Big Test - Energy, Work, Power Springs

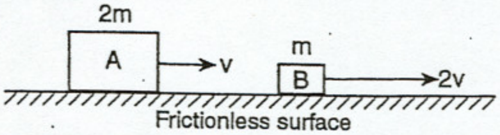
Sample Test

Name

Part I - Multiple Choice

PART I - 50 Points

(1) The diagram below shows block *A*, having mass 2*m* and speed *v*, and block *B* having mass *m* and speed 2*v*.

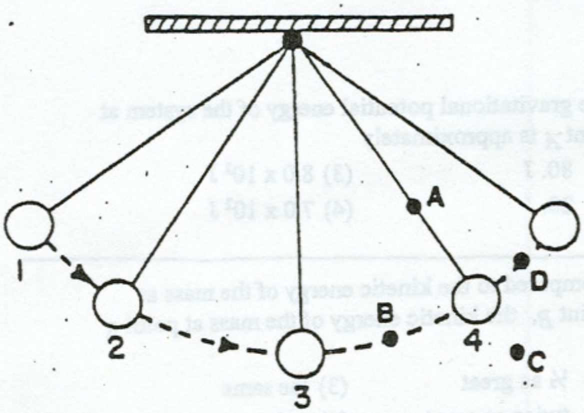


Compared to the kinetic energy of block *A*, the kinetic energy of block *B* is

(1) the same
(2) twice as great
(3) one-half as great
(4) four times as great

The diagram below which represents a simple pendulum with a 2.0-kilogram bob and a length of 10. meters. The pendulum is released from rest at position 1 and swings without friction through position 4. At position 3, its lowest point, the speed of the bob is 6.0 meters per second.

2 & 3



(2) 61 At which position does the bob have its maximum kinetic energy?

(1) 1
(2) 2
(3) 3
(4) 4

(3) 62 What is the potential energy of the bob at position 1 in relation to position 3?

(1) 18 joules
(2) 36 joules
(3) 72 joules
(4) 180 joules

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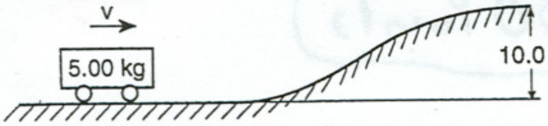
(4) One joule is equivalent to one

(1) $\frac{\text{newton}}{\text{meter}^3}$
(2) kilogram-meter^3
(3) watt^2-newton
(4) $\frac{\text{kilogram-meter}^2}{\text{second}^2}$

5) The diagram below shows a moving, 5.00-kilogram cart at the foot of a hill 10.0 meters high. For the cart to reach the top of the hill, what is the minimum kinetic energy of the cart in the position shown? [Neglect energy loss due to friction.]



(1) 4.91 J
(2) 50.0 J
(3) 250. J
(4) 491 J

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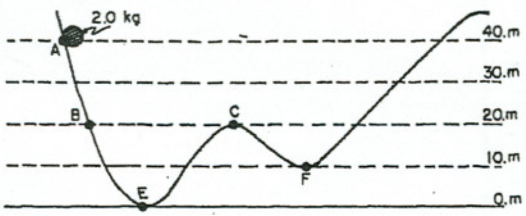
6 to 10

Base your answers to questions through on the diagram below. Which represents a 2.0-kilogram mass placed on a frictionless track at point A and released from rest. Assume the gravitational potential energy of the system to be zero at point E.



6) The gravitational potential energy of the system at point A is approximately

(1) 80. J
(2) 20. J
(3) 8.0×10^2 J
(4) 7.0×10^2 J

7) Compared to the kinetic energy of the mass at point B, the kinetic energy of the mass at point E is

(1) ½ as great
(2) twice as great
(3) the same
(4) 4 times greater

8) As the mass travels along the track, the maximum height it will reach above point E will be closest to

