Test: *Work & Energy*

Equations and Constants:

$\bar{v} = \frac{\Delta x}{\Delta t}$ $v = \frac{dx}{dt}$ $\bar{a} = \frac{\Delta v}{\Delta t}$ $a = \frac{dv}{dt}$ $\bar{v} = \frac{1}{2}(v_i + v_f)$ $|g| = 10\ m/s^2$

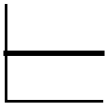
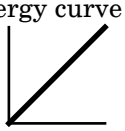
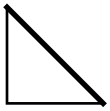
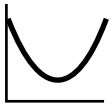
$x = \frac{1}{2}at^2 + v_i t + x_i$ $v = at + v_i$ $v_f^2 = v_i^2 + 2a\Delta x$ $R = \frac{v^2 \sin 2\theta}{g}$ $a_c = \frac{v^2}{r}$

$\sum F = ma$ $w = mg$ $w_\perp = mg\cos\theta$ $w_\parallel = mg\sin\theta$ $f = \mu N$

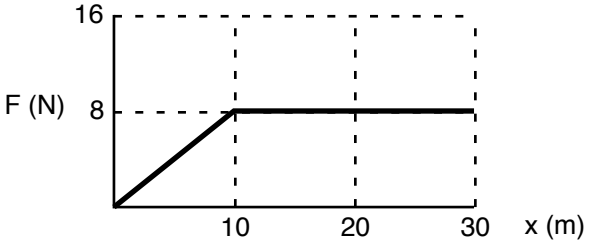
$W = Fd\cos\theta$ $W = \int \vec{F} \cdot d\vec{x}$ $K = \frac{1}{2}mv^2$ $P = \frac{dW}{dt}$ $P = Fv$ $U_{gravity} = mgh$ $U_{spring} = \frac{1}{2}kx^2$

Multiple Choice: *Choose the letter of the best answer. 3 points each.*
Unless otherwise stated, ignore the effects of air resistance. $|g| = 10\ m/s^2$

1. _____ How much work would it take to stop a 2000 kg car traveling at 25 m/s?
   a. –625,000 J. b. –500,000 J. c. –20,000 J. d. –4 J.
   e. impossible to say because you need to know the distance required to stop the car.

2. _____ Which potential energy curve would show a stable equilibirum situation?
   a.  b.  c.  d.  e. 

3. _____ The force verses displacement graph for a force F acting on a body. How much work is done by the force from x = 0 to x = 20 meters?



   a. 160 J. b. 200 J. c. 240 J. d. 120 J. e. 40 J.

4. _____ A force acting on a particle is called conservative if:
   a. its work is zero when the particle moves exactly once around any closed path.
   b. its work equals the change in the kinetic energy of the particle.
   c. it obeys Newton's second law.
   d. it obeys Newton's third law.
   e. it is not a frictional force.

5. _____ A woman carries a 50 kg mass up some stairs, a total height of 15 meters, in 10 seconds. The power she generated was
   a. 75,000 W. b. 7500 W. c. 750 W. d. 75 W.

6. _____ A parachutist jumps out of an airplane. While she is falling, and before she pulls her parachute open, which of the following is false?
   a. She gains kinetic energy while she loses potential energy.
   b. Her total mechanical energy is constant.
   c. Gravity does positive work on her.
   d. Air resistance does negative work on her.

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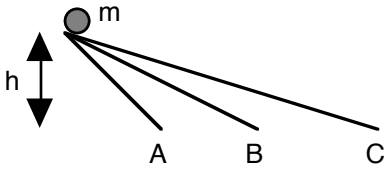
Questions 7 to 9 refer to the following:

A ball of mass m is at the top of 3 frictionless slides, all having the same height, but different lengths, as shown in the diagram.



7. _____ The ball would have the highest speed at the bottom if released from track
a. A. b. B. c. C. d. all the same.

8. _____ The normal force would do the most work on the ball if released from track
a. A. b. B. c. C. d. all the same.

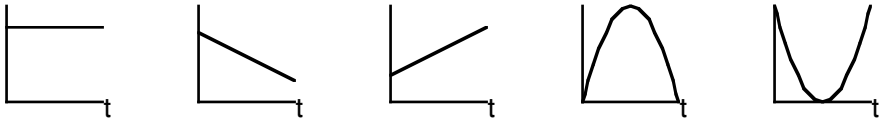
9. _____ Gravity would do the most power if released from track
a. A. b. B. c. C. d. all the same.

