Closed book and closed notes. No work needs to be shown.

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1. Three rocks are thrown with identical speeds from the top of the same building. Rock X and rock Y both have mass M, while rock Z has a mass of 2M. Rock X is thrown vertically downward, rock Y is thrown vertically upward, and rock Z is thrown horizontally. Which ball has the greatest speed just before it hits the ground? Assume air resistance is negligible.

a. Rock X.
b. Rock Y.
c. Rock Z.
d. Both Rock X and Rock Y.
e. All rocks hit the ground with the same speed.

2. A block slides across a horizontal, frictionless floor with an initial velocity of 3.0 m/s, it then slides up a ramp which makes a 30^o angle to the horizontal floor. What distance will it travel up the ramp?

a. 1.5 meters.
b. 0.92 meters.
c. 0.53 meters.
d. 0.46 meters.
e. 0.23 meters.

3. An ideal spring is compressed 12.0 cm from equilibrium, and the potential energy stored is 72.0 J. What compression (as measured from equilibrium) would result in 100 J being stored for this spring?

a. 16.7 cm.
b. 14.1 cm.
c. 13.6 cm.
d. 24.0 cm.
e. 8.64 cm.

4. In raising an object to a given height by means of an inclined plane, as compared with raising the object vertically, there is a reduction in:

a. work required
b. distance pushed
c. friction
d. force required
e. value of the acceleration due to gravity

5. In which of the following scenarios is work being done?

a. A ball bounces off of a wall without loosing speed.
(Consider the normal force the ball receives from the wall.)

b. A woman carries a heavy suitcase as she walks across a horizontal surface.
(Consider the force needed to keep the suitcase lifted)

c. A parachute allows a man to fall at a constant speed.
(Consider the drag force from the parachute creating resistance with the air.)

d. A satellite orbits the earth.
(Consider the force of gravity keeping the satellite in orbit)

e. A man holds a dumbbell 1.5 m off the ground with arms stretched out in front of him.
(Consider the force needed to keep the dumbbell lifted)

6. Two balls are dropped from the same height from the roof of a building. One ball has twice the mass as the other. Air resistance is negligible for this question. Just before hitting the ground, the heavier ball has:

a. one-quarter the kinetic energy of the lighter ball.
b. one-half the kinetic energy of the lighter ball.
c. the same kinetic energy of the lighter ball.
d. twice the kinetic energy of the lighter ball.
e. four times the kinetic energy of the lighter ball.

7. A 5.0 kg cart is moving horizontally at 6.0 m/s. In order to change its speed to 10.0 m/s, the net work down on the cart must be:

a. 40 J.
b. 90 J.
c. 160 J.
d. 400 J.
e. 550 J.

8. A hockey puck sliding along frictionless ice with speed v to the right collides with a horizontal spring and compresses it by 2.0 cm before coming to a momentary stop. What will be the spring's maximum compression if the same puck hits it at a speed of $2v$?

a. 2.0 cm
b. 2.8 cm
c. 4.0 cm
d. 5.6 cm
e. 8.0 cm

9. An ideal spring hangs from the ceiling next to a ruler that measures the *total* length of a spring. When a 100 N weight is attached, the total length of the spring is 40 cm. When a 200 N weight is attached, the total length of the spring is 60 cm. When an unknown weight is attached, the total length of the spring is 30 cm. What is the unknown weight? [*Hint: try making a graph.*]

a. 10 N
b. 20 N
c. 30 N
d. 40 N
e. 50 N

10. A skier of mass 70.0 kg is pulled up a slope by a motor-driven cable. The cable pulls her a distance of 60.0 m along a 30^o frictionless slope at a constant speed of 2.00 m/s. What power must a motor have to perform this task?

a. 412 W.
b. 206 W.
c. 686 W.
d. 22.9 W.
e. 1370 W.

11. A 20-N crate starting at rest slides down a rough 5.0-m long ramp, inclined at 25^o with the horizontal. 20 J of energy is lost to friction. What will be the speed of the crate at the bottom of the incline?

a. 0.98 m/s.
b. 1.9 m/s.
c. 3.2 m/s.
d. 4.7 m/s.
e. 6.4 m/s.

12. A man throws a 0.150 kg baseball at a speed of 40.0 m/s at an initial angle of 30.0^o with respect to the horizontal. What is the kinetic energy of the baseball at the highest point of its motion? Ignore air resistance.

a. zero.
b. 120 J.
c. 30.0 J.
d. 52.0 J.
e. 90.0 J.

13. A sled is dragged 8.0 m along a horizontal path at a constant speed of 0.30 m/s by a rope that is inclined at an angle of 25^o above the horizontal. The tension in the rope is 450 N. What was the magnitude of the energy lost due to friction?

a. 20 J.

b. 1.9×10^2 J.

c. 3.3×10^3 J.

d. 3.6×10^3 J.

e. 1.6×10^2 J.