(1) 10. m
(2) 20. m
(3) 30. m
(4) 40. m

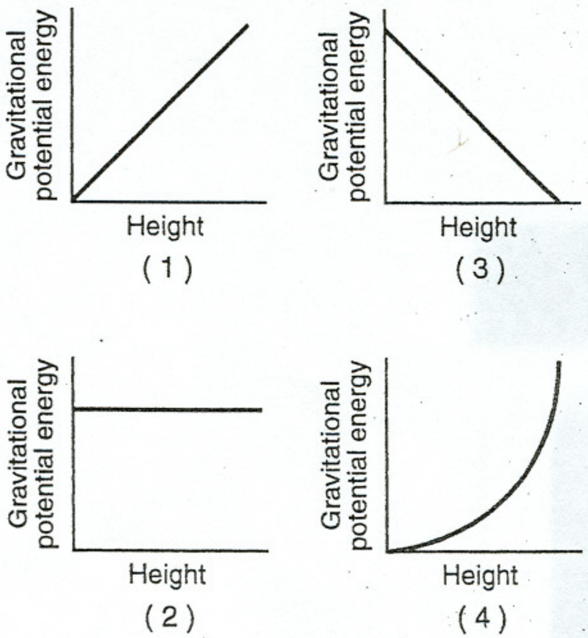
9) If the mass were released from rest at point B, its speed at point C would be

(1) 0. m/s
(2) 0.50 m/s
(3) 10. m/s
(4) 14 m/s

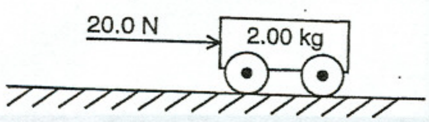
10) Compared to the total mechanical energy of the system at point A, the total mechanical energy of the system at point F is

(1) less
(2) more
(3) the same

11 Which graph best represents the relationsh between the gravitational potential energy of freely falling object and the object's height abo the ground near the surface of Earth?



12 In the diagram below, a 20.0-newton force is used to push a 2.00-kilogram cart a distance of 5.00 meters.



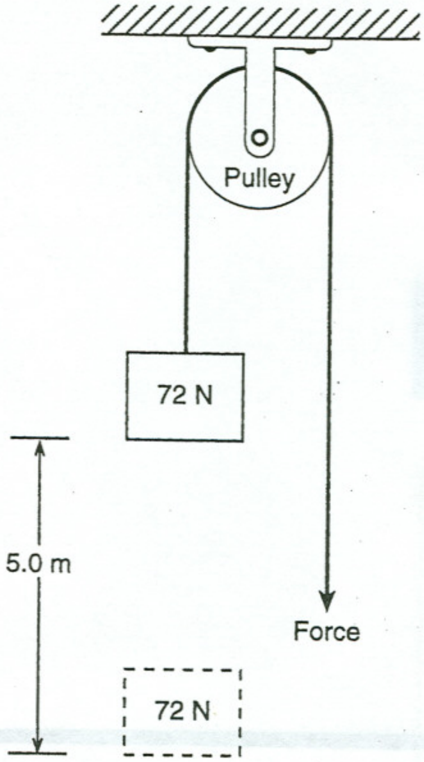
The work done on the cart is

(1) 100. J
(2) 200. J
(3) 150. J
(4) 40.0 J

13 A constant force of 1900 newtons is required to keep an automobile having a mass of 1.0×10^3 kilograms moving at a constant speed of 20. meters per second. The work done in moving the automobile a distance of 2.0×10^3 meters is

(1) 2.0×10^4 J
(2) 3.8×10^4 J
(3) 2.0×10^6 J
(4) 3.8×10^6 J

14) In the diagram below, 400. joules of work is done raising a 72-newton weight a vertical distance of 5.0 meters.



How much work is done to overcome friction as the weight is raised?

(1) 40. J
(2) 360 J
(3) 400. J
(4) 760 J

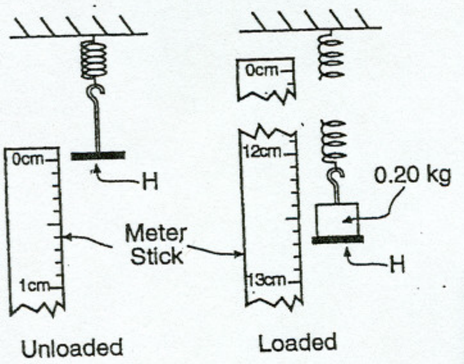
15) Which combination of units can be used to express work?

(1) $\frac{\text{newton} \cdot \text{second}}{\text{meter}}$
(2) $\frac{\text{newton} \cdot \text{meter}}{\text{second}}$
(3) newton/meter
(4) newton•meter

16 A spring of negligible mass has a spring constant of 50. newtons per meter. If the spring is stretched 0.40 meter from its equilibrium position, how much potential energy is stored in the spring?

