Honors

Review Problems for Energy

NAME_____ DATE_____ BLOCK___

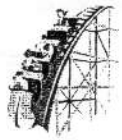
1. On a ski weekend in Colorado, Bob, whose mass is 75.0 kg, skis down a hill that is 25.0 m high. How much work is done by gravity on Bob as he goes down the hill?

$W = Fd$
$= (735N)(25m)$
$= 18{,}375\ J$

$W = mg$
$= (75\ kg)(9.8\ m/s^2)$
$= 735\ N$

Answer: 18,375 J

2. At Six Flags New England a ride called the Cyclone is a giant roller coaster that ascends a 34.1 m hill and then drops 21.9 m before ascending the next hill. The train of cars has a mass of 4727 kg. a) How much work is required to get an empty train of cars from the ground to the top of the first hill? b) How much PE is converted into KE from the top of the first hill to the bottom of the 21.9 m drop?



a. $W = Fd$
$= (46{,}325N)(34.1m)$
$= 1{,}579{,}689\ J$

$W = mg$
$= (4727\ kg)(9.8\ m/s^2)$
$= 46{,}325\ N$

b. $PE = mgh$
$= (4727\ kg)(9.8\ m/s^2)(21.9m)$
$= 1{,}014{,}509\ J$

Answer: a. 1,579,689 J

Answer: b. 1,014,509 J

3. A flea gains 1.0×10^{-7} J (or .0000001 J) of PE jumping to a height of .030 m from a dog's back. What is the mass of the flea?

$$m = \frac{PE}{gh} = \frac{1.0 \times 10^{-7} J}{(9.8 m/s^2)(.030m)}$$

Answer: 3.4×10^{-7} kg OR .00000034 kg

4. At target practice, Diana holds her bow and pulls the arrow back a distance of .30 m by exerting an average force of 40.0 N. What is the potential energy stored in the bow the moment before the arrow is released?

$PE = Fd$

$= (40.0\ N)(.30m)$

$= 12\ J$

Answer: 12 J

5. Blackie, a cat whose mass is 5.45 kg, is napping on top of the refrigerator when he rolls over and falls. Blackie has a KE of 85.5 J just before he lands on his feet on the floor. How tall is the refrigerator?

$h = \frac{KE}{mg}$

$= \frac{85.5\ J}{(5.45kg)(9.8m/s^2)}$

$= 1.60\ m$

Answer: 1.60 m

6. A .08 kg robin, perched on a power line 6.0 m above the ground, swoops down to snatch a worm from the ground and then returns to an 8.0 m high tree branch with his catch. a. By how much did the bird's PE increase in its trip from the power line to the tree branch? b. How would your answer have changed if the bird had flown around a bit before landing on the tree branch.

$PE = mgh$

$= (.08kg)(9.8m/s^2)(2m)$

$= 1.568\ J$

Answer: a. 1.568 J

Answer: b. be the same

7. From a height of 2.15 m above the floor of Boston's Fleet Center, forward Paul Pierce tosses a shot straight up next to the basketball hoop with a KE of 5.40 J. If his regulation size basketball has a mass of .600 kg, will his shot go as high as the 3.04 m hoop?

$$h_f = \frac{(KE)\ \frac{1}{2}mv_0^2 + mgh_0 - \frac{1}{2}mv_f^2}{mg}$$

$$= \frac{(5.40\ J + (.600\ kg)(9.8\ m/s^2)(2.15m) - 0)}{(.600\ kg)(9.8\ m/s^2)}$$

$$= \frac{(5.40J + 12.642J)}{5.88\ N} = \frac{18.042J}{5.88N}$$

$$3.07\ m$$

Answer: 3.07m - yes!

