Name: _____

Power

Questions

Date:

Time:

Total marks available: 56

Total marks achieved: _____

Mark Scheme

Q1.

Question Number	Answer	Mark
	D	**1**

Q2.

Question Number	Answer	Mark
	B	1

Q3.

Question Number	Answer	Mark
	D	**1**

Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of efficiency = output energy / input energy (1) • With energy output = load × change in height (1) • Energy input = IVt (1)	May be answered in terms of power For MP1 & MP2 accept electrical energy for energy input and work done/GPE for energy output Answers can be in terms of headings from table or cell numbers or values Example of calculation ΔE_{grav} = 4.00 N × 0.825 m = 3.30 J W = 2.1 A × 4.3 V × 2.19 s = 19.8 J Efficiency = $\frac{3.30\text{ J}}{19.8\text{ J}}$ = 0.167	3

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• Use of $P = VI$ **Or** use of $\triangle E_{grav} = mg\triangle h$ **(1)** • Use of efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ **(1)** • Efficiency = 0.75 to 0.78 (or 75 % to 78%) **(1)**	Accept use of efficiency $= \frac{\text{useful energy output}}{\text{total energy input}}$ with corresponding times Example of calculation $P_{motor} = (85 \times 10^{-3})$ A × 3.0 V = 0.255 W P_{block} = 0.05 kg × 9.81 N kg^{-1} × 0.40 m s^{-1} = 0.196 W Efficiency = $\frac{0.196\text{ W}}{0.255\text{ W}}$ = 0.77 (no unit)	**3**

Q6.

Question Number	Answer	Mark
	Use of $W = VIt$ **(1)** W = 69 000 (J) **(1)** Use of efficiency = (useful energy / total energy) (x 100%) **(1)** Efficiency = 0.42 (or 42%) **(1)** **Or** Use of $P = IV$ **(1)** Use of $P = W/t$ (to calculate rate of increase of internal energy of water) **(1)** Use of efficiency = (output power / input power) (x 100%) **(1)** Efficiency = 0.42 (or 42%) **(1)** Example of calculation W = 5.0 A × 230 V × 60 s = 69 000 J Efficiency = 29 000 J / 69 000 J = 0.42	**4**

Q7.

Question Number	Answer	Mark
(a)	The balloon has the maximum/greatest speed/velocity **Or** the greatest distance is covered in the shortest/same time **(1)**	**1**

Question Number	Answer		Mark
(b)	Use of $\Delta E_{grav} = mg\Delta h$ (with a Δh and not just h)	(1)	
	Use of average rate of energy transfer $= \frac{\text{energy}}{0.15\ s}$ (do not penalise power of ten errors for MP2)	(1)	
	Average rate of energy transfer = 0.18 – 0.19(W)	(1)	3
	Example of calculation $\Delta E_{grav} = 0.004\ \text{kg} \times 9.81\ \text{N kg}^{-1} \times (1.8\ \text{m} - 1.1\ \text{m}) = 0.027\ \text{J}$ Average rate of energy transfer $= \frac{0.027\ \text{J}}{0.15\ s} = 0.18\ \text{W}$		

Q8.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of $\cos\theta$ = vertical force ÷ applied force	(1)	Example of calculation $\cos\theta = 50\ \text{N} \div F$ $F = 55.2\ \text{N}$	
	• Answer 55 N	(1)		2

Question Number	Acceptable answers		Additional guidance	Mark
(ii)	• Correct use of trigonometrical function to determine force in direction of motion	(1)	MP3 allow ecf from (b)(i)	
	• Use of $W = Fs$ **and** $P = W/t$ **Or** use of $v = s/t$ **and** $P = Fv$	(1)	Example of calculation $F = 55.2\ \text{N} \times \sin 25° = 23.3\ \text{N}$ $P = \frac{23.3\ \text{N} \times 15\ \text{m}}{4.2\ s}$ $= 83.2\ \text{W}$	
	• $P = 83$ W	(1)		3

Q9.

Question Number	Acceptable Answers	Mark
(a)(i)	Energy = power × time **Or** power = $\frac{\text{energy}}{\text{time}}$ **Or** see 4.2 × 0.4 **(1)** Energy = 1.7 (J) **(1)** Example of calculation Energy = 4.2 W × 0.4 s Energy = 1.68 (J)	**2**

Question Number	Acceptable Answers	Mark
(a)(ii)	Use of $E_k = ½ mv^2$ **(1)** v = 5.9 / 6.0 ms^{-1} (ecf) **(1)** Example of calculation $v = \sqrt{\frac{2 \times 1.68\ \text{J}}{0.095\ \text{kg}}}$ v = 5.9 m s^{-1}	**2**

Question Number	Acceptable Answers	Mark
(a)(iii)	Energy is dissipated to heat **Or** work is done against friction **Or** not all the energy becomes kinetic energy **Or** air resistance on car **Or** friction between car/wheels/pin and track **Or** resistance in motor **(1)**	**1**

Question Number	Acceptable Answers	Mark
(b)	No resistant force is acting on the car **(1)** (do not credit use of external force) (Car) continues moving: in a straight line **Or** in same direction **Or** with same velocity. **(1)**	**2**
	Total for question	**7**

Q10.

