UP1 Exam 1 Review Questions

Multiple Choice

1. A ball is tossed at a 30° angle from the ground. At the instant when the ball is at its maximum height, select the true statement:

   A. The acceleration of the ball is zero

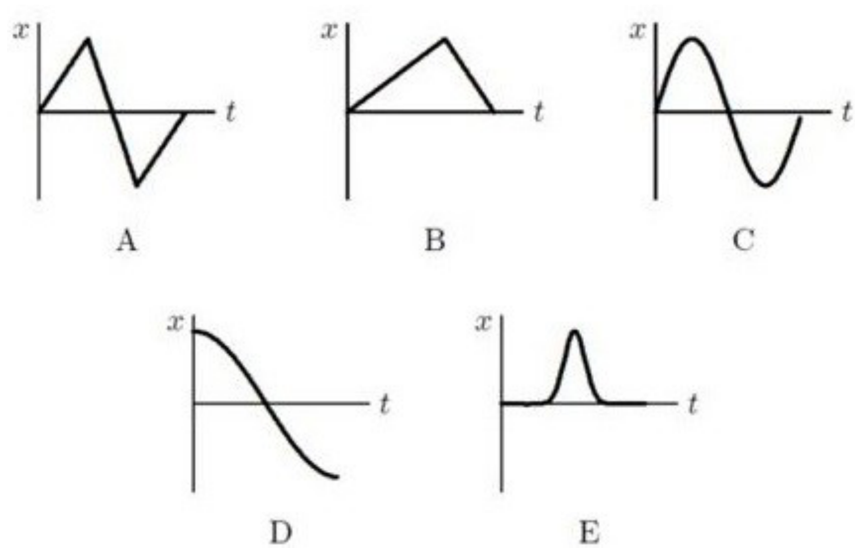
   B. The velocity of the ball is zero

   C. The acceleration of the ball is downwards

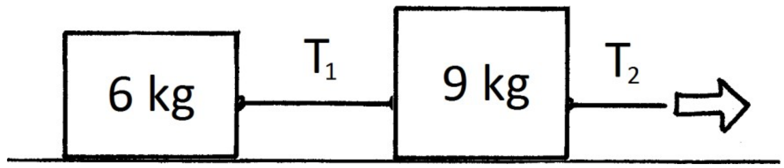
   D. The velocity of the ball is downwards

   E. The velocity of the ball is parallel to the acceleration of the ball

2. A car accelerates from rest on a straight road. A short time later, the car decelerates to a stop and then returns to its original position in a similar manner, by speeding up and then slowing to a stop. Which of the following coordinate versus time graphs best describes the motion?



3. Consider two blocks attached by a rope as shown. Ignore friction. The 9 kg is being pulled to the right by a rope, causing both blocks to accelerate to the right. The tension in the right rope is T_2. The tension in the joining rope between the blocks is T_1. How does T_1 compare to T_2?



   A. $T_1 < T_2$
   B. $T_1 = T_2$
   C. $T_1 > T_2$
   D. Require the magnitude of the pulling force to answer this
   E. None of the above

4. A student of mass m is standing on a scale in an elevator that is near the surface of the Earth. The elevator is moving downward and slowing down with an acceleration of magnitude g/4. What weight does the scale read?
   A. $\frac{3}{4}$ mg
   B. $\frac{1}{4}$ mg
   C. $\frac{5}{4}$ mg
   D. 4 mg
   E. mg
   F. 3 mg

5. In the same situation as the previous problem, where a student is standing on a scale in an elevator that is moving downward and slowing down, which of the following statements is true

   A. The force of the scale on the student is greater in magnitude than the force of the student on the scale.

   B. The force of the scale on the student is equal in magnitude to the force of the student on the scale.

   C. The force of the scale on the student is lesser in magnitude than the force of the student on the scale.

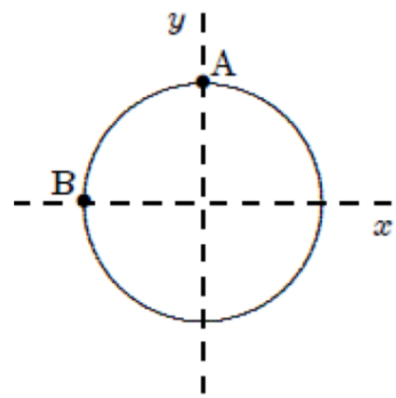
   D. There is not enough information to determine whether any of the above answers is correct.

