

Mark Scheme

Q1.

Question Number	Answer	Additional guidance	Mark
	an explanation linking use of lubrication / oil (1) to reduce friction (between parts) (1)		(2) AO 2 1

Q2.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) ($\Delta GPE =$) $64 \times 10 \times 24$ evaluation (1) 15 000 (J)	accept 15 360(J) or 15 400(J) award full marks for correct answer without working.	(2) A02

Question number	Answer	Additional guidance	Mark
(ii)	substitution (1) ($KE =$) $\frac{1}{2} \times 64 \times 6^{(2)}$ calculation of 6^2 (1) evaluation (1) 1200 (J)	accept 1152(J) award full marks for correct answer without working. 192 (J) scores 2 marks	(3) A02

Question number	Answer	Additional guidance	Mark
(iii)	<p>an explanation linking any two from:</p> <p>the kinetic energy (store)/it decreases (to zero) (1)</p> <p>(the energy) has dissipated (1)</p> <p>to the surroundings (1)</p> <p>thermal energy (store) increases (1)</p>	<p>transferred</p> <p>to ground/brake(s) pads</p> <p>make the brakes hot</p>	(2) AO2

Q3.

Question Number	Answer	Additional guidance	Mark
(i)	1840 (J) (1)		(1)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>substitution (1)</p> <p>(efficiency =) $\frac{160}{2000}$</p> <p>evaluation (1)</p> <p>0.08 OR 8 (%)</p>	<p>Ignore any units</p> <p>award full marks for the correct answer without working</p>	(2)

Question Number	Answer	Additional guidance	Mark
(iii)	reference to : thermal (energy) (1) OR (lost to) environment /surroundings/dissipated (1) OR transferred/changed to another form of energy (1)	IGNORE gets re-used / recycled heat OR (to) atmosphere / (to) the air /sky/ steam accept named form of energy	(1)

Question Number	Answer	Additional guidance	Mark
(iv)	an answer that makes reference to any two from produces/ releases/makes/gives off carbon dioxide / CO ₂ /greenhouse gases (1) produces carbon monoxide / CO (1) produces air pollution (1) produces sulphur dioxide/ SO ₂ (1) produces soot /smoke (1) mining coal (1)	IGNORE unqualified pollutes/pollution IGNORE ozone layer IGNORE non-renewable IGNORE 'fumes' (causes) greenhouse effect OR contributes to global warming/climate change allow CO ₂ causes carbon monoxide poisoning accept (harmful) particles /dust causes <u>acid rain</u> blackens/ stains buildings/statues slag heaps/ mining damages the landscape/habitats/ecosystem OR ground needs to be dug up	(2)

Question number	Answer	Additional guidance	Mark
(i)	Substitution (1) PE = $7.26 \times 10 \times 1.3$ Answer (1) 94.4 (J)		(2)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): <ul style="list-style-type: none"> (energy stored changes between) gravitational potential energy, kinetic energy (1) Potential energy increases as it rises / decreases as it falls. (1) 	Ignore reference to energy change after hitting the ground (eg sound / heat)	(2)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	5000(J)	24 000 – 19 000	(1) AO2

Question number	Answer	Additional guidance	Mark
(ii)	substitution (1) (efficiency =) $\frac{19000}{24000} (x100\%)$ evaluation(1) 0.79 or 79%	allow 0.8 do not award 79 without percentage award full marks for correct answer without working.	(2) AO2

Q6.

	Answer	Additional guidance	Mark
	substitution (1) $(\Delta GPE =) 57 \times 10 \times 2.1$ evaluation (1) $(\Delta GPE =) 1200(J)$	ignore attempts to convert kg to g for this MP only 1197 allow numbers that round to 1200 no ecf from MP1 award full marks for the correct answer without working.	(2) AO2

Q7.

