GCE

Physics A

H556/03: Unified physics

A Level

Mark Scheme for June 2025

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING
RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training: OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. There is a NR (**No Response**) option. Award NR (No Response):
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g., 'can't do', 'don't know')
   - OR if there is a mark (e.g., a dash, a question mark) which is not an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. **Annotations**

Annotation		Meaning
	Correct response	Used to indicate the point at which a mark has been awarded (**one tick per mark awarded**).
	Incorrect response	Used to indicate an incorrect answer or a point where a mark is lost.
AE	Arithmetic error	Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
BOD	Benefit of doubt given	Used to indicate a mark awarded where the candidate provides an answer that is not totally satisfactory, but the examiner feels that sufficient work has been done.
BP	Blank page	Use BP on additional page(s) to show that there is no additional work provided by the candidates.
CON	Contradiction	No mark can be awarded if the candidate contradicts himself or herself in the same response.
ECF	Error carried forward	Used in numerical answers only, unless specified otherwise in the mark scheme. Answers to later sections of numerical questions may be awarded up to full credit provided they are consistent with earlier incorrect answers. Within a question, ECF can be given for AE, TE and POT errors but not for XP.
L1	Level 1	L1 is used to show 2 marks awarded and L1^ is used to show 1 mark awarded.
L2	Level 2	L2 is used to show 4 marks awarded and L2^ is used to show 3 marks awarded.
L3	Level 3	L3 is used to show 6 marks awarded and L3^ is used to show 5 marks awarded.
POT	Power of 10 error	This is usually linked to conversion of SI prefixes. Do not allow the mark where the error occurs. Then follow through the working/calculation giving ECF for subsequent marks if there are no further errors.
SEEN	Seen	To indicate working/text has been seen by the examiner.
SF	Error in number of significant figures	Where more SFs are given than is justified by the question, do not penalise. Fewer significant figures than necessary will be considered within the mark scheme. **Penalised only once in the paper.**

Annotation		Meaning
TE	Transcription error	This error is when there is incorrect transcription of the correct data from the question, graphical read-off, formulae booklet or a previous answer. Do not allow the relevant mark and then follow through the working giving ECF for subsequent marks.
XP	Wrong physics or equation	Used in numerical answers only, unless otherwise specified in the mark scheme. Use of an incorrect equation is wrong physics even if it happens to lead to the correct answer.
^	Omission	Used to indicate where more is needed for a mark to be awarded (what is written is not wrong but not enough).

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
✓	Used to indicate the point at which a mark has been awarded (**one tick per mark awarded**).
/	Separates marking points
Not	Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
Ignore	Statements which are irrelevant
Allow	Answers that can be accepted
( )	Words which are not essential to gain credit
___	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject Specific Marking Instructions**

CATEGORISATION OF MARKS

The marking schemes categorise marks on the MACB scheme.

M marks These are method marks upon which **A**-marks (accuracy marks) later depend. For an **M**-mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular **M**-mark, then none of the dependent **A**-marks can be scored.

A marks These are accuracy or answer marks, which either depend on an **M**-mark, or allow a **C**-mark to be scored.

C marks These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a **C**-mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C**-mark is given.

B marks These are awarded as independent marks, which do not depend on other marks. For a **B**-mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

SIGNIFICANT FIGURES

If the data given in a question is to 2 sf, then allow an answer to 2 or more significant figures.
If an answer is given to fewer than 2 sf, then penalise once only in the entire paper.
Any exception to this rule will be mentioned in the Guidance.

Question			Answer	Mark	Guidance
1	(a)	(i)	V (= Ed) = 0.2 × 10^{-3} × 20,000 × 10^{3} **or** V = 4000 (V)	C1	**Allow** F (= QE) = 1.6 × 10^{-19} × 0.2 × 10^{-3} **or** F = 3.2 × 10^{-23} (N)
			W (= QV) = 1.6 × 10^{-19} × 4000	C1	**Allow** W (= Fd) = 3.2 × 10^{-23} × 20,000 × 10^{3}
			6.4 × 10^{-16} (J)	A1	
1	(a)	(ii)	electrons move in opposite direction to (electric) field/conventional current	M1	**Allow** electrons are negatively charged
			(so electric field is) upwards	A1	
1	(b)		11.7 – 9.4 (= 2.3 eV)	C1	**Allow** 13.6 – 11.7 (= 1.9 eV) **or** 13.6 – 9.4 (= 4.2 eV)
			$\lambda = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{2.3\times1.6\times10^{-19}}$	C1	**Allow** a full substitution with an energy level change of 9.4, 11.7 or 13.6 eV for this C1 mark only
			5.4 × 10^{-7} (m)	A1	**Allow** an answer consistent with 1.9 eV or 4.2 eV (i.e.296 nm or 654 nm gains 3 marks)
			Correct reasoning to select 540 nm • the middle wavelength (from red, green, UV) • the middle frequency • the middle photon energy • the middle-sized electron transition	B1	**Allow** up to 4 marks for working backwards from stating wavelength of green light is ~550 nm i.e. $E = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{550\times10^{-9}\times1.6\times10^{-19}}$ E = 2.3 eV 11.7 – 9.4 (= 2.3 eV)