14. In the figure below, the pulley has negligible mass, and both it and the inclined plane are frictionless. Block A has a mass of 1.00 kg, block B has a mass of 2.00 kg and the angle of the incline is 30.0^o. If the blocks are released from rest, what is the velocity of block A when block B has fallen 25.0 cm?

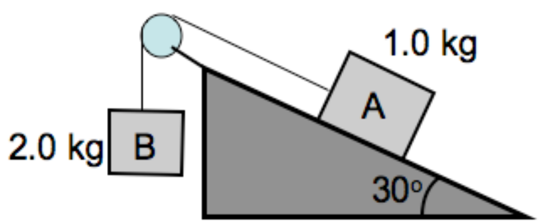
a. 1.28 m/s.

b. 2.21 m/s.

c. 3.13 m/s.

d. 2.71 m/s.

e. 1.57 m/s.



15. A wrecking ball is suspended from a 5.0 m long cable that makes a 30^o angle with the vertical. The ball is released and swings down. What is the ball's speed at the lowest point?

a. 7.7 m/s

b. 4.4 m/s

c. 3.6 m/s

d. 3.1 m/s

e. 5.0 m/s

Equations and Constants

$$\begin{Bmatrix} x = r\cos\theta \\ y = r\sin\theta \end{Bmatrix}; \qquad \begin{Bmatrix} r = \sqrt{x^2+y^2} \\ \theta = \tan^{-1}\left(\frac{y}{x}\right) \end{Bmatrix};$$

$$\begin{Bmatrix} v_x = v_{0x} + a_x t \\ \Delta x = \frac{1}{2}(v_{0x}+v_x)t \\ \Delta x = v_{0x}t + \frac{1}{2}a_x t^2 \\ v_x^2 = v_{0x}^2 + 2a_x\Delta x \end{Bmatrix}; \qquad \begin{Bmatrix} v_y = v_{0y} + a_y t \\ \Delta y = \frac{1}{2}(v_{0y}+v_y)t \\ \Delta y = v_{0y}t + \frac{1}{2}a_y t^2 \\ v_y^2 = v_{0y}^2 + 2a_y\Delta y \end{Bmatrix};$$

$$\begin{Bmatrix} \Delta x = x_f - x_i \\ speed_{ave} = \frac{d}{\Delta t} \end{Bmatrix}; \qquad \begin{Bmatrix} v_{ave} = \frac{\Delta x}{\Delta t} \\ a_{ave} = \frac{\Delta v}{\Delta t} \end{Bmatrix}; \qquad \begin{Bmatrix} v = \lim_{\Delta t\to 0}\frac{\Delta x}{\Delta t} \\ a = \lim_{\Delta t\to 0}\frac{\Delta v}{\Delta t} \end{Bmatrix};$$

$$\begin{Bmatrix} a_c = \frac{v^2}{r} \\ T = \frac{2\pi r}{v} \end{Bmatrix}; \qquad x = \frac{-B \pm \sqrt{B^2-4AC}}{2A};$$

$$\begin{Bmatrix} \sum \vec{F} = 0 \rightarrow \vec{a} = 0 \\ \sum \vec{F} = m\vec{a} \\ \vec{F}_{2on1} = -\vec{F}_{1on2} \end{Bmatrix}; \qquad \begin{Bmatrix} \sum F_x = ma_x \\ \sum F_y = ma_y \end{Bmatrix}; \qquad \begin{Bmatrix} 0 \le f_s \le \mu_s F_N \\ f_k = \mu_k F_N \\ F_g = mg \\ \vec{F}_d = -b\vec{v} \end{Bmatrix};$$

$$\begin{Bmatrix} F_g = G\frac{Mm}{r^2} \\ G = 6.67\times 10^{-11}\ \mathrm{N\cdot m^2/kg^2} \\ g = 9.80\ \mathrm{m/s^2} \\ M_{Earth} = 5.98\times 10^{24}\mathrm{kg} \\ R_{Earth} = 6.27\times 10^{6}\mathrm{m} \end{Bmatrix};$$

$$\begin{Bmatrix} W = \vec{F}\cdot\Delta\vec{x} \\ W = |F|\cdot|\Delta x|\cos\theta \\ W = \int \vec{F}(x)\cdot d\vec{x} \\ KE = \frac{1}{2}mv^2 \\ PE_g = mgh \\ P = \frac{\Delta E}{\Delta t} \end{Bmatrix}; \qquad \begin{Bmatrix} \vec{F}_s = -k\Delta\vec{x} \\ PE_s = \frac{1}{2}k(\Delta x)^2 \end{Bmatrix}; \qquad \begin{Bmatrix} W_c + W_{nc} = \Delta KE \\ W_c = -\Delta PE \\ E_{tot} = KE + PE_s + PE_g \\ \Delta E_{tot} = \Delta KE + \Delta PE_s + \Delta PE_g \\ \Delta E_{tot} = W_{nc} \end{Bmatrix};$$