	Answer	Additional guidance	Mark
(i)	600 (J)	accept 3000 – 2400 accept -600	(1) AO3

	Answer	Additional guidance	Mark
(ii)	substitution (1) $(\text{efficiency} =) \frac{2400}{3000}$ evaluation (1) 0.8(0)	allow $\frac{4}{5}$ accept 80 (%) award full marks for the correct answer without working allow 1.25 for 1 mark for selecting and evaluating from the correct pair of values	(2) AO3

Q8.

Question Number	Answer	Additional guidance	Mark
	substitution (1) $\frac{1}{2} \times 8 \times 1.5^2$ calculation of v^2 (1) 2.25 evaluation (1) 9(.0) (J)	9000 (J) scores 2 marks 6(.0)(J) scores 2 marks 6000 (J) scores 1 mark award full marks for the correct answer without working	(3)

Q9.

	Answer	Additional guidance	Mark
	select correct equation (1) $KE = \frac{1}{2} \times m \times v^2$ substitution (1) $(KE =) \frac{1}{2} \times 70 \times 8(0)^{(2)}$ evaluation (1) $(KE =) 2200 \text{ (J)}$	 ignore attempts to convert kg to g for this MP only allow numbers that round to 2200 e.g. 2240 280 or 35×8 seen scores 2 marks award full marks for the correct answer without working.	(3) AO2

Q10.

Question number	Answer	Additional guidance	Mark
(i)	substitution $\text{Time} = 37/25$ (1) Evaluation (1) $= 1.5$ (s)	 Allow 1.48 (s) full marks will be awarded for correct numerical answer without working	(2)

Question number	Answer	Additional guidance	Mark
(ii)	substitution $K.E. = 0.5 \times 1300 \times 20^2$ (1) evaluation (1) $= 260,000 \text{ J}$	260 kJ full marks will be awarded for correct numerical answer without working	(2)

Q11.

Question number	Answer	Additional guidance	Mark
	Calculation of area (1) 7×11 Substitution (1) 77×0.12 Answer (1) 9.2 (J)	77 ecf area award full marks for correct numerical answer without working	(3)

Q12.

		Indicative Content
QWC	*	A discussion including some of the following points

Energy saving lamp	Filament lamp
<p>Advantages</p> <ul style="list-style-type: none"> Saves energy / uses energy more efficiently Cost efficient Lasts longer Lower power (needed) Less fossil fuels burnt Cool to touch Efficiency 20% Lasts 9000 hours longer Lasts 10 times longer Produces 4 times as much light energy for every 100J of electrical energy supplied. More readily available <p>Disadvantages</p> <ul style="list-style-type: none"> Higher initial cost May contain harmful gases Takes longer to reach maximum brightness Not such a bright light Costs 5 times as much Costs £1.20 more 	<p>Disadvantages</p> <ul style="list-style-type: none"> Wastes more energy Less efficient Shorter lifetime Higher power (needed) More fossil fuels burnt Gets very hot Only 5% efficient Wastes 95% of energy supplied Uses 4 times as much power Less readily available <p>Advantages</p> <ul style="list-style-type: none"> Costs less to buy Do not contain harmful gases Lights immediately Bright light

Table of information given in the question

Energy saving lamp	Filament lamp
power = 15 W	power = 60 W
Cost = £1.50	Cost = £0.30
Lifetime = 10 000 hours	Lifetime = 1000 hours
Produces 20J of light energy for every 100J of electrical energy supplied	Produces 5J of light energy for every 100J of electrical energy supplied

Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> A limited description of one advantage or one disadvantage e.g. energy saving lamps last a long time/ filament lamps get very hot <p>OR</p> <p>A correct value quoted from information with no comparison.</p> <ul style="list-style-type: none"> The answer communicates ideas using simple language and uses limited scientific terminology Spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> A simple description of two different advantages / disadvantages e.g. energy saving lamps cost more but last longer / filament lamps have a short life time and use more power <p>OR</p> <p>Correct values quoted from table and used to provide two comparisons without calculations</p> <ul style="list-style-type: none"> the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> A detailed description of two different advantages / disadvantages using a quantitative comparison.

