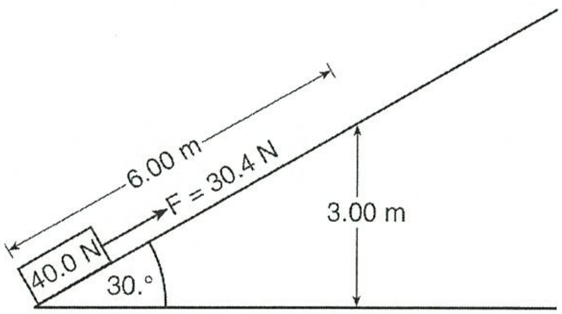
Skills 28-32
Long Answer Review

90. Calculate the average power required to lift a 490-newton object a vertical distance of 2.0 meters in 10. seconds. [Show all work, including the equation and substitution with units.]

$P = \frac{F_g h}{t} = \frac{(490N)(2m)}{10s} = \frac{980 Nm}{10 s} = 98W$

Base your answers to questions **91** through **94** on the information and diagram below.

A 30.4-newton force is used to slide a 40.0-newton crate a distance of 6.00 meters at constant speed along an incline to a vertical heights of 3.00 meters.



91. State what happens to the internal energy of the crate as it slides along the incline.

increases

$Q = $ ~~PE~~ top W done − Energy gained

92. State what happened to the kinetic energy of the crate as it slides along the incline.

remains the same (constant speed)

93. Calculate the total increase in the gravitational potential energy of the crate after it has slid 6.00 meters along the incline. [Show all work, including the equation and substitution with units.]

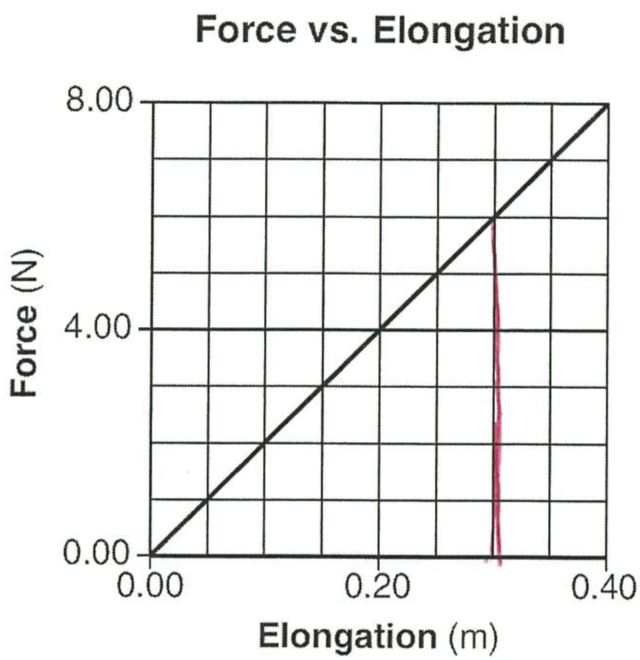
$PE = mgh = (40N)(3m) = 120J$

94. Determine the total work done by the 30.4-newton force in sliding the crate along the incline.

$W = Fd = (30.4N)(6m) = 182.4J$

95. Base your answer to the following question on the information below.

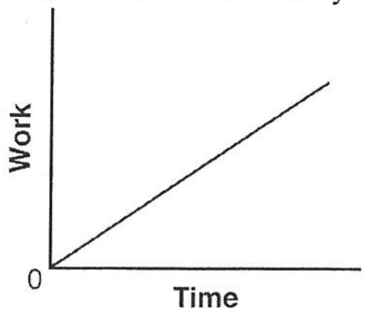
A student produced various elongations of a spring by applying a series of forces to the spring. The graph below represents the relationship between the applied force and the elongation of the spring.



Calculate the energy stored in the spring when the elongation is 0.30 meter. [Show all work, including the equation and substitution with units.]

PE_s = Area under line
= 1/2 (6N)(.3m)
= .9J

96. The graph below represents the relationship between the work done by a person and time.



$\frac{y}{x} = \frac{W}{t}$ = Power

Identify the physical quantity represented by the slope of the graph.

Power

97. Calculate the kinetic energy of a particle with a mass of 3.34×10^{-27} kilogram and a speed of 2.89×10^{5} meters per second. [Show all work, including the equation and substitution with units.]

$\frac{1}{2}mv^2 = \frac{1}{2}(3.34\times10^{-27}\,kg)(2.89\times10^{5}\,m/s)^2$

$= 1.4\times10^{-16}\,J$

Base your answers to questions **98** and **99** on the information below.

A roller coaster car has a mass of 290. kilograms. Starting from rest, the car acquires 3.13×10^{5} joules of kinetic energy as it descends to the bottom of a hill in 5.3 seconds.

98. Calculate the magnitude of the average acceleration of the roller coaster car as it descends to the bottom of the hill. [Show all work, including the equation and substitution with units.]

$a = \frac{\Delta v}{t} = \frac{46.4\,m/s}{5.3\,s} = 8.8\,m/s^2$

99. Calculate the speed of the roller coaster car at the bottom of the hill. [Show all work, including the equation and substitution with units.]

$KE_{bottom} = \frac{1}{2}mv^2$

$3.13\times10^{5}\,J = \frac{1}{2}(290\,kg)(v^2)$

$v = 46.4\,m/s$

100. A box at the top of a rough incline possesses 981 joules more gravitational potential energy than it does at the bottom. As the box slides to the bottom of the incline, 245 joules of heat is produced. Determine the kinetic energy of the box at the bottom of the incline.

