AP Physics Study Guide Chapter 6 Work, Energy and Power Name_____________

Circle the vector quantities below and underline the scalar quantities below

Force Displacement Work Kinetic Energy Elastic Potential Energy

Gravitational Potential Energy Power

Write the equation that defines each quantity, include units

Work by a constant force potential energy stored in ideal spring Gravitational Potential Energy

Kinetic Energy Work-Kinetic Energy Theorem Conservation of Mechanical Energy

Total Mechanical Energy 3 different expressions for power Spring force

Explain how work can be positive, negative or zero when a force is applied to an object and it moves as a result of that force.

Positive work:

Negative work:

Zero work:

Explain how to use a force-displacement graph to calculate work

Explain the two criteria that define a conservative force

1)

2)

List 2 examples of conservative forces.

Define a non-conservative force – include 2 examples in your explanation

Explain what it means when energy is "conserved".

Explain what the spring constant k of a spring is and how it can be calculated.

Write a statement of the law of conservation of energy using words not equations. Include the 3 assumptions that apply for it to be valid.

Explain what the concept of path independence means and how it is used when solving problems with the law of conservation of energy.

Show how you would use an expression for power to calculate energy transfer.

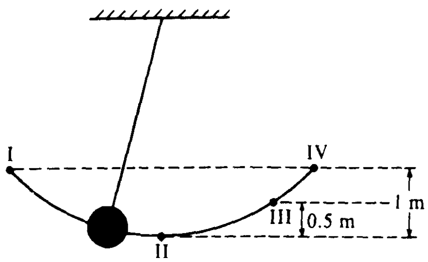
Explain how efficiency is defined using both words and an equation.

No process is required for these multiple choice questions.

1. A person pushes a box across a horizontal surface at a constant speed of 0.5 meter per second. The box has a mass of 40 kilograms, and the coefficient of sliding friction is 0.25. The power supplied to the box by the person is

(A) 0.2 W (B) 5 W (C) 50 W (D) 100 W (E) 200 W 1)_________

Questions 2 – 3



A ball swings freely back and forth in an arc from point I to point IV, as shown above. Point II is the lowest point in the path, III is located 0.5 meter above II, and IV is I meter above II. Air resistance is negligible.

2. If the potential energy is zero at point II, where will the kinetic and potential energies of the ball be equal?

(A) At point II (B) At some point between II and III (C) At point III

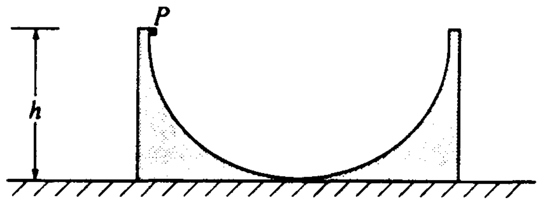
(D) At some point between III and IV (E) At point IV 2)_______

3. The speed of the ball at point II is most nearly 3)_______

(A) 3.0 m/s (B) 4.5 m/s (C) 9.8 m/s (D) 14 m/s (E) 20 m/s

4. A weight lifter lifts a mass m at constant speed to a height h in time t. What is the average power output of the weight lifter?

(A) mg (B) mh (C) mgh (D) mght (E) mgh /t 4)________

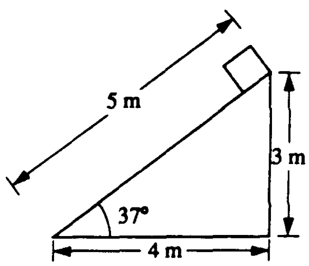


5)________

5. The figure above shows a rough semicircular track whose ends are at a vertical height h. A block placed at point P at one end of the track is released from rest and slides past the bottom of the track. Which of the following is true of the height to which the block rises on the other side of the track?

(A) It is equal to $h/2\pi$ (B) It is equal to h/4 (C) It is equal to h/2 (D) It is equal to h

(E) It is between zero and h; the exact height depends on how much energy is lost to friction.



A plane 5 meters in length is inclined at an angle of 37°, as shown above. A block of weight 20 newtons is placed at the top of the plane and allowed to slide down.