		<p>e.g. energy saving lamps cost 5 times more but last 10 times longer. / Energy saving lamps produce 4 times as much light energy for every 100J of electrical energy supplied and are much more efficient. / Energy saving lamps last 9,000 hours longer than and they use less power.</p> <ul style="list-style-type: none"> • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors
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Q13.

Question number	Answer	Additional guidance	Mark
	<p>A description to include:</p> <p>mention relevant energy store such as GPE or chemical (1)</p> <p>'correct' transfer in context (1)</p>	<p>allow KE or mechanical or thermal or heat</p> <p>chemical to (G)PE or chemical to KE (in lifting) allow misread GPE to KE/thermal on <u>slope</u></p> <p>Allow KE to GPE in lifting</p>	(2)

Q14.

	Answer	Additional guidance	Mark
	<p>a description giving</p> <p>as the density (of expanded polystyrene) increases the (thermal) conductivity decreases (1)</p> <p>non-linear / gradient decreases / at a decreasing rate / levels off / plateaus / becomes (almost) constant (1)</p>	<p>ORA</p> <p>allow inversely proportional / exponential for non-linear in this context</p> <p>ignore negative correlation</p> <p>unqualified quoted values are insufficient</p>	<p>(2) AO3</p>

Q15.

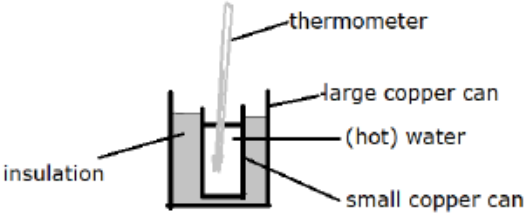
Question number	Indicative content	Mark
	<p>Answers will be credited according to the candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;">A03 (6 marks)</p> <p><u>Apparatus</u></p> <ul style="list-style-type: none"> • beakers • thermometer(s) • stop watch • foam and new material <p><u>Measurement of energy loss</u></p> <ul style="list-style-type: none"> • put material around cylinder/ beaker/calorimeter (or use foam jacket to start with) • put hot water into cylinder/beaker • measure temperature • measure temperature at intervals/at start / at finish/after fixed period of time • or measure time taken to cool to set temperature <p><u>Comparison between two materials</u></p> <ul style="list-style-type: none"> • change to other material around cylinder/beaker • compare the temperatures of the two after fixed time • or compare time taken to cool • the better insulator cools down more slowly <p><u>Measures to ensure fair test</u></p> <ul style="list-style-type: none"> • same mass of water • same thickness of material • same starting temperature • same time interval • same room temperature <p><u>Accuracy</u></p> <ul style="list-style-type: none"> • repeat readings • take average of readings 	(6)

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> • No awardable content
Level 1	1-2	<ul style="list-style-type: none"> • Analyses the scientific information but understanding and connections are flawed. (AO3) • An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3-4	<ul style="list-style-type: none"> • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. (AO3) • A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5-6	<ul style="list-style-type: none"> • Analyses the scientific information and provide logical connections between scientific enquiry, techniques and procedures. (AO3) • A well-developed plan that synthesises relevant understanding coherently. (AO3)

Q16.

	Answer	Acceptable answers	Mark
	<input checked="" type="checkbox"/> B conservation of energy		(1)

Q17.

Question Number	Answer	Additional guidance	Mark
(i)	<p>A diagram showing:</p> <p>apparatus labelled to include three from</p> <ul style="list-style-type: none"> • thermometer • water • insulator / sand / sawdust/ material • (copper) can <p>(1)</p> <p>thermometer in the water (1)</p> <p>arrangement for water and insulator in and between copper cans (e.g. as in diagram below) (1)</p> 	<p>independent of arrangement</p> <p>ignore kettle and stop clock</p> <p>accept reverse positions for water and insulator</p>	(3) AO2

Question Number	Answer	Additional guidance	Mark
(ii)	any three factors from: {mass / volume} of water (1) {volume / thickness / mass} of insulators /materials (1) {starting / initial} temperature of water (1) time interval / temperature change (1)	accept amount / specified values / "how much" accept amount / specified values / "how much" accept temperature of hot / boiling water / specified values accept specified values of interval or change unqualified "same time" is insufficient	(3) AO3

Q18.