8. One of Johnny's chores is to shovel after it snows. a. Calculate the work needed to lift a 90 N block of ice a vertical distance of 3 m. b. What PE does it have?

$$W = Fd$$
$$= (90\ N)(3m)$$
$$= 270\ J$$

Answer: a. 270 J

Answer: b. 270 J

9. Niagara Falls is located between the United States and Canada and is a very beautiful sight. a. Calculate the change in potential energy of 8 million (8,000,000) kg of water dropping 50 m over Niagara Falls. b. Would this be a good place to build a power plant?

$$PE = mgh$$
$$= (8{,}000{,}000\ kg)(9.8 m/s^2)(50m)$$
$$= 3{,}920{,}000{,}000\ J$$

Answer: a. 3,920,000,000 J

Answer: b. yes! hydroelectric

10. a. Calculate the kinetic energy of a 3.0 kg toy cart that moves at 4 m/s. b. Calculate the kinetic energy of the same cart at twice the speed.

a. $KE = \frac{1}{2}mv^2$ ~~PE = Fd~~ oops!

$= \frac{1}{2}(3kg)(4m/s)^2$ ~~$= (40.0N)(.30m)$~~

$= 24J$ ~~$= 12J$~~

b. $KE = \frac{1}{2}mv^2$

$= \frac{1}{2}(3kg)(8m/s)^2$

$= 96J$

Answer: a. 24 J

Answer: b. 96 J

11. A 200 g ball is thrown upwards with an initial kinetic energy of 10 Joules. What maximum height will the ball attain? (neglect air resistance) *(Hint! You will need to modify one of the equations on your list to find the answer – but it should be an easy modification)*

$PE = KE \quad \therefore \quad PE = 10J$

top ↑ ↑ bottom

$200g = .200kg$

$PE = mgh$

$h = \frac{PE}{mg}$

$= \frac{10J}{(.200kg)(9.8m/s^2)}$

$= 5.1m$

Answer: 5.1 m

12. A roller coaster at the top of a 39.0 m high vertical loop is traveling 13.8 m/s. Find the speed of the cars as they move through the bottom of the loop.

$V_f = \sqrt{V_0^2 + 2g(h_0 - h_f)}$

$= \sqrt{(13.8m/s)^2 + 2g(39m - 0m)}$

$= \sqrt{190.44 m^2/s^2 + 764.4 m^2/s^2}$

$= \sqrt{954.84 m^2/s^2} = 30.9 m/s$

Answer: 30.9 m/s

13. A boulder sits at the top of a ledge. a. How many joules of PE does a 1000 N boulder have at the top of a 5 m ledge? b. If it falls, with how much KE will it strike the ground? c. What will be its speed on impact?

a. $PE = mgh$
$= (1{,}000N)(5m)$
$= 5{,}000J$

b. $PE = KE = 5{,}000J$

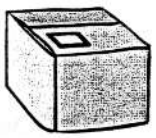
c. $V = \sqrt{2gh}$
$= \sqrt{2(9.8m/s^2)(5m)}$
$= \sqrt{98m^2/s^2}$
$= 9.9m/s$

Answer: a. 5,000J

Answer: b. 5,000J

Answer: c. 9.9 m/s

14. A pulley system is designed that allows Carl to lift a box of books that weighs 800 N by pulling on a rope with a force of 50 N. What is the mechanical advantage of this pulley system?



$M.A. = \frac{F_{out}}{F_{in}} = \frac{800N}{50N} = 16$

Answer: 16

15. If Shane exerts a force of 100 N on a simple machine that has a mechanical advantage of 12, what will the output force that the machine exerts be?

$F_{out} = MA \times F_{IN}$
$= 12 \times 100N$
$= 1200N$

Answer: 1200N

16. When opening a can of tuna, Candice does 500 J of work on a can opener. If the can opener does 350 J of work on the can of tuna, how efficient is the can opener?

$$Eff = \frac{W_{out}}{W_{IN}} = \frac{350\,J}{500\,J} = .7 \times 100\% = 70\%$$

Answer: 70%

17. You cut the lawn with a hand lawn mower. If the work done by the lawn mower in cutting the lawn is 200,000 J, and the efficiency of the lawn mower is 80%, how much work do YOU do on the lawn mower?

$$W_{IN} = \frac{W_{out}}{Eff} = \frac{200{,}000\,J}{.80} = 250{,}000\,J$$

Answer: 250,000 J

18. You do 1,500 J of work in using a hammer. The hammer does 825 J of work on a nail. What is the efficiency of the hammer?

$$Eff = \frac{W_{out}}{W_{in}} = \frac{825\,J}{1500\,J} = .55 \times 100\% = 55\%$$

Answer: 55%