6. The work done on the block by the gravitational force during the 5-meter slide down the plane is most nearly

(A) 20 J (B) 60 J (C) 80 J (D) 100 J (E) 130 J 6)________

7. A student weighing 700 N climbs at constant speed to the top of an 8 m vertical rope in 10 s. The average power expended by the student to overcome gravity is most nearly

a. 1.1 W b. 87.5 W c. 560 W d. 875 W e. 5,600 W 7)________

8. Units of power include which of the following? 8)________

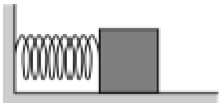
I. Watt

II. Joule per second

III. Kilowatt-hour

a. I only b. III only c. I and II only d. II and III only e. I, II, and III

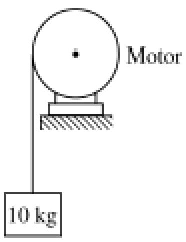
9) 9)________



. A block on a horizontal surface of negligible friction is placed in contact with an ideal spring, as shown above. The block is moved to the left so that the spring is compressed a distance x from equilibrium and then released from rest. The block has kinetic energy K_1 when it separates from the spring. When the spring is compressed a distance $2x$ and the block is released from rest, the kinetic energy of the block when it separates from the spring is

(A) $K_1/2$
(B) K_1
(C) $\sqrt{2}K_1$
(D) $2K_1$
(E) $4K_1$

10) and 11) 10)__________ 11)__________

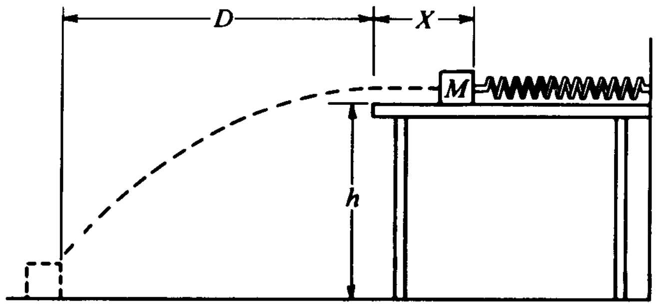


A 10 kg block is attached to a light cord that is wrapped around the pulley of an electric motor, as shown above. At what rate is the motor doing work when it is pulling the block upward with an instantaneous speed of 3 m/s and an upward acceleration of 2 m/s^2 ?

(A) 120 W
(B) 240 W
(C) 300 W
(D) 360 W
(E) 600 W

A ball is tossed straight up and later returns to the point from which it was launched. If the ball is subject to air resistance as well as gravity, which of the following statements is correct?

(A) The speed at which the ball returns to the point of launch is less than its speed when it was initially launched.
(B) The time for the ball to fall is the same as the time for the ball to rise.
(C) The force of air resistance is directed downward both when the ball is rising and when it is falling.
(D) The net work done by air resistance on the ball during its flight is zero.
(E) The net work done by gravity on the ball during its flight is greater than zero.



1) One end of a spring is attached to a solid wall while the other end just reaches to the edge of a horizontal, frictionless tabletop, which is a distance *h* above the floor. A block of mass M is placed against the end of the spring and pushed toward the wall until the spring has been compressed a distance X, as shown above. The block is released, follows the trajectory shown, and strikes the floor a horizontal distance D from the edge of the table. Air resistance is negligible.

Determine expressions for the following quantities in terms of M, X, D, h, and g. Note that these symbols do not include the spring constant.

a. The time elapsed from the instant the block leaves the table to the instant it strikes the floor

a)______________

b. The horizontal component of the velocity of the block just before it hits the floor

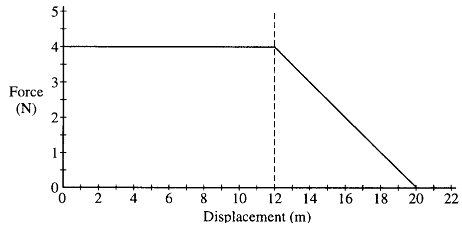
b)______________

c. The work done on the block by the spring

c)___________

d. The spring constant

d)___________



2) A 0.20 kg object moves along a straight line. The net force acting on the object varies with the object's displacement as shown in the graph above. The object starts from rest at displacement x = 0 and time t = 0 and is displaced a distance of 20 m. Determine each of the following.

