Cambridge Assessment International Education

# Cambridge IGCSE™

**PHYSICS** **0625/42**

Paper 4 Extended Theory **October/November 2020**

MARK SCHEME

Maximum Mark: 80

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.



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**[Turn over**

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## Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen). |
| GENERIC MARKING PRINCIPLE 6:<br><br>Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind. |

**Science-Specific Marking Principles**

| | |
|---|---|
| 1 | Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly. |
| 2 | The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored. |
| 3 | Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection). |
| 4 | The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted. |
| 5 | ‘List rule’ guidance<br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.<br>• Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science. |

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient ($a$) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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## NOTES ABOUT MARK SCHEME SYMBOLS AND OTHER MATTERS

B marks are 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 answer.

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

C marks are compensatory marks in general applicable to numerical questions. These can be scored even if the point to which they refer are not written down by the candidate, **provided 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 substitution or working which shows he knew the equation, then the C mark is scored. A C mark is not awarded if a candidate makes two points which contradict each other. Points which are wrong but irrelevant are ignored.

A marks A marks are accuracy or answer marks which either depend on an M mark, or which are one of the ways which allow a C mark to be scored. A marks are commonly awarded for final answers to numerical questions. If a final numerical answer, eligible for A marks, is correct, with the correct unit and an acceptable number of significant figures, all the marks for that question are awarded. However, an A mark following an M mark is a dependent mark and is only awarded if the M mark has been awarded.

Brackets ( ) Brackets around words or units in the mark scheme are intended to indicate wording used to clarify the mark scheme, but the marks do not depend on seeing the words or units in brackets, e.g. 10 (J) means that the mark is scored for 10, regardless of the unit given. However, if a word in brackets is replaced with another word that is clearly wrong then the mark should not be awarded.

Underlining Underlining indicates that this **must** be seen in the answer offered, or something very similar.

OR / or This indicates alternative answers, any one of which is satisfactory for scoring the marks.

eeoo. This means 'each error or omission'.

owtte. This means 'or words to that effect'.

Ignore This indicates that something which is not correct or irrelevant i.e. it is not a contradiction (CON) is to be disregarded and does not incur a penalty.

Spelling Be generous about spelling and use of English. If an answer can be understood to mean what we want, give credit. However, do not allow ambiguities, e.g. spelling which suggests confusion between reflection / refraction / diffraction or thermistor / transistor / transformer.

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Not/NOT This indicates that an incorrect answer is not to be disregarded, but cancels another otherwise correct alternative offered by the candidate, i.e. right plus wrong penalty applies.

ecf meaning 'error carried forward' is mainly applicable to numerical questions, but may in particular circumstances be applied in non-numerical questions. This indicates that if a candidate has made an earlier mistake and has carried an incorrect value forward to subsequent stages of working, marks indicated by ecf may be awarded, provided the subsequent working is correct, bearing in mind the earlier mistake. This prevents a candidate from being penalised more than once for a particular mistake, but **only** applies to marks annotated ecf in the mark scheme. **Always annotate ecf if applied.**

cao correct answer only

Significant Figures Answers are normally acceptable to any number of significant figures ≥ 2.
Any exceptions to this general rule will be specified in the mark scheme. Annotate with SF from the toolbar. A second (or further) sig. fig. error in a single question is not penalised; annotate with SF SF. It is normally acceptable to quote just 1 s.f. for answers, which are exact to 1 s.f

Units Deduct one mark for each incorrect or missing unit from an answer that would otherwise gain all the marks available for that answer: **maximum 1 per question**. No deduction is incurred if the unit is missing from the final answer but is shown correctly in the working. Annotate with U.
For more than one unit error in a question, annotate UU to indicate an error which has not been penalised.
Unless listed here or stated in the mark scheme for the question, do not accept derived units e.g. kg m $s^{-2}$ for N is NOT acceptable.
The following are acceptable alternatives: Nm for J, $Js^{-1}$ or $Nms^{-1}$ for W, $Nm^{-2}$ for Pa, Ns and kg m $s^{-1}$ are both acceptable for both momentum and impulse.
Beware : J NOT acceptable for moments.
Condone wrong use of upper and lower case symbols, e.g. pA for Pa.

