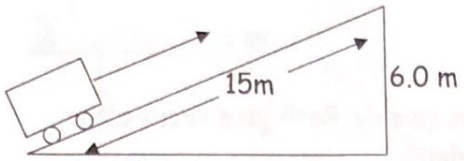
Work, Energy & Power Worksheet Key

(name)

1. If the cart goes from the bottom to the top in 60. seconds, how much power was developed?



mass 40. kg, no friction

$$P = \frac{W}{t} = \frac{mgh}{t}$$

$$= \frac{(40\,kg)(9.81\,m/s^2)(6\,m)}{60\,s}$$

P = 39 W

2. A 12 kW motor lifts a 1500 kg car 5.0 m in 15 s. Calculate the efficiency of the system.

$$Eff = \frac{P_{out}}{P_{in}} \times 100\% = \frac{\frac{mgh}{t}}{P_{in}} \times 100\% = \frac{(1500\,kg)(9.81\,m/s^2)(5\,m)}{15\,s} \times 100\%$$

$$12 \times 10^3\,W$$

Eff = 41 %

3. How much work must be done to stop a 2200kg mass travelling at 33 m/s?

$$W = \Delta E_k = \frac{1}{2}m\cancel{v_f^2}^{0} - \frac{1}{2}mv_i^2$$

$$= \frac{1}{2}(2200\,kg)(33\,m/s)^2$$

(no direction for energy)

W = 1.2×10^6 J

4. A carpenter holds a 21 kg, sheet of plywood against a 2.5m high ceiling for 35 seconds while his partner nails it in place. How much work did the carpenter do?

$$W = Fd$$

$$\uparrow$$

$$= 0m$$

W = 0 J

5. A workman on the CN Tower in Toronto dropped a 2.0 kg wrench. Given that the CN Tower is 300. m high calculate the work done by the force of gravity on the wrench.

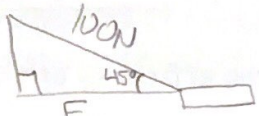
$W = mgh = (2\text{kg})(9.81\frac{\text{m}}{\text{s}^2})(300\text{m})$

W = 5.9×10^3 J

6. A job is done slowly, and an identical job is done quickly. Both jobs require the same amount of work, but different amounts of what?

Power

7. A gardener exerts a 100. N force on a lawn mower handle at a 45° angle to the horizontal. How much work is done to move it 30. m?

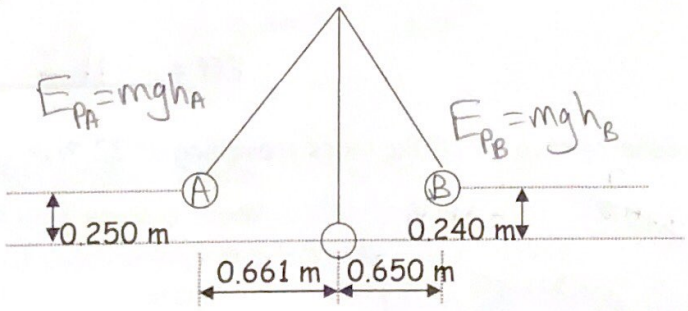


$F_x = 100\cos 45°$

$W = Fd$
$= (100\text{N}\cos 45°)(30\text{m})$

W = 2.1×10^3 J

8. A pendulum with a bob of mass 0.750 kg is initially displaced to the left as shown.



$E_{PA} = mgh_A$

$E_{PB} = mgh_B$

$E_h = E_{PA} - E_{PB}$
$= mgh_A - mgh_B$
$= (0.75\text{kg})(9.81\frac{\text{m}}{\text{s}^2})[0.25\text{m} - 0.24\text{m}]$
$= 7.36 \times 10^{-2}$ J

(a) How much heat energy is produced ~~because of friction?~~ as it swings from left to right?

H = 7.36×10^{-2} J

(b) If there were no friction, what would the speed of the bob be as it first passed through its lowest point?

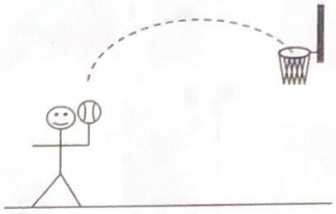
$E_p = E_k$

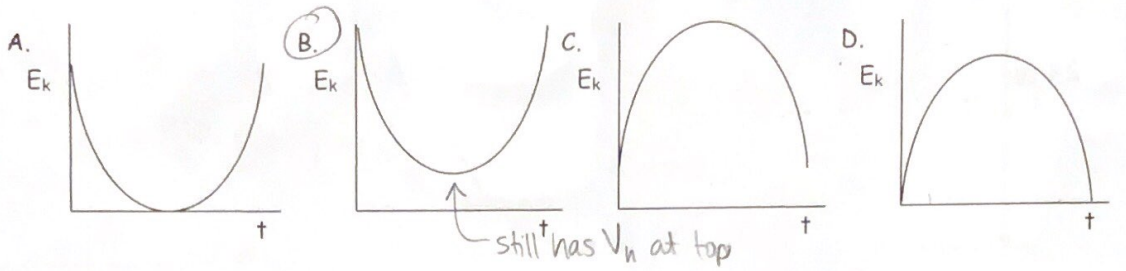
$mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh} = \sqrt{2(9.81\frac{\text{m}}{\text{s}^2})(0.25\text{m})}$

