AP Physics

Name: ______________________________

Period: ________ Date: ___________________

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

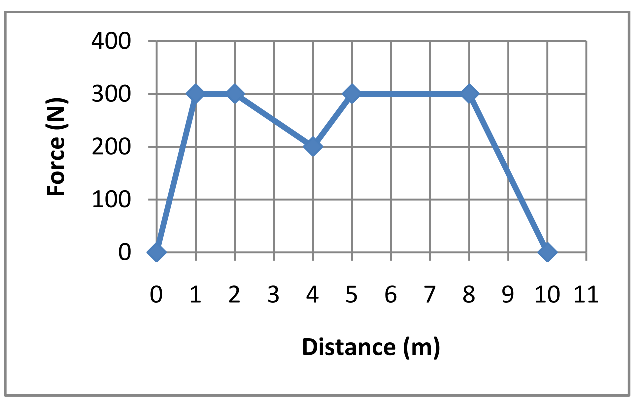
AP EXAM		CHAPTER TEST	
50 Multiple Choice • 45 Single Response • 5 Multi-Response	90 min, 1 point each	25 Multiple Choice • 22 Single Response • 3 Multi-Response	45 min
Free Response • 3 Short Free Response • 2 Long Free Response	90 min • 13 min ea, 7 pts ea • 25 min ea, 12 pts ea	Free Response • 2 Short Free Response • 1 Long Free Response	45 min • 12 min ea, 7 pts ea • 20 min ea, 12 pts ea

CHAPTER 6 TEST REVIEW -- MARKSCHEME

MULTIPLE CHOICE

1. (__/1) What is the work done by friction on a 15 kg object pulled horizontally in a straight line for 15 meters, if the coefficient of friction between the object and the surface is given by $\mu_k = 0.4$?
   a. -59 J
   b. -91 J
   c. -145 J
   d. -590 J
   e. -890 J

2. How much work must be done on a 27.5 kg object to move it 18 m up a 30° incline?
   a. 4800 J
   b. 4200 J
   c. 2400 J
   d. 250 J
   e. 430 J



3. According to the above distance vs. force (parallel) graph, what is the work done in this process as the object moves from 2 m to 8 m?
   a. 1650 J
   b. 3300 J
   c. 1900 J
   d. 1750 J
   e. 1850 J

4. What is the work done to slow a 1.8×10^5 kg train car from 60 m/s to 20 m/s?
   a. 3.6×10^6 J
   b. 5.8×10^8 J
   c. 3.1×10^6 J
   d. 1.4×10^8 J
   e. 2.9×10^8 J

5. A 45 kg object slides down an uneven frictionless incline from rest without rotating. What is its speed after it travels 2.5 meters vertically?
   a. 3.0 m/s
   b. 4.3 m/s
   c. 5.7 m/s
   d. 7.0 m/s
   e. 11 m/s

6. Which of the following are equivalent units for the spring constant, *k*?

   I. N·m^2

   II. kg/s^2

   III. J/m^2

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

7. For an object sliding down a frictionless uneven incline without rolling, which of the following represents the change in height necessary for its velocity to double in terms of initial velocity *V*?
   a. $2V^2g$
   b. $3V/g^2$
   c. $3V^2/2g$
   d. $3V/2g$
   e. $2g/3V^2$

8. A 2.0 kg ball compresses a spring 0.10 meters and is released from rest. If the ball leaves the spring at a speed of 0.20 m/s, what is the value of the spring constant?
   a. 5.0 N/m
   b. 8.0 N/m
   c. 12 N/m
   d. 16 N/m
   e. 18 N/m

9. What is the force of friction as a 12 kg object slides for 30 meters down a 30° incline at a constant velocity?
   a. 59 N
   b. 98 N
   c. 280 N
   d. 540 N
   e. 1100 N

10. What is the average power necessary to move a 35 kg block up a frictionless 30° incline at 5 m/s?
   a. 68 W
   b. 121 W
   c. 343 W
   d. 430 W
   e. 860 W