Arithmetic errors If the **only** error in arriving at a final answer is clearly an arithmetic one, then the mark awarded will be one mark lower than the maximum mark.
Regard a power-of-ten error as an arithmetic error unless otherwise specified in the mark scheme. Annotate with POT. Do not penalise the same POT error more than once. Annotate POT POT. However, if the power-of-ten error is due to the wrong omission or inclusion of *g* (= 10 N / kg) this rule does not apply.
The use of a wrong SI prefix in the final answer is counted as a power-of-ten error rather than a unit error.

Transcription errors If the only error in arriving at a final answer is because previously calculated data has clearly been misread, but used correctly, then for that part question the mark will be one less than the maximum mark.

Fractions Allow these only where specified in the mark scheme; they are a form of sig. fig. error; annotate with SF. Consequently, when a sig. fig. error and a fraction is used in the same question, the second answer may still be awarded full marks.

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Crossed out Work which has been crossed out **and not replaced but can easily be read**, should be marked as if it had not been crossed out. Look to see if it has been replaced on a blank page or another part of the same page.

Use of **NR** (# or / key on the keyboard). Use this if the answer space for a question is completely blank or contains no readable words, figures or symbols.

**RM Assessor 3**

Please note that 0625 papers are now marked using RM assessor3. Videos and documents are available by using the Help icon in the top right hand cornet when logged in or from the RM support site. Familiarisation mode is also available on RM Assessor 3. The tool bar is now located on the left of the screen and you drag items used frequently to the right hand side of the tool bar. Note – the tool bar won't be visible until you have scripts to mark rather than just browse.

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**RM Assessor3 annotations:**

| annotation | suggested use |
|---|---|
| tick | mark awarded (note the ticks are added up next to the tick annotation, check the total you enter agrees) |
| cross | no mark awarded |
| SEEN | indicates page seen |
| BOD | benefit of doubt given |
| NBOD | no benefit of doubt given |
| on page comment | gives a text box to write comment –much easier to use than in the previous version of RM assessor |
| ECF | error carried forward |
| ^ | omission mark |
| ? | unclear |
| U<br>UU | unit penalty applied<br>unit penalty not applied because already applied earlier in same question |

| annotation | suggested use |
|---|---|
| wavy line (horizontal or vertical) | used to highlight a particular point |
| CON | contradiction |
| | |
| NAQ | not answered question |
| PD | poor diagram |
| SF<br><br>SFSF | error in number of significant figures<br>significant figure error not penalized. |
| POT<br>POT POT | power-of-ten error<br>POT penalty not applied as already applied |
| TV | too vague |
| I | ignore |
| | |
| SC | special case |

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**Guidance on the expression : words, symbols or numbers**
Accept numbers if, in the context of the question, that number can reasonably be a value for the quantity in the equation/formula.
Accept alternative symbols that can reasonably represent the quantity in the equation but not if there is confusion with another quantity that is represented by that symbol in the syllabus e.g. Q is often acceptable for thermal energy but not if, as has happened, if there is confusion with charge.

## Linking pages to other questions RM Assessor3

It is not unusual for candidates to write all or parts of answers to question outside the normal marking zone for that question. It is absolutely vital that such work is marked. Examiners need to follow up cases where candidates reach the end of the answer zone in the middle of a sentence or cross out all the work that fills the answer zone, or use an asterisk or arrowed line or otherwise to suggest that an answer is completed or replaced elsewhere on the paper.

If all the extra work is clearly visible **in the next marking zone** there is no need to link it.
**In all other cases** where there is extra work that cannot be seen in the normal marking zone, examiners will need to use full screen mode to find the page which needs linking to a particular question and click 'link to question'. The page is then automatically linked to that question and will appear below the zone for that question when marked.

## Blank Pages and Blank AOs

There are no blank pages.
Annotate with 'seen' from toolbar that you have seen any blank Additional Objects.