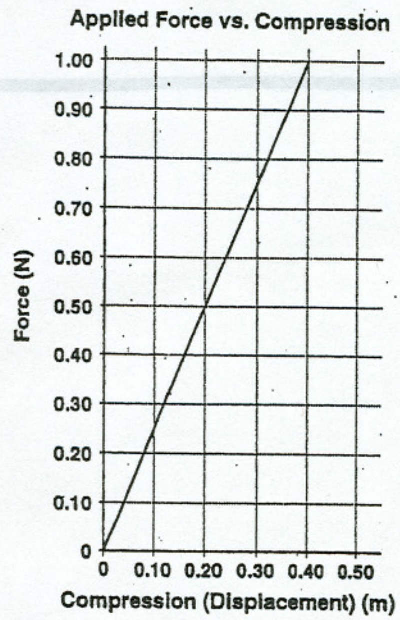
(1) 20. J
(2) 10. J
(3) 8.0 J
(4) 4.0 J

17) What is the displacement of the mass hanger (*H*) shown in the diagram after a 0.20-kilogram mass is loaded on it? [Assume the hanger is at rest in both positions.]



(1) 12.30 cm
(2) 12.50 cm
(3) 12.70 cm
(4) 13.30 cm

18) The graph below represents the relationship between the force applied to a spring and the compression (displacement) of the spring.



What is the spring constant for this spring?

(1) 1.0 N/m
(2) 2.5 N/m
(3) 0.20 N/m
(4) 0.40 N/m

19) Car *A* and car *B* of equal mass travel up a hill. Car *A* moves up the hill at a constant speed that is twice the constant speed of car *B*. Compared to the power developed by car *B*, the power developed by car *A* is

1 the same
2 twice as much
3 half as much
4 four times as much

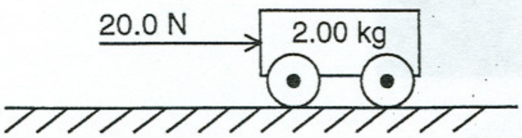
20) A 5.0×10^2-newton girl takes 10. seconds to run up two flights of stairs to a landing, a total of 5.0 meters vertically above her starting point. What power does the girl develop during her run?

(1) 25 W
(2) 50. W
(3) 250 W
(4) 2,500 W

PART II - Fill In's
(20 point)

21) (2 points)

In the diagram below, a 20.0-newton force is used to push a 2.00-kilogram cart a distance of 5.00 meters.



The work done on the cart is ______ joules

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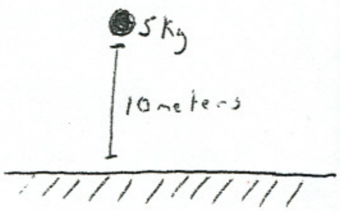
22) (5 point)

ⓐ When a 5-kilogram mass is lifted from the ground to a height of 10 meters, the gravitational potential energy of the mass is increased by approximately ______ joules. (2 point)



ⓑ If the 5 kilogram mass falls halfway (5 meters) to the ground its velocity will be ______ m/s (3 point)

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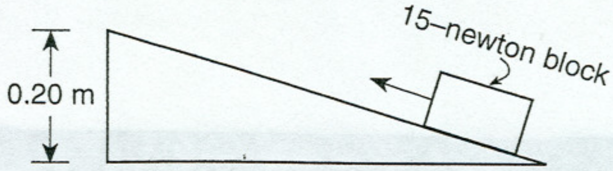
23)

(5 points)

A block weighing 15 newtons is pulled to the top of an incline that is 0.20 meter above the ground, as shown below.



If 4.0 joules of work are needed to pull the block the full length of the incline,

- The mass of the block is ______ kg (1pt)

- The Potential Energy of the block at the top of the incline is ______ joules (2pt)

- The work done against friction is ______ joules (2pt)

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24)

(2 point)

A catapult with a spring constant of 1.0×10^4 newtons per meter is required to launch an airplane from the deck of an aircraft carrier. The plane is released when it has been displaced 0.50 meter from its equilibrium position by the catapult. The energy acquired by the airplane from the catapult during takeoff is approximately

______ joules (2 point

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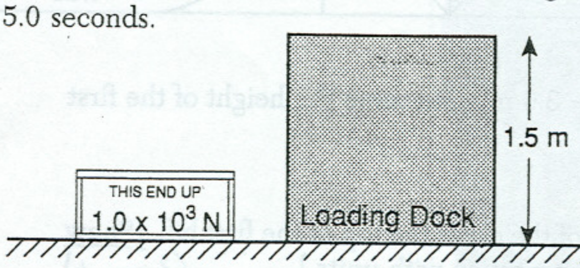
25)

(4 point)

The diagram below shows a 1.0×10^3-newton crate to be lifted at constant speed from the ground to a loading dock 1.5 meters high in 5.0 seconds.