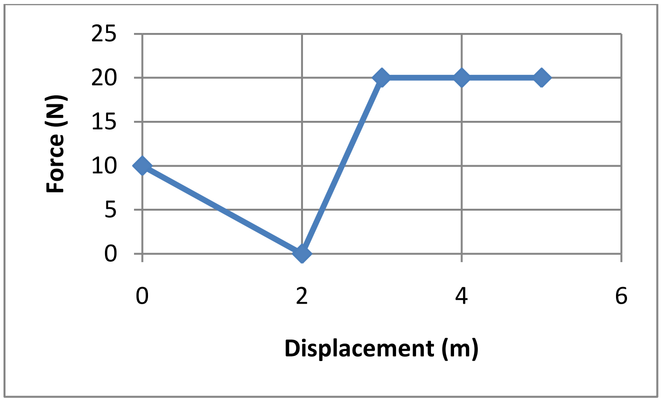
11. A student weighing 700 N climbs at constant speed to the top of an 8.00 m long vertical rope in 10.0 s. What is the approximate average power expended by the student in overcoming gravity?
   a. 1.10 W
   b. 87.5 W
   c. 560 W
   d. 875 W
   e. 5600 W

12. How much energy is required to stop a car of mass 100 kg moving at a speed of 25.0 m/s?
   a. 1150 J
   b. 21,150 J
   c. 31,250 J
   d. 32,250 J
   e. 42,250 J

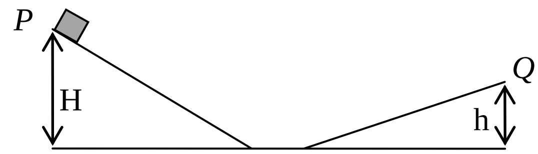
13. A 5.0 kg block of ice is sliding across a frozen (frictionless) pond at 2.0 m/s. A 7.6 N force is applied in the direction of motion during which time the ice block slides 15.0 m, and then the force is removed. What is the work done by the applied force?
   a. +19.7 J
   b. -114 J
   c. +114 J
   d. -735 J
   e. +735 J

14. A 51 kg woman runs up a flight of stairs with an average speed of 1.0 m/s. What average power did the woman expend while she was running?
   a. 0.25 kW
   b. 0.51 kW
   c. 0.75 kW
   d. 1.00 kW
   e. 5.00 kW

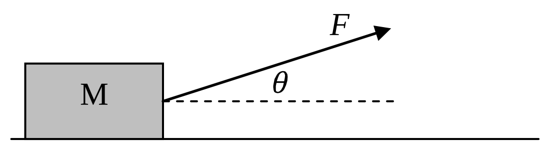
15. A block of unknown mass falls from rest through a distance of 6.0 m in an evacuated tube near the surface of the Earth. What is the speed after it has fallen the 6.0 m distance?
   a. 8.0 m/s
   b. 11.0 m/s
   c. 13.0 m/s
   d. 26.0 m/s
   e. 120.0 m/s



16. The above force vs. displacement graph for an object being pushed along a straight line starting from rest is as shown. After the object has moved a distance of 2.0 m, how much work has been done on it?
    a. 2.5 J
    b. 5.0 J
    c. 10 J
    d. 20 J
    e. 25 J
17. A block of mass *m* moving with initial velocity *v* is subjected to a horizontal friction force on a rough surface. The coefficient of friction between the block and the surface is μ. What distance does the block travel before completely coming to rest?
    a. $\frac{v}{2\mu g}$
    b. $\frac{v^2}{2\mu m g}$
    c. $\frac{v^2}{\mu g}$
    d. $\frac{v^2}{2\mu g}$
    e. $\frac{v}{2\mu m g}$
18. A spring needs a force of 1.0 N to compress it 0.1 m. Approximately how much ***work*** is needed to stretch it 0.4 m?
    a. 0.5 J
    b. 0.8 J
    c. 2.0 J
    d. 4.0 J
    e. 10.0 J



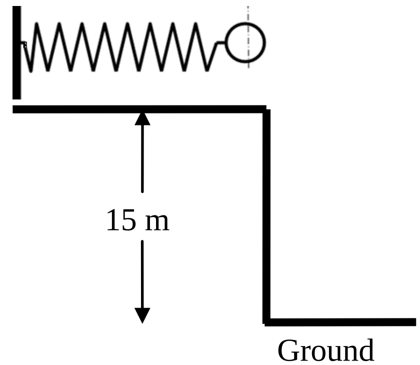
19. A small block above at point *P* is released from rest and slides along the frictionless path toward point *Q* as shown. At Q, which of the following best describes the speed of the block?
    a. $\frac{(H-h)^2}{2g}$
    b. $2g(H-h)$
    c. $\frac{H-h}{2g}$
    d. $2g\sqrt{(H-h)}$
    e. $\sqrt{2g(H-h)}$