6. The position of an object on a 2 dimensional plane is given by: $\vec{r}(t) = 18t\hat{\imath} - 2t^3\hat{\jmath}$, where the position is measured in meters. What is the speed of the object at t=2 seconds?

   A. 20 m/s
   B. 6 m/s
   C. 30 m/s
   D. 39 m/s
   E. 72 m/s

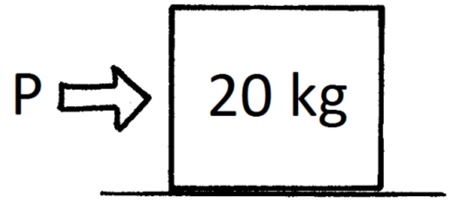
7. A toy racing car moves with constant speed around the circle shown below. When it is at the point A its coordinates are $x = 0, y = 3\ m$ and its velocity is $\left(6\frac{m}{s}\right)\hat{\imath}$. When it is at the point B its velocity and acceleration are:

   A. $\left(6\frac{m}{s}\right)\hat{\jmath}$ and $\left(12\ \frac{m}{s^2}\right)\hat{\imath}$ respectively
   B. $\left(6\frac{m}{s}\right)\hat{\imath}$ and $\left(-12\ \frac{m}{s^2}\right)\hat{\imath}$ respectively
   C. $\left(-6\frac{m}{s}\right)\hat{\jmath}$ and $\left(12\ \frac{m}{s^2}\right)\hat{\imath}$ respectively
   D. $\left(6\frac{m}{s}\right)\hat{\imath}$ and $\left(12\ \frac{m}{s^2}\right)\hat{\jmath}$ respectively
   E. $\left(6\frac{m}{s}\right)\hat{\jmath}$ and $\vec{0}\ \frac{m}{s^2}$ respectively



8. A block of mass 20.0 kg is initially sitting at rest on level ground. A person then pushes on the block with a horizontal force P. The coefficient of kinetic friction between the block and the ground is 0.200 and the coefficient of static friction is 0.300. What is the minimum force P that the person must push with in order to start the box moving?

   A. 4.00 N
   B. 196 N
   C. 39.2 N
   D. 58.9 N
   E. 19.6 N
   F. 98.1 N



9. A stone is thrown directly upward from the surface of the Earth with an initial speed $\boldsymbol{v_0}$. Ignore air resistance. The total time of flight, from when it's initially thrown straight up until it hits the ground, is?

A. $v_0/4g$

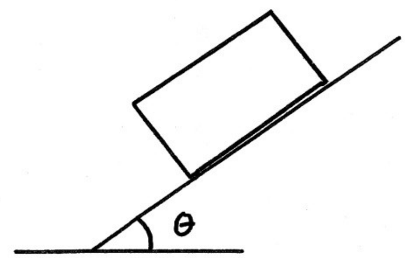
B. $v_0/2g$

C. v_0/g

D. $2v_0/g$

E. $4v_0/g$

10. A crate first slides <u>up</u> an inclined ramp (0˚< θ < 90˚), momentarily comes to rest, and then slides back down the ramp. <u>There is friction</u> between the crate and the ramp. Which of the following statements is true?



A. The magnitude of the block's acceleration is greatest as it travels up the ramp.

B. The magnitude of the block's acceleration is the same going up or down the ramp.

C. The magnitude of the block's acceleration is greatest as it travels down the ramp.

D. The static coefficient of friction is greater than tan θ.

E. There is not enough information given to determine any of these options

11. Vectors $\vec{A}$ and $\vec{B}$ are shown in the figure, where $\vec{A}$ is 42.0º from the y-axis and $\vec{B}$ is 31.0º below the negative x-axis. The magnitude of the vector $\vec{A}$ is 16.00 m and the magnitude of vector $\vec{B}$ is 7.00 m. Vector $\vec{C}$ is given by $\vec{C} = \vec{A} + \vec{B}$. What is the component of the vector $\vec{C}$ along the $\hat{\imath}$ direction?