Question			Answer	Mark	Guidance
1	(c)		(conventional) current opposite to electron flow **or** (right) to left (magnetic field) out of the page	**B1** **B1**	**Allow** annotation of figure to show circular magnetic field lines around current **or** arrow labelled current towards left on Fig 1.1
1	(d)		heating effect ionisation of atoms / lightning strikes	**B1** **B1**	 Allow (ionisation causes) horizontal force / acceleration of gas (due to F = BIL / motor effect)
			Total	**13**	

Question			Answer	Mark	Guidance
2	(a)		(oscillating) force acting on (current carrying) wire in magnetic field (produces) waves travelling in opposite directions (along the wire) which interfere /superpose	B1 B1	**Ignore** $F = BIl\sin\theta$ unless quantities defined **Ignore** wire moves/oscillates **Allow** forms nodes / anti-nodes for interfere **Allow** produces a (progressive) wave which reflects (from a fixed bridge) and interferes **Allow** bridge needs to be placed at integer number of half wavelengths (for a standing wave to form)
2	(b)	(i)	B/flux density (only) affects size of force / amplitude (of stationary wave)	B1	**Ignore** flux density does not affect frequency / wavelength / speed / period **accept** <u>maximum</u> displacement for amplitude
2	(b)	(ii)	measure length of wire (with ruler) **and** measure mass of wire using balance mass per unit length is mass divided by length	B1 B1	**Allow** any other valid method that includes measurement **Allow** any other valid analysis eg finding gradient of a suitable graph
2	(c)	(i)	worst acceptable line drawn through all error bars	B1	Must pass through +/- half a small square of: RH extreme of bottom bar and LH extreme of top bar for steepest line **or** LH extreme of bottom bar and RH extreme of <u>penultimate</u> bar for shallowest line

2	(c)	(ii)	(calculated) gradient of line of worst fit	M1	**Accept** gradient within the ranges 2.40 to 2.70 for shallow line or 3.00 to 3.30 for steep line.
			(calculated)absolute uncertainty in gradient	C1	**Accept** 0.15 – 0.45
			(calculated) percentage uncertainty	A1	**Accept** 5.0% to 16.0%
2	(c)	(iii)	$f = \frac{\text{gradient}}{2\sqrt{\mu}}$	C1	**Allow** any subject and any substituted gradient for this C1 mark only
			$\left(f = \frac{2.81}{2\sqrt{8.0\times10^{-4}}} =\right)$ 49.7 (Hz)	A1	**Accept** 50 (Hz) (2 sig figs) on answer line if 49.7 or 49.67 seen in working Note f = 49.674
			(% uncertainty =) (c)(ii) + 1 correctly evaluated	B1	eg (11 + 1 =) 12 (%)
2	(c)	(iv)	% difference $\left(= \frac{50.0 - 49.7}{\mathbf{50.0}} \times 100\%\right) = 0.6$ %	M1	**ECF** their f from (c)(iii) for 49.7 but **not** f = 50(.0) Note if 49.67 is used % diff is 0.66 % **Accept** calculated upper (and lower) bound of f i.e. 49.7 x (1 + % uncertainty from (c)(iii)/100) eg 49.7 x 1.12 = 56 Hz
			correct comparison of values for % uncertainty and % difference and appropriate comment	A1	**Accept** calculated upper bound > 50 Hz therefore accurate / falls within the range of stated bounds eg 56 Hz > 50 Hz so accurate
			Total	**14**	

Question			Answer	Mark	Guidance
3	(a)		(motion of truck) moves/spins coil/wire in magnetic field (rate of) change in flux linkage (causes induced e.m.f. driving a current through the battery) Any **one** from: • work done by gravity / weight (reduces GPE) • work done on charge by magnetic field (transfer to electric energy) • work done by charge passing through battery (transfer to chemical energy)	**B1** **B1** **B1**	**Allow** (motion of truck) moves/spins magnet in coil of wire or description of relative motion between coil and magnet/magnetic field **Allow** lines of flux are cut (inducing an emf)
3	(b)		Any **3** from: • (internal energy is) sum of kinetic **and** potential energy of particles (in the wax) • increase in temperature in solid wax corresponds to particles increasing their kinetic energy (but potential energy remains constant) • change of state corresponds to particles increasing their potential energy • increase in temperature in liquid wax corresponds to particles increasing their kinetic energy (but potential energy remains constant)	**B1x3**	**Accept** KE for kinetic energy and PE for potential energy throughout **Allow** KE ∝ temperature **Allow** during change of state work is being done against intermolecular attractive forces Note only award KE mark once unless one comment is clearly for solid wax and the other for liquid wax i.e. before and after melting