20. A block of mass *M* is pulled by a constant force *F* at an angle of θ relative to the level ground as shown above, covering a distance *L*. Which of the following best represents the work done on the block by force *F* if θ is 30°?
    a. $FL\cos 30°$
    b. $MFL\cos 30°$
    c. $L\cos 30°$
    d. $\frac{F\cos 30°}{ML}$
    e. $\frac{ML\cos 30°}{F}$
21. Which of the following objects would require the greatest amount of work to stop it?
    a. an object of mass *3M* and speed *V*
    b. an object of mass *2M* and speed *3V*
    c. an object of mass *3M* and speed *2V*
    d. an object of mass *M* and speed *4V*
    e. an object of mass *4M* and speed *V*
    f.

22. An elevator car is rising at a constant velocity. Select all of the statements that are correct.
    a. The upward force of the cable is constant.
    b. The kinetic energy of the elevator is constant.
    c. The gravitational potential energy of the elevator is constant.
    d. The acceleration of the elevator is zero.
    e. The kinetic plus potential energies of the elevator is constant.
23. A watt-second is a unit of what?
    a. force
    b. velocity
    c. power
    d. energy
    e. displacement
24. A 4.0 kg mass hangs on a spring and stretches it 0.05 m. The spring is then cut exactly in half. The same 4.0 kg mass, when hung on this new spring, will cause the spring to be stretched how far?
    a. 0.400 m
    b. 0.020 m
    c. 0.100 m
    d. 0.025 m
    e. 0.050 m
25. A block of mass m slides on a frictionless, horizontal table with an intitial speed v. It then hits and compresses a spring whose force constant is k and is then brought to rest but does not oscillate. Which of the following describes the maximum compression of the spring?
    a. $\frac{v^2}{2g}$
    b. $\frac{mgv}{k}$
    c. $\frac{mv}{k}$
    d. $v\sqrt{\frac{k}{m}}$
    e. $v\sqrt{\frac{m}{k}}$

FREE RESPONSE



26. A 6 kg ball is pressed against a spring with a *k* value of 23 N/m, compressing it by 0.5 m. The spring is horizontal with a ledge. The length of the spring in its resting position equals the length of the ledge. The ledge is 15 m above the ground.

a. (__/2) What is the elastic potential energy initially?

2.9 J, straight definition

$$PE_E = \frac{1}{2}kx^2 = \frac{1}{2}(23)(0.5)^2 = 2.88J$$

b. (__/2) What is the gravitational potential energy when the ball leaves the spring?

883 J, straight definition

$$PE_g = mgh = (6)(9.81)(15) = 883J$$

c. (__/1) What is the gravitational potential energy when the ball hits the ground?

0 J, the last sentence indicates the ground is the reference point

d. (__/4) Find the magnitude of the velocity vector when the ball hits the ground.

17.2 m/s, think of this as either a vector problem or projectile motion problem: the spring gives it an x-velocity and gravity gives it a y-velocity

In the horizontal direction, $PE_E = KE_x$

$$2.88J = \frac{1}{2}m{v_x}^2$$

$$\sqrt{\frac{(2)(2.88J)}{6}} = v_x = 0.98\frac{m}{s}$$

In the vertical direction, $PE_g = KE_y$

$$883J = \frac{1}{2}m{v_y}^2$$

$$\sqrt{\frac{(2)(883J)}{6}} = v_y = 17.2\frac{m}{s}$$

$$v_R = \sqrt{{v_x}^2 + {v_y}^2} = \sqrt{(0.98)^2 + (17.2)^2 = 17.2}$$

e. (__/X) How far from the base of the ledge will the ball land? (*think projectile motion*)

