Energy and power GCSE AQA Higher Physics Past Papers Answers

01.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	weight (lifted) **or** height (lifted)		1	AO3/3a 4.1.2.2 WS2
2	any **two** from: • calculate a mean • spot anomalies • reduce the effect of random errors		2	AO3/3a 4.1.2.2 WS3
3	as speed increases, the efficiency increases (but) graph tends towards a constant value **or** appears to reach a limit	accept efficiency cannot be greater than 100%	1 1	AO3/2b 4.1.2.1
4	heating the surroundings		1	AO1/1 4.1.2.1
5	0 (%)		1	AO1/1 4.1.2.2
Total			**7**	

02.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	g.p.e. = mass × gravitational field strength × height	accept $E_p = mgh$	1	AO1/1 4.1.1.2
2	$E_p = 50 \times 9.8 \times 20$ 9800 (J)	allow 9800 (J) with no working shown for **2** marks answer may also be correctly calculated using W = Fs ie allow W = 490 x 20 for **1** mark or answer of 9800 (J) using this method for **2** marks	1 1	AO2/1 4.1.1.2
3	7840 (J)	allow ecf from '11.2'	1	AO2/1 4.1.1.2
4	$7840 = ½ \times 50 \times v^2$ $v = \sqrt{\dfrac{7840}{1/2 \times 50}}$ 17.7(0875) (m/s) 18 (m/s)	allow $v^2 = \dfrac{7840}{(1/2 \times 50)}$ for this point allow ecf from '11.3' correctly calculated for **3** marks allow 18 (m/s) with no working for **2** marks answer may also be correctly calculated using $v^2 - u^2 = 2as$	1 1 1 1	AO2/1 4.1.1.2
5	extension = 35 (m) and conversion of 24.5 kJ to 24500 J $24\,500 = ½ \times k \times 35^2$ 40	allow 40 with no working shown for **3** marks an answer of '16.2' gains **2** marks	1 1 1	AO2/2 4.1.1.2 WS4.3
Total			**11**	

03.

Question	Answers	Extra information	Mark	AO/ Spec. Ref
1	chemical	in this order only	1	AO1 4.1.1.1
	equal to	allow the same as	1	
2	power = $\dfrac{\text{work done}}{\text{time}}$	allow P = $\dfrac{W}{t}$	1	AO1 4.1.1.4
3	$200 = \dfrac{W}{1800}$	an answer of 360 000 (J) scores **3 marks**	1	AO2 4.1.1.4
	$W = 200 \times 1800$		1	
	$W = 360\ 000$ (J)		1	
4		an answer that rounds to 15.8 (%) scores **2 marks**		AO2 4.1.1.1
	$11 - 9.5 = 1.5$ (m/s)	allow a change in speed between 1.2 and 1.5 (m/s)	1	
	$\left(\dfrac{1.5}{9.5}\right) \times 100 = 15.8$ (%)	allow an answer consistent with their change in speed	1	
		an answer of 16 (%) scores **2 marks**		
5	maximum speed is lower		1	AO1 4.1.1.4
	because maximum power output of cyclist is constant	allow maximum force on pedals is constant	1	
	(but) additional work is done (against gravity) **or** gravitational potential energy (of cyclist) is increased	do **not** accept additional work done against friction or air resistance	1	
Total			**11**	

04.

Question	Answers	Extra information	Mark	AO/ Spec. Ref
1		an answer of 27 600 (kg) scores **3 marks**		AO2 4.3.1.1
	$1.2 = \dfrac{m}{2.3 \times 10^4}$		1	
	$m = 1.2 \times 2.3 \times 10^4$		1	
	$m = 27\ 600$ (kg) or $m = 2.76 \times 10^4$ (kg)	allow an answer of 28 000 (kg) or 2.8×10^4 (kg)	1	
2		allow power output for kinetic energy throughout		AO3 4.1.1.2
	mass of air passing the turbine blades is halved which decreases kinetic energy by a factor of two		1	
	(wind speed is halved) decreasing kinetic energy by a factor of four		1	
	so kinetic energy decreases by a factor of eight		1	
3		an answer that rounds to 7.50 (m/s) scores **3 marks**		AO2 4.1.1.2
	$388\ 000 = 0.5 \times 13\ 800 \times v^2$	this mark may be awarded if P is incorrectly / not converted	1	
	$v^2 = \dfrac{(2 \times 388\ 000)}{13\ 800}$ or $v^2 = \dfrac{388\ 000}{(0.5 \times 13\ 800)}$ or $v^2 = 56.2$	this mark may be awarded if P is incorrectly / not converted	1	
	$v = 7.50$ (m/s)	an answer that rounds to 7.50 (m/s) only	1	
Total			**9**	