a. The acceleration of the particle when its displacement x is 6 m. a)_________

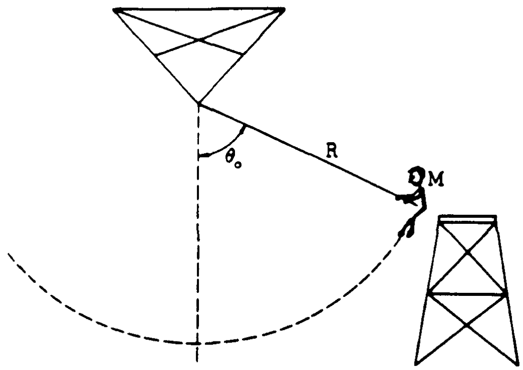
b. The time taken for the object to be displaced the first 12 m. b)__________

c. The amount of work done by the net force in displacing the object the first 12 m.

c)__________

d. The speed of the object at displacement x = 12 m. d)__________

e. The final speed of the object at displacement x = 20 m. e)_________



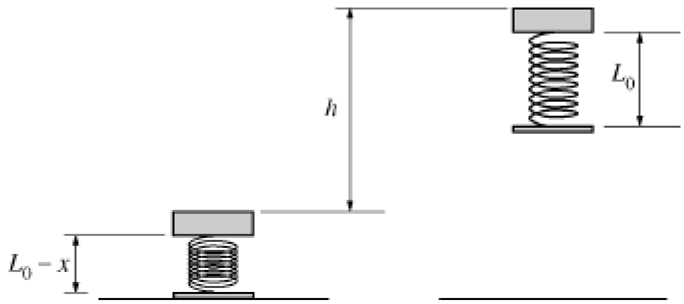
3) A child of mass M holds onto a rope and steps off a platform. Assume that the initial speed of the child is zero. The rope has length R and negligible mass. The initial angle of the rope with the vertical is θ_o, as shown in the drawing above.

a. Using the principle of conservation of energy, develop an expression for the speed of the child at the lowest point in the swing in terms of g, R, and cos θ_o

a)____________________

b. The tension in the rope at the lowest point is 1.5 times the weight of the child. Determine the value of cos θ_o.

b)__________________



4)

In an experiment, students are to calculate the spring constant k of a vertical spring in a small jumping toy that initially rests on a table. When the spring in the toy is compressed a distance x from its uncompressed length L_0 and the toy is released, the top of the toy rises to a maximum height h above the point of maximum compression. The students repeat the experiment several times, measuring h with objects of various masses taped to the top of the toy so that the combined mass of the toy and added objects is m. The bottom of the toy and the spring each have negligible mass compared to the top of the toy and the objects taped to it.

(a) Derive an expression for the height h in terms of m, x, k, and fundamental constants.

a)____________________

With the spring compressed a distance $x = 0.020$ m in each trial, the students obtained the following data for different values of m.

	m (kg)	h (m)	
	0.020	0.49	
	0.030	0.34	
	0.040	0.28	
	0.050	0.19	
	0.060	0.18	

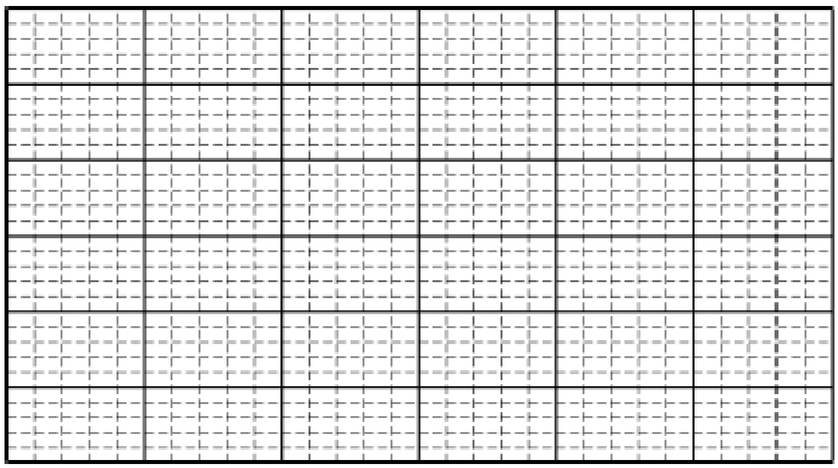
(b)

i. What quantities should be graphed so that the slope of a best-fit straight line through the data points can be used to calculate the spring constant k ?

b)____________________

ii) Fill in one or both of the blank columns in the table with calculated values of your quantities, including units.

(c) On the axes below, plot your data and draw a best-fit straight line. Label the axes and indicate the scale.



d) Using the slope of your best fit line calculate the value of the spring constant k

slope value__________

k = ________________

over for more

e) describe a procedure for measuring the height h in the experiment , given that the toy is only momentarily at that maximum height