Question Number	Answer		Mark
(a)	Use of power = intensity x area Use of time = energy / power Time = 19 s Example of calculation $P = 8000\ \text{W m}^{-2} \times 1.5 \times 10^{-5}\ \text{m}^2$ $= 0.12\ \text{J s}^{-1}$ $t = 2.3\ \text{J} \div 0.12\ \text{J s}^{-1}$ $= 19\ \text{s}$	(1) (1) (1)	3
(b)(i)	Use of $E = IVt$ Energy = 19 000 J (2 sf)(no ue) Example of calculation $E = 1.4\ \text{A} \times 3.7\ \text{V} \times (60 \times 60)\ \text{s}$ $= 18\ 648\ \text{J}$	(1) (1)	2
(b)(ii)	Energy required = 210 x 2.3 J Use of efficiency = output energy / input energy Efficiency = 0.026 or 2.6% Example of calculation efficiency = $210 \times 2.3\ \text{J} \times 100\ \% \div 19\ 000\ \text{J}$ $= 0.026$ or 2.6%	(1) (1) (1)	3
	Total for question		8

Q11.

Question Number	Answer		Mark
(a)(i)	Use of $P = IV$ Power = 2900 W Example of calculation Power = $12.5\ \text{A} \times 230\ \text{V} = 2875\ \text{W}$	(1) (1)	2
(a)(ii)	$P = E/t$ Energy = 400 000 J (ecf from (i)) Example of calculation Energy = $2875\ \text{W} \times 140\ \text{s} = 402\ 500\ \text{J}$	(1) (1)	2
(a)(iii)	Use of efficiency = useful energy output / total energy input = 0.87 or 87% (ecf from (ii)) (do not award if > 100%) Example of calculation Efficiency = 351 000 J / 402 500 J = 0.87 or 87%	(1) (1)	2
(b)	Some energy transferred by heating the kettle / element / wires / surroundings **Or** Some energy transferred as sound So not all of the (input) energy is transferred to (heating) the water **Or** so useful energy output is less than energy input **Or** only the energy heating the water is useful	(1) (1)	2
	Total for question		8

Q12.

Question Number			Mark
(a) (i)	Use of equation of motion suitable for a, e.g. $v = u + at$	(1)	
	a = 16.3 m s^{-2} (2.1 ×10^5 km h^{-2} or 58.7 km h^{-1} s^{-1})	(1)	**2**
	Example of calculation $a = \frac{37.5 \text{ m s}^{-1} - 0}{2.3 \text{ s}}$ a = 16.3 m s^{-2}		
(a) (ii)	Use of $E_k = ½ mv^2$	(1)	
	Use of $P = E/t$	(1)	
	Power = 3.1×10^6 W	(1)	
	Or		
	Use of $F = ma$ (must be a from (i)) **and** Use of equation to find distance **and** use of work done = Fd	(1)	
	Use of $P = E/t$	(1)	
	Power = 3.1 × 10^6 W	(1)	**3**
	(distance = 43 m)		
	Examples of calculations E_k = ½ × 10 000 kg × (37.5 m s^{-1})^2 = 7.03 ×10^6 J Power = 7.03 × 10^6 J / 2.3 s = 3.1 × 10^6 W		
(a) (iii)	Energy transferred by heating **Or** energy transferred due to friction **Or** work done against friction **Or** idea that more energy required (due to energy transfer) due to friction.	(1)	**1**
	(do not accept 'lost' but accept air resistance as an alternative to friction)		
***(b)**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate)		
	larger force is needed **Or** the (same) force is insufficient	(1)	
	need same acceleration/ (max) velocity **OR** acceleration/(max) velocity is too small	(1)	
	more energy needed (to reach top) **Or** insufficient energy (to reach top)	(1)	**3**
(c)	Viscosity of oil decreases (with increasing temperature) **Or** the (warm) oil is less viscous	(1)	
	(accept a reverse argument e.g. when cold oil is more viscous)		
	Lower frictional/resistive force **Or** less viscous drag	(1)	**2**
	Total for question		**11**