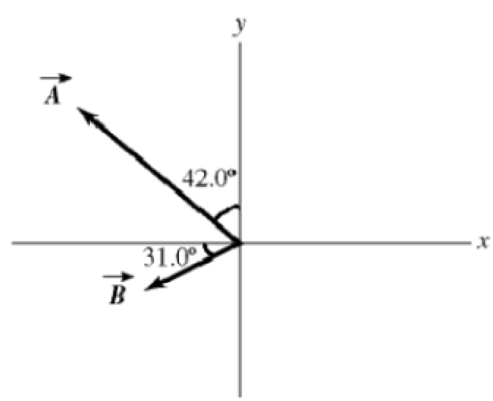
A. -16.7 m $\hat{\imath}$

B. -17.9 m $\hat{\imath}$

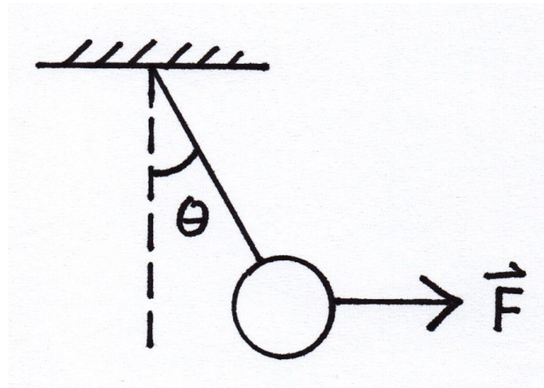
C. -15.5 m $\hat{\imath}$

D. -14.3 m $\hat{\imath}$

E. -19.7 m $\hat{\imath}$



12. A pendulum bob with a weight of 1 N is held at an angle θ from the vertical by a 2 N horizontal force F as shown. What is the tension in the string supporting the pendulum bob?



A. $1\ N$

B. $\sqrt{3}\ N$

C. $3\ N$

D. $\sqrt{5}\ N$

E. $4\ N$

13. A UFO moves in one dimension according to the equation $v(t) = 4.00 - 9.00t^2$ for $t \geq 0$. What are the units of 9.00 in this equation?

A. m/s

B. m

C. m/s^2

D. m/s^3

E. m/s^4

14. A UFO starting with an initial velocity $\vec{v_o} = -18.0\frac{m}{s}\ \hat{\imath}$ moves in one dimension according to the equation $a(t) = 18.00t^2$ for $t \geq 0$. At what time is the UFO momentarily at rest?

A. 0.00 s

B. 1.44 s

C. 0.50 s

D. 1.00 s

E. 2.00 s

15. A particle is displaced by $\Delta\vec{r} = (30.0\ m)\hat{\imath} - (10.0\ m)\hat{\jmath}$ while being acted upon by a constant force $\vec{F} = (1.00\ N)\hat{\imath} - (2.00\ N)\hat{\jmath} - (3.00\ N)\hat{k}$. The work done on the particle by this force is?

A. 10.0 J

B. $(30.0\ J)\hat{\imath} + (20.0\ J)\hat{\jmath}$

C. 50.0 J

D. -60.0 J

E. 0.00 J

F. Impossible to calculate without knowing what other forces might be involved

16. A force acting upon a particle is called conservative if

A. it obeys Newton's Second Law

B. it obeys Newton's Third Law

C. its work equals the change in the kinetic energy of the particle

D. its work is independent of the path between any two points

E. it is not a frictional force

17. An object moves in a circular path at constant speed. The work done by the centripetal (radial) force is zero because?

A. the magnitude of the acceleration is zero

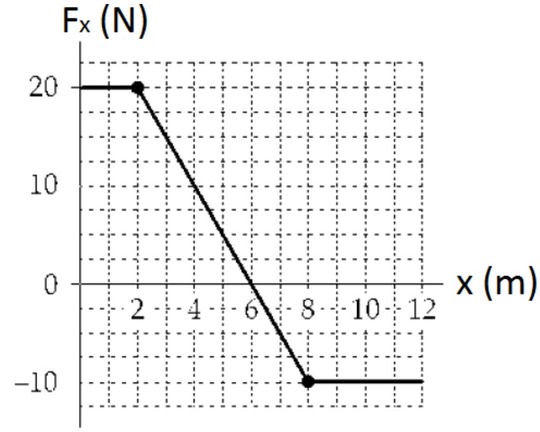
B. the average force for each revolution is zero

C. there is no friction

D. the displacement for each revolution is zero

E. the centripetal (radial) force is perpendicular to the velocity

18. An object moving along the x-axis is acted on by a force Fx that varies with position as shown. How much work is done by this force on the object as it moves from x = 2.00 m to x = 8.00 m?



