GCE A LEVEL MARKING SCHEME

SUMMER 2025

A LEVEL
PHYSICS – UNIT 3
1420U30-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE A LEVEL PHYSICS

UNIT 3 – OSCILLATIONS AND NUCLEI

SUMMER 2025 MARK 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

SECTION A

<table>
<tr><th colspan="3" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>ΔU – <u>Increase / change</u> in internal energy (1)
Q - Heat <u>supplied / into</u> to system (1)
W - Work done <u>by</u> system (1)
Penalise 1 mark max if gas or system missing in all definitions.
Penalise the in / out only once e.g. change in internal energy OR heat flowing in/out OR work done by/on
This gets 1 mark because “system” or “gas” is missing throughout. The “heat in/out” is penalised but the candidate gains the last mark “work done by/on”.
Allow 1 mark for:
Internal energy (missing change and system)
Heat energy (missing system and in)
Work done (missing system and by) but ecf is available here too</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>p / 10^5 Pa</th><th>V / m^3</th><th>T / K</th><th>pV / 10^5 Pa m^3</th></tr>
<tr><td>3.6</td><td>1.0</td><td>510</td><td>3.60</td></tr>
<tr><td>2.6</td><td>1.4</td><td>515</td><td>3.64</td></tr>
<tr><td>2.0</td><td>1.8</td><td>510</td><td>3.60</td></tr>
<tr><td>1.8</td><td>2.0</td><td>510</td><td>3.60</td></tr>
<tr><td>1.5</td><td>2.4</td><td>510</td><td>3.60</td></tr>
<tr><td>1.2</td><td>3.0</td><td>510</td><td>3.60</td></tr>
</table>
Calculating T at 1 point OR checking pV at a point (1)
Calculating T at another point OR checking pV constant at 2nd point (1)
Calculating T at a 3rd point OR checking pV constant at 3rd point (1)
Sensible comment e.g. T constant OR valid conclusion and T calculated (1) (no ecf)
N.B. Penalise power of 10 slip in temperature only once. Power of 10 omissions in pV method do not need to be penalised if consistent (but can be penalised if inconsistent)</td><td></td><td></td><td>4</td><td>4</td><td>2</td><td></td></tr>
</table>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	Reasonable attempt at calculating area **or** using $p\Delta V$ (1) W = 395 500 [$\pm$ 50 000] [J] (1) Award 1 mark only for 480 000 [J]	1	1		2	2	
		(iii)	Work done = $2 \times 1.2 \times 10^5$ (1) Total work = 395 500 - ($2 \times 1.2 \times 10^5$) + 0 **ecf** (1) $\Delta U = 0$ (over whole cycle) (1) can't be implied Q = 155 500 [J] (1) allow **ecf** on total work Note: any attempts at ΔU using temperatures can't be credited **Alternative 1** Work done = area enclosed (in cycle) (1) Reasonable attempt at enclosed area (accept triangle as an attempt) (1) $\Delta U = 0$ (1) Correct answer (accept 155 000 ± 50 000) (note there is **ecf** on (b)(i) and on 2nd mark) (1) **Alternative 2** Heat = area enclosed (in cycle) (1) Reasonable attempt at enclosed area (accept triangle as an attempt) (1) $\Delta U = 0$ (1) (note that this will almost certainly be lost if they start from the 1st mark) Correct answer (accept 155 000 ± 50 000) (note there is **ecf** on (b)(i) and on 2nd mark) (1) Penalise bad triangle approximation only once		4		4	4	
			Question 1 total	**4**	**5**	**4**	**13**	**8**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	Conversion of temperature into Kelvin = 293.15 [K] (1) Use of $pV = nRT$ (1) n = 6.22 [moles] (1) N.B. Award equation mark even if T = 20 used (expect 91 mol) but not if T = 20 and another silly error e.g. $V = 0.15^3$	1 1	1		3	2	
		(ii)	Use of valid equation e.g. $p = \frac{1}{3}\rho\overline{c^2}$ (1) $\rho = \frac{6.22\times0.004}{0.15}$ (1) $\bar{c} = 1350$ [m s^{-1}] (1) N.B. 1376 [m s^{-1}] if n = 6 used Allow 2 marks for $\sqrt{\overline{c^2}}$= 42.7 (from not converting gramme) Allow 2 marks for $\overline{c^2}$= 1.8 × 10^6 (forgetting to square root) **Alternative:** $\frac{1}{2}m\overline{c^2} = \frac{3}{2}kT$ (1) m = 4 × 1.66 × 10^{-27} (1) $\bar{c} = 1350$ [m s^{-1}] (1)	1	1 1		3	2	
