GCSE MARKING SCHEME

SUMMER 2017

GCSE (NEW)
PHYSICS - UNIT 1

3420U10/1
3420UA0/1

INTRODUCTION

This marking scheme was used by WJEC for the 2017 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response question).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

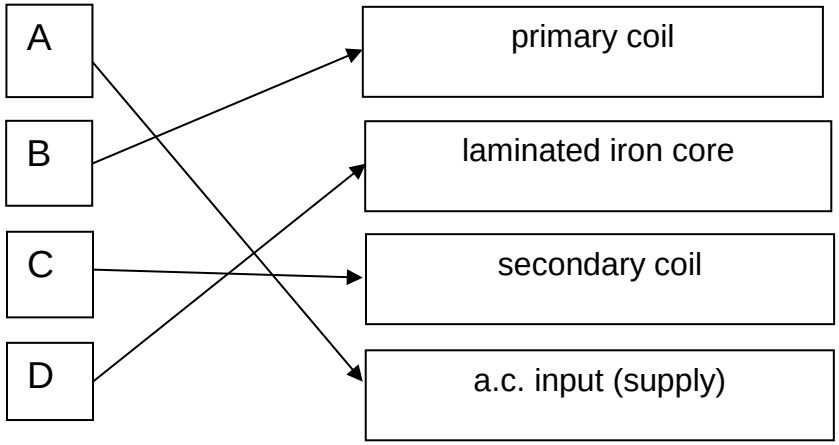
Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1 FT	(a)			 4 correct **3 marks** 2 or 3 correct **2 marks** 1 correct **1 mark** 0 correct **0 mark** More than one line drawn from a letter don't credit	3			3		
	(b)			Bigger (1) Smaller (1) Stay the same (1) Accept any means of identifying the answer	1	1 1		3		
	(c)	(i)		P identified anywhere	1			1		
		(ii)		No CO_2 or SO_2 [emissions] / no greenhouse gases emitted / doesn't burn gas or fossil fuels / doesn't add to global warming / doesn't add to acid rain **Don't accept** no pollution / less CO_2 etc / harm the environment / less gas / doesn't cause global warming	1			1		
				Question 1 total	**6**	**2**	**0**	**8**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2 FT	(a)			3	1			1		
	(b)			A identified anywhere	1			1		
	(c)	(i)		Frequency	1			1		
		(ii)		Amplitude	1			1		
	(d)	(i)		Substitution: distance = 20 × 0.5 (1) =10 [cm] (1) Answer only of 10 [cm] not necessarily on answer line award 2 marks	1	1		2	2	
		(ii)		Must be half answer to (d)(i) i.e. expect 5 [cm]		1		1	1	
	(e)	(i)		em wave or any named em wave / S waves or secondary / <u>heat radiation</u> Don't accept surface waves / solar waves	1			1		
		(ii)		Longitudinal or phonetic spelling **Don't accept** longitude / compression	1			1		
				Question 2 total	**7**	**2**	**0**	**9**	**3**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3 FT	(a)			In clockwise direction: cell / battery (1) variable resistor / rheostat (1) voltmeter (1) don't accept voltameter / voltage ammeter (1) don't accept ampmeter	4			4		4
	(b)	(i)		100 mA identified anyway			1	1		1
		(ii)	(I)	0.05 [A]		1		1	1	1
			(II)	Substitution: $\frac{1}{0.05}$ (1) **ecf** = 20 [Ω] (1)	1	1		2	2	2
		(iii)		All 8 points correct ± <1 small square division (2) 7 points correct ± <1 small square division (1) 1-6 points correct ± <1 small square division (0) Correct curve of best fit starting between 0.4 - 0.6 V up to 1.0 V (1) **Don't accept** thick, double, whispy or disjointed curves		3		3	3	3
		(iv)		Reading taken from candidate's graph ± 1 mA		1		1	1	1
		(v)		The current increases as the voltage increases / positive correlation (1) at an increasing rate / each increase gets bigger / use of numbers e.g. current increased by 5 [mA] between 0.4 and 0.6 [V] and increased by 30 [mA] between 0.8 and 1 [V] (1) **Don't accept** in a non-proportional way / the increase gets steeper / non-linear		2		2		2
		(vi)		Diode / LED **Don't accept** circuit symbol			1	1		1
				Question 3 total	**5**	**8**	**2**	**15**	**7**	**15**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4 FT	(a)	(i)		There is a <u>current</u> [through the rod] (1) **Don't accept** electricity So the <u>magnetic field</u> produces a <u>force</u> (1)		2		2		2
		(ii)		Use FLHMR or by implication (1) [First finger N → S and thumb away from magnet and] <u>second finger</u> indicates current from Y → X [so I disagree] (1) Alternative for 2nd mark - If current X → Y <u>thumb</u> points into the magnet			2	2		2
		(iii)		**Any 2 (×1) from:** • stronger (more powerful) magnet[ic field] • <u>wider</u> magnet • larger current / higher voltage / higher power accept (stronger) **Don't accept** bigger power supply / bigger magnet / longer rod / add another power supply or battery / bigger area / iron rod / move horizontal bars / lighter rod	2			2		2
	(b)			[Electric] motor / [loud]speaker / named device that contains motor or speaker	1			1		
				Question 4 total	**3**	**2**	**2**	**7**	**0**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5 FT	(a)			Missing state = liquid (1) Missing process = boiling / evaporation / vaporisation (1)	2			2		