10. _____ A person on the edge of a roof throws a ball downward, and it hits the ground with 100 J of kinetic energy. The person then throws an identical ball upward with the same initial speed. Ignoring air resistance and assuming the ground is level, the second ball hits the ground with a kinetic energy of
a. < 100 J. b. 100 J. c. > 100 J.
d. not enough information to tell.

11. _____ Which of the following is NOT an expression for energy?
a. mgh. b. Fd. c. $1/2\ mv^2$. d. ma. e. Pt.

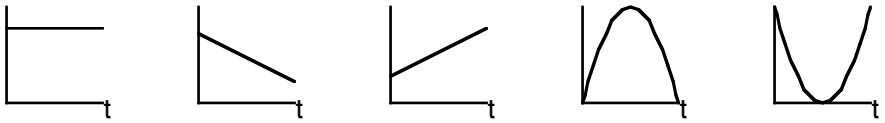
12. _____ A flower pot of mass m falls from rest to the ground below, a distance h. Which statement is correct?
a. The speed of the pot when it hits the ground depends on m.
b. The speed of the pot when it hits the ground is proportional to h.
c. The kinetic energy of the pot when it hits the ground is proportional to h.
d. The kinetic energy of the pot when it hits the ground does not depend on m.
e. none of the above is correct.

13. _____ A ball is tossed into the air. The graph of the total energy vs. time of the ball looks like



a. b. c. d. e.

14. _____ A ball is tossed into the air. The graph of the kinetic energy vs. time of the ball looks like



a. b. c. d. e.

15. _____ A car has 1000 J of kinetic energy. If it were to go 3 times as fast, how much kinetic energy would it have?
a. 1000 J. b. 3000 J. c. 6000 J. d. 9000 J.

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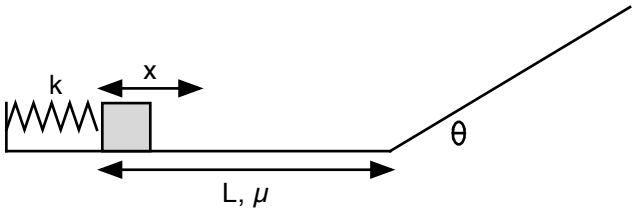
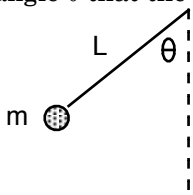
Problem Solving: *Show all work. 11 points each.*
Use work/energy principals!

16. A compressed spring (k=150 N/m) launches a 0.4 kg mass across a table with a coefficient of friction of 0.3. 2.2 meters from the release point of the mass, there is a frictionless incline of base angle 35°. The spring is compressed 15 cm. Where does the mass finally come to rest? (Either the final height of the mass, or the total distance it slides on the table.)



17. A 0.25 kg mass is attached to a string of length 1.5 meters. It is pulled back an angle of θ and then released. The maximum tension that the string can supply is 4 N. What is the maximum angle θ that the mass can be pulled back?



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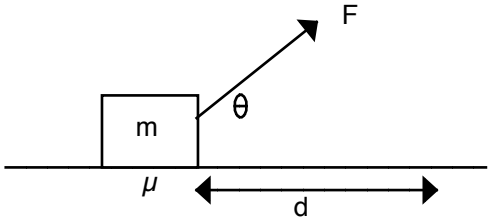
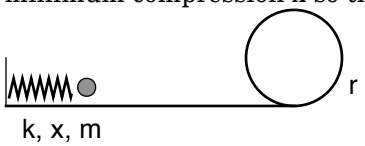
19. A box of mass m is at rest on a table with a coefficient of friction of μ. It is then pulled by an applied force of F directed at an angle θ above the horizontal. If it has a final speed of v, what was the distance that the box was pulled?



18. A compressed spring (k) launches a mass m through a loop-the-loop of radius r. What is the minimum compression x so that the mass just makes the loop? The system is frictionless.



20. A mass M on a table is attached to a little mass m via a string and pulley. There is a coefficient of friction of μ between the mass M and the table. After falling a distance h, how fast is the system moving, assuming it started from rest?