GCE A LEVEL MARKING SCHEME

SUMMER 2018

A LEVEL
PHYSICS - COMPONENT 3
A420U30-1

© WJEC CBAC Ltd.

INTRODUCTION

This marking scheme was used by WJEC for the 2018 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.

© WJEC CBAC Ltd.

A LEVEL COMPONENT 3 – Light, Nuclei and Options

MARK SCHEME

GENERAL INSTRUCTIONS

The mark scheme should be applied precisely and no departure made from it.

Recording of marks

Examiners must mark in red ink.

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

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.

© WJEC CBAC Ltd.

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

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*		Constant phase difference [accept: relationship] (between the 2 sources) ['in phase' not enough]	1			1		
	(b)		Interference or diffraction (1) Provided evidence for wave behaviour (1) [NB. independent marks]	2			2		
	(c)	(i)	Using more than one fringe separation (1) Answer = (0.80 ± 0.03) cm (1) [Ignore s.f.]		2		2	1	2
		(ii)	Substitution into $\lambda = \frac{ay}{D}$ [or by implication] (1) Answer = 515 nm **ecf** from (i) (1) [accept 2 or 3 s.f.]	1	1		2	2	2
		(iii)	Fringes are less bright [so more difficult to see] (1) [not: less clear or wider; not: fewer fringes will be seen] Separation of fringes is greater [can be measured with a smaller % uncertainty] **or** qualified more accurate based on fringe spacing] (1)			2	2		2
			Question 1 total	**4**	**3**	**2**	**9**	**3**	**6**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*		Use of Snell's law (1), e.g. $\sin 18.4^{o} = 1.65 \sin\theta_2$ Manipulation or Answer = 11.0° (1) accept $\sin^{-1}\left(\frac{\sin 18.4^{o}}{1.65}\right)$ but not just 10°	1	1		2	1	
	(b)		ϕ = 90 – θ (79 or 80) (1) $n_2 \sin\theta_2 = n_3 \sin 90$ applied (1) **or** $n_2 \sin 79 = n_3 \sin\theta$ Answer = 73.2° (1) **or** no solution for θ Conclusion = Yes since ϕ greater than critical (1) [allow ecf on a calculated value of critical angle] **or** Yes refraction is impossible			4	4	3	
			Question 2 total	**1**	**1**	**4**	**6**	**4**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*		Photons have enough energy [or frequency or hf high enough] (1) to emit / release electrons (from metal surface) (1) These arrive at the anode / [collecting] (& give current) (1)	1 1	1		3		3
	(b)		Applying Einstein's equation i.e. 2.7 + 1.2 (= 3.9 eV) (1) Converting to J i.e. $\times$ 1.6 $\times$ 10^{-19} (1) Answer = 9.4 $\times$ 10^{14} Hz (1) N.B. 5.9$\times$$10^{33}$ Hz $\rightarrow$ 1 mark only	1	1 1		3	2	
	(c)	(i)	Reverse polarity of supply [or equivalent, e.g. make collecting electrode negative / reversing the photocell] (1) [Increase pd] until current is [just] zero (1) Record the pd (from voltmeter) [or this is the stopping potential] (1)		3		3		3
		(ii)	(Alpha particles +ve so) opposite current (1) Current zero at smaller pd (1) More accurate if light intensity large (accept any insightful comment e.g. obtain activity and compensate / measure the dark current) [Accept - wait for activity to decrease] (1)			3	3		3
			Question 3 total	**3**	**6**	**3**	**12**	**2**	**9**

© WJEC CBAC Ltd.