05.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1		an answer of 0.50 scores **3** marks allow a correct answer that rounds to 0.50 for **3** marks		4.1.1.2 AO2
	$41 = \dfrac{9.8 \times h}{0.12}$		1	
	$h = \dfrac{41 \times 0.12}{9.8}$		1	
	$h = 0.50$ (m)		1	
2	kinetic energy = 0.5 × mass × (speed)^2 *or* $E_k = \tfrac{1}{2}mv^2$		1	4.1.1.2 AO1
3		an answer of 60 (kg) scores **3** marks		4.1.1.2 AO2
	$270 = \tfrac{1}{2} \times m \times 3^2$		1	
	$m = \dfrac{270}{(\tfrac{1}{2} \times 3^2)}$ *or* $m = \dfrac{270}{4.5}$		1	
	$m = 60$ (kg)		1	

4	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear.		3–4	WS3.5 4.1.1.2 AO3
	Level 1: Relevant features are identified and differences noted.		1–2	
	No relevant content		0	
	Indicative content • males have a greater muscle power than females for most of their lives • males have a greater muscle power than females above 9/10 years old • males have a lower muscle power than females below 9/10 years old • there is a similar pattern for males and females as age increases • males have a peak muscle power at 25 years old whereas females have a peak muscle power at 20/21 years old • at 9/10 years old males have the same muscle power as females • peak muscle power for males (47 W/kg) is greater than peak muscle power for females (37 W/kg) • the rate of increase of muscle power is greater for males than females (between 5 and 25 years old) • the rate of decrease of muscle power is greater for males than females. Ignore comments relating to strength			
5	any **1** from: • maximum height reached is a better indicator of maximum muscle power • maximum / peak muscle power was being investigated, not mean / average muscle power • volunteer may not use maximum effort on the first try • performance may improve with practise • performance may get worse with tiredness	allow maximum time in the air for maximum height reached / jumped	1	WS3.7 4.1.1.4 AO3
Total			12	

06.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	electric car journey will take a (much) longer time	allow diesel car journey will take a shorter time	1	4.1.3 AO3
	(because) battery will need recharging **or** (because) the car will need to stop for 40 minutes	allow diesel car will not need to be refuelled	1	
2	energy stored in diesel = 45 × 51 = 2295 (MJ)		1	4.1.3 1AO1 1AO2
	energy stored in batteries = 0.95 × 280 = 266 (MJ)		1	1AO3
	(so) the diesel stores more energy than the battery (and the diesel car has a higher range)	this mark is dependent on correct calculations of energy stored	1	
3	any 2 from: • recharging is a continuous process	allow cars do not need to stop to recharge allow shorter journey times allow don't have to wait for battery to recharge allow longer time between recharges allow the range of the electric car is increased	2	4.1.3 AO1
	• fewer cells needed in the car	allow smaller battery needed in the car		
	• more cars can be charged at the same time	allow do not need to find a charging point allow fewer charging stations needed ignore it is quicker ignore cost of charging ignore methods of electricity generation		
4	when cars are plugged in		1	4.1.3 AO1
	the energy from car batteries could be transferred back to the National Grid	allow mains supply for National Grid allow energy from car batteries could be used to power household appliances	1	
Total			**9**	

07.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1		an answer of 2.5 (m) scores **3** marks		4.1.1.2 AO2
	$1470 = 60 \times 9.8 \times h$	this mark may be awarded if E_p is incorrectly/not converted	1	
	$h = \dfrac{1470}{60 \times 9.8}$ or $h = \dfrac{1470}{588}$	this mark may be awarded if E_p is incorrectly/not converted	1	
	$h = 2.5$ (m)	this answer only	1	
7.2	(work done against) air resistance **or** (work done against) friction (between zip line and pulley)		1	4.1.1.1 AO1
	causes thermal energy to be transferred to surroundings	ignore sound energy	1	
3	different people have different surface areas	allow streamlining allow body position body size is insufficient	1	4.1.1.1 4.1.1.2 AO1
	so would be affected by air resistance differently **OR** initial speed may not be zero (1) which would add to the total energy (of the system) (1)	allow people have different masses / weights (1) so people have different terminal velocities (1) reference to mass changing the kinetic energy or gravitational potential energy negates both these marks	1	
Total			**7**	