	(b)			2^{nd} and 5^{th} boxes ticked i.e. The atoms in a solid are in fixed positions (1) A solid has atoms that vibrate more as they gain energy (1) Lose 1 mark for each extra tick	2			2		
	(c)	(i)		660 [^{o}C]		1		1	1	
		(ii)		3 000 [s]		1		1	1	
	(d)	(i)		Substitution: $\frac{288\,000\,000}{3\,000(\ \text{ecf})}$ (1) = 96 000 [W] (1) Conversion = 96 [kW] (1) **Alternative:** Conversion = 288 000 [kJ] (1) $\frac{288\,000}{3\,000(\ \text{ecf})}$ (1) = 96 [kW] (1) N.B. Conversion by dividing by 1 000 award 1 mark	1	1 1		3	3	
		(ii)		Substitution: $\frac{288\,000\,000}{900 \times 640}$ **or** $\frac{288\,000\,000}{576\,000}$ (1) = 500 [kg] (1)	1	1		2	2	
	(e)			Substitution: $1\,500 \times 400\,000$ (1) = 600 000 000 [J] (1)	1	1		2	2	
				Question 5 total	**7**	**6**	**0**	**13**	**9**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6 FT	(a)			**Indicative content:** Energy will transfer from the hot liquid to the cold surroundings. The plastic stopper/glass walls are both good insulators. These will significantly reduce the heat loss via conduction. The silver coatings are poor emitters and good reflectors of heat radiation / infra-red and will significantly reduce heat loss via radiation. The vacuum will prevent both conduction and convection losses as there are no particles. The stopper also stops any hot gases rising from the inside of the flask. This reduces heat transfer via convection. **5-6 marks** Detailed description of how heat transfer is reduced by conduction, convection and radiation. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Detailed description of how heat transfer is reduced by 2 out of conduction, convection and radiation. Alternatively, a brief correct description of all 3 methods. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Detailed description of how heat transfer is reduced by 1 out of conduction, convection and radiation. Alternatively, a brief correct description of up to 2 of the methods. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. Note. 3 marks AO1 description of process. 3 marks AO2 application to novel situation. **0 marks** *No attempt made or no response worthy of credit.*	3	3		6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			Correct for first 2 hours [as $\frac{10}{2} = 5\,^{o}$C/hour] (1) Incorrect for the whole 10 hours as $\frac{30}{10} = 3\,^{o}$C/hour / incorrect because for the last 8 hours $\frac{20}{8} = 2.5\,^{o}$C/hour (1) **Alternative:** After 2 hours temperature reduced by $10\,^{o}$C (1) after 10 hours should have reduced by $50\,^{o}$C / after 10 hours should have finished at $40\,^{o}$C / in the last 8 hours it should have dropped by $40\,^{o}$C so not always correct (1)			2	2	2	
				Question 6 total	**3**	**3**	**2**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7 FT 1 HT	(a)	(i)		X marked where the 3 circles intersect		1		1		
		(ii)		Using 1 station means many possible epicentre locations / using 2 stations means there are 2 possible locations for the epicentre location (1) Three stations are needed to eliminate the other options / three circles only cross at one place (1) Accept reference to triangulation		2		2		
	(b)			Station C (1) as it has the smallest circle or diameter or radius / smallest distance or closest [to the epicentre] (1)		2		2		
	(c)			The time delay for B is half that for A or converse (1) Accept time is halved provided one arrival time is correct [Time taken for P wave to arrive at station A = 10 s Time taken for P wave to arrive at station B = 5 s so the time would be] **1:15:15** (1) [The time lag would be half (25 s) the time lag for station A so the time S wave would arrive at station B] = **1:15:40** **or** [$\frac{60}{2}$ = 30 s added to 1:15:10 to give] **1:15:40** (1) **N.B. both calculations correct but no statement award 2 marks only**		1 1	1	3	2	