		(iii)	Correct method i.e. rms = $\sqrt{\frac{950^2+1200^2+1325^2+1500^2+1625^2}{5}}$ (1) Beware! Calculating $\overline{\sqrt{c}}^2$ has been seen i.e. $\left(\frac{\sqrt{950}+\sqrt{1200}+..}{5}\right)^2$ = (1309) Correct answer = 1340 [m s^{-1}] (1) Correct conclusion e.g. yes, the rms speed of the sample molecules is slightly lower (1) Allow **ecf** for final conclusion (even if (a)(ii) has a silly number) e.g. range of speeds (950-1625) is consistent with (a)(ii) N.B. calculating mean (1320) or $\overline{\sqrt{c}}^2$ can only obtain the last conclusion mark		1 1	1	3	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)	Thermal energy transferred from an object at a higher temperature to an object at lower temperature Accept energy transfer due to temperature difference / gradient Accept thermal energy in transit **OR** the transfer of thermal energy **OR** similar e.g. thermal energy from 1 object to another Accept energy transferred [by a system] through {thermal / blackbody} radiation Accept [thermal] energy flowing from high to low temperature [because the temperature implies the thermal] Do not accept "transfer of energy from high to low" and no implication of "thermal"	1			1		
		(ii)	**Any 2×(1) from:** – Heat flows out of balloon **OR** heat linked to temperature of helium decreasing Accept heat travels from high temp to low temp because the question states that the outside is far colder – -Gas in balloon and surroundings at same temperature **OR** same KE of particles inside and out – [Thermal] equilibrium N.B. Award 2 marks for: Because heat is transferred from an area of high temperature to an area of low temperature until both temperatures are the same.	2			2		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iii)	**Natalie:** Same KE (beware candidates implying this by using $\frac{1}{2}m\overline{c^2} = \frac{3}{2}kT$ and stating same T) (1) Oxygen slower linked to larger mass (**OR** reverse He faster and lighter) (1) this is an independent mark but does not imply the 1st mark) These 2 marks are implied by rms of O_2 = rms of He /$\sqrt{8}$ **OR** rms of He/$2\sqrt{2}$ etc. **Mona:** KE (or speed) depends on (only) temperature **OR** pressure difference irrelevant (1) Conclusion both wrong (1) **Alternative for Natalie points only:** Calculation of He speed (using same volume even though not quite valid) $\sqrt{\overline{c^2}} = \sqrt{\frac{3p}{\rho}} = \sqrt{\frac{3\times28000}{0.16}} = 725\ or\ 712$ (1) Using Avogadro's gas law to get oxygen rms speed i.e. $\sqrt{\overline{c^2}} = \sqrt{\frac{3p}{\rho}} = \sqrt{\frac{3\times28000}{0.16\times8}} = 256$ OR $\sqrt{\overline{c^2}} = \sqrt{\frac{3p}{\rho}} = \sqrt{\frac{3\times25000}{0.16\times8}} = 242$ (1)			4	4		
			Question 2 total	**6**	**5**	**5**	**16**	**6**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		β- decay proton number increases **OR** goes right (1) Neutron number decreases **OR** goes down (1) Correct conclusion backed up by something valid (no ecf but independent mark) (1) e.g. Meg wrong because needs to get closer to line e.g. X does β- because proton produced Beware: sometimes candidates talk about 48 neutrons and 32 protons becoming 47 neutrons and 33 protons - perfectly correct for the first 2 marks but needs conclusion for 3rd mark) **Alternative: (can't pick and choose from both)** (β- decay) neutron → proton + (electron + electron-neutrino) (1) i.e. goes down **OR** right (or proton number increase or neutron decrease) (1) Correct conclusion backed up by something valid (no ecf but independent mark) (1) e.g. Meg wrong because needs to get closer to line e.g. X does β- because proton produced Do not accept answers similar to "electron is $^{1}_{0}\beta$ so neutron number goes down" - although there seems to be an awardable mark, we cannot award a mark for completely wrong physics! Accept for 1 mark "X has too many neutrons and not enough protons so Elliot is right" (it's the conclusion mark, although some good physics is implied we have requested "explain your reasoning") Any reasoning based on a helium nucleus scores zero marks Elliot correct because a proton is lost - 0 marks			3	3		