		Indicative Content
QWC	*	a description including some of the following points: <ul style="list-style-type: none"> • chemical to kinetic while in his hand • kinetic (gradually) to potential while rising / fro • eventually all potential at 10 m with a little the energy • some mention of conservation of energy • potential (gradually) to kinetic as falls / 10 m-0 • with a little more thermal (heat) energy • at 0 m sound energy • at 0 m thermal (heat) energy
Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> • a limited description which identifies a change in one relevant type energy or a transfer of energy from one form to another e.g. kinetic energy increases OR kinetic energy changes to sound. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> • a simple description giving detail of a relevant energy change/transfer e.g. kinetic energy changes into potential energy as it moves upwards OR kinetic energy increases as it falls.

		<ul style="list-style-type: none"> the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> a detailed description of a sequence of relevant energy changes /transfers e.g. kinetic energy is transferred into potential energy as it rises. This then changes back into kinetic energy as it falls back down. the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately spelling, punctuation and grammar are used with few errors

Q19.

	Answer	Acceptable answers	Mark
	Description including 3 of the following: <ul style="list-style-type: none"> (Gravitational) potential energy (transferred) to KE(1) Idea of energy transfer to heat/sound whilst descending (1) Chemical energy is transferred to heat energy in Andrew (1) Idea of energy dissipated on stopping (1) 	(G)PE (transferred) to KE Allow gravitational energy for GPE Energy transferred to heat because of air resistance/ friction The energy goes to heat as he stops. Energy is transferred to the surroundings	(3)

Q20.

	Answer	Acceptable answers	Mark
(i)	12 (J) Ignore any unit given by candidate.	20 - 8 (J)	(1)
(ii)	An explanation linking any two of <ul style="list-style-type: none"> (For the) same amount of {electrical/supplied} 	Same input (energy)	(2)

	(energy/power) (1) <ul style="list-style-type: none"> • (CFL/it) has a greater output (of light energy) (1) • (CFL/it) wastes less (electrical energy) (1) 	gives out/produces more {light/useful} (energy) Do not accept more energy is used in the (CFL/it) Ignore brightness. (CFL/it) produces less thermal/heat (energy) Accept explanations using data from the energy transfer diagrams as comparisons eg (CFL/it) is four times as efficient gains both marks	
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Q21.

Question Number	Answer	Additional guidance	Mark
(i)	kinetic (1)	only (adding another incorrect alternative negates)	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	any one of increase the speed (of spinning) (1) increase the mass / weight (of the flywheel) (1)	accept (idea of) faster ignore make it bigger	(1) AO 2 1

Q22.

	Answer	Acceptable answers	Mark
	kinetic (energy)	Movement (energy) KE	(1)

Q23.

	Answer	Acceptable answers	Mark
(i)	350 (J)	400 - 50 (J)	(1)
(ii)	Substitution $50 \div 400$ (1) or $50 \times 100/400$ (%) Evaluation 13(%) (1)	12.5(%), 0.125, 0.13 or 1/8 Give full marks for correct answer, no working	(2)

Q24.

Question Number	Answer	Acceptable answers	Mark
(i)	electrical	electric	(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	chemical		(1)

Q25.