## Annotation

To increase marking transparency, reduce the number of enquiries about results and assist team leaders, the following is mandatory :

- For **all** questions with two or more marks, examiners should tick to indicate where each credit is awarded.
- For questions with one mark, examiners do not need to annotate the script to indicate that credit is awarded.
- Any text annotation or annotation in a comment box should never contain -1 or allow a possible misinterpretation that negative marking was applied.

Normally place the ticks close to where the mark is scored.

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| Question | Answer | | Guidance |
|---|---|---|---|
| | | | Any correct final answer scores full marks even if reached by wrong Physics. |
| | | | Any numerically correct final answer with a unit error scores (full marks – 1) even if reached by wrong Physics. Annotate U. |
| | | | |

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| Question | Answer | Marks |
|---|---|---|
| 1(a)(i) | X near (30,60) | **B1** |
| 1(a)(ii) | Y AND Z near any horizontal section of graph | **B1** |
| 1(b) | any **two** from:<br>• weight OR force of / due to gravity acts down<br>• (force of / due to) air resistance / drag / friction acts up / opposes motion<br>• initially / up to 10 s: resultant force is downward OR downward force is greater than upward force<br>• resultant force causes acceleration<br>• air resistance increases as speed increases / she accelerates | **B1** |
| | any **two** from:<br>• acceleration (down) initially / for first 10 s<br>• acceleration decreases as air resistance increases / resultant force decreases<br>• zero acceleration / constant speed / terminal velocity reached when upwards force = downwards force OR when no / zero resultant OR when forces balanced OR when downward force = air resistance<br>• terminal velocity / constant speed reached after (about) 10 s OR at 60 m / s | **B2** |
| 1(c) | (average speed =) {initial speed + final speed} / 2 words, symbols or numbers<br>OR (average speed =) distance (from area) / time words, symbols or numbers | **C1** |
| | (average speed = 40 / 2 =) 20 m / s<br>OR (av speed = 80 / 4 = ) 20 m / s | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 2(a) | force × <u>perpendicular</u> distance (from point) | **B1** |
| 2(b)(i) | 0.80 N | **B1** |
| 2(b)(ii) | (moment = force × distance = ) 0.8 × 0.25 | **C1** |
| | (moment =) 0.20 N m | **A1** |
| 2(b)(iii) | same value as (ii) with correct unit | **B1** |
| 2(b)(iv) | $F \times 0.75 = 0.20$ in any form OR ($F$ =) 0.2 / 0.75 | **C1** |
| | ($F$ = 0.2 / 0.75 = ) 0.27 N | **A1** |
| 2(c) | (perpendicular) distance (from pivot) of F decreases / is less (than 0.75 m)<br>OR<br>(perpendicular) distance (from pivot) of<br>W increases / is more (than 0.75 m) | **M1** |
| | (so) increased / greater (force $F$) (needed for greater moment) | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 3 | (output) $P = VI$ OR $E = VIt$ OR $E = Pt$ in any form words, symbols or numbers<br>OR ($P$ =) $VI$ OR ($P$ =) $240 \times 9$ OR ($P$ =) 2160 (W)<br>OR ($E$ =) $240 \times 9 \times 60 = 129\,600$ (J) | **C1** |
| | (rate of energy input = 720 000 / 60 =) 12 000 (J / s)<br>OR energy input = 720 000 (J) | **C1** |
| | (efficiency =) (100 ×) output power / input power<br>OR (100 ×) output energy / input energy<br>words, symbols or numbers | **C1** |
| | (efficiency =) $100 \times \{2160 / 12\,000\}$ | **C1** |
| | (efficiency =) 18(%) | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | thermocouple | **B1** |
| 4(b) | ($\Delta T$ =) $\{1.7 / 5.4\} \times 100$ | **C1** |
| | ($T$ = 31 + 20 =) 51°C | **A1** |