Question			Marking details		Marks available				
				AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*		{Multiple passes of beam / reflection / keeps most of the light} for more amplification / stimulated emission or increased collimation (1) Some light (1%) transmitted by 99% mirror (1)	2			2		
	(b)		Increase of stimulated emission (1) Compared with absorption (1) [Exponential] increase in intensity or amplification or more power] (1) NB Stimulated emission > absorption → 2 marks	3			3		
	(c)	(i)	Energy of photon = 1.89×10^{-19} [J] seen or implied (1) $\frac{2 \times 10^{15}}{1.89 \times 10^{-19}}$ seen or implied (1.056×10^{34}) (1) [no e.c.f.]		2		2	2	
		(ii)	$p = \frac{6.63 \times 10^{-34}}{1.05 \times 10^{-6}}$ [kg m s^{-1}] seen or implied [= 6.314×10^{-28} N s]		1		1	1	
		(iii)	$1.06 \times 10^{34} \times 6.31 \times 10^{-28}$ [N] seen or implied (1) 2 × due to reflection stated (1) [→1.33×10^{7} N] [Using the 'show that' figures → 1.2×10^{7} N]		2		2	1	
		(iv)	$E = \frac{\text{stress}}{\text{strain}}$ used (1) [or by implication] $\text{Stress} = \frac{F}{A}$ used (1) [or by implication] Answer = 0.0083 or 0.011 (or 0.0105) seen (depends on (iii) but check) (1) [0.83% ✓]	1 1	1		3	3	
			Question 4 total	**7**	**6**	**0**	**13**	**7**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*		Energy - progressive carries [stationary not] or converse (1) Phase – stationary: constant in loop or successive loops in antiphase; progressive: varies with distance [or can have any value] along (1) Amplitude - antinodes & nodes or varies in stationary, constant amplitude in progressive(1)	3			3		
	(b)		$n \times \frac{\lambda}{2} = L$ (1) Multiply by the frequency or substitution: $\lambda = \frac{v}{f}$ (1) Neatly laid out algebra (1) NB.Stating $\lambda = \frac{2L}{n} \rightarrow$ no credit for 2nd mark.		3		3	2	3
	(c)		'Good agreement' on its own $\rightarrow$ 0 Straight line [with positive gradient] & good agreement (1) Lines / line of best fit [allow: mean line] pass(es) through all error bars (1) Lines straddle the origin [accept: line of best fit passes through the origin] (1)			3	3		3
	(d)		Velocity decreases (1) Gradient decreases [implied if factor < 1] (1) By factor $\sqrt{1.5}$ (1) [changes by factor $\frac{1}{\sqrt{1.5}}$ or $\times 0.82$ - not: 25%]		3		3	1	3

© WJEC CBAC Ltd.

	(e)		**Any sensible 2 ×(1) from:** e.g. higher concentrations (might) cause bad effects (precautionary principle) Some pedestrians suffer health effects die - respiratory problems Respiratory problems caused by other chemicals Acid rain produced by NO_2 Some pedestrians claim NO_2 bad - psychosomatic Reliable data difficult to obtain - Worse for asthma sufferers Data may be more conclusive in future Accept cheating NO_2 figures is fraud Sensible conclusion (1)			3	3		
			Question 5 total	**3**	**6**	**6**	**15**	**3**	**9**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*		N.B. no marks for beta and alpha Answer = 232 (1) Answer = 90 (1)		2		2		
	(b)		Conversion to second ($\times 10^9 \times 365 \times 24 \times 3\,600$) [$4.4\times10^{17}$] (1) Use of decay constant = $\frac{0.693}{\text{half-life}}$ [1.6×10^{-18} s^{-1}] (1) $N = \frac{5.0 \times 10^{-3}\ \text{kg}}{3.9 \times 10^{-25}\ \text{kg}}$ [allow $\frac{5\times10^{-3}}{232\times1.66\times10^{-27}}$](1) Use of $A = \lambda \times N$ (1) Answer = 20 kBq ((**unit**)) (1) [accept s^{-1} for Bq] [Accept: correct answer in other units, e.g. 1.7×10^9 day^{-1} If not in Bq and no unit 3max]	1 1 1	1 1 1		5	4	
	(c)	(i)	**Either** Half-life around 3.8 throws (or get λ from equation or check that decreased by a sixth once) (1) 2× half-lives around 7.8 throws (or calculate another point using λ or check that decreased by a sixth again) (1) Expected activity as one sixth checked e.g. $\frac{6\,000}{6} \approx 1\,009$ (or check that reduced by a sixth for 3rd occasion) (1) Considered conclusion - all is about right (1) **Or** Exp decay if same interval → same fractional change (1) Calculation of fractional change for a given throw interval (1) Calculation of fractional change for two further same throw intervals (1) Conclusion: about right (1) Or Calculate λ 3 times using three different point → conclusion NB conclusion only after legitimate work			4	4	3	4

© WJEC CBAC Ltd.