- The work done to lift the crate is ______ joules (2 point)

- The power required to lift the crate (2 point) is ______ watts

26)

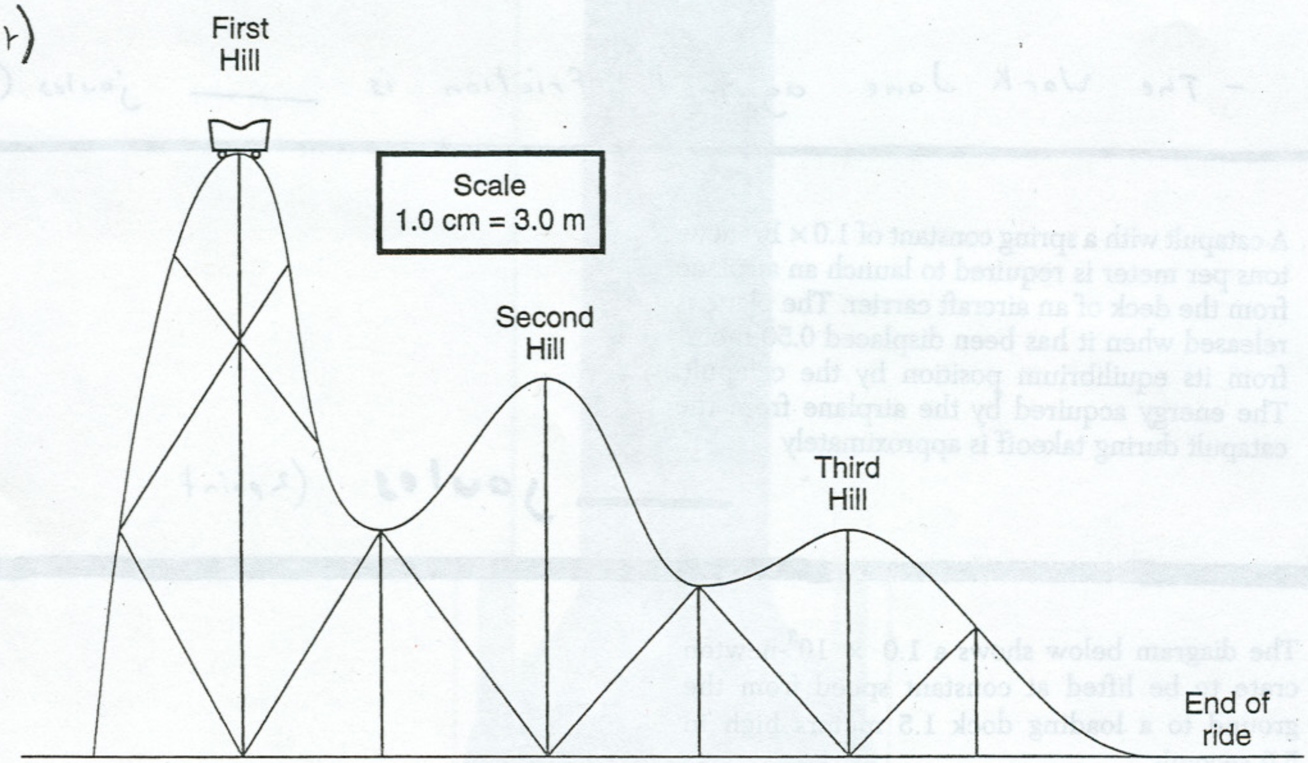
(2 points) A 10.-newton force is required to move a 3.0-kilogram box at constant speed. How much power is required to move the box 8.0 meters in 2.0 seconds?

______ Watts

PART III
(Problems 30 pt)

27) A 650-kilogram roller coaster car starts from rest at the top of the first hill of its track and glides freely. [Neglect friction.]

(8 point)



116 Using a metric ruler and the scale of 1.0 cm = 3.0 m, determine the height of the first hill. (2 point)

117 Determine the gravitational potential energy of the car at the top of the first hill. [Show all calculations, including the equation and substitution with units.] (3 point)

118 Using one or more complete sentences, compare the kinetic energy of the car at the top of the second hill to its kinetic energy at the top of the third hill. (3 point)

28) (10 point)

Base your answers to parts *a* through *d* on the information below.

