Year 11 Physics Solutions: Energy and Momentum Test

1.

(a) $W = Fs = 5.6\times10^{2}\times154 = 8.6\times10^{4}$ J

(b) $P = \frac{W}{t} = \frac{8.6\times10^{4}}{182} = 4.7\times10^{2}$ W

(c) $efficiency = \frac{power\ out}{power\ in}\times100$

$= \frac{4.7\times10^{2}}{1.0\times10^{3}}\times100$

$= 47$ %

2. $K = \frac{1}{2}mv^{2} = \frac{1}{2}\times4.6\times10^{3}\times11^{2} = 2.8\times10^{5}$ J

3.

(a) $E_p = mgh = 1\times9.8\times2 = 20$ J (1 s.f.)

(b) 20 J since energy is conserved, it changed form from work to gravitational potential.

(c) It converts to kinetic energy.

4.

a) $\vec{F} = \frac{\Delta\vec{p}}{\Delta t}$

$\therefore \Delta\vec{p} = \vec{F}\Delta t = 37\times0.52 = 1.924\times10^{1}$ kgms^{-1}

$\Delta\vec{p} = \vec{p}_f - \vec{p}_i$

$\therefore \vec{p}_f = \Delta\vec{p} + \vec{p}_i = 1.924\times10^{1} + 0 = 1.924\times10^{1}$ kgms^{-1}

The final magnitude of momentum of the skateboarder is 19 kgms^{-1} (2 s.f.)

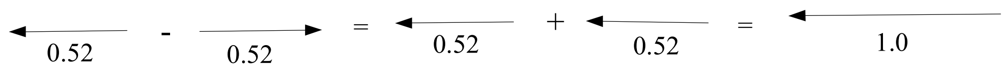
b) Momentum must be conserved so the trolley has equal change in the opposite direction.

Therefore the final magnitude of momentum of the trolley is 19 kgms^{-1} (2 s.f.)

5.

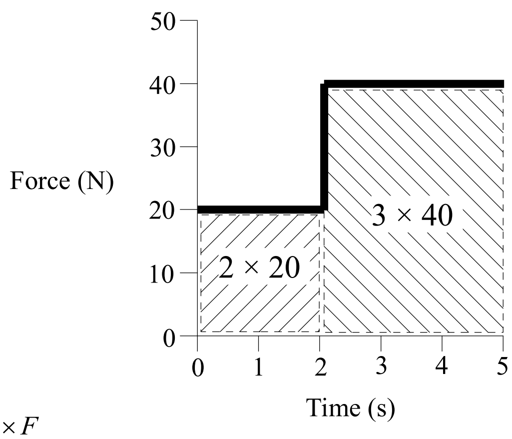
$p = mv = 0.12\times4.3 = 0.52$ kg ms^{-1}

$\Delta\vec{p} = \vec{p}_f - \vec{p}_i =$



The change in momentum of the ball is 1.0 kg ms^{-1} away from the wall.

6.



$\Delta p = \Delta t\times F$

$= 2\times20 + 3\times40 = 160$ kg m/s

7.

(a) $p = mv$

$= 0.013 \times 91$

$= 1.2 \text{ kgms}^{-1}$

Momentum is conserved $\therefore$ total final momentum is 1.2 kgms^{-1}

$$v = \frac{p}{m} = \frac{1.2}{1.313} = 0.90 \text{ ms}^{-1}$$

(b) $K_i = \tfrac{1}{2} m_i v_i^2$ $\quad$ $K_f = \tfrac{1}{2} m_f v_f^2$

$= \tfrac{1}{2} \times 0.013 \times 91^2$ $\quad$ $= \tfrac{1}{2} \times 1.313 \times 0.9^2$

$= 54 \text{ J}$ $\quad$ $= 0.53 \text{ J}$

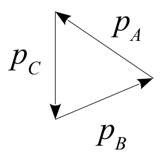
The collision is inelastic as there is less kinetic energy after the collision.

8.

(no single right answer)

BONUS:

Momentum is conserved so $\vec{p}_A + \vec{p}_B + \vec{p}_C = 0$



$p_A = m_A v_A = 0.25\times36 = 9.0 \text{ ms}^{-1}$

$p_B = m_B v_B = 0.20\times45 = 9.0 \text{ ms}^{-1}$

$p_C = m_C v_C = 0.30\times30 = 9.0 \text{ ms}^{-1}$

The triangle is equilateral (all sides same length) so the angle in the triangle is 60°.
Therefore pieces A and B are 120° from each other.