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)

Q26.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): foam contains pockets of air OR foam / air is an insulator (1) which reduces energy transfer to surroundings (1)		(2)

)7200kWh per year (at 13mph) / will produce 6000 kWh (with given wind speed). (1)	than 13mph to produce 6000kWh	
(aii)	Substitution (1) 0.14×6000 Evaluation (1) (£)840	Allow incorrect conversion of p to £ such as 0.014×6000 for 1 mark only 84 000 p correct answer with no working shown gains both marks	(2)
(aiii)	Divide the installation cost by the annual saving (to find the time in years) (1)	£840 for annual saving	(1)
(aiv)	A suggestion linking (energy saving lamps) would not transfer so much thermal energy (1) he may have to use additional heating / lights (which would cost money to run/ purchase) (1)	not get hot / produce so much heat reverse argument such as insufficient heat for chicks to thrive (Ignore references to light output.)	(2)

QWC		Indicative Content
	*(b)	A discussion including some of the following points <ul style="list-style-type: none"> • Both HEP and Solar power are renewable • Both HEP and Solar power would save fossil fuel • HEP only possible in some locations • HEP requires reservoirs and damming of rivers • This can damage environment /takes a lot of land • Energy from solar power installation is currently less than energy from fossil fuel powered station • Solar power only suitable in certain locations • Solar power reliability dependent on constant • Neither of them cause atmospheric pollution
Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> • a limited description such as at least one relevant detail of each resource eg: Solar power doesn't give off atmospheric pollution. HEP generates more power than solar power. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> • a simple discussion such as one which gives comparisons between the two or at least an advantage and disadvantage of both. eg: HEP does not use fossil fuels but it can damage the environment where is it located. Solar power will never run out but it requires lots of light/land. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately

3	5 - 6	<ul style="list-style-type: none"> • spelling, punctuation and grammar are used with some accuracy • a detailed comparison such as one which relates advantages and disadvantages of both HEP and solar power to a particular situation for possible large scale use e.g.: Solar power uses a renewable energy source but it currently does not produce as much energy as fossil fuel station where there is little sunlight. HEP can produce a lot more energy where there are hills and water but only possible in certain geographical locations. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors
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Q30.

	Answer	Acceptable answers	Mark
(i)	Model A because Model A (can produce up to)7200kWh per year (at 13mph) / will produce 6000 kWh (with given wind speed). (1)	Model B produces less than 6000kWh per year at 13mph /requires wind speed of more than 13mph to produce 6000kWh	(1)
(ii)	Substitution (1) 0.14×6000 Evaluation (1) (£)840	Allow incorrect conversion of p to £ such as 0.014×6000 for 1 mark only 84 000 p correct answer with no working shown gains both marks	(2)
(iii)	Divide the installation cost by the annual saving (to find the time in years) (1)	£840 for annual saving	(1)
(iv)	A suggestion linking (energy saving lamps) would not transfer so much thermal energy (1) he may have to use additional heating / lights (which would cost money to run/ purchase) (1)	not get hot / produce so much heat reverse argument such as insufficient heat for chicks to thrive (Ignore references to light output.)	(2)

Q31.

	Answer	Acceptable answers	Mark
(i)	Substitution: (1) 60 × 10 × 50 or 600 × 50 Evaluation: (1) 30 000 Unit: (1) J / Nm	give two marks for correct answer no working J / joule 30 kJ for full marks	(3)
(ii)	After falling 50 m / when the cord becomes straight/when cord starts to stretch	tension starting to increase at terminal velocity ignore maximum velocity/speed	(1)
(iii)	An explanation linking any two of not all GPE is transferred to KE (1) some {of the GPE transfers to thermal energy /work is done} (1) due to drag (1)	not all GPE goes to KE maximum energy is same (value) as GPE before falling /speed does not reach the speed at which he should fall some lost as heat/sound (of rope or movement through air) (air) resistance / friction ignore wind	(2)

Q32.

	Answer	Acceptable answers	Mark
(i)	Substitution: (1) 60 × 10 × 50 or 600 × 50 Evaluation: (1) 30 000 Unit: (1) J / Nm	give two marks for correct answer no working J / joule 30 kJ for full marks	(3)
(ii)	After falling 50 m / when the cord becomes straight/when cord starts to	tension starting to increase	(1)

	stretch	at terminal velocity ignore maximum velocity/speed	
(iii)	An explanation linking any two of not all GPE is transferred to KE (1) some {of the GPE transfers to thermal energy /work is done} (1) due to drag (1)	not all GPE goes to KE maximum energy is same (value) as GPE before falling /speed does not reach the speed at which he should fall some lost as heat/sound (of rope or movement through air) (air) resistance / friction ignore wind	(2)

Q33.