				Question 7 FT **Question 1 HT total**	**0**	**7**	**1**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8 FT 2 HT	(a)			Correct addition shown or by implication (1) Conclusion must match addition (1)			2	2	1	
	(b)	(i)		Shows an increase [Jan-May], reaches a constant [May-Jul] and decreases [Jul-Dec] **Alternative** for reaches a constant [May-Jul] – reaches a maximum for the summer months **Don't accept** same shape			1	1	1	
		(ii)		Biased information / information misleading or unfair / maximum values are misleading **Don't accept** different amounts of sunshine each year			1	1		
	(c)	(i)		2^{nd}, 5^{th} and 6^{th} boxes ticked i.e. Apr 16 was the month that had the most actual sunshine hours (1) Apr16 had 4 times the actual number of sunshine hours compared to Jan 16 (1) There is only one month where the actual and the expected sunshine hours were the same (1) Lose 1 mark for each extra tick			3	3		
		(ii)		$\frac{600}{200} = 3$ [kW] **or** $\frac{600}{3} = 200$ [h] **or** $200 \times 3 = 600$ [kWh] (1) Claim [is correct] must be consistent and backed up by calculations (1)			2	2	1	
	(d)	(i)		3 670 – 3 400 = 270 [kWh] (1) $270 \times 29 = 7\,830$ [p] (1) **Alternative:** $3\,670 \times 29 = 106\,430$ [p] **and** $3\,400 \times 29 = 98\,600$ [p] (1) 106 430 [p] - 98 600 [p] = 7 830 [p] (1) Don't award the answer mark for £78.30 p		2		2	2	
		(ii)		Reduce [payback] time / quicker [payback] time	1			1		
				Question 8 FT **Question 2 HT total**	**1**	**2**	**9**	**12**	**5**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3 HT	(a)			A [changing] current in the base or primary coil (1) sets up a [changing] magnetic field in the iron core (1) If there is no reference to either a **changing** current or **changing** magnetic field award 1 of the first 2 marks only induces a voltage (accept current) in the secondary coil (1) **Don't accept** cutting magnetic flux lines	3			3		
	(b)	(i)		The [electrical] energy (or power) [**don't accept** electricity] (1) is not lost or wasted [as heat] / supplied to the primary coil is totally passed through to the secondary coil (1) **Or** total energy in = [electrical or] useful energy out (2) **Or** power in = power out (2)	2			2		
		(ii)		$\frac{V_1}{V_2} = \frac{N_1}{N_2}$ so $\frac{230}{V_2} = \frac{9200}{480}$ (1) for substitution Therefore $V_2 = \frac{230 \times 480}{9200}$ =12 [V] (1)	1	1		2	2	
		(iii)		Selection of : $P = V \times I$ or by implication (1) Substitution and conversion:12 (**ecf**) $\times$ 0.1 (1) = 1.2 [W] (1) Answer of 1.2 $\times$ 10^n award 2 marks	1	1 1		3	2	
				Question 3 total	**7**	**3**	**0**	**10**	**4**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4 HT	(a)	(i)		If a fault develops to make a <u>metal casing live</u> / <u>live</u> wire touches the <u>metal case</u> (1) it takes the current safely to ground / it prevents electric shock or protects the user / causes the fuse to blow or trips the mcb or rccb (1) **Don't accept** takes the electricity to ground or reference to electrified	2			2		
		(ii)		Faster acting or more sensitive **and** can be reset or reused - **both required for the mark. Don't accept** less expensive	1			1		
		(iii)		Total current = 24 A (1) which is **split between the two routes** [so no wire carries more than its rated value of 21 A] / which is less than 42 A / 12 A would travel each way (1)	2			2		
	(b)			**Conduction in the saucepan base:** Particles near the bottom vibrate <u>more</u> **and** pass their energy along (1) [Delocalised] electrons take energy through the metal pan (1) **Convection in the water:** Particles in the water move further apart (1) reducing density / so hot water rises / sets up a convection current (1)	4			4		
				Question 4 total	**9**	**0**	**0**	**9**	**0**	**0**

