GCSE MARKING SCHEME

SUMMER 2019

PHYSICS UNIT 1 HIGHER (SEPARATE AWARD)
3420UA0-1

INTRODUCTION

This marking scheme was used by WJEC for the 2019 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.

GCSE PHYSICS

UNIT 1: ELECTRICITY, ENERGY AND WAVES

HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

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.

<u>Marking rules</u>

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.

<u>Extended response question</u>

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	*(a)*			Windows at 15% — 4 correct — **3 marks** Floor at 10% — 2 or 3 correct — **2 marks** Roof at 25% — 1 correct — **1 mark** Walls at 35% — 0 correct — **0 mark**		3		3	1	
	(b)	(i)		Fibre-glass is an insulator **or** it contains air **or** it contains air pockets **or** <u>reduces</u> conduction through the ceiling (1) **Don't accept** traps air <u>Reduces</u> convection <u>currents</u> in the loft **or** air in the loft heats up less (1)	2			2		
		(ii)		**3 × (1):** Ticks in boxes alongside statements 2, 4 and 5 i.e. The required thickness of loft insulation in 2000 is 8 times thicker than in 1970. A house built in 1980 needs 210 mm of loft insulation added to bring it up to 2015 standards. The general trend of the graph indicates that the thickness of required loft insulation has increased at an increasing rate. Deduct 1 mark for each additional tick		3		3	3	
		(iii)		$4.50 \times 120 = £540$ (1) $\frac{540}{98} = 5.51$ or 5.5 or 6 [years] (1) **Don't accept** 5 [years] Answer of 0.0459 [years] award 1 mark only		2		2	2	
		(iv)		**(1) for either calculation:** Insulation 1 saving $(40 - 5.0) \times £84 = £2\,940$ Insulation 2 saving $(40 - 6.0) \times £111 = £3\,774$ **(1) for second calculation and comment/agreement with builder** **Alternative 1:** **(1) for either calculation:** $5 \times 84 = £420$ **and** $40 \times 84 = £3\,360$ **and** the difference = £2 940 $6 \times 111 = £666$ **and** $40 \times 111 = £4\,440$ **and** the difference = £3 774 **(1) for second calculation and comment/agreement with builder**			2	2	1	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				Alternative 2: 5 × 84 = £420 **and** 6 × 111 = £666 **or** 40 × 84 = £3 360 **and** 40 × 111 = £4 440 (1) The differences are £3 774 **and** £2 940 so the builder is correct (1) **Alternative 3:** **(1) for either calculation:** 3.5 × 120 = £420 **and** 40 × 84 = £3 360 **and** the difference = £2 940 5.5 × 120 = £666 **and** 40 × 111 = £4 440 **and** the difference = £3 774 **(1) for second calculation and comment/agreement with builder** **Alternative 4:** 3.5 × 120 = £420 **and** 5.5 × 120 = £666 **or** 40 × 84 = £3 360 **and** 40 × 111 = £4 440 (1) The differences are £3 774 **and** £2 940 so the builder is correct (1) **Alternative 5:** **(1) for either calculation:** (111 – 84) × 40 = £1 080 **or** 666 – 420 = £246 £1 080 – £246 = £834 **(1) and comment/agreement with builder** N.B. Any reference to insulation 3 treat as neutral						
				Question 1 total	**2**	**8**	**2**	**12**	**7**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*	(i)		Repeat measurements **OR** measure more than 1 wavelength **Don't accept** reference to the ruler or more accurate ripple tank			1	1		1
		(ii)		Wave speed is [directly] proportional to wavelength (1) As wave speed 2 times faster in deep water **or** 2 times slower in shallow water (1) so teacher is incorrect **Alternative 1:** Candidates may make up a freq and use it on both sides e.g. 4 Hz In shallow water $4 \times 5 = 20$ [mm/s] **and** in deep water $4 \times 10 = 40$ [mm/s] (1) As wave speed 2 times faster in deep water **or** 2 times slower in shallow water (1) so teacher is incorrect **Alternative 2:** Wave in deep water travels double the distance (1) in the same time compared to shallow water (1) so teacher is incorrect N.B. To award both marks conclusion must be present. **Award 1 mark only** Waves in shallow water travel slower than waves in deep water so teacher claim is incorrect			2	2	2	2
	(b)	(i)		<u>Total internal reflection</u> accept TIR	1			1		
		(ii)		Light [ray directed] from high density to low density (1) <u>Angle</u> [of incidence] > critical angle **or** <u>angle</u> [of incidence] > 42^{o} (1)	2			2		