v = 2.21 m/s

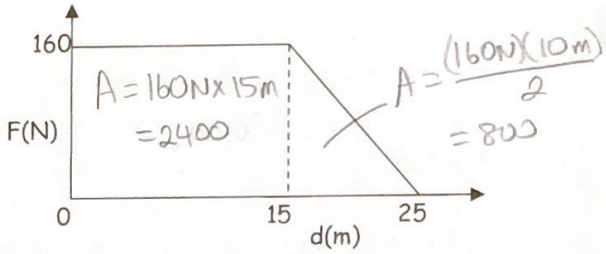
9. A basketball is thrown into the basket, as shown in the diagram below. The ball leaves the player's hand at t= 0 s and reaches the basket at t = 3 s.
Which of the following graphs best represents the ball's kinetic energy E_k, as a function of time?





10. A cyclist travelling at 10. m/s applies her brakes and stops in 25 m. The graph shows the magnitude of the braking force versus the distance travelled.

What is the total mass of bike and cyclist?



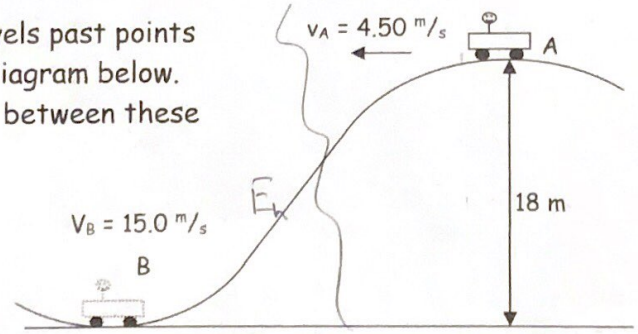
$W = Fd = \text{area} = \Delta E_k$

$3200\,J = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$m = \frac{2(3200\,J)}{(10\,m/s)^2}$

m = 64 kg

11. A 250 kg roller coaster car travels past points A and B with speeds shown in the diagram below. How much heat energy is produced between these points? (7 marks)



$E_{T_B} = E_{T_A}$

$E_h + E_{K_B} = E_{K_A} + E_{P_A}$

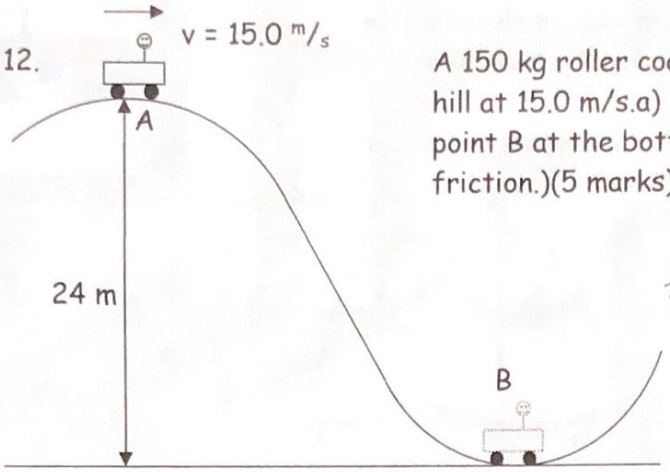
$E_h + \frac{1}{2}mv_B^2 = \frac{1}{2}mv_A^2 + mgh_A$

$E_h + \frac{1}{2}(250kg)(15m/s)^2 = \frac{1}{2}(250kg)(4.5m/s)^2 + (250kg)(9.81m/s^2)(18m)$

$E_h = 1.855 \times 10^4\,J$

Heat = 1.9×10^4 J

12.



A 150 kg roller coaster car passes the crest of a hill at 15.0 m/s.a) What is the speed of the car at point B at the bottom of the hill? (Neglect friction.)(5 marks)

$E_{TA} = E_{TB}$

$\frac{1}{2}mv_A^2 + mgh_A = \frac{1}{2}mv_B^2$

$\frac{1}{2}(15\frac{m}{s})^2 + (9.8\frac{m}{s^2})(24m) = \frac{1}{2}(v_B^2)$

$v_B =$ 26 m/s

b) i) If the mass of the roller coaster car is increased by adding a passenger, how will the speed at B now compare to your answer for part a)? (Circle one.)

(A.) equal to B. less than C. greater than (1 mark)

ii) Explain your answer using principles of physics. (3 marks)

mass cancels out so is irrelevant in this context

Answers: 1. 39 W 2. 41% 3. 1.2×10^6 J 4. 0J 5. 5.9×10^3 J 6. Power
7. 2.1×10^3 J 8. (a) 0.0736J (b) 2.21 m/s 9. B. 10. 64 kg
11. $E_{heat} = 1.9 \times 10^4$ J (19 kJ) 12 a. v = 26 m/s b.i) equal to
b.ii) Mass cancels out so is irrelevant in this case; PE (**M**gh) transferred to KE ($\frac{1}{2}$**M**v^2) - increase the mass **M**, both PE and KE increase by the same amount