Work, Energy and Power - Mark Scheme

Q1.

Question Number	Answer	Mark
	Either (1) • Use of $\sin\theta = \frac{2.0}{15}$ **Or** use of $\theta = 7.7\,°$ (1) • Use of Work done = $F\Delta s$ **Or** use of $E_{grav} = mg\Delta h$ (1) • Use of efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ ($\times$ 100 %) (1) • Efficiency = 83 or 84 % so less than 90 % (MP4 dependent on scoring all points MP1& 2 &3) <u>Example of calculation</u> (1) $\sin^{-1}\left(\frac{2.0}{15}\right) = 7.7\,°$ (1) $W_{50} = 50\text{ kg} \times 9.81\text{ N kg}^{-1} \times 2.0\text{ m} \times \frac{2.0}{15} = 130.8\text{ J}$ (1) $W_8 = 8.0\text{ kg} \times 9.81\text{ N kg}^{-1} \times 2.0\text{ m} = 157.0\text{ J}$ (1) Efficiency = $\frac{130.8\text{ J}}{157.0\text{ J}} \times 100\,\% = 83\,\%$	4
	Total for question	**4**

Q2.

Question Number	Answer	Mark
	C is the correct answer as 1 kWh = 1000 W × 3600 s = 3.6× 10^6 J A is not the correct answer as 0.28 J= $\frac{1000\text{ W}}{3600\text{ J}}$ B is not the correct answer as 0.28 W= $\frac{1000\text{ W}}{3600\text{ J}}$ and the unit should be J and not W D is not the correct answer as the unit should be J and not W.	**(1)**

Q3.

Question Number	Answer	Mark
	C is the correct answer as efficiency = $\frac{\text{useful energy output}}{\text{total energy input}} = \frac{200\text{ N} \times 4\text{ m}}{90\text{ N} \times 10\text{ m}}$ A is not the correct answer as this is the total energy input divided by the useful energy output B is not the correct answer as this is the useful energy output divided by the total of the energy output and the energy input D is not the correct answer as this is the total energy input divided by the total of the energy output and the energy input	**(1)**

Q4.

Question Number	Answer	Mark
	A is the correct answer as E_{grav} decreases at an increasing rate as the ball accelerates towards the ground and increases at a decreasing rate as the ball decelerates away from the ground after the bounce B is not the correct answer as E_{grav} increases as the height of the ball above the ground decreases and decreases as height of the ball above the ground increases. C is not the correct answer as the graph does not show the change in as E_{grav} at an increasing and decreasing rate as in response A, as the height of the ball above the ground changes D is not the correct answer as E_{grav} increases as the height of the ball above the ground decreases and decreases as the height of the ball above the ground increases.	**(1)**

Q5.

Question Number	Answer	Mark
	The only correct answer is B as power output = kinetic energy per second of the ejected water. $P = \frac{\frac{1}{2} \times 0.2\ kg \times (3\ m\ s^{-1})^2}{1\ second} = \frac{0.2 \times 3^2}{2}$ **A** *is not the correct answer because the mass has not been converted into kg which is required for a power in watts.* **C** *is not the correct answer because the mass is in g and the velocity has not been squared* **D** *is not the correct answer because the velocity has not been squared*	**(1)**

Q6.

Question Number	Answer	Mark
(a)	• Use of $v^2 = u^2 + 2as$ AND $u = 0$ **Or** $mgh = ½mv^2$ (1) • $v = 3.4$ (m s^{-1}) (1) Example of calculation $v^2 = 2 \times 9.81$ m s^{-2} $\times$ 0.60 m $v = \sqrt{11.77}$ m s^{-1} $v = 3.43$ m s^{-1}	**(2)**
(b)	• Horizontal 3.4 × sin 70° **Or** 3.4 × cos 20° **Or** calculated value. (1) • Vertical 3.4 × cos 70° **Or** 3.4 × sin 20° 1.16 **Or** calculated value. (1) Allow e.c.f. from part (a)	**(2)**

(c)	Use of $v = s/t$ to determine time to end of ramp (0.38 s). • Use of $s = ut - ½ g t^2$ to determine drop in altitude after time t (0.27 m). (1) • Ball does not bounce on the ramp. (1) • Justifies conclusion from numbers calculated. e.g. $0.86 - 0.27 > 0.00$ means has not reached ground by end of ramp. (1) <u>Example of calculation</u> (1) $t = \frac{1.23\ \text{m}}{3.4\ \text{m s}^{-1} \times \sin 70°}$ $t = 0.39$ s $s = (3.4\ (\text{m s}^{-1}) \times \cos 70° \times 0.39\ \text{s}) + (½ \times (-9.81\ \text{m s}^{-2}) \times (0.39\ \text{s})^2)$ $s = -0.28$ m	

	Or • Use of $s = ut - ½ g t^2$ to determine time to $s = -0.86$ • Use of $s = vt$ to calculate s (1) • Ball does not bounce on the ramp. (1) • Justifies conclusion from numbers calculated. e.g. $1.23 < 1.79$ (1) **Or** (1) • Use of $v = u - gt_1$ with $v = 0$ to get time to max height (0.12s) **and** use of $s = ½ g t_1^2$ to get gain in height (0.07m) **and** use of $s = ut + ½ g t_2^2$ with $u = 0$ and $s = 0.93$ to get time from there to the ground (0.44s) Total time $t = t_1 + t_2$. (1) • Use of $s = vt$ to calculate s (1) • Ball does not bounce on the ramp. (1) • Justifies conclusion from numbers calculated. e.g. $1.23 < 1.79$ (1)	**(4)**

Q7.

Question Number	Answer	Mark
	D is the correct answer A is not the correct answer as it gives units of J^{-1} which is not a unit for energy. B is not the correct answer for the same reason that A is not. C is not the correct answer as $68 \neq 68\%$.	**(1)**

Q8.

Question Number	Answer		Mark
	Horizontal force/component = $F\cos\theta$	(1)	
	Work done = $F_H \times s$ **Or** Work done = $F\cos\theta \times s$	(1)	
	As θ increases, $\cos\theta$ / F_H / $F\cos\theta$ decreases so work done decreases. **Or** As θ decreases, $\cos\theta$ / F_H / $F\cos\theta$ increases so work done increases.	(1)	**(3)**
	Total for question		**3**