		(ii)	Smaller numbers involved (1) More [%] random error expected (1)			2	2		2
			Question 6 total	**2**	**5**	**6**	**13**	**7**	**6**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*		Mass can be converted to energy (or vice versa or $E = mc^2$) (1) So mass-energy cons used if change of mass (1) i.e. short concluding comment stating briefly mass-energy conservation (rather than simple energy conservation) also accept $m_0c^2 + E$ conserved (or similar)	2			2		
	(b)		Baryon number OK [1+1 = 5-3+1-1+0+0+0] **or** 2=2 (1) Accept U and D conservation : 4U + 2D = 4U + 2D Or Quark number: 6 = 6 Lepton number not OK [0+0 ≠ 0+0+0+0+0+0+4] or 0≠4 (1) Charge conservation OK [1+1 = 5-3+0+0+2-2+0] or 2=2] (1) Mass energy not OK not enough energy to produce products (1) If not 4 correct conclusions 3max.			4	4		
			Question 7 total	**2**	**0**	**4**	**6**	**0**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
8			**Indicative content:** 1 Mention/explanation of mass defect e.g. nucleus lighter than (constituent) nucleons 2 Mass defect or mass loss link to mass-energy or $E = mc^2$ 3 Definition/explanation of BE e.g. energy required to separate nucleons 4 BE/N is BE divided by number of nucleons 5 Energy released if BE/N increases or stability increases (or reverse or equivalent) 6 Increased BE/N gives increased stability (or reverse or equivalent), eg ^{56}Fe is the most stable 7 Fission defined (large nucleus $\rightarrow$ small); 8 Fusion defined (merging nuclei) 9 Alpha emission also increases BE/N – linked to stability of He4 nucleus 10 Gradient (or equiv) of BE/N curve greater at low N end of graph than at high N, linked to energy released [per kg] in fission and fusion	6			6		

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			5 - 6 marks Expect at least 6 points *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3 - 4 marks** Expect 4-5 points *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1 - 2 marks** Expect 1-3 points *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.*						
			Question 8 total	**6**	**0**	**0**	**6**	**0**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
9	*(a)*		Conversion $4.32 \times 10^{6} \times 1.6 \times 10^{-19}$ i.e. 6.912×10^{-13} [J] (1) Rearrangement for v i.e. $v = \sqrt{\frac{2E}{m}}$ (1) Answer = 1.44×10^{7} m s^{-1} (1)		3		3	2	
	(b)		24 total energy 'kicks' (or 2 per revolution) (1) 4.32 MeV divided by 24 (=180 000) (1) Also need to divide by $2e$, Answer = 90 000 V (1) (2 marks for 180 kV, 1 mark for 360 kV, 2.16 MV $\rightarrow$1 mark)		3		3	2	
	(c)		Equating: $m\omega^2 r = Bqv$ (1) or $\omega = \frac{Bq}{m}$ Rearrangement: $f = \frac{Bq}{2\pi m}$ (1) By implication can give 2 marks for this Answer = 3.6 MHz (**ecf** on part (b) i.e. using $1e$ instead of $2e$ 1.8 MHz) (1)		3		3	2	
			Question 9 total	**0**	**9**	**0**	**9**	**6**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
10	*(a)*		Flux changes in ring as it approaches [or recedes from] magnet (1) Emf induced (1) [or by implication by next marking point] Current induced (complete circuit) (1) [Motor effect force] opposes motion or energy lost or Lenz's law stated(1)		4		4		
	(b)		Nothing [or equiv](1) Always opposes motion (Lenz) / field in opposite direction / current in opposite [not: the force opposite] (1)		2		2		
	(c)		Length = $2\pi r$ used (1) [0.157 m] $R = \frac{1.59\times10^{-8}\times2\pi\times0.025}{2.4\times10^{-5}}$ seen (or 1.04×10^{-4} [Ω] seen) (1)	1	1		2	1	
	(d)		Ohm's law used (1) $\text{Emf} = \frac{BNA}{t}$ i.e. Faraday's used (1) [= 0.55 mV] [NB c.s.a of wire used → no credit and no ecf] Answer, $\frac{B}{t}$ = 0.29 T s^{-1} (or 0.28 depending on rounding)(1)	1	1 1		3	2	
			Question 10 total	**2**	**9**	**0**	**11**	**3**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
11	*(a)*	(i)	1.8 - 1.9 squares for peak (or 3.6 - 3.8 for double) **Or** 0.002× and /$\sqrt{2}$ (1) Answer = 2.5 – 2.7 mV (1)		2		2	2	
		(ii)	7.9 - 8.3 squares for period **Or** 0.05 × and $f = \frac{1}{T}$ (1) Answer = 2.4 – 2.5 Hz (1)		2		2	2	
	(b)	(i)	Pd proportional to rate of change/cutting of flux (linkage) (1) Rate of change/cutting is proportional (accept increases with) angular velocity (1)	2			2		
		(ii)	Vertical: no flux cut/flux does not change (1) Horizontal: flux cut/changes at max rate (1) **Alternative:** rate of change/cutting depends on angle (1) Clarification e.g. vertical component of velocity does cutting Or vertical/horizontal positions explained briefly (1)	2			2		
	(c)	(i)	Pds across C and L cancel or equivalent (1) $I = \frac{15}{120}$ (1)	1	1		2	1	
		(ii)	Valid method employed e.g. $X_C = X_L$ (1) Answer = 15 850 Hz (1)		2		2	1	
		(iii)	X_C and X_L calculated correctly (or implied, 2 229, 2 564) (1) Impedance equation used (1) $I = \frac{15}{355}$ seen or 42.3 mA (1)	1	1 1		3	2	