3	**(c)**		**Level 3 (5–6 marks)** Clear correct calculations, including efficiency, for both sand and wax **and** clear quantitative discussion comparing the two methods **or** limited quantitative discussion and discussion of pros/cons of both methods *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Some correct calculations for both sand and wax including a specific heat capacity calculation **OR** Limited calculation(s) for sand and/or wax **and** some discussion of pros/cons *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* **Level 1 (1–2 marks)** Limited calculation(s) **OR** Limited discussion *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6 × B1**	Use level of response annotations in RM Assessor No ticks **Indicative scientific points may include:** **Calculations** • ΔGPE = $mg\Delta h$ ≈ 1 × 9.81 × 1000 = 9.8 kJ • useful = 0.7 × 10 kJ = 6.9 kJ • $\Delta E = mc\Delta\theta$ = 1 × 2.6 × (51–18) = 86 kJ • $\Delta E = mL$ = 1 × 160 = 160 kJ • $\Delta E = mc\Delta\theta$ = 1 × 3.0 × (70–51) = 57 kJ • Total E for wax = 300 kJ • useful for wax= 0.95 × 300 ≈ 290 kJ **Discussion** • Thermal system stores ~40 times as much energy per kg of material • GPE pros: readily available material; no new infrastructure required; energy stored in batteries can be directly released to the grid; energy can be stored indefinitely • GPE cons: requires mountainous terrain; slow response time • Thermal pros: high energy density; easily scaled up or automated; can be built in any location • Thermal cons: energy stored cannot readily be converted to electrical energy for the grid; limited storage time as wax cools
			Total	**12**	

Question			Answer	Mark	Guidance
4	(a)		(below pivot to provide restoring force so that) needle rests vertically (with the pointer at the bottom) when there is no charge (short distance so that moment due to weight is as small as possible) to increase sensitivity	B1 B1	Must be clear that needle is vertical when at rest eg $\theta = 0°$ **Allow** to increase the resolution / to be able to clearly discriminate between charge values
4	(b)	(i)	Relevant comment **and** curved line of best fit drawn through 0.3 kV (by eye/ ±1 small square) at 0 deflection	B1	**Allow** statement that curved line of best fit would pass through 0.3 kV if line is missing/incomplete
4	(b)	(ii)	value read from their lobf at 45 degrees their value read at 45 degrees corrected for zero error $Q = CV = 20 \times 10^{-12} \times 1300$ (= 2.6×10^{-8} C) $2.6 \times 10^{-8} \div 1.6 \times 10^{-19}$ 1.6×10^{11} (electrons)	B1 B1 C1 A1	**Allow** 1.60 ± 0.05 kV if no line has been drawn Expect 1.30 ± 0.05 for range stated above **Allow** any value for V between 0 and 4.5 kV Expect (2.5 to 2.7) × 10^{-8} for ranges above (1.6 to 1.7) × 10^{11} Note answers in the range (1.9 - 2.1) x10^{11} gain both calculation marks (zero error not applied). **Accept** this answer given to one sig fig. An answer of 2 x10^{11} (one sig fig) gains 4 marks if (1.6 to 1.7) × 10^{11} seen in working Note an answer of (1.6 to 1.7) × 10^{11} gains 4 marks

Question			Answer	Mark	Guidance
			Total	**7**	

Question			Answer	Mark	Guidance
5	**(a)**		(ionising radiation may) kill cells / damage DNA/cells/gametes	**B1**	**Ignore** cancer or damages organs/tissues **Accept** mutation of DNA/cells / causes free radicals (that react with DNA)
5	**(b)**	**(i)**	(relevant) property of alpha eg • not very penetrating or is easily absorbed • has a short range (in air) • strongly ionising (relevant) consequence in context from the chosen property	**B1** **B1**	 eg • would not reach far side of (the 10 cm) canister • (strongly ionising so) will kill insects before they have a chance to mate Note for short range comments there must be a clear comparison between the sizes of the range and canister for both marks to be awarded