08.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	density = $\dfrac{mass}{volume}$ or $\rho = \dfrac{m}{V}$		1	AO1 4.3.1.1
2	$998 = \dfrac{m}{6\,500\,000}$		1	AO2 4.3.1.1
	m = 998 × 6 500 000		1	
	m = 6 487 000 000		1	
	m = 6.487 × 10⁹ (kg)	allow a correct conversion of their calculated value of mass into standard form	1	
3	energy transferred = power × time or $E = Pt$		1	AO1 4.2.4.2
4	t = 18 000 (s) or t = 5 × 60 × 60		1	AO2 4.2.4.2
	E = 1.5 × 10⁹ × 18 000	allow a correct substitution using an incorrectly/not converted value of t	1	
	E = 2.7 × 10¹³ (J)	allow a correct calculation using an incorrectly/not converted value of t	1	
5	the variation in demand is (much) greater than 1.5 × 10⁹ W	allow the increase in demand is greater than the (power) output of the (hydroelectric) power station	1	AO3 4.1.3
	demand remains high for longer than 5 hours	allow 04:00 to 16:00 is 12 hours allow 04:00 to 16:00 is greater than 5 hours	1	
Total			11	

09.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	% increase = $\frac{(10\,000 - 3200)}{3200} \times 100$		1	AO3 4.1.3
	% increase = 212.5 (%)		1	
2	Any **two** from: • no sulfur dioxide released • doesn't cause acid rain • no particulates released • doesn't cause global dimming • less carbon dioxide released (per kg of fuel burned) • less global warming • no solid waste • gas mining is less destructive than coal mining	allow less climate change allow less greenhouse gases ignore less air pollution	2	AO1 4.1.3
3	mean sea surface temperature shows a (steady) increase		1	AO3 4.1.3
	over the time period on the graph **or** from 16.45 (°C) to 16.96 (°C)	conditional on scoring 1st marking point allow between a correct pair of dates at least 10 years apart allow a correct pair of temperatures at least 10 years apart	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	thermistor C		1	AO3 4.2.1.4
	(because) the change in resistance is greatest	conditional on scoring 1st marking point allow the gradient is highest allow more sensitive to temperature change	1	
	between 0 and 25 °C	conditional on scoring 2nd marking point allow between 16 and 17 °C if thermistor C is not chosen, allow for 1 mark each: not thermistor A because there is no/little change in resistance not thermistor B as there is only a small change in resistance not thermistor D as there is no data available between 0 and 40 °C	1	
Total			9	

10.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	Length of sled		1	AO2 4.1.1.2
	Time for sled to pass light gate		1	
2	$E_p = 8330$ (J)		1	AO2 4.1.1.2
	$8330 = m \times 9.8 \times 17.0$	allow a correct substitution using an incorrectly/not converted value of E_p	1	
	$m = \dfrac{8330}{9.8 \times 17.0}$	allow a correct rearrangement using an incorrectly/not converted value of E_p	1	
	$m = 50.0$ (kg)	allow a correct calculation using an incorrectly/not converted value of E_p	1	
3	$\frac{1}{2} mv^2 = mgh$ or decrease in E_p = increase in E_k		1	AO1 4.1.1.2
	masses cancel on both sides of the equation or $v^2 = 2gh$		1	
	(final) speed only depends on vertical height (and gravitational field strength)		1	
	variations will be due to air resistance/friction or different initial speed		1	
Total			**10**	

11.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	$E = \dfrac{1.25\times10^{18}}{3.16\times10^{7}}$		1	AO2 4.1.1.4
	$E = 3.96 \times 10^{10}$ (J)	an answer that rounds to 3.96 × 10¹⁰ (J) scores **1** mark	1	
2	t = 86 400 (s)		1	AO2 4.2.1.2
	27 000 = I × 86 400	allow a correct substitution of an incorrectly/not converted value of t	1	
	$I = \dfrac{27\ 000}{86\ 400}$	allow a correct rearrangement using an incorrectly/not converted value of t	1	
	I = 0.3125 (A)	allow a correct calculation using an incorrectly/not converted value of t

allow a correctly calculated answer rounded to 2 or 3 sf | 1 | |
3	$0.15 = \dfrac{\text{useful power output}}{7800}$	allow a correct substitution of an incorrectly/not converted value of total power input	1	AO2 4.1.2.2
	useful power output = 0.15 × 7800	allow a correct rearrangement using an incorrectly/not converted value of total power input	1	
	useful power output = 1170 (W)	this answer only but allow 1200 (W) if correct working shown	1	
4	a really large area of land would need to be covered with solar cells		1	AO2 4.1.3
	due to the low useful power output of the solar cells	allow due to the low efficiency of the solar cells	1	

		or number of hours of daylight is too low (in UK) **or** low solar intensity (in UK) **or** solar radiation (in UK) is too low **or** material for construction of solar cells and/or lithium batteries is in limited supply		
Total			11	