	(b)		Time for {number of nuclei / [radio]activity / mass} to halve	1			1		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		$A = \frac{A_0}{2}$ and $T_{\frac{1}{2}}$ "appear" correctly (1) Logs taken correctly e.g. $\ln\frac{A}{A_0} = -\lambda t$ **OR** $\ln\frac{1}{2} = -\lambda T_{\frac{1}{2}}$ **OR** $\ln A - \ln A_0 = -\lambda t$ **OR** $\ln A_0 - \ln 2 = \ln A_0 - \lambda T_{\frac{1}{2}}$ (1) Algebra ok i.e. sorting ½ and -ve problem without algebraic mistakes e.g. $\ln\frac{1}{2} = -\lambda T_{\frac{1}{2}} \rightarrow 2 = e^{\lambda T_{\frac{1}{2}}} \rightarrow \ln 2 = \lambda T_{\frac{1}{2}}$ QED (last step in question so accept $\ln 2 = \lambda T_{\frac{1}{2}}$) (1) N.B. $\frac{A}{A_0} = e^{-\lambda t} \rightarrow \ln\frac{A}{A_0} = -\lambda t \rightarrow \frac{\ln\frac{A}{A_0}}{\lambda} = t \rightarrow \frac{\ln 2}{\lambda} = T_{\frac{1}{2}}$ loses last mark for imperfect algebra, definitely gains 2nd mark for taking logs, receives 1st mark (with BOD) Beware of $\ln\frac{A_0}{2} = \ln A_0 - \ln 2$, it is correct and can be seen in some correct answers. Beware of $\frac{A}{A_0} = e^{-\lambda t} \rightarrow \frac{1}{2} = e^{-\lambda T_{\frac{1}{2}}} \rightarrow \ln 2 = -\lambda T_{\frac{1}{2}} \rightarrow \rightarrow \frac{\ln 2}{\lambda} = T_{\frac{1}{2}}$ All these types of answers gain 2 marks	3			3	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)		Correct substitution into $A = A_0e^{-\lambda t}$ i.e. $\frac{82}{100} = e^{-730\lambda}$ (1) Taking logs i.e. $\ln\frac{82}{100} = -730\lambda$ (1) Using $T_{1/2} = \frac{\ln 2}{\lambda}$ so λ = 2.72 × 10^{-4} $year^{-1}$ or 8.6 × 10^{-12} s^{-1} (1) $T_{1/2}$ = 2550 year **or** 8.05 × 10^{10} s (1) **UNIT MARK** (**ecf** on 18%) Allow 1 mark for 2030 years i.e. 730 × 50%/18% Allow 3 marks for 295 years or 9.3 × 10^9 s i.e. 82% drop down to 18% **Alternative:** Substitution into: $\frac{A}{A_0} = \frac{1}{2^n}$ i.e. $\frac{82}{100} = \frac{1}{2^n}$ Taking logs i.e. $n\log 2 = \log\frac{100}{82}$(1) $n = 0.286$ [half-lives] (1) $T_{1/2} = \frac{730}{0.286} = 2550$ year **or** 8.05 × 10^{10} s (1) **UNIT MARK**	1	1 1 1		4	3	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(e)		$\frac{2}{6} = 0.333$, $\frac{3}{8} = 0.375$ **OR** equivalent (1) Probability of decay higher for 8-sided **OR** reverse **OR** more of 8-sided decay per throw **OR** $\frac{\ln 2}{0.33}$ **OR** $\frac{\ln 2}{0.375}$ (giving half-life in number of throws) (1) Note calculating the numbers for the 1st mark followed by stating that these are the probabilities gets the 2nd Shorter half-life for 8-sided or longer half-life for 6-sided (1) **Alternative:** $\frac{6}{2} = 3$ and $\frac{8}{3} = 2.67$ (1) Probability of not decaying higher for 6 sided (or reverse) **OR** calling these numbers the "expected rolls" (1) Shorter half-life for 8-sided **or** longer half-life for 6-sided (1) **Alternative:** $\frac{2}{6} = 0.333$, $\frac{3}{8} = 0.375$ (1) Using half-life equation e.g. $\frac{\ln 2}{0.33}$ expect 2.1 and 1.85 throws (1) 8-sided has shorter half-life (1)			3	3	3	
			Question 3 total	**5**	**3**	**6**	**14**	**8**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		Correct position marked (by eye) Allow circling of iron 56 rather than the curve But (by eye) all parts of the circle should be $20 \leq A \leq 100$ Circle must contain A = 56 to A = 62 (Ni-62 is the highest)	1			1		
	(b)		It only has one particle in the nucleus Accept “It is just a proton” Accept “It has no neutrons and 1 proton” Accept “just one nucleon” Accept “it has no neutrons”		1		1		