1.72 m, This is all a projectile motion review problem: get the time from the y-equation and multiply the x-velocity times the time to get the x-distance

$$y = \cancel{y_0} + \cancel{v_{y0}t} + \frac{1}{2}gt^2$$

$$(v_x)(t) = x = (0.98)(1.75)$$

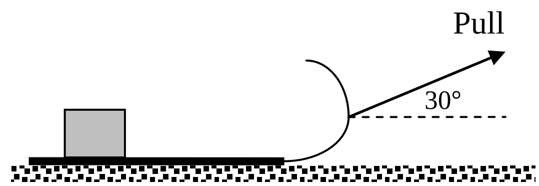
$$y = \frac{1}{2}gt^2$$

$$(0.98)(1.75) = x = 1.72m$$

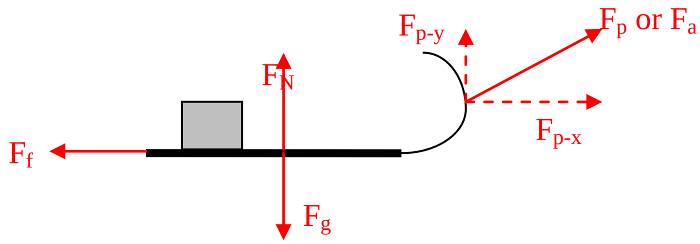
$$\sqrt{\frac{2y}{g}} = t$$

$$\sqrt{\frac{2(15)}{9.81}} = t = 1.75s$$

27. A child pulls a 20.0 kg sled (on which a 4.0 kg box sits) from rest along a straight path on a level surface. The child exerts a force of 60.0 N on the sled at an angle of 30° above the horizon as shown above. The coefficient of kinetic friction between the sled and the surface is 0.22.



a. (__/2) On the diagram below, draw and label a free-body diagram for the system as it is pulled along the surface.



b. (__/2) Calculate the normal force exerted on the sled.

205 N, no movement in the vertical direction, so forces are balanced. But, you have to remember that the vertical component of the pull force makes the normal force less than the weight. A good free-body diagram would tell you that.

$\sum F = 0$

$F_N + F_{p-y} - F_g = 0$

$F_N = F_g - F_{p-y}$

$F_N = mg - F_p \sin\theta$

$F_N = (24)(9.81) - (60)\sin(30) = 205N$

c. (__/2) Calculate the acceleration of the sled.

0.286 m/s^2 , just a horizontal Newton Second Law equation with friction (use computed F_N)

$\sum F = ma$

$F_{p-y} - F_f = ma$

$\frac{F_{p-y} - F_f}{m} = a$

$F_{p-y} = F_p \cos\theta = (60)\cos 30$

$F_f = F_N \mu = (205)(0.22)$

$\frac{F_{p-y} - F_f}{m} = \frac{(60)\cos 30 - (205)(0.22)}{(24)} = a = 0.286\, m/s^2$

d. (__/2) Calculate the net work done on the system as the sled moves a distance of 7.0 m.

48.0 J, the "net work" is the work done by the net force which is the same as $\sum F$ in c.

$W_{net} = F_{net} d$

$F_{net} = F_{p-y} - F_f = (60)\cos 30 - (205)(0.22)$

$W_{net} = [(60)\cos 30 - (205)(0.22)](7) = 48.0J$

e. (__/2) Determine the average power developed by the net force acting on the sled during the 7.0 m pull.

6.86 W, power is work divided by time. Use the W_{net} computed above, but you need to do some kinematics to find the time. Take heart my little ones, it's all review for the AP exam

