Mark Scheme

Q1.

Question Number:	Answer	Additional Guidance	Mark
	an explanation linking: over the **same time / in 300s**, more work done / energy transferred in session 1 than in session 2 (1) (therefore) more power (developed) in session 1 (1)	allow reverse argument power in session 1 = $\frac{45.2}{300}$ = 0.15 (kW) or 150(W) allow statement that power = work / time or power = energy(transferred) / time for MP1 power in session 2 = $\frac{37.9}{300}$ = 0.13 (kW) or 126(W)	**(2)** AO 3 2a AO 3 2b

Q2.

Question Number:	Answer	Mark
(i)	efficiency = **useful** (energy transferred by the device) (x100) / total (energy supplied to the device)	**(1)** AO 1 1

Question Number:	Answer	Additional guidance	Mark
(ii)	determine useful energy (1) 7500 -3200 = 4300		**(1)** AO 2 1

Question Number:	Answer	Additional guidance	Mark
(iii)	substitution (1) efficiency = $\frac{4300}{7500}$ evaluation (1) 0.57	 allow ECF from (i) and/ or (ii) for 1 mark maximum accept 57(.33)(%), 0.6, 60(%) award full marks for the correct answer without working	**(2)** AO 2 1

Q3.

Question Number	Answer	Acceptable answers	Mark
(i)	20 (J)	200 – 180 (even if calculated value from this is incorrect)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	(changed to) {thermal energy / heat}	dissipated (lost) to {surroundings / motor / air / atmosphere} sound / noise **reject** if kinetic, light or chemical is mentioned	**(1)**

Question Number	Answer	Acceptable answers	Mark
(iii)	 $\frac{180}{200} \times 100$ (1) 90 (%) (1)	award full marks for correct answer with no working $\frac{180}{200}$ 0.9, 9/10 Or [100 – (20/200)] % not needed but if a unit is given then maximum score is 1	**(2)**

Q4.

Question Number	Answer	Additional guidance	Mark
(i)	(In every second), distance moved by chain around large gear = distance moved by chain around small gear (1) 2 x 48 = turns x 12 rearrangement and evaluation (1) 8 (turns each second)	accept use of gear ratio seen or implied e.g. 4:1 or 4/1 or 48:12 or 48/12 or converse e.g. 1:4 award full marks for the correct answer without working	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking reduces friction/amount of thermal energy transferred (1) extra useful energy is available/less input energy is required (1) efficiency = useful energy transferred (by the bicycle) ÷ total energy supplied (to the bicycle) (1)	 (oil provides) lubrication less energy wasted allow for the last **two** mark points; **either** less input energy is required to produce the same output for **2** marks **or** more output energy is available for the same input energy for **2** marks	(3)

Q5.

Question Number	Answer	Additional guidance	Mark
(i)	recall (1) (P =) $\frac{E}{t}$ substitution and evaluation (1) (P=) 75 (W)	P = work done ÷ time P = $\frac{45}{0.6}$ award full marks for the correct answer without working	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	substitution into E = $\frac{1}{2} \times k \times x^2$ (1) $45 = \frac{1}{2} \times 140 \times x^2$ rearrangement (1) $(x =) \sqrt{\frac{2 \times 45}{140}}$ evaluation (1) 0.8(0) (m)	allow substitution and rearrangement in either order $x^2 = (\frac{E}{0.5k} =) \frac{2 \times 45}{140}$ $x^2 = 0.64(28571)$ accept values that round to 0.80 e.g. 0.80178 award full marks for the correct answer without working	(3)

Q6.