A. 30.0 J

B. -10.0 J

C. 10.0 J

D. -30.0 J

E. 60.0 J

19. The potential energy of a body of mass m is given by $U = \frac{1}{2}kx^2 + mgx + 5$. The corresponding force on the mass is?

A. $(\frac{kx^3}{6} - \frac{mgx^2}{2} + 5x)\hat{\imath}$

B. $(-\frac{kx^3}{6} - \frac{mgx^2}{2} + 5)\hat{\imath}$

C. $(\frac{kx}{2} + mg)\hat{\imath}$

D. $(kx + mg)\hat{\imath}$

E. $(-kx - mg)\hat{\imath}$

20. A 5.00 kg object is acted on by a net force in the x-direction that does 600 J of work as it moves a distance of 2.00 m in 6.00 s. The average power being applied to the object is?

A. 100 W

B. 200 W

C. 900 W

D. 2400 W

E. 3600 W

21. A block is given an initial speed v and then moves across a level surface with coefficient of kinetic friction μk. How far does it travel across the rough surface before stopping?

A. $\sqrt{\frac{2\mu_k g}{m}}$

B. $\sqrt{2\mu_k mg}$

C. $\frac{mv^2}{2\mu_k g}$

D. $\frac{v^2}{2\mu_k g}$

E. $\frac{mv^2}{\mu_k}$

22. A ball of unknown mass is thrown off of a building of height h at some unknown angle. Its speed just before striking the level ground below is v_f. What is the initial speed of the ball, ignoring air resistance?

A. $\sqrt{v_f^2 + 2hg}$

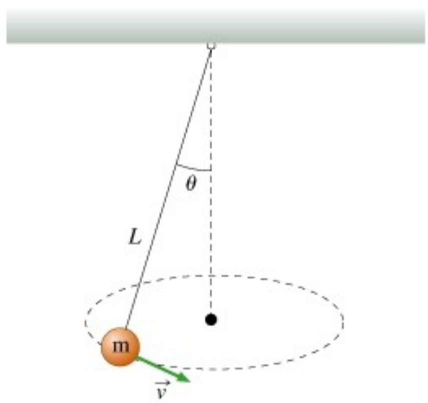
B. $\sqrt{v_f^2 - 2hg}$

C. $\sqrt{-v_f^2 + 2hg}$

D. One need to also know the launch angle and the mass to answer this.

E. One needs to also know the launch angle, but not the mass, in order to answer this.

23. A ball of mass m is attached to a string of length L. It is made to rotate as a conical pendulum, making an angle of θ with the vertical, as shown. What is the speed of the ball?



A. $\sqrt{g\ tan\theta}$

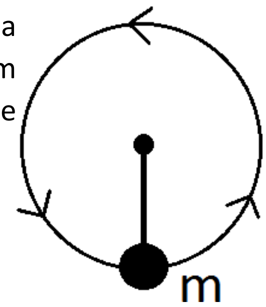
B. $\sqrt{Lg\ tan\theta}$

C. $\sqrt{Lg\ sin\theta\ tan\theta}$

D. $\sqrt{Lg\ sin\theta}$

E. $\sqrt{gL}$

24. A ball of mass m, at one end of a string of length L, rotates in a vertical circle just barely fast enough to prevent the string from going slack at the top of the circle. The speed of the ball at the bottom of the circle is?



A. $\sqrt{2gL}$

B. $\sqrt{3gL}$

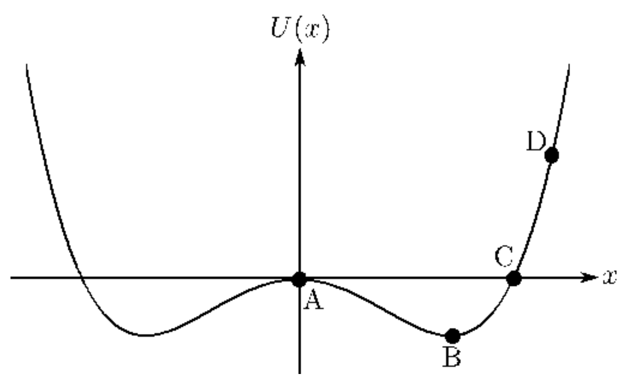
C. $\sqrt{4gL}$

D. $\sqrt{5gL}$

E. $\sqrt{7gL}$

25. Consider the potential energy diagram shown. Which of the points has a force that is directed towards the left (along the negative x axis)?