5	**(b)**	**(ii)**	**Level 3 (5–6 marks)** Clear description of how both gamma and X-rays are produced **and** clear comparison of practical considerations, including safety *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Clear description how both gamma and X-rays are produced **OR** Clear description of how gamma or X-rays are produced **and** limited advantages/disadvantages of practical considerations **OR** Limited description of how both gamma and X-rays are produced **and** clear advantages/disadvantages of practical considerations *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* **Level 1 (1–2 marks)** Limited description **or** Limited comparison *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6 × B1**	Use level of response annotations in RM Assessor **Indicative scientific points may include:** **Description** Gamma rays production • radioactive decay of unstable nuclei • following alpha or beta decay • (from) production of Tc-99m, Co-60 • from the de-excitation of nuclei • from annihilation of particle-antiparticle (pairs) X-ray production • electrons accelerated to a high velocity / by large p.d. • electrons collide with anode/metal target • kinetic energy converted to X-ray photons • formed when electrons (in target) de-excite • produced by deceleration of fast electrons **Comparison** • Safety: similar penetration and ionisation properties so shielding requirements are similar / short exposure time / precautions when handling/storing sources • X-ray: source requires large equipment / requires large electrical power / can be turned on and off / energy of X-rays can be controlled • Gamma source: can be small / no electrical power source required / continuous/spontaneous emission / must be replaced at regular intervals / intensity decreases over time
			Total	**9**	

Question			Answer	Mark	Guidance
6	(a)	(i)	$strain = \frac{extension}{\textbf{original}\ length}$	B1	**Allow** (strain is) extension per **unit** length **Allow** compression for extension **Allow** $\varepsilon = \frac{x}{L}$ with terms defined
6	(a)	(ii)	use of area = πr^2	C1	**Allow** use of $\pi d^2/4$ or $\pi (d/2)^2$
			F = Young modulus × strain × area $F = 130 \times 10^9 \times 10^{-21} \times \pi \times (1.0 \times 10^{-3})^2$	C1	Note area = 3.14×10^{-6} (m^2) **Allow** calculation using $E = \sigma / \varepsilon$ and $F = \sigma A$ i.e. stress = $130 \times 10^9 \times 10^{-21} = 1.3 \times 10^{-10}$ **and** $F = 1.3 \times 10^{-10} \times \pi \times (1.0 \times 10^{-3})^2$
			$4(.08) \times 10^{-16}$ (N)	A1	**Allow** 2 marks for $4(.08) \times 10^n$ (N)
6	(a)	(iii)	strain is <u>very small</u> / <u>very small</u> force required to produce similar strain	B1	
			difficult to distinguish signal from background noise / signal will be hidden by the effect of other forces	B1	**Ignore** references to measuring instruments/detectors

6	**(b)**	**(i)**	$F = -\frac{GM^2}{D^2}$	**B1**	**Accept** correct formula without negative sign
6	**(b)**	**(ii)**	**one** from: • $\frac{Mv^2}{D/2} = \frac{GM^2}{D^2}$ • $v = \frac{\pi D}{T}$ **one** from: • $E = -\frac{GM^2}{D} + 2(\frac{1}{2}Mv^2)$ • $E = -\frac{GM^2}{D} + 2(\frac{1}{4}\frac{GM^2}{D})$ steps leading to $E = k\,(\pi^2G^2M^5)^{1/3}\,(1/T^{2/3})$	**M1** **M1** **A1**	**Allow** m for M throughout GPE must be negative for this marking point Note this comes from substituting $v^2 = \frac{GM}{2D}$ eg use of $v^2 = \frac{GM}{2D}$ and $v = \frac{\pi D}{T}$ to obtain $D^3 = \frac{GMT^2}{2\pi^2}$ and $E^3 = -\frac{G^3M^6}{8D^3}$

6	**(b)**	**(iii)**	A to C = 0.4247 – 0.4173 (= 7.4×10^{-3}) **or** C to E = 0.4293 – 0.4247 (= 4.6×10^{-3}) E = $-2.04 \times 10^{46} \times (7.4 \times 10^{-3})^{-2/3}$ (= -5.38×10^{47}) **or** E = $-2.04 \times 10^{46} \times (4.6 \times 10^{-3})^{-2/3}$ (= -7.38×10^{47}) $(7.38 - 5.37) \times 10^{47} = 2(.0) \times 10^{47}$ J	**C1** **C1** **A1**	**Accept** 7.2×10^{-3} to 7.6×10^{-3} **Accept** 4.4×10^{-3} to 4.8×10^{-3} **Accept** -5.28×10^{47} to -5.47×10^{47} **Accept** -7.17×10^{47} to -7.60×10^{47} **Accept** 1.69×10^{47} to 2.32×10^{47}
6	**(b)**	**(iv)**	$\Delta t = 0.4273 - 0.4214 = 5.9 \times 10^{-3}$ s $P \left(= \frac{E}{t}\right) = \frac{2.01 \times 10^{47}}{5.9 \times 10^{-3}} = 3.4 \times 10^{49}$ (W)	**C1** **A1**	**Accept** 5.8×10^{-3} to 6.1×10^{-3} **Allow** calculation using value of E calculated in 6(b)iii **Expect** 3.30×10^{49} to 3.47×10^{49} if 2.01×10^{47} used
			Total	**15**	

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