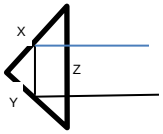
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5 HT	(a)	(i)		All 4 points plotted correctly ± <1 small square division (1) 1-3 points plotted correctly ± <1 small square division (0) Straight line of best fit between 1.0 – 6.0 V within ± <1 small square division of each point (1)		2		2	2	2
		(ii)		As the voltage increases, the current increases (1) at a decreasing rate (1) Award 2 marks - equal increases of voltage produce smaller increases in current **Don't accept** in a non-proportional way / the increase gets less steep / non-linearly		2		2	2	2
	(b)	(i)		Substitution: $\frac{3.0}{0.85}$ (1) = 3.53 [Ω] (1) Accept 3.5 [Ω] **Don't accept** 3.52 [Ω]	1	1		2	2	2
		(ii)		0.85 (1) **i.e. denominator from (b)(i)** + 0.6 **ecf** from graph = 1.45 [A] (1)		2		2	2	2
		(iii)		Substitution and recognition of total current I: $R = \frac{V}{I} = \frac{3.0}{1.45\ \textbf{ecf}}$ (1) = 2.07 [Ω] (1) Accept 2.1 or 2 [Ω] **Alternative:** $R_{\text{wire}} = \frac{V}{I} = \frac{3.0}{0.6\ \textbf{ecf}} = 5$ (1) then $\frac{1}{3.53\ \textbf{ecf}} + \frac{1}{5\ \textbf{ecf}} = 0.483$ so R_{total} = 2.07 [Ω] (1) Accept 2.1 or 2 [Ω]		2		2	2	2
		(iv)		By having two loops from the battery there is more current (1) Greater current implies smaller resistance (1)	2			2		2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(v)		The current through the lamp is smaller than the current through the resistor or values stated 1.2 [A] for the resistor and 1.125 [A] for the lamp (1) [Since the voltage is the same] bigger resistance results in a smaller current (1) **Alternative: calculations based** R = 5 [Ω] for wire (1) and R = 5.33 [Ω] for lamp (1) Don't accept reference to gradients		2		2	2	2
		(vi)		**Any 2 × (1) from:** • At 5.50 V or where the lines cross [the currents are equal so] the powers are equal • [$I_{resistor}$ is less than I_{lamp}] up to 5.50 V, therefore P_{lamp} > $P_{resistor}$ (since voltages are the same and $P=VI$) • Beyond 5.50 V, [$I_{resistor}$ is greater than I_{lamp} therefore] P_{lamp} < $P_{resistor}$		2		2	2	2
				Question 5 total	**3**	**13**	**0**	**16**	**14**	**16**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6 H T	(a)			**Indicative content:** The term latent is used because the energy supplied does not raise the temperature of the substance but merely goes to enable the change of state to take place [per kg]. The term "fusion" refers to the change from a solid to liquid at its melting point and the energy supplied goes into breaking bonds between molecules. In the case of fusion, only a small number of bonds are broken. The latent heat of vaporisation refers to a liquid changing to a gas and is always a much larger value because the change requires a much larger number of bonds to be broken. **5 – 6 marks** The term latent is explained as supplying energy to a change of state without a change in temperature and a detailed description of the difference in molecular bond breaking is given during both changes of state. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3 – 4 marks** Either the term latent is explained as supplying energy to a change of state without a change in temperature or a detailed description of the difference in molecular bond breaking is given during both changes of state. Or brief attempts are made at both aspects. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.*	6				0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks A limited attempt is made at either the term latent as being explained as supplying energy to a change of state without a change in temperature or a description of the difference in molecular bond breaking is given during a change of state. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. **0 marks** *No attempt made or no response worthy of credit.*						