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iv)	RMS values used – correct (1) Current not in phase with pd or all pd not across R (1) Actual power is $I_{\text{rms}}{}^2R$ or equivalent (1) Real value is 0.21 W (1) Conclusion – invalid calculation (1) **Or** Current not in phase with pd so cannot use $\langle P \rangle = V_{\text{rms}} I_{\text{rms}}$ (1) So Alistair is incorrect (1) Only resistor dissipates power so $\langle P \rangle = I_{\text{rms}}^2 R$ is valid (1) So real value is 0.21 W (1) So Michonne is correct (1)			5	5	2	
			Question 11 total	**6**	**9**	**5**	**20**	**10**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
12	*(a)*		Metal filter to remove **low energy** X-rays (1) So they are not absorbed by tissue causing damage (1) Lead grid to absorb **scattered** X-rays (1) to increase contrast / reduce shadow areas (1)	4			4		
	(b)	(i)	$Q = It$ / current is charge per second (1) no of electrons per second = $\frac{0.015}{1.6 \times 10^{-19}} = 9.4 \times 10^{16}$ (1)	1	1		2	2	
		(ii)	**Either**: Application of $eV = ½\ mv^2$ (1) $v = 1.03 \times 10^8$ m s^{-1} (1) $F = mv \times$ no of electrons per sec = 8.79×10^{-6} [N] (1) **Or**: Application of $p = \sqrt{2mE_k}$ (1) Electron momentum = 9.35×10^{-23} N s (1) $F = p \times$ no. of electrons per second = 8.79×10^{-6} [N] (1)		3		3	3	
	(c)		MRI works and non ionising/time consuming/expensive-ish (1) (£500) PET works but ionising/expensive/limited availability/low resolution (1) (£900) Ultrasound B won't work/too much air reflection (1) (£150) CT works but ionising/expensive-ish (1) (£500) Conclusion all work except ultrasound but MRI best (1)			5	5		
	(d)	(i)	Kidney to check flow / Thyroid to check uptake (of iodine)/blood flow through the brain check for blockages /any other example	1			1		

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	$\frac{0.12}{5}$ = 0.024 [Bq cm^{-3}] (1) Activity = $160e^{(-0.0462 \times 7)}$ [or $160 \times 2^{-\frac{7}{15}}$] = 115.8 or 116 [Bq] (1) Volume ($\frac{115.8}{0.024}$) = 4 825 cm^3 (1)		3		3	3	
		(iii)	Rearrangement $v = \frac{\Delta f_c}{2 f_0 \cos\theta}$ (1) v = 0.14[4] m s^{-1} (1)		2		2	2	
			Question 12 total	**6**	**9**	**5**	**20**	**10**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
13	*(a)*		Centre of gravity/Weight of cyclist (and normal reaction) and bicycle acts though the base of the wheel	1			1		
	(b)	(i)	The moment of inertia about an axis is the sum (1) Of mass × radius^2 (distance from the axis) (1) **Or** $I = \sum mr^2$ (1) and symbols explained – see above (1) accept Moment (1) per unit angular acceleration (1)	2			2		
		(ii)	Calculating M of I $= \frac{1}{12} 60 \times 1.68^2 =$ 14.112 kg m^2 (1) Rearranging $\omega = \frac{J}{I} = \frac{92.1}{14.112}$ (1) Angular velocity = 6.53 rad s^{-1} (1)		3		3	2	
		(iii)	Applying conservation of angular momentum (1) Substitution of values $\omega = \frac{92.1}{2.7}$ (1) Angular velocity = 34.1 rad s^{-1} (1)	1	1 1		3	2	
	(c)	(i)	Substitution into torque $\tau = I\alpha$ or $\tau = \frac{\Delta(I\omega)}{t}$ or $\tau = \frac{I\Delta\omega}{t}$((1) Substitute values for $\alpha = \frac{220-170}{0.310}$ or $\Delta(I\omega)$=1.10×(–50) [ignore sign] (1) $\tau = 177$ N m (1)	1	1 1		3	2	
		(ii)	Substitution into rotational KE = $\frac{1}{2} I\omega^2$ (1) Factor ×4 (four wheels) (1) **Rotational** KE lost = 42.9 × 10^3 J (1)	1	1 1		3	2	