Question Number:	Answer	Additional Guidance	Mark
(i)	recall efficiency equation (1) $\text{efficiency} = \frac{\text{useful output}}{\text{input}}$ rearrangement (1) output energy = 0.70 x 6500 recall power equation (1) $\text{power} = \frac{\text{energy}}{\text{time}}$ evaluation (1) (power =) 76 (kW)	$\text{efficiency} = \frac{\text{power output}}{\text{power input}}$ 4550 (kJ) seen scores 2 marks (from 0.7 x 6500 (kJ)) $\frac{4550}{60}$ accept ecf from output energy accept values that round up to 76 (kW) e.g. 75.8 award full marks for correct answer without working	**(4)** AO 1 1 AO 2 1

Question Number:	Answer	Additional Guidance	Mark
(ii)	an explanation linking: (useful) output energy is less than input energy (1) some energy is transferred to less useful forms (1)	input energy is greater than output energy (only) 70% of the input energy is useful energy is dissipated / wasted / lost (to surroundings) energy is lost / transferred as thermal / heat 30% is lost /dissipated / wasted / lost for 2 marks	**(2)** AO 1 1

Q7.

	Answer	Acceptable answers	Mark
(i)	An explanation linking • 60 % of {total/electrical/input/output} energy (is used/transferred) (1) • into/is kinetic/useful energy (1) If no other marks scored accept: 60% (of the energy produced by the motor) is useful/40% is wasted for 1 mark	**Accept reverse argument ie** 40 % of {total/electrical/input/output} energy (is/transferred) into/lost as/thermal (heat)/waste energy	**(2)**
(ii)	☒ **B** energy		**(1)**
(iii)	substitution 20 × 15 (1) evaluation 300 (J) (1) If no other mark scored award 1 mark for correct transposition ie E= P × t Ignore any unit given by candidate	Power of 10 error maximum of 1 mark eg 300 000 (J) gains 1 mark Give full marks for correct answer, no working	**(2)**
(iv)	substitution 18 ÷ 24 (× 100) (1) evaluation 0.75 or 75% (1) Ignore any unit given by candidate	Power of 10 error maximum of 1 mark give full marks for correct answer, no working	**(2)**

Q8.

Question Number	Answer	Acceptable answers	Mark
(a)	A transverse and electromagnetic		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	Evaluation 171.5 (1) Substitution (34.3/171.5) x 100 (1) Evaluation 20 (%) (1)	award full marks for correct answer with no working 34.3 x 5 [34.3 /(34.3 x 5)] x 100 [34.3 /(34.3 x 5)] [34.3 /171.5] Allow 0.2 or 1/5 for 3 marks	**(3)**

Question Number	Answer	Acceptable answers	Mark
(c)	rate of {energy/heat} (from the Sun){absorbed/taken in} (1) equals rate of {energy/heat} {radiated/emitted/given out}(1)	Allow 'energy in = energy out' for 1 mark 'power in = power out' for 2 marks	**(2)**

Q9.

Question Number:	**Answer**	**Mark**
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative (example) content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content • Description of an experiment which will allow work done over a given time to be measured. • E.g. running upstairs, step-ups, lifting weights • Apparatus to be used, weighing scales, known weights ruler, stop clock • Measurements to be made • E.g. weight of person/weights lifted, vertical distance moved, time taken. • Calculation of work done for each student using work done =force x distance moved in direction of force • Calculation of power for each student using power=work done/time taken Comparison of powers by lifting same weights, in a constant time and comparing the distance moved	**(6)** AO 2 2

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	• The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	• The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Q10.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	C - power		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	energy work	Must be in correct order	**(1)**

Question Number	Answer	Acceptable answers	Mark
a(iii)	Substitution 50 x 4 (1) Evaluation 200 (kg m/s) (1)	 Allow full marks for correct answer with no working shown	**(2)**

Question Number	Answer	Acceptable answers	Mark
a(iv)	Substitution 450 / 1.5 (1) Evaluation 300 (N) (1)	 Allow full marks for correct answer with no working shown Allow (1) for 167 (N) obtained by 450-200 / 1.5	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(v)	An explanation to include (quantity has) a size and a direction	ignore any named examples	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation which uses conservation of momentum to link three from Mother and daughter have different mass (1) Momentum is conserved / is zero to start with (1) Both have same size momentum (after the push) (1) so speed of the daughter is greater than that of the mother (1)	An explanation based on Newton's laws and linking three from Each have a different mass (1) Each experience the same size force / action and reaction are equal (1) Each experiences a different acceleration (1) so speed of the daughter is greater than that of the mother (1)	**(3)**

(Total for Question = 10 marks)