Question Number	Answer	Mark
(i)	The only correct answer is C 20 m/s A is not correct because 0.2 m/s is too slow B is not correct because 2 m/s is too slow D is not correct because 200 m/s is too fast	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>recall (1) $(\Delta GPE) = m \times g \times \Delta h$</p> <p>substitution (1) $(\Delta GPE =) 75 \times 10 \times 20$</p> <p>evaluation (1) 15 000 (J)</p>	<p>NO PoT error</p> <p>NO ecf from wrong equation</p> <p>mgh or $m \times g \times h$</p> <p>75 x 10 x 20 scores the first 2 marks</p> <p>accept 14700 (J) from using $g = 9.8$ (N/kg)</p> <p>award full marks for the correct answer without working</p>	(3)

Q34.

	Answer	Acceptable answers	Mark
(a)(i)	<p>An explanation linking</p> <ul style="list-style-type: none"> 60 % of {total/electrical/input/output} energy (is used/transferred) (1) into/is kinetic/useful energy (1) <p>If no other marks scored accept: 60% (of the energy produced by the motor) is useful/40% is wasted for 1 mark</p>	<p>Accept reverse argument ie</p> <p>40 % of {total/electrical/input/output} energy (is/transferred)</p> <p>into/lost as/thermal (heat)/waste energy</p>	(2)
(a)(ii)	<input checked="" type="checkbox"/> B energy		(1)
(a)(iii)	<p>substitution 20×15 (1)</p> <p>evaluation 300 (J) (1)</p> <p>If no other mark scored award 1 mark for correct transposition ie $E = P \times t$</p> <p>Ignore any unit given by candidate</p>	<p>Power of 10 error maximum of 1 mark</p> <p>eg 300 000 (J) gains 1 mark</p> <p>Give full marks for correct answer, no working</p>	(2)
(a)(iv)	substitution	Power of 10 error maximum of 1 mark	(2)

	$18 \div 24 (\times 100) (1)$ evaluation 0.75 or 75% (1) Ignore any unit given by candidate	give full marks for correct answer, no working	
(b)	<input checked="" type="checkbox"/> B conservation of energy		(1)

Q35.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) $(\Delta GPE =) 65 \times 10 \times 200$ evaluation (1) $1.3 \times 10^5 / 130\,000 (J)$	allow substitution mark with 65000 (g) allow 1 mark for answers that round to 1.3 with any other power of ten do not allow 13000 award full marks for the correct answer without working	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	substitution (1) (KE) $\frac{1}{2} \times 65 \times 36^2$ squaring (1) 36^2 (=1296) (completing) evaluation (1) $42\ 120 / 4.2(1) \times 10^4$ (J)	using 36 → 1170 (J) OR $36 \times 2 \rightarrow 2340$ (J) scores 2 marks (apply power of ten error as well if occurring e.g. 117000 (J) gets 1 mark) award full marks for the correct answer without working allow 2 marks for answers that round to 4.2 with any other power of ten omitting $\frac{1}{2}$ gives 84240(J) scores 2 marks	(3) AO 2 1

Q36.

		Indicative Content
		<p>A discussion including some of the following points</p> <ul style="list-style-type: none"> • Both HEP and Solar power are renewable • Both HEP and Solar power would save fossil fuel • HEP only possible in some locations • HEP requires reservoirs and damming of rivers • This can damage environment /takes a lot of land • Energy from solar power installation is currently more expensive than energy from fossil fuel powered station • Solar power only suitable in certain locations • Solar power reliability dependent on constant sunlight • Neither of them cause atmospheric pollution
Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> • a limited description such as at least one relevant detail of each resource eg: Solar power doesn't give off atmospheric pollution. HEP generates more power than solar power. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> • a simple discussion such as one which gives comparisons between the two or at least an advantage and disadvantage of both. eg: HEP does not use fossil fuels but it can damage the environment where is

		<p>it located. Solar power will never run out but it requires lots of light/land.</p> <ul style="list-style-type: none"> • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> • a detailed comparison such as one which relates advantages and disadvantages of both HEP and solar power to a particular situation for possible large scale use e.g.: Solar power uses a renewable energy source but it currently does not produce as much energy as fossil fuel station where there is little sunlight. HEP can produce a lot more energy where there are hills and water but only possible in certain geographical locations. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q37.

