Physics 432 Name Key

# Work and Energy

This worksheet was generated using questions from the www.physicsclassroom.com website. You can always reference the Work and Energy Lessons for help.

## Energy

1. Read each of the following statements and identify them as having to do with Kinetic Energy, Potential Energy or Both.

| Kinetic, Potential or Both | Statement |
|---|---|
| Kinetic | If an object is at rest it does NOT possess this form of energy. |
| Potential | Depends upon object mass and height |
| Both | The amount is expressed using the unit joule |
| ~~Potential~~ Both | If an object is at rest on the ground, it certainly does NOT possess this form |
| Kinetic | The energy an object possesses due to its motion |

2. A toy car is moving along with 0.4 J of kinetic energy. If its speed is doubled, then its new kinetic energy will be _____

   a. 0.1 J b. 0.2 J c. 0.8 J d. 1.6 J

   $\frac{1}{2}mv^2$

3. A young boy's glider is soaring through the air with a kinetic energy of 0.2 J, possessing 0.8 J of potential energy. If the wind does work to it and its speed is doubled and its height is doubled, the new potential energy would be _____ (×4 ×2)

   a. 0.2 J b. 0.4 J c. 1.6 J d. 3.2 J e. 0.8 J

   The new kinetic energy would be _____

   a. 0.2 J b. 0.4 J c. 0.8 J d. 1.6 J e. 3.2 J

4. Calculate the kinetic energy of a 5.2 kg object moving at 2.4 m/s.

   $\frac{1}{2}mv^2 = 1/2(5.2kg)(2.4m/s)^2 = 14.976\ J$

5. Calculate the potential energy of a 5.2 kg object positioned 5.8 m above the ground.

   $mgh = (5.2kg)(9.8m/s^2)(5.8m) = 295.57\ J$

6. Calculate the speed of a 5.2 kg object that possesses 26.1 J of kinetic energy.

   $KE = 1/2\ mv^2 \quad 26.1\ J = 1/2(5.2kg)\ v^2$

   $v = 3.16\ m/s$

7. If an object moves in such a manner as to conserve its total energy, then the _____.

   a. amount of kinetic energy remains the same throughout its motion
   b. amount of potential energy remains the same throughout its motion
   c. amount of both potential energy and kinetic energy remain the same throughout its motion
   d. sum of the potential energy and kinetic energy remain the same throughout its motion

8. Calculate the total energy of a 5.2 kg object moving at 2.4 m/s and positioned 5.8 m above the ground.

$TE = KE + PE$ $TE = \frac{1}{2}mv^2 + mgh$ $= 310.546\,J$

$TE = \frac{1}{2}(5.2kg)(2.4m/s)^2 + (5.2kg)(9.8m/s^2)(5.8m)$

What would be the highest height that it could reach?

$TE = PE$ $TE = mgh$ $h = 6.094m$

KE = 0 @ highest pt $310.546J = (5.2kg)(9.8m/s^2)h$

What would be the fastest speed it could have?

$TE = KE$ $TE = \frac{1}{2}mv^2$

PE = 0 @ fastest P $310.5 = \frac{1}{2}(5.2kg)v^2$ $V = 10.9m/s$

**Work**

9. Work is Force acting over some amount of distance to cause a change in energy.

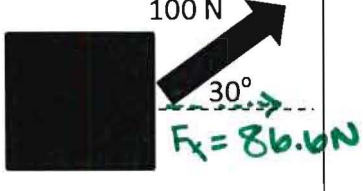
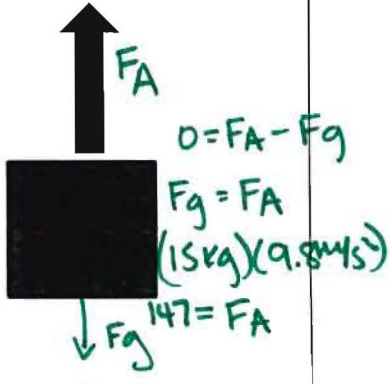
10. Indicated whether or not the following represent examples of work:

| Example | Work Done? | Explanation |
|---|---|---|
| A teacher applies a force to a wall and becomes exhausted. | NO | NO movement / displacemen |
| A waiter carries a tray full of meals across a dining room at a constant speed | NO | Force applied is at a Right angle to the displacement * Energy is NOT changed * |
| A rolling marble hits a piece of clay and moves it across the table | Yes | Force applied & displacement |
| A weightlifter lifts barbells above her head. | Yes | Force applied in same direction of displacement *Note energy has changed |

11. Which sets of units represent legitimate units for the quantity of work? Circle all correct answers.

(a.) Joule
(b.) Foot x Pound (d F)
(c.) N x m
d. Kg x m/s
e. Kg x $m/sec^2$
(f.) Kg x $m^2/sec^2$

12. For each of situation calculate the amount of work done by the applied force.

| A 100 N force is applied to move a 15 kg object a horizontal distance of 5 m. | A 100 N force is applied at an angle of 30° to the horizontal move a 15 kg a horizontal distance of 5 m. | An upward force is applied to lift a 15 kg object to a height of 5 m at a constant speed. |
|---|---|---|
|   $W = F \cdot d$ $W = 100N(5m)$ $= 500\,J$ |   $W = F_x d$ $W = (86.6N)(5m)$ $W = 433\,J$ |   $0 = F_A - F_g$ $F_g = F_A$ $(15kg)(9.8m/s^2)$ $147 = F_A$ $W = F_A \cdot d$ $W = (147N)(5m)$ $W = 735\,J$ |

13. Before beginning its initial descent a roller coaster car is always pulled up the hill to a high initial height. Work is done on the car – usually by a chain – to achieve the initial height. A coaster designer is considering three different angles at which to drag a 2000 kg car to the top of a 60 m hill. Her big question is: which angle would require the least amount of work? **NOTE:** The distance is longer for the smaller angles because this distance represents the distance the chain will be pulling on the force for.

| Angle of the Hill | Force Applied | Distance | Work |
|---|---|---|---|
| 35° | $1.5 \times 10^4$ N | 105 m | 1575000 J |
| 45° | $1.41 \times 10^4$ N | 84.9 m | 1197090 J |
| 55° | $1.64 \times 10^4$ N | 73.2 m | 1200480 J |

All should have been the same whoops!

Explain why your answer makes sense!

All will have the same potential energy at the bottom & same potential at the top. This means the same work will be done (same change in energy)

14. Determine the amount of work done in the following situations:

a. Jim Neysweeper is applying a 21.6 N downward at an angle of 57.2° with the horizontal to displace a broom a distance of 6.28 m.


$21.6 \cos 57.2° = F_x = 11.7\text{ N}$

$W = F_x \cdot d$

$W = (11.7\text{ N})(6.28\text{ m})$

$W = 73.48\text{ J}$

b. Ben Pumpiniron applies an upward force to lift a 129 kg barbell to a height of 1.98 m at a constant speed.


$0 = F_A - F_g$

$F_g = F_A$

$(129\text{ kg})(9.8\text{ m/s}^2) = F_A$

$F_A = 1.2642\text{ N}$

$W = F_A \cdot d$

$W = (1.2642\text{ N})(1.98\text{ m})$

$W = 2.5\text{ J}$