	(c)		**Indicative content:** **Fusion** Nuclei join together Left of stable region Moving toward higher BE/N Stability linked to BE/N OR also stating moving to higher stability Linked to reduced mass Linked to energy release ($E = mc^2$) Possible numbers would be BE/N increases from 2 to 7 for fusion **Fission** Nucleus splits (into smaller nuclei) Right of stable region Moving toward higher BE/N Stability linked to BE/N OR also stating moving to higher stability Linked to reduced mass Linked to energy release ($E = mc^2$) Possible numbers: BE/N increases from 7.5 to 8.5 for fission	6			6		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			5-6 marks Comprehensive account of both fission and fusion provided. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Comprehensive account of either fission or fusion provided or limited description of both. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Limited description of either fission or fusion. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with little structure.* **0 marks** No attempt made or no response worthy of credit.						
	(d)		Attempting LHS – RHS i.e. 5.0291 u - 5.0102 u = 0.0189 [u] (1) $\times$ 931 (1) $\times$ 1.6 $\times$ 10^{-19} **or** $\times$ 1.6 $\times$ 10^{-13} (1) = 2.82 $\times$ 10^{-12} [J] (1) **Alternative:** Attempting LHS – RHS i.e. 5.0291 u - 5.0102 u = 0.0189 [u] (1) $\times$ 1.66 $\times$ 10^{-27} (1) $\times$ c^2 (1) = 2.82 $\times$ 10^{-12} [J] (1)	1	1 1 1		4	3	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(e)		**Any 3 × (1) from:** **Pro:** Will reduce carbon emissions **OR** global warming **OR** CO_2 **OR** reduce reliance on fossil fuel Could solve future energy problems / plentiful supply **OR** renewable Not dependent on wind / solar **OR** reliable (accept <u>constant</u> energy BOD) Releases a lot of energy **OR** releases more energy than fission No nuclear waste / short half-life products No SOx NOx OR acid rain Research itself is a benefit **Con:** Money could be spent on NHS **OR** schools **OR** charities Money could be spent on developing (more efficient) wind turbines / solar panels **OR** other renewable Not yet proven **OR** further research needed NOT efficient - boiling water is inefficient NOT - clean energy NOT - create jobs NOT - cheaper			3	3		
			Question 4 total	**8**	**4**	**3**	**15**	**3**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		Vertical forces are balanced (accept vertical equilibrium) (1) $T\cos\theta$ is vertical component (accept doing trig to show that $T\cos\theta$ is the vertical component) (1)	1	1		2	1	
	(b)		$\frac{5}{2}$ = 2.5 and $3.0\sin\theta$ labelled in the diagram (or explained in words) **Accept** radius is 2.5 m and $3.0\sin\theta$ is the component of the displacement horizontally		1		1	1	
	(c)	(i)	Substitution into $T\cos\theta = mg$ (1) Answer = 22° (21.95) **OR** 0.383 rad (1)	1	1		2	1	
		(ii)	2.5 + 3 sin(22) **ecf** = 3.6 [m]		1		1	1	
		(iii)	Use of $\frac{mv^2}{r}$ (1) **ecf** Equating to $T\sin\theta$ (1) **ecf** Answer = 3.8 [m s^{-1}] (1)		3		3	3	
		(iv)	Use of $v = \frac{2\pi r}{T}$ **OR** $v = \omega r$ and $\omega = \frac{2\pi}{T}$ (1) **ecf** Answer = 6.0 [s] (1)		2		2	1	
			Question 5 total	**2**	**9**	**0**	**11**	**8**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)		Air resistance / drag (1) Accept resistive forces Dissipates energy / mass does work against air resistance / always opposes motion (or equivalent e.g. gives KE to air molecules) (1) Accept "collides with air molecules"	2			2		2
	(b)	(i)	1.46 (1) 0.07 (1)		2		2	2	2
		(ii)	Data point plotted within ½ square (1) **ecf** Error bar plotted correctly within ½ square i.e. ±3 or 3.5 or 4 squares (1) **ecf**		2		2	2	2
		(iii)	**Any 5 × (1) from:** – Taking logs i.e. $\ln A = \ln A_0 - kt$ – Intercept agrees – Negative gradient agrees – Straight line agrees – A valid straight line plotted through <u>all</u> error bars – Statement – line passes through all error bars – Statement linking time and the number of oscillations			5	5	2	5
			Question 6 total	**2**	**4**	**5**	**11**	**6**	**11**

