in its flight, the direction of the acceleration is...

- a) left
- b) right
- c) up
- d) down
- e) zero
MC.xxii) A wheel of diameter 0.80 m accelerates from rest at a rate of 8.0 rad/s^2. After 5.0 s the speed of a point on the rim of the wheel is…
   a) 16 m/s
   b) 32 m/s
   c) 40 m/s
   d) 64 m/s
   e) not enough information provided to determine the speed

MC.xxiii) A wheel of diameter 0.80 m accelerates from rest at a rate of 8.0 rad/s^2. After 5.0 s the tangential acceleration of a point on the rim of the wheel is…
   a) 0
   b) 3.2 m/s^2
   c) 32 m/s^2
   d) 40 m/s^2
   e) 640 m/s^2

MC.xxiv) Two blocks rest on a frictionless surface. A force of 100 N pushes the leftmost, smaller block to the right. What is the force that the left block exerts on the right block?
   a) 0
   b) less than 50 N
   c) 50 N
   d) more than 50 N
   e) 100N

   ![Diagram of two blocks with a force of 100 N pushing the left block to the right]

MC.xxv) King Kong jumps from the top of Lincoln Tower (79 m high). What is his approximate speed as he hits the ground?
   a) 0
   b) 10 m/s
   c) 20 m/s
   d) 40 m/s
   e) not enough information provided to determine the speed

MC.xxvi) What is the minimum speed that a looping roller coaster must have at the top of the 12 m diameter loop so that it completes the loop without falling?
   a) 7.7 m/s
   b) 10.8 m/s
   c) 15.3 m/s
   d) 21.7 m/s
   e) need to know the mass of the roller coaster