		(iii)		CT scans are ionising **or** X-rays are ionising (1) and [X-rays] mutate cells / cause cancer (1) **OR** [Endoscope uses] light that is not ionising (1) and [light] doesn't mutate cells / doesn't cause cancer (1)	2			2		
				Question 2 total	**5**	**0**	**3**	**8**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*			**Any 2 × (1) from:** - increasing wavelength - decreasing frequency - decreasing energy **Accept** gamma has the highest frequency or lowest wavelength or highest energy	2			2		
	(b)	(i)		Gamma	1			1		
		(ii)		Microwaves **accept** radio waves	1			1		
	(c)			Gamma		1		1		
				Question 3 total	**4**	**1**	**0**	**5**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			[Electrical items have] become more [energy] efficient **Don't accept** more efficient energy	1			1		
	(b)			Selection of units used (kWh) = power (kW) $\times$ time (h) (1) Substitution: 181 = 130 $\times$ time (1) Time = 1 392.3 h (1) [1 392 hours and 18 minutes] Mean number of hours per day = $\frac{1392.3\textbf{ecf}}{365}$ = 3.8 or 4 (1) **N.B.** Answer of 1.39 $\times$ 10^n where n is not equal to 3 award 2 marks Answer of 3.8 $\times$ 10^n where n is not equal to 0 award 3 marks **Alternative 1:** Selection of energy transferred = power $\times$ time (1) Substitution: 181 $\times$ 3 600 000 = 130 $\times$ time (1) Time = 5.01 $\times$ 10^6 [s] (1) [= 1 392.3 h] Mean number of hours per day = $\frac{1392.3\textbf{ecf}}{365}$ = 3.8 or 4 (1) **Alternative 2:** $\frac{181}{365}$ = 0.5 [kWh per day] (1) Selection of units used (kWh) = power (kW) $\times$ time (h) (1) Substitution: 0.5 = 130 $\times$ time (1) Mean number of hours per day = 3.8 or 4 (1) **Alternative 3:** $\frac{181000}{365}$ = 496 [Wh per day] (1) Selection of units used (kWh) = power (kW) $\times$ time (h) (1) Substitution: 496 = 130 $\times$ time (1) Mean number of hours per day = 3.8 or 4 (1)	1 1	1 1		4	4	
	(c)			Substitution: 392 = 77.8 $\times$ cost per unit (ignore conversions) (1) Cost per unit = 5.0 (1) [p] Answer of 0.05 award 1 mark only	1	1		2	2	
				Question 4 total	**4**	**3**	**0**	**7**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			Substitution: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{12} + \frac{1}{6}$ **or** $R = \frac{12 \times 6}{12 + 6}$ (1) R = 4 [Ω] (1) $R = R_1 + R_2$ = 4 (**ecf** only from use of parallel equation) + 16 = 20 [Ω] (1) Answer of 16.25 [Ω] award 2 marks	1	1 1		3	3	3
	(b)			$P = I^2R$ = 1.5^2 × 20(**ecf**) = 45 [W] (1) Substitution: $t = \frac{75.6\,[\times 10^3]}{45(\textbf{ecf})}$ (1) = 1 680 [s] (1) $\frac{1680(\textbf{ecf})}{60}$ = 28 [minutes] (1) Answer of 1.68 × 10^n where n is not equal to 3 award 2 marks Answer of 2.8 × 10^n where n is not equal to 1 award 3 marks	1	1 1 1		4	4	4
				Question 5 total	**2**	**5**	**0**	**7**	**7**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*			**Indicative content**: **STATION A** Station A will detect both seismic waves as they are both able to travel through the solid mantle. The P wave will arrive first, then the S wave. S waves travel at a slower speed than P waves. This results in a small time lag between the detection of the P and S waves. **STATION B** Station B will detect the waves in the same order as station A. However, the P waves will be detected at a later time than station A because station B is further away from the earthquake. Compared to station A, there will be a larger time lag between the detection of the P and S waves. This is due to the greater distance travelled. **STATION C** Station C will detect P waves but no S waves. It will be the last station to detect the P waves as it is furthest from the origin of the earthquake. P waves are able to travel through both liquid and solid rock. It will not detect any S waves as they are unable to travel through the liquid rock in the Earth's core. The amplitude of the detected waves will decrease as the distance from the earthquake increases. **5-6 marks** Detailed description/explanation of both seismic waves at all three stations. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3-4 marks** A description/explanation of both of the seismic waves detected at two stations **OR** a limited description of both seismic waves at all three stations. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks**	3	3		6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				A limited description/explanation of the seismic waves detected at one / two stations **OR** some description of properties only. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