Question Number	Answer	Additional guidance	Mark
	<p>any two sources from:</p> <ul style="list-style-type: none"> • oil • (natural) gas • coal • nuclear/uranium 	<p>accept petrol /diesel for oil</p> <p>accept fossil fuel(s) for any of the first three i.e. fossil fuel and oil or coal or gas scores 1 mark but fossil fuel and nuclear scores 2 marks</p>	<p>(2)</p> <p>AO 1 1</p>

Q38.

Question Number	Answer	Additional guidance	Mark
	<p>discussion to involve two points each giving change and effect (max 4 marks)</p> <p>some examples:</p> <p>change: biomass-solar-geothermal (fraction) increases (1) effect: e.g. reduces greenhouse gas / CO₂ emissions (1)</p> <p>change: 'wind' (fraction) increases (1) effect: e.g. visual/noise pollution arguments (1)</p> <p>change: 'natural gas' (fraction) increases (1) effect: e.g. contributes to global warming (1)</p> <p>change: 'uranium' (fraction) decreases (1) effect: e.g. less radioactive waste (1)</p>	<p>ignore vague responses such as 'environmentally friendly', less pollution etc.</p> <p>candidates may give positive or negative effects</p> <p>for this change (and for oil) allow decreases (with a correct accompanying effect for 2 marks)</p> <p>accept conserves non-renewables but not just 'more renewable'</p>	<p>(4) AO 3 2a AO 3 2b</p>

Q39.

Question Number	Answer	Additional guidance	Mark
(i)	bioenergy	biofuel / biomass	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
(ii)	largest area / fraction / percentage (idea)	must be referring to the chart , not just repeating 4bi stem- can't have greatest/ largest amount by itself	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
(iii)	wind		(1) AO 3 1b

Q40.

	Answer	Acceptable answers	Mark
	light → electrical → chemical energy energy energy (1) (1)	These answers must be in the correct order	(2)

Q41.

Question number	Answer	Additional guidance	Mark
(i)	Any one of: solar panel (1) bio-gas (1) geothermal (1)	reject wind unless reference made to electrical heater supplied by wind-powered dynamo.	(1)

Question number	Answer	Additional guidance	Mark
(ii)	substitution and rearrangement (1) efficiency. = useful energy / total energy 0.96 x 7500 evaluation (1) 7200 (J)	full marks will be awarded for correct numerical answer without working	(2)

Q42.

Question number	Answer	Mark
	As chemical energy in the battery	(1)

Q43.

Question number	Answer	Additional guidance	Mark
	(original) GPE – KE (at bottom) (1)	allow (idea of) input – output allow wrong way round (eg output-input)	(1)

Q44.

Question number	Answer	Additional guidance	Mark
	(vertical) height of slope (1) mass (of the toy car) (1)	allow (in this context) weight if no other mark scored allow 1 mark for quoting either equation $(\Delta)GPE = mgh$ OR $KE = \frac{1}{2} mv^2$	(2)

Q45.

	Answer	Acceptable answers	Mark
(i)	1400 - 1300 (= 100) (kJ) (1)		(1)
(ii)	Substitution (1) $1300 / 1400 \times 100$ Evaluation (1) 93(%) or 0.93	A value which rounds to 93(%) or 0.93 Correct answer with no working scores 2 marks	(2)

Q46.