12.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	the total energy of the racing track and the car is constant.		1	AO1 4.1.2.1
2	$E_p = 0.040 \times 9.8 \times 0.90$	allow a correct substitution of an incorrectly/not converted value of h	1	AO2 4.1.1.1 4.1.1.2
	$E_p = 0.3528$ (J)	this answer only	1	
	$0.3528 = 0.5 \times 0.040 \times v^2$	allow a correct substitution of a calculated E_p	1	
	$v^2 = \dfrac{0.3528}{0.5 \times 0.040}$	allow a correct rearrangement using a calculated E_p	1	
	$v = 4.2$ (m/s)	allow an answer consistent with their calculated E_p	1	
3	more than 0.20 J		1	AO3 4.1.1.1
	(because) the car needs to be moving at the top of the loop or (because) the car needs to be moving to complete the loop or not all E_k at **B** will be transferred to E_p at **C**	this mark is dependent on scoring the first mark	1	
		allow energy dissipated to the surroundings		
Total			**8**	

13.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	P = 696 000 000 (W)		1	AO2 4.1.3
	P = 1200 (W)	allow an answer consistent with their incorrectly / not converted value of P	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	any **2** from: • wind is unreliable • wind turbines don't turn when the wind is too strong/weak • there are not enough wind turbines (in the UK)	allow it was not windy (on that day) allow some wind turbines may be offline for maintenance allow energy from wind may not be enough (to generate 34 000 MW) ignore weather conditions unqualified	2	AO2 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	the efficiency would increase		1	AO3
	because the percentage / proportion / amount of energy usefully transferred would increase **or** because the percentage / proportion / amount of energy wasted would decrease	ignore more electricity generated allow less energy wasted	1	AO1 AO1 4.1.2.1 4.1.2.2
	(because) less (work is done against) friction		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4	more efficient devices waste less energy **or** more efficient devices need a lower energy input (for the same energy output)	ignore use less electricity	1	AO3 4.1.2.2 4.1.3
	which would minimise the electricity / energy demand **or** which would minimise the environmental impact from (fossil fuel) electricity generation	allow less electricity needs to be generated allow lower energy / electricity bill allow examples of environmental impact e.g. lower CO_2 emissions ignore 'better for the environment' unless qualified ignore answers that discuss 'saving energy' unless qualified ignore answers that discuss alternative methods of generating electricity	1	

Total Question☐		9

14.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	$h = 1.75$ (m)		1	AO2 4.1.1.4
	$E_p = 60 \times 9.8 \times 1.75$	allow a correct substitution using an incorrectly / not converted value of h	1	4.1.1.2
	$E_p = 1029$ (J)	allow a correct calculation using an incorrectly / not converted value of h	1	
	$P = \dfrac{1029}{1.40}$	allow a correct substitution using their calculated value of E_p	1	
	$P = 735$ (W)	allow an answer consistent with their value for E_p	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	girl increases her kinetic energy (as well as increasing her gravitational potential energy)		1	AO2 4.1.1.1 4.1.2.1
	some energy is wasted in her muscles **or** some energy transferred as thermal energy (to surroundings)	allow some energy transferred due to air resistance ignore unqualified references to friction ignore references to sound	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3	the boy's mass was greater than the girl's mass		1	AO3 4.1.1.1

Total Question		8

15.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1	E_p = 367 500 000 (J)		1	AO2 4.1.1.2
	367 500 000 = 2 500 000 × 9.8 × h	allow a correct substitution using an incorrectly/not converted value of E_p	1	
	$h = \dfrac{367\,500\,000}{2\,500\,000 \times 9.8}$	allow a correct rearrangement using an incorrectly/not converted value of E_p	1	
	h = 15 (m)	allow an answer consistent with their value of E_p	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	3 kW = 3000 W		1	AO2 4.1.1.4
	$3000 = \dfrac{2.16 \times 10^7}{t}$	all subsequent marks can score using an incorrectly / not converted value of P	1	
	$t = \dfrac{2.16 \times 10^7}{3000}$		1	
	t = 7200 (s)		1	
	t = 7.2 × 10³ (s)	allow an answer given in standard form from a calculation using data given in the question	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3		allow reference to specific months eg April to September		AO3 4.1.3
	in the summer the power output from the hydroelectric generator is lower but the solar power output would be greater	allow power output of hydroelectric generator depends on rainfall **and** power output of solar power system depends on light intensity	1	
	so less variation in total power output (which improves the reliability of the supply)	allow electricity supply for total power output	1	

Total Question ☐		11