	(b)			Vibrations or oscillations (1) In a transverse wave these are 90^{o} to [the direction] the wave [travels] but in a longitudinal wave they are parallel / same direction (1)	2			2		
				Question 6 total	**5**	**3**	**0**	**8**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*			[Flemings] LH rule identified (1) or inferred First finger (N→S) field **and** second finger (L→R or + → -) current (1) Thumb points up so wire moves up (1) so student correct Full marks can only be awarded if the conclusion is present.			3	3		3
	(b)	(i)		40×10^{-3} **or** 0.04 [N] (1) Any value in the range 1.75 - 1.8 [A] (1)		2		2		2
		(ii)		Force increases as current increases (1) at a constant rate (1) **Alternative:** Force is [directly] proportional to current **or** if current doubles then force doubles (2)		2		2	2	2
		(iii)		Gradient = Bl (1) Intercept = 0 (1)		2		2	2	2
		(iv)		Gradient e.g. = $\frac{90\,[\text{x}\,10^{-3}]}{4}$ = 22.5 [$\times 10^{-3}$] (1) $B = \frac{22.5\text{ecf}}{5}$ [$\times 10^{-1}$] (1) B = 0.45 [T] (1) **N.B. Tolerance on graph readings** i.e. force ± 1 [$\times 10^{-3}$] N and current ± 0.05 [A] Answer of 4.5×10^{n} where n is not equal to -1 award 2 marks **Alternative:** Selection and manipulation of $B = \frac{F}{Il}$ (1) Substitution into rearranged equation: $B = \frac{90\,[\text{x}\,10^{-3}]}{4\ \text{x}\ 5\,[\text{x}\,10^{-2}]}$ [$\times 10^{-1}$] (1) B = 0.45 [T] (1)			3	3	2	2
				Question 7 total	**0**	**6**	**6**	**12**	**6**	**11**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*			Reference to the ratio of output power to input power **or** the efficiency equation (1) Output power becomes a smaller fraction of the input power (1) so agree. **Alternative 1:** 100 % efficient up to about 46 V (1) Then output power is less than input power (1) so agree. **Alternative 2:** Minimum of 2 efficiency calculations (2) so agree. To award both marks the conclusion must be present.			2	2		2
	(b)			Substitution: $I = \frac{P}{V} = \frac{180}{100}$ (1) = 1.8 [A] (1)	1	1		2	2	2
	(c)			Less heat loss (1) **accept** eddy currents reduced **or** no heat loss **or** prevents overheating More efficient (1)	2			2		
	(d)			[High voltage] results in low current (1) **Don't accept** low amps <u>Less</u> heating effects in wires **or** <u>more</u> efficient transmission (1) **Don't accept** prevents or no heat loss	2			2		
				Question 8 total	**5**	**1**	**2**	**8**	**2**	**4**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
9	(a)			Scale on x-axis 20 °C/division **and** scale on y-axis 1.0 cm^3/div (1) All points plotted correctly ± < 1 small square (1) Best fit line judged between 10 – 80 [°C] (1)		3		3	3	3
	(b)			Best fit line extrapolated to 100 [°C] **OR** 25 [cm^3] (1) At 100 °C the volume of gas will be greater than 25 cm^3 / the syringe limit so it can't be used **OR** at 90 °C it reaches 25 cm^3 limit so it can't be used (1)		2		2	2	2
	(c)			Volume increases **OR** separation of molecules increases (1) so density decreases (1)	2			2		2
	(d)			Molecules gain energy **OR** molecules move more quickly (1) So more <u>frequent</u> collisions (1)	2			2		2
	(e)			$\frac{3.5}{50}$ = 0.07 [cm^3/°C] (1) $\frac{19.5}{0.07}$ = 278.6 [°C] (1) 10 °C – 278.6 °C = -268.6 [°C] (1) **Alternative 1:** $\frac{50}{3.5}$ = 14.29 [°C/cm^3] (1) 19.5 × 14.29 = 278.6 [°C] (1) 10 °C – 278.6 °C = -268.6 [°C] (1) **Alternative for the 3rd mark (if working in Kelvin):** 283 K – 278.6 K = 4.4 K so 4.4 K – 273 [°C] = -268.6 [°C] (1) **Alternative 2:** $\frac{3.5}{50}$ = 0.07 [cm^3/°C] (1) $\frac{23.0}{0.07}$ = 328.6 [°C] (1) 60 °C – 328.6 °C = -268.6 [°C] (1)			3	3	3	3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				Alternative 3: $\frac{50}{3.5}$ = 14.29 [^{o}C/cm^{3}] (1) 23.0 $\times$ 14.29 = 328.6 [^{o}C] (1) 60 ^{o}C – 328.6 ^{o}C = -268.6 [^{o}C] (1)						
	(f)			Absolute zero	1			1		
				Question 9 total	**5**	**5**	**3**	**13**	**8**	**12**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	8	2	12	7	0
2	5	0	3	8	2	3
3	4	1	0	5	0	0
4	4	3	0	7	6	0
5	2	5	0	7	7	7
6	5	3	0	8	0	0
7	0	6	6	12	6	11
8	5	1	2	8	2	4
9	5	5	3	13	8	12
TOTAL	**32**	**32**	**16**	**80**	**38**	**37**