A 6.0-kilogram concrete block is dropped from the top of a tall building. The block has fallen a distance of 55 meters and has a speed of 30. meters per second when it hits the ground.

a At the instant the block was released, what was its gravitational potential energy with respect to the ground? [Show all calculations, including the equation and substitution with units.] (3 pt)

b Calculate the kinetic energy of the block at the point of impact. [Show all calculations, including the equation and substitution with units.] (3 pt)

c How much mechanical energy was "lost" by the block as it fell? (2 pt)

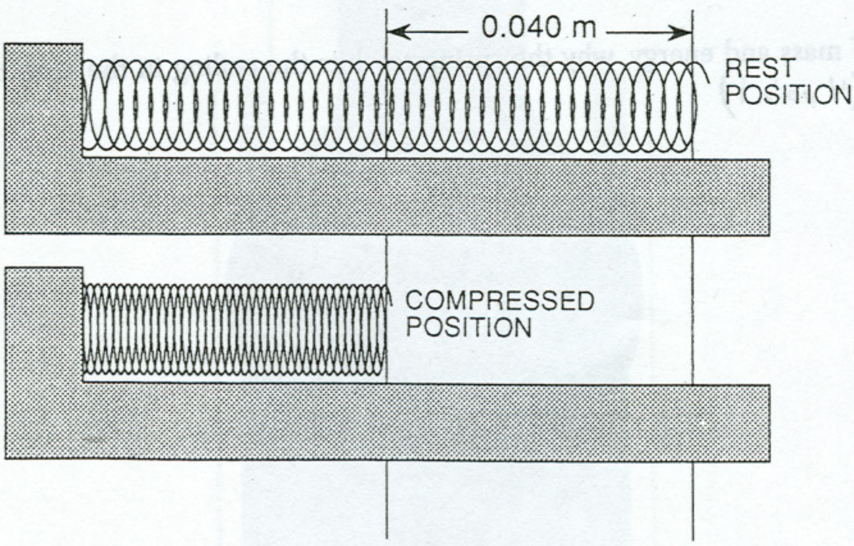
d Using one or more complete sentences, explain what happened to the mechanical energy that was "lost" by the block. (2 pt)

(a) (b)

(c) (d)

29) (4 point)

The diagram below shows a spring compressed by a force of 6.0 newtons from its rest position to its compressed position.



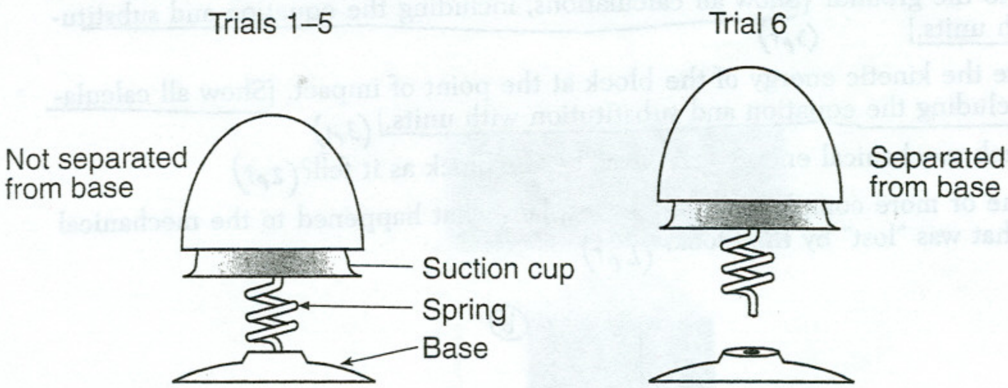
Calculate the spring constant for this spring. [Show all calculations, including equations and substitutions with units.]

(4 pt)

20)

(8 points)

Using a spring toy like the one shown in the diagram, a physics teacher pushes on the toy, compressing the spring, causing the suction cup to stick to the base of the toy.



When the teacher removes her hand, the toy pops straight up and just brushes against the ceiling. She does this demonstration five times, always with the same result.

When the teacher repeats the demonstration for the sixth time the toy crashes against the ceiling with considerable force. The students notice that in this trial, the spring and toy separated from the base at the moment the spring released.

The teacher puts the toy back together, repeats the demonstration and the toy once again just brushes against the ceiling.

a) describe the conversions that take place between pairs of the three forms of mechanical energy, beginning with the work done by the teacher on the toy and ending with the form(s) of energy possessed by the toy when it hits the ceiling. [Neglect friction.] (4 point)

b) Explain, in terms of mass and energy, why the spring toy hits the ceiling in the sixth trial and not in the other trials. (4 point)

a -

b -