$KE = PE_{top} - Q = 981J - 245J$
$= 736J$

101. Base your answer to the following question on the information below.

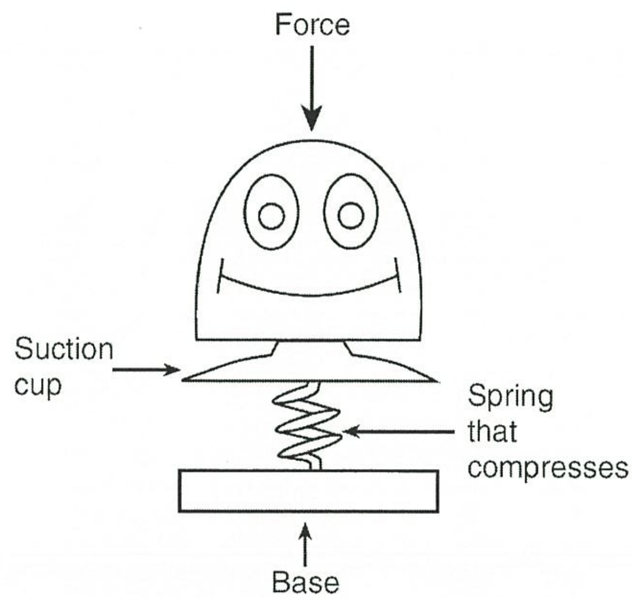
A 65-kilogram pole vaulter wishes to vault to a height of 5.5 meters.

Calculate the *minimum* amount of kinetic energy the vaulter needs to reach this height if air friction is neglected and all the vaulting energy is derived from kinetic energy. [Show all work, including the equation and substitution with units.]

$KE = PE$
$= mgh$
$= (65kg)(9.81 m/s^2)(5.5m)$
$= 3507J$

Base your answers to questions **102** and **103** on the information below.

A pop-up toy has a mass of 0.020 kilogram and a spring constant of 150 newtons per meter. A force is applied to the toy to compress the spring 0.050 meter.



102. The toy is activated and all the compressed spring's potential energy is converted to gravitational potential energy. Calculate the maximum vertical height to which the toy is propelled. [Show all work, including the equation and substitution with units.]

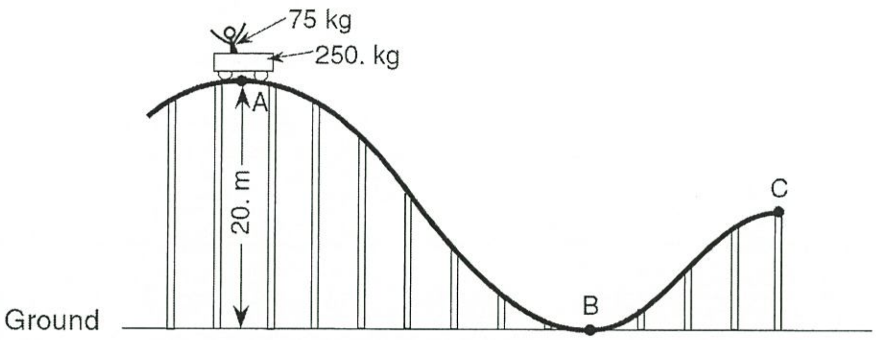
$PE_s = mgh$
$.1875J = (.02kg)(9.8 m/s^2)h$
$h = .96m$

103. Calculate the potential energy stored in the compressed spring. [Show all work, including the equation and substitution with units.]

$PE_s = \frac{1}{2}kx^2$
$= \frac{1}{2}(150 N/m)(.05m)^2$
~~.1875J~~ $= .1875J$

Base your answers to questions **104** and **105** on the information and diagram below.

A 250.-kilogram car is initially at rest at point *A* on a roller coaster track. The car carries a 75 -kilogram passenger and is 20. meters above the ground at point *A*. [Neglect friction.]



104. Compare the total mechanical energy of the car and passenger at points *A*, *B*, and *C*.

Total mechanical energy is the same at all points

105. Calculate the total gravitational potential energy, relative to the ground, of the car and the passenger at point *A*. [Show all work, including the equation and substitution with units.]

PE = mgh

= (325 kg)(9.81 m/s²)(20 m)

= 63765 J

Skills 28-32

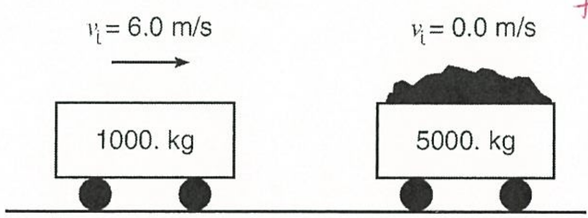
Base your answers to questions **106** through **108** on
the information and diagram below.

A 1000.-kilogram empty cart moving with a speed of 6.0 meters per second is about to collide with a stationary loaded cart having a total mass of 5000. kilograms, as shown. After the collision, the carts lock and move together. [Assume friction is negligible.]

	1 (Before)	2 (Before)	1,2 (After)
m	1000 kg	5000 kg	6000 kg
v	6 m/s	0	1 m/s
p	6000 kg m/s	0	6000 kg m/s
total	6000 kg m/s		

$KE = \frac{1}{2}mv^2$ = 18000 J

$KE = \frac{1}{2}mv^2$ 3000 J



106. How does the kinetic energy of the combined carts after the collision compare to the kinetic energy of the carts before the collision?

 KE is Less after the collision

107. Calculate the kinetic energy of the combined carts after the collision.

 $KE = \frac{1}{2}mv^2 = \frac{1}{2}(6000\,kg)(1\,m/s)^2 = 3000\,J$

108. Calculate the speed of the combined carts after the collision.

 $V = \frac{P_{after}}{m} = \frac{6000\,kg\,m/s}{6000\,kg} = 1\,m/s$