Work, Power, & Energy Practice Test - Solutions

June-28-10
10:00 AM

Physics 12

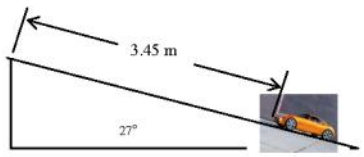
Work, Power, & Energy Test - Practice Test

Name _____

Bk. _____

27 marks

1. What is the minimum work needed to push a 2.4 kg toy car 3.45 m up a 27° incline against a total frictional force of 2.5 N? *(4 marks)*



$W = F_A \times d$

$F_A = F_{||} + F_f$

$F_{||} = mg\sin\theta$ $\quad F_f = 2.5N$

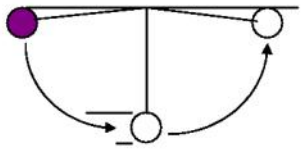
$F_{||} = 2.4 \times 9.8 \times \sin 27°$

$= 10.7\ N$

$\therefore W = (F_{||} + F_f) \times d$

$= (10.7 + 2.5)\ 3.45 = 46\ J$

2. A 3.4 m long pendulum holds a 2.0 kg steel ball. The pendulum is held horizontal and then released. What is the maximum speed of the ball? (Ignore friction forces.) *(3 marks)*



$E_p = E_k$

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

$\sqrt{2gh} = v$

$\sqrt{2 \times 9.8 \times 3.40} = v$

$8.2\ m/s = v$

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3. A 1.5 hp (1200 W) motor lifts a 450 kg load of steel to a height of 6.7 m in 28 s.

a. What is the efficiency of this motor system? *(4 marks)*

$$EFF = \frac{W_{out}}{W_{in}} \times 100$$

$$= \left(\frac{29547}{33600}\right) \times 100$$

$$= 88\%$$

① $W_{out} = E_p = mgh$

$= 450 \times 9.80 \times 6.7$

$= 29547\ J$

② $W_{in} = P \times t$

$= 1200 \times 28$

$= 33600\ J$

b. What quantity of heat energy is generated during this process? *(3 marks)*

$$Q = E_{loss} = E_{in} - E_{out}$$

$$= 33600 - 29547$$

$$= 4100\ J$$

4. An average force of 130 N is used to propel an 85 kg rider and his bike from an initial speed of 3.6 m/s to a final speed of 7. 3 m/s. How far did the bike rider travel during this motion? *(4 marks)*

$$W = \Delta E = E_{k_2} - E_{k_1}$$

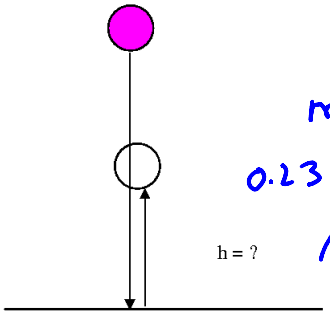
$$F \times d = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$$

$$130N \times d = \frac{1}{2} 85 \times 7.3^2 - \frac{1}{2} \times 85 \times 3.6^2$$

$$130 \times d = 2264.8 - 550.8$$

$$d = \frac{1714}{130} = 13\ m$$

5. A 0.23 kg ball falls from a height of 4.8 m and rebounds off the floor. The ball looses a total of 3.4 J of energy to heat during the whole process. How high will the ball rebound to? *(4 marks)*



$E_{T_b} = E_{T_a}$

$E_{p_1} = E_{p_2} + E_{k_2} + Q$

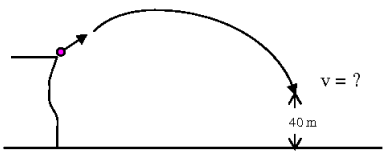
$mgh_1 = mgh_2 + \frac{1}{2}mv^2 + Q$

$0.23 \times 9.8 \times 4.8 = 0.23 \times 9.8 \times h + 0 + 3.4$

$10.82 = 2.254h + 3.4$

$h = \frac{(10.82 - 3.4)}{2.254} = 3.3\ m$

6. A 15 kg ball is projected with an initial speed of 45 m/s at an angle of 35° above the horizontal over a 220 m high cliff. **Using conservation of energy principles** determine the speed of the ball when it is only 40 m above the ground. (Ignore friction for this problem.) *(5 marks)*



$E_{T_b} = E_{T_a}$

$E_{p_1} + E_{k_1} = E_{p_2} + E_{k_2}$

$mgh_1 + \frac{1}{2}mv_1^2 = mgh_2 + \frac{1}{2}mv_2^2$

$15 \times 9.8 \times 220 + \frac{1}{2} \times 15 \times 45^2 = 15 \times 9.8 \times 40 + \frac{1}{2} 15 \times v_2^2$

$32340 + 1519 = 5880 + 7.5 v_2^2$

$\frac{41647 - 5880}{7.5} = v^2$

$74.5\ m/s = v$