$x = \cancel{x_0} + \cancel{v_{x0}}t + \frac{1}{2}at^2$

$\sqrt{\frac{2x}{a}} = t$

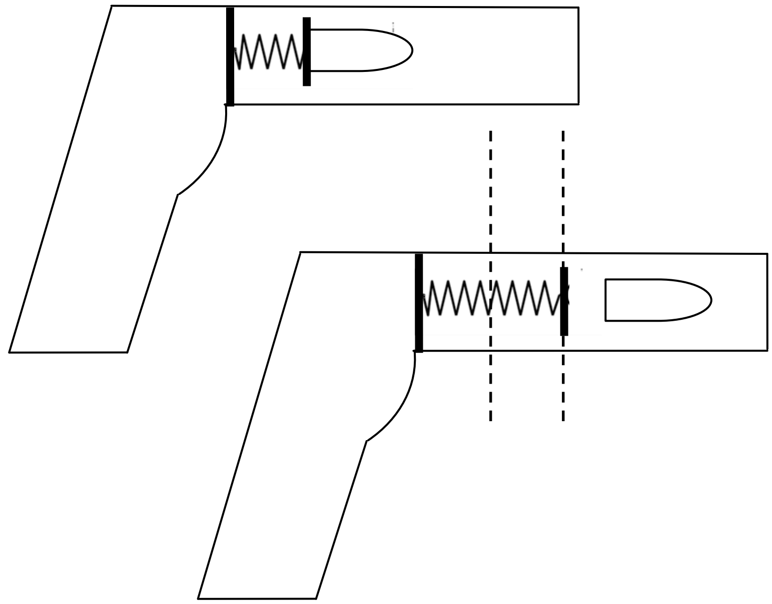
$P = \frac{W_{net}}{t}$

$x = \frac{1}{2}at^2$

$\sqrt{\frac{2(7)}{0.286}} = t = 7.00s$

$P = \frac{48}{7} = 6.86W$

28. A toy gun contains a spring of spring constant k = 250.0 N/m. The spring is initially compressed 4.0 cm (top diagram) and then released to propel a bullet of mass 10.0 g horizontally. The bullet loses contact with the spring the moment the spring reaches its equilibrium position as shown in the bottom diagram. Thereafter, the bullet travels a distance d through the barrel of the gun.



This one may be difficult because you are so enchanted by my MS Shapes artwork, but try to stay focused.

Oh, and watch your compatible units in this one.

a. (__/2) Determine the amount of work done by the spring on the bullet in accelerating it to the equilibrium position.

0.2 J, with the work-energy principle, work done by a spring is equal the energy of a spring

$$W_{spring} = PE_E = \frac{1}{2}kx^2 = \frac{1}{2}(250)(0.04m)^2 = 0.2J$$

b. (__/2) Determine the ideal speed (i.e. no air resistance or friction) the bullet should have the moment it is released from the spring at the equilibrium position.

6.3 m/s, conservation of energy: work/PE of the spring translates into KE of the bullet

$$PE_{spring} = KE_{bullet} \qquad \sqrt{\frac{2(PE_{spring})}{m_b}} = v_b$$

$$PE_{spring} = \frac{1}{2}m_b {v_b}^2 \qquad \sqrt{\frac{2(0.2)}{(0.01)}} = v_b = 6.32\,m/s$$

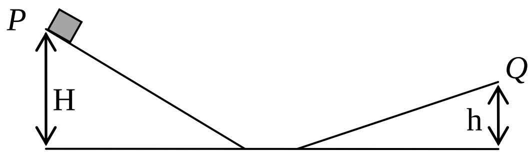
c. (__/2) A student places a photogate assembly at the end of the barrel to measure the speed with which the bullet exits the barrel and determines it to be 4.0 m/s after the bullet has travelled a distance d = 12 cm. Assume that the student was not a member of Table 7 and that the photogate was placed correctly (and no, we're not changing seats today). Based on this information, calculate the ***force*** of friction between the bullet and the inside of the gun's barrel.

-0.998 N, the work done by friction (F_f x d) results in a change (decrease) in kinetic energy of the bullet

$$W_f = \Delta KE \qquad F_f = \frac{\left(\frac{1}{2}(0.01)(4)^2 - \frac{1}{2}(0.01)(6.32)^2\right)}{(0.12)} = -0.998N$$

$$F_f d = \frac{1}{2}m{v_f}^2 - \frac{1}{2}m{v_i}^2$$

$$F_f = \frac{\left(\frac{1}{2}m{v_f}^2 - \frac{1}{2}m{v_i}^2\right)}{d}$$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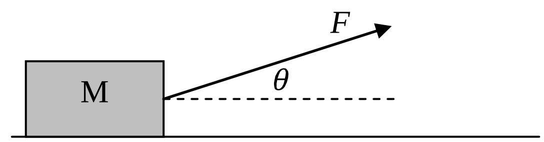
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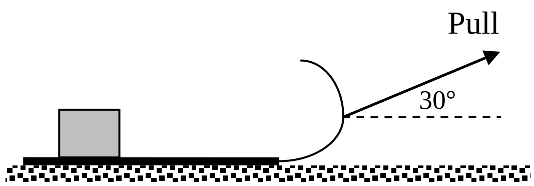
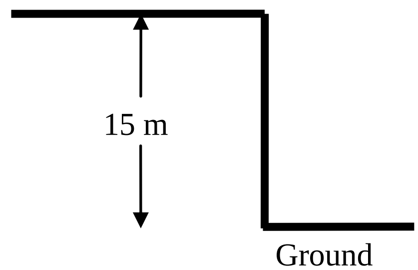

Pull
30°


15 m
Ground