	(b)	(i)		Temp rise = $\Delta\theta$ = 640 [°C] (1) Energy required to raise temp to boiling point = $mc\Delta\theta$ = 500 × 900 × 640 **ecf** = 288 000 000 [J] (1) Energy required to melt aluminium = 500 × 400 000 = 200 000 000 J (1) Total energy required = 4.88 × 10^8 J (1) **ecf** Substitution and conversion: time = $\frac{4.88 \times 10^8 \text{ ecf}}{8.7 \times 10^4}$ Answer **with unit** = 5 609.2 s **or** 93.5 min **or** 1.56 h (1) A conclusion consistent with their answer i.e. the one hour deadline is not met (1) **Alternative for 5th and 6th marks:** Number of kWh = 87 converted to J = 3.13 × 10^8 (1) This is less than the energy required **so** the one hour deadline is not met (1) **Alternative for 5th and 6th marks:** 4.88 × 10^8 J = 135.6 [kWh] (1) This is more energy than the heater can provide in one hour **so** the one hour deadline is not met (1) **Alternative:** Energy supplied = 87 000 × 3 600 (1) = 3.13 × 10^8 [J] (1) Temp rise = $\Delta\theta$ = 640 [°C] (1) 3.13 × 10^8 = $m(c\Delta\theta + L)$ so 3.13 × 10^8 = m (900 × 640 + 400 000) (1) $m = \frac{3.13 \times 10^8}{976\,000}$ = 320.7 [kg] (1) A conclusion consistent with their answer i.e. the one hour deadline is not met (1)			6		6	
		(ii)		Energy is needed to raise the temperature of heater and container / some energy is lost [to the surroundings]	1			1		
				Question 6 total	**7**	**0**	**6**	**13**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7 HT	(a)	(i)		Ultraviolet / UV (1) Microwaves (1)	2			2		
		(ii)		They all travel in a vacuum / at the same speed [in a vacuum] / all undergo reflection / refraction / travel in straight lines. Accept diffraction / interference / polarisation / transverse waves **Don't accept** transfer energy	1			1		
	(b)	(i)		 The vertical ray XY (by eye) (1) YZ roughly parallel with the incident ray and passing straight outside the prism (1)		2		2		
		(ii)		Angle [of incidence] needs to be greater than the critical angle (or 36^{o}) / it is smaller than the critical angle (1) - for it to be totally internally reflected / it otherwise gets refracted [out of the back of] the prism] (1) Accept converse argument	2			2		
		(iii)		$c = f\lambda = (5.639 \times 10^{14}) \times (532 \times 10^{-9}) = 2.9999 \times 10^{8}$ [m/s] (1) $d = s \times t$ (1 – manip) **ecf** for c $= 2.9999 \times 2.5626 = 7.6876 \times 10^{8}$ [m] (1) Distance to moon = 3.8438×10^{8} [m] (1) NB1. If 3×10^{8} is used without calculation shown then first mark is lost. NB2. If workings are shown and 2.9999 is rounded up to 3 then all marks are available. (Answer is then 3.8439×10^{8})		4		4	4	
		(iv)		So there is no overlap between the outward and return pulses Accept they don't interfere with or interrupt each other		1		1		
				Question 7 total	**5**	**7**	**0**	**12**	**4**	**0**

Summary of marks allocated

FOUNDATION TIER

Question	Marks Available					
	AO1	AO2	AO3	Total	Maths	Prac
1	6	2	0	8	0	0
2	7	2	0	9	3	0
3	5	8	2	15	7	15
4	3	2	2	7	0	6
5	7	6	0	13	9	0
6	3	3	2	8	2	0
7	0	7	1	8	2	0
8	1	2	9	12	5	0
Total	**32**	**32**	**16**	**80**	**28**	**21**

Summary of marks allocated

HIGHER TIER

Question	Marks Available					
	AO1	AO2	AO3	Total	Maths	Prac
1	0	7	1	8	2	0
2	1	2	9	12	5	0
3	7	3	0	10	4	0
4	9	0	0	9	0	0
5	3	13	0	16	14	16
6	7	0	6	13	6	0
7	5	7	0	12	4	0
Total	**32**	**32**	**16**	**80**	**35**	**16**