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)		Converting km hr^{-1} to m s^{-1} correctly (1) Substituting values in $F = \frac{mv-mu}{t}$ or $a = \frac{v-u}{t}$ (1) F = 64.5 kN or 58 kN for car or 6.4 kN for driver **or** a = 90.9 m s^{-2}(1) Acceleration/Force is large/Need to reduce F or a (1) Grass or gravel area will increase the time or slow down before impact with wall etc.(1)			5	5	2	
			Question 13 total	**6**	**9**	**5**	**20**	**10**	**0**

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
14	*(a)*	(i)		Object totally or partially immersed in a fluid (accept liquid or gas) is buoyed (accept lifted, upward force, upthrust) by a force equal to the weight of the displaced fluid	1			1		
		(ii)	(I)	Volume = $1.5 \times 10^6 \times 2.1 = 3.15 \times 10^6$ km^3 and correct conversion of units seen (e.g 3.15×10^{15} m^3) (1) Mass = $920 \times 3.15 \times 10^{15} = 2.9 \times 10^{18}$ kg seen (1)		2		2	2	
			(II)	Volume of water produced = $\frac{2.9 \times 10^{18}}{10^3}$ (= 2.9×10^{15} m^3) (1) (accept 3.0×10^{15} m^3 if value given used) Sea level rise = $\frac{2.9 \times 10^{15}}{3.6 \times 10^{14}}$ = 8.05 (m) (seen) (or 8.3 if 3.0×10^{18} kg used) (1)			2	2	2	
	(b)	(i)		Mass of air (per second) = ρAu (1) Convincing substitution into ½ mu^2 (1)	2			2		
		(ii)		Doubling blade length will increase power by a factor of 4 (accept 2^2) (1) Doubling speed will increase power by a factor 8 (accept 2^3) (1)		2		2		
		(iii)		**Either** Correct substitution and power calculated for either input or output power: i.e. input P = 0.87 MW, Output P = 0.21 MW **Or** $P_{IN} = \frac{1}{2}\pi \times 30^2 \times 1.2 \times (8^3 - 5^3)$ (1) P_{IN} calculated (0.87 – 0.21 = 0.66) (1) (**ecf** for either or both powers]. % efficiency = $(\frac{0.66}{0.87}) \times 100$ = 75.9% [accept 76%, 0.759 or 0.76](1)		3		3	2	
		(iv)		Friction between moving parts (in the turbine). Don't accept 'heat', 'sound'.			1	1		

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		All units correctly identified: $\frac{\Delta Q}{\Delta t}$: J s^{-1}; A: m^2 ; $\frac{\Delta \theta}{\Delta x}$: K m^{-1} (1) Correct substitution and convincing algebra (1)	2			2		
		(ii)		Understanding shown that heat flow through both materials is the same (even if substitution below incorrect) (1) **Either** $\frac{0.06 \times A \times (18 - \theta_B)}{8} = \frac{0.9 \times \quad \times (A \quad - \theta_B}{120}$ (1) Convincing algebra to show θ_B = 13 °C (1) **Or** With 13 °C: Carpet heat flow/m^2 = 37.5 W m^{-2} or Concrete heat flow / m^2 = 37.5 W m^{-2} (1) Other heat flow shown to be the same, thus confirming (1)	1	1 1		3	2	
		(iii)		Either carpet: $\frac{\Delta Q}{\Delta t} = \frac{0.06 \times 48 \times 5}{0.008}$ [or 48 × 37.5] or concrete: $\frac{\Delta Q}{\Delta t} = \frac{0.9 \times 48 \times 5}{0.12}$ [or 48 × 37.5] (1) = 1.8 kW = 50% ∴ claim verified (1)			2	2	2	
				Question 14 total	**6**	**9**	**5**	**20**	**10**	**0**

© WJEC CBAC Ltd.

A LEVEL COMPONENT 3: Light, Nuclei and Options - SUMMARY OF ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	3	2	9	3	6
2	1	1	4	6	4	0
3	3	6	3	12	2	9
4	7	6	0	13	7	0
5	3	6	6	15	3	9
6	2	5	6	13	7	6
7	2	0	4	6	0	0
8	6	0	0	6	0	0
9	0	9	0	9	6	0
10	2	9	0	11	3	0
11	6	9	5	20	10	0
12	6	9	5	20	10	0
13	6	9	5	20	10	0
14	6	9	5	20	10	0
TOTAL	**36**	**54**	**30**	**120**	**45**	**30**

© WJEC CBAC Ltd.