A. Point A only
B. Point B only
C. Point C only
D. Point D only
E. Both points C and D



26. A crate of mass 15 kg is on a level floor that has a coefficient of kinetic friction of 0.230. A person is pushing the crate across the floor by applying a force parallel to the ground. They are getting tired as they push so the force they exert is given by F(x) = (80 N) – (10 N/m)x , where x = 0 is the starting position. They push the crate from rest a total of 5.0 m. What is the speed of the block at 5.0 m?

A. 3.76 m/s

B. 5.12 m/s

C. 6.00 m/s

D. 4.64 m/s

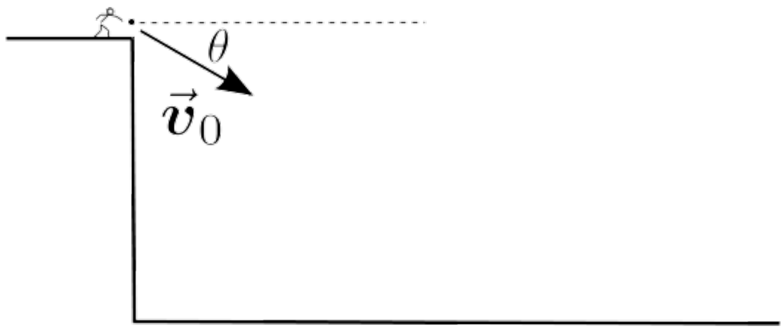
E. 12.6 m/s

F. 14.1 m/s

Long Problems

Example 1:

Chuck throws a stone from the edge of the roof of a building with an initial speed of 25.0 m/s at an angle 35.0˚ below the horizontal, as shown in the figure. Chuck releases the stone 90.0 m above the ground. Assume that the ground is perfectly horizontal and air resistance is negligible.



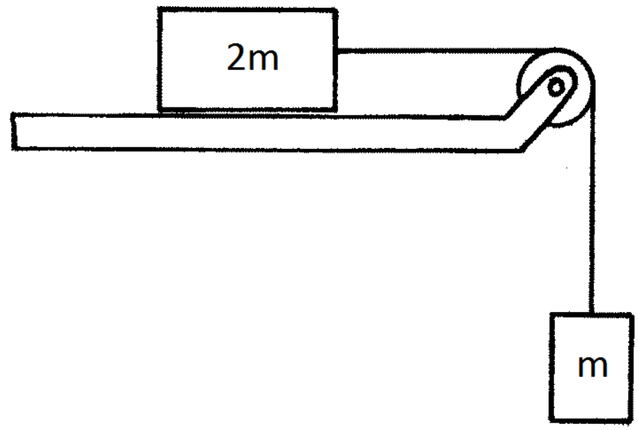
a) Sketch the stone's trajectory in the figure above.

b) Calculate the horizontal distance from the base of the building to where the stone strikes the ground.

c) Calculate the speed of the stone the instant before it strikes the ground **and** the impact angle. Indicate the angle you have calculated clearly on the diagram.

Example 2:

A modified Atwood's machine has a mass 2m **<u>initially</u> <u>sliding to the left</u>** on a horizontal table as shown, attached to a dangling mass m. The coefficient of kinetic friction between sliding mass and the table is μ_k.



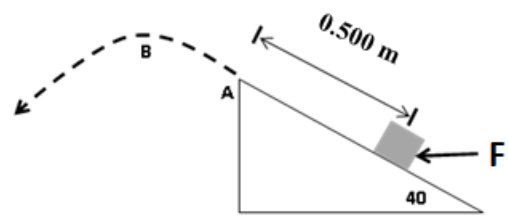
(a) Write an expression for the <u>magnitude</u> of the initial acceleration of the system <u>and</u> the tension in the cable in terms of the given parameters {m, μ_k, g}. Make sure to draw a Free-Body Diagram, either on the drawing or in the space below (it counts for points).

(b) Say the initial speed of the 2m block was v_o. How far does the 2m block travel before coming momentarily to rest?