SECTION B

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Radius is a quarter wavelength **OR** equivalent, $\lambda = 4R$ (1) Use of $v = f\lambda$ **OR** $v = \frac{\lambda}{T}$ (1) Substitution of $f = \frac{1}{T}$ and tidying **OR** subbing $v = \frac{\lambda}{T}$ and rearranging (1) **Accept:** $\lambda = 4R$ (1) $T = \frac{\lambda}{v}$ (1) (we have to BOD this!) $v = \frac{4R}{T}$ (1)	1	1 1		3	1	
	(b)		$\frac{3}{2}kT$ is KE of one {particle / atom / ion / molecule} **OR** $U = \frac{3}{2}NkT$ (1) Star is mainly hydrogen (don't allow H_2) (1) $\frac{M}{m_H}$ is the number of {particles / atoms / ions / molecules} (1)	1	1 1		3	1	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		$\frac{\text{N m}^2\text{ kg}^{-2}\text{ x kg}^2}{\text{m}}$ **OR** $\frac{\text{kg m s}^{-2}\text{ x m}^2\text{ kg}^{-2}\text{ x kg}^2}{\text{m}}$ (1) Giving N m **OR** kg m^2 s^{-2} – equivalent to J (1) (Equations are not required because should know N m and kg m^2 s^{-2} but expect to see $W = Fd = ma \times d$ = kg m s^{-2} × m) Award 1 mark for candidates who simply state that it is the same as gravitational PE equation which is in J **OR** that $\frac{GM}{r}$ is J kg^{-1} and that $\frac{GM^2}{r}$ is J Beware $\frac{\text{Nm}^2\text{kg}^{-2}\text{kg}^2}{\text{m}} = \text{Nm}$ - It needs QED or = J to be finished		1 1		2	2	
	(d)	(i)	Correct substitution (implied by correct answer) (1) $\tau \approx 4 \times \sqrt{\frac{3 \times (7 \times 10^8)^3}{\frac{5}{3} \times 6.67 \times 10^{-11} \times 2 \times 10^{30}}}$ Correct answer 2.39 hour **OR** 2.4 hour (1) Don't accept 8605 s without comment	1	1		2	1	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	Both nominator and denominator decrease by 1000× (1) Hence true (1) (not a standalone mark, only for those who spot the above point) Allow **ecf** on slips in substitution for 2nd mark only e.g. 100× too large instead of smaller **Alternative:** Correct substitution (1) i.e. $\tau \approx 4 \times \sqrt{\frac{3 \times (7 \times 10^7)^3}{\frac{5}{3} \times 6.67 \times 10^{-11} \times 2 \times 10^{27}}}$ Correct answer (8605 s) and comment (1) **Alternative** Equation not valid because $\gamma \neq \frac{5}{3}$ (because Jupiter not made of monatomic) (1) Michele incorrect (1)			2	2	1	
	(e)		**Any 4 × (1) from:** – Star getting hotter linked to ionisation – Ionisation linked to greater absorption – Absorption or ionisation linked to further increase in temperature – Increased temperature linked to increased pressure – Increased temperature **OR** pressure linked to expansion – Expansion linked to cooling (and light escaping) – Contraction linked to increase in temperature (and repeat)		4		4		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(f)		Cepheid variable changes intensity **OR** a normal star doesn't vary Accept changing brightness or intensity or luminosity Ignore reference to 25% increase in radius		1		1		
	(g)		There is a link between period and luminosity or equivalent e.g. luminosity obtained from period **OR** get luminosity from Leavitt's Law **OR** similar (1) Measure intensity (1) Calculate distance using (only) luminosity and intensity **OR** use inverse square law **OR** $I = \frac{L}{4\pi d^2}$ (accept $I = \frac{P}{A}$) (1)		3		3		
			Question 7 total	**3**	**15**	**2**	**20**	**6**	**0**

A2 UNIT 3: OSCILLATIONS AND NUCLEI

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	5	4	13	8	0
2	6	5	5	16	6	0
3	5	3	6	14	8	0
4	8	4	3	15	3	0
5	2	9	0	11	8	0
6	2	4	5	11	6	11
7	3	15	2	20	6	0
TOTAL	**30**	**45**	**25**	**100**	**45**	**11**