Question number	Indicative content	Mark
*	<p>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.</p> <p>The indicative 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.</p> <p>AO2</p> <ul style="list-style-type: none"> • fuel forms a store of chemical (potential) energy • chemical energy is transferred to kinetic energy and thermal energy when the car moves • kinetic energy transferred to thermal energy as the car slows down <p>AO3</p> <ul style="list-style-type: none"> • during X, kinetic energy increases as the car's speed increases/car accelerates and the increase in kinetic energy is provided by the chemical energy store • during all three sections, work is done against frictional forces in the moving parts of the car and against the drag from the air • during Y, kinetic energy stays constant when the car moves at constant speed but energy is still transferred to thermal energy • during Z, kinetic energy decreases as the car slows down 	(6)

Level	Mark	Descriptor
	0	No awardable content.
1	1-2	<ul style="list-style-type: none"> • Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The description attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
2	3-4	<ul style="list-style-type: none"> • Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The description is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
3	5-6	<ul style="list-style-type: none"> • Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The description is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Q47.

	Answer	Acceptable answers	Mark
(a)	<input checked="" type="checkbox"/> B charge		(1)
(b)	Substitution 12×230 (1) evaluation 2800 (W) (1)	2760 (W) give full marks for correct answer, no working Power of 10 error max. 1 mark.	(2)
(c)	Conversion 0.4 (kW) (1) Substitution $0.4 \times 10 \times 15$ (p) (1) or $0.4 \times 10 \times 0.15$ (£) Evaluation 60 (p) or $\pounds 0.6$ (1)	give marks for correct answer, no working 60 (p) or $\pounds 0.6$ (3) $60,000$ (p) or $\pounds 600$ (2) 6 to any other power of 10 (1) $(400/40/4) \times 10 \times (15/0.15)$ gains one mark if no mark can be awarded for evaluation.	(3)

		Indicative Content	
QWC	*(d)	A discussion including some of the following points	

Energy saving lamp	Filament lamp
<p>Advantages</p> <ul style="list-style-type: none"> Saves energy / uses energy more efficiently Cost efficient Lasts longer Lower power (needed) Less fossil fuels burnt Cool to touch Efficiency 20% Lasts 9000 hours longer Lasts 10 times longer Produces 4 times as much light energy for every 100J of electrical energy supplied. More readily available <p>Disadvantages</p> <ul style="list-style-type: none"> Higher initial cost May contain harmful gases Takes longer to reach maximum brightness Not such a bright light Costs 5 times as much Costs £1.20 more 	<p>Disadvantages</p> <ul style="list-style-type: none"> Wastes more energy Less efficient Shorter lifetime Higher power (needed) More fossil fuels burnt Gets very hot Only 5% efficient Wastes 95% of energy supplied Uses 4 times as much power Less readily available <p>Advantages</p> <ul style="list-style-type: none"> Costs less to buy Do not contain harmful gases Lights immediately Bright light

Table of information given in the question

Energy saving lamp	Filament lamp
power = 15 W	power = 60 W
Cost = £1.50	Cost = £0.30
Lifetime = 10 000 hours	Lifetime = 1000 hours
Produces 20J of light energy for every 100J of electrical energy supplied	Produces 5J of light energy for every 100J of electrical energy supplied

Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> A limited description of one advantage or one disadvantage e.g. energy saving lamps last a long time/ filament lamps get very hot <p>OR</p> <p>A correct value quoted from information with no comparison.</p> <ul style="list-style-type: none"> The answer communicates ideas using simple language and uses limited scientific terminology Spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> A simple description of two different advantages / disadvantages e.g. energy saving lamps cost more but last longer / filament lamps have a short life time and use more power <p>OR</p> <p>Correct values quoted from table and used to provide two comparisons without calculations</p> <ul style="list-style-type: none"> the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> A detailed description of two different advantages / disadvantages using a quantitative comparison.

		<p>e.g. energy saving lamps cost 5 times more but last 10 times longer. / Energy saving lamps produce 4 times as much light energy for every 100J of electrical energy supplied and are much more efficient. / Energy saving lamps last 9,000 hours longer than and they use less power.</p>
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- the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately
- spelling, punctuation and grammar are used with few errors