Example 3:

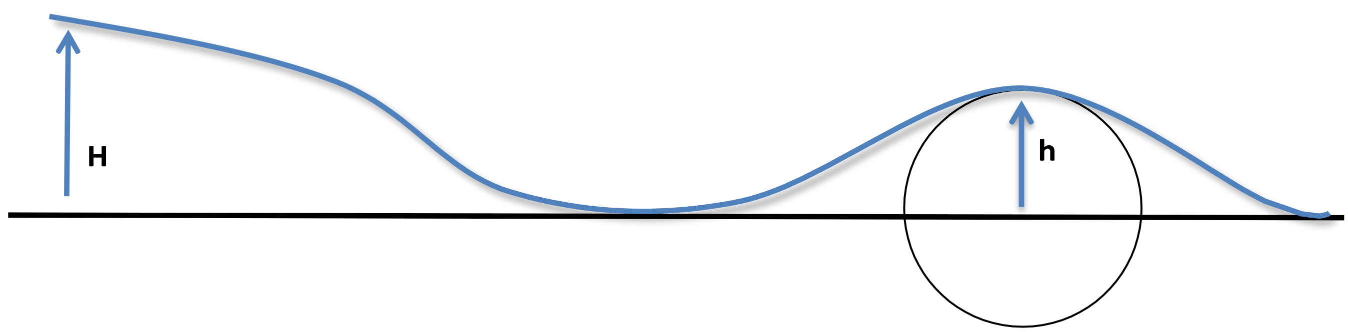
A block of mass 2.00 kg starts from rest a distance 0.500 m from the top edge of a ramp as shown. It is pushed up the ramp by a 30.0 N force, F, acting parallel to the ground as shown. The ramp makes an angle of 40.0^{o} with the horizontal, and the coefficient of kinetic friction between the block and ramp is 0.250. When the block reaches the top of the ramp, the force F stops acting so that the block is only under the influence of gravity. The block is therefore launched from the top of the ramp at the same angle of the ramp, and it follows a parabolic trajectory in the air. Take the acceleration due to Earth's gravity to be 9.80 m/s^2.

How long does it take for the block to travel from the edge of the ramp (point A) to the top of its trajectory (point B)? Clearly show all work and steps to receive any credit.



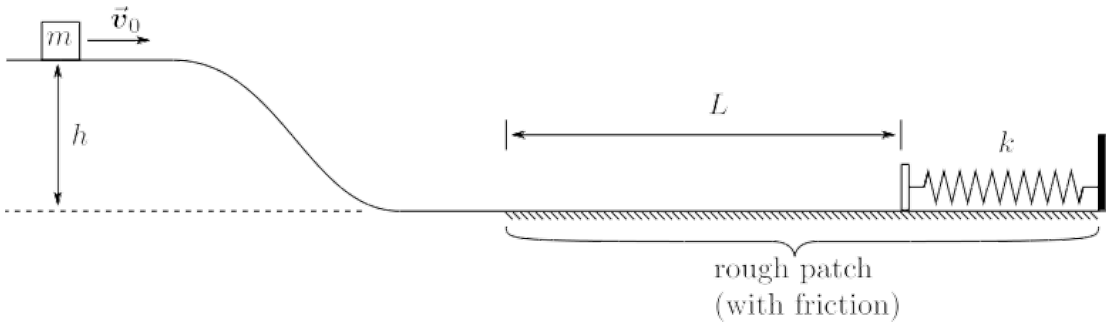
Example 4:

A block of mass m starts from rest at the top of a frictionless hill of height H. It slides down the hill and then over another hill of height h as shown. The top of the second smaller hill can be modeled as part of a circle with radius h. If $H = 5h/4$, what is the normal force that the track exerts on the block when it is at the top of the second hill? Express your answer in terms of m and g. If any part of your solution involves a free-body diagram, it must be clearly shown.



Example 5:

A block of mass m = 8.00 kg moves with initial speed v_0 = 6.00 m/s along a track, as shown. The upper part of the track is a height h = 10.0 m above the lower part of the track. There is no friction between the block and the track until the block reaches the rough patch on the lower part of the track, at which point the coefficients of kinetic and static friction are μk =0.250 and μs = 0.350 respectively. After traveling a distance L = 16.0 m over the rough patch, the block collides with a very long, ideal spring with spring constant k. The block compresses the spring by a maximum distance d = 4.00 m, with friction still acting upon the block.



a) Calculate the numerical value of the spring constant, with appropriate units.

b) After the mass stops at the maximum spring compression, will it move again?