Year 11 Physics Worksheet Work, Energy and Momentum

- 1. $K = \frac{1}{2}mv^2 = \frac{1}{2} \times 1200 \times (15^2) = 135000 \text{ J}$ The car has $1.4 \times 10^5 \text{ J}$ of kinetic energy. (2 s.f.)
- 2. First find the weight of the object: $F = mg = 200 \times 9.8 = 1960$ N s = 4.00 m $\theta = 0^{\circ}$ $W = F s \cos \theta = 1960 \times 4.00 \times \cos (0) = 7840$ J Lifting the object to 4 m would take 7.84×10^3 J of energy (work). (3 s.f.)
- 3. $7.84 \times 10^3 \text{ J}$
- 4. $7.84 \times 10^3 \text{ J}$

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

$$\therefore v^{2} = \frac{K}{\frac{1}{2}m}$$

$$\therefore v = \sqrt{\frac{K}{\frac{1}{2}m}} = \sqrt{\frac{7.84 \times 10^{3}}{\frac{1}{2} \times 200}} = 8.85$$

The object's speed is 8.85 ms⁻¹ on impact. (3 s.f.)

- 5. It was never lost, it just changed form (from work to potential energy to kinetic energy).
- 6. F = 25000 N s = 1000 m $\theta = 15.00^{\circ}$ $W = F s \cos \theta = 25000 \times 1000 \times \cos(15.00^{\circ}) = 2.4148 \times 10^{7} \text{ J}$ Each tugboat does $2.415 \times 10^{7} \text{ J}$ of work. (4 s.f.)



So the magnitude of change in velocity is $\Delta v = \sqrt{5^2 + 5^2} = 7.07 \text{ ms}^{-1}$ {using pythagoras}

The change in velocity of the ball is 7 ms⁻¹ away from the wall.

The magnitude of change in momentum of the ball is $7 \times 1 = 7$ kg ms⁻¹ So the change in momentum of the ball is 7 kg ms⁻¹ away from the wall.

$$\vec{F} = \frac{\Delta \vec{p}}{\Delta t} = \frac{7}{0.1} = 70 \text{ N}$$

The wall exerts 70 N to the left on the ball. The ball exerts 70 N to the right on the wall.

8. (a) p = mv

 $p_{initial} = 6 \times 1 = 6 \text{ kg ms}^{-1}$ $p_{final} = (6+2) \times v$ $\therefore 8v = 6 \quad \{\text{conservation of momentum says that } p_{initial} = p_{final} \}$ $\therefore v = \frac{6}{8} = 0.75 \text{ ms}^{-1}$

The velocity of the large fish after lunch is 0.8 ms⁻¹ in the same direction it was going originally.

(b) Initial kinetic energy:

 $K_{bigfish} = \frac{1}{2}mv^2 = \frac{1}{2} \times 6 \times 1^2 = 3 \text{ J}$ $K_{smallfish} = 0 \text{ J} \quad (\text{it is at rest})$ $K_{TOTAL} = 3 + 0 = 3 \text{ J}$ Final kinetic energy: $K_{combinedfish} = \frac{1}{2}mv^2 = \frac{1}{2} \times (6 + 2) \times (0.75)^2 = 2.25 \text{ J}$

The total kinetic energy went down from 3 to 2.25, so the collision is inelastic because kinetic energy changed into something else.

9.

To conserve momentum, the total momentum of the puck and octopus before the collision must be the same as the total momentum afterwards, so:



Using pythagoras: $p_{final} = \sqrt{4.03^2 + 2.65^2} = 4.82 \text{ kg ms}^{-1} \{\text{using pythagoras}\}$

Assuming the octopus and hockey puck stick together, they will have a final magnitude of momentum of 4.82 kg ms^{-1} (3 s.f.)