| 4(c) | any application involving high(er) / low(er) temperatures OR rapidly changing temperatures OR on vibrating machinery OR remote sensing OR data logging OR small areas / masses | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | (thermal) energy (needed) to change state | **M1** |
| | of unit mass / 1 kg (of material) NOT per °C | **A1** |
| 5(a)(ii) | molecules must be separated OR (intermolecular) bonds must be broken / overcome | **B1** |
| | work done (against bonds) OR energy is required / needed<br>NOT increase of KE / speed | **B1** |
| 5(b) | $E = ml$ in any form or ($l =$) $E \div m$<br>words, symbols or numbers | **C1** |
| | ($m =$) 1.5 OR 1500 OR OR 3.8 – 2.3<br>OR 3800 – 2300 | **C1** |
| | ($l = 1.26 \times 10^6 \div 1.5 =$) $8.4 \times 10^5$ J / kg | **A1** |
| 5(c) | insulate OR apply lagging / insulation (to container) | **B1** |
| | reduction of thermal energy / heat losses | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | **1** amplitude marked correctly | **B1** |
| | **2** wavelength marked correctly | **B1** |
| 6(a)(ii) | trough labelled T | **B1** |
| 6(b) | $f$ = 15 / 60 (= 0.25) | **B1** |
| | $v = f\lambda$ in any form OR ($v$ =) $f\lambda$ words, symbols or numbers | **B1** |
| | ($v$ =) 0.08 × 0.25 (= 0.02 m / s) OR 0.25 × 8 (= 2.0 cm / s) | **B1** |
| | Alternative route 1 :<br>$v = d \div t$ words, symbols or numbers | **(B1)** |
| | distance moved in one minute = 15 × 8 OR 120 OR 15 × 0.08 OR 1.2 | **(B1)** |
| | ($v$ =) 120 / 60 (= 0.02 m / s) OR 120 ÷ 60 OR 15 × 0.08 ÷ 60 OR 1.2 ÷ 60 | **(B1)** |
| | Alternative route 2 :<br>time for 1 oscillation = 4 s | **(B1)** |
| | distance moved in 4 s = 8 cm | **(B1)** |
| | so speed = 8 ÷ 4 = 2 cm / s | **(B1)** |
| 6(c) | oscillation at right angles to the direction of propagation / travel / energy transfer (of the wave) | **B1** |
| | oscillation parallel to / in the direction of propagation / travel / energy transfer (of the wave) OR has compressions and rarefactions OR needs / must have a medium | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 7(a)(i) | total internal reflection OR T.I.R. | **B1** |
| 7(a)(ii) | sin $C = 1 \div n$ in any form OR ($C$ =) $\sin^{-1}\{1 \div 1.4\}$ | **C1** |
| | ($C = \sin^{-1}\{1 \div 1.4\} = \sin^{-1} 0.714$ =) 46° | **A1** |
| 7(b) | description of fibre passing to site to be examined / treated | **B1** |
| | light passes down fibre (to site) AND (image) returns (to sensor / observer)<br>OR alternative use to endoscopy | **B1** |
| | extra detail, e.g. laser light source, illuminated organ, image, camera / type of sensor | **B1** |
| 7(c) | any mention of frequency | **B1** |
| | (all of light) same / single / one frequency | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 8(a) | conditions (outdoors) may be damp / wet | **C1** |
| | water conducts (electricity) OR clear statement of need for waterproof / outdoor specification (components) | **A1** |
| 8(b) | protects components / appliances / circuit / wires / user / mains supply<br>prevents electrical supply overheating / fires / electrocution / shocks | **B1** |
| | excess current / power in circuit / wires OR fuse melts / blows OR circuit breaker opens | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 9(a)(i) | C pointing horizontally to right | **B1** |
| | B AND D pointing horizontally to left | **B1** |
| 9(a)(ii) | S on left AND N on right | **B1** |
| 9(b) | any one of the following methods: | |
| | **1** heat magnet | **C1** |
| | to high temperature / red hot | **A1** |
| | **2** hammer the magnet | **(B1)** |
| | repeatedly / in E–W direction | **(B1)** |
| | **3** (place) magnet in a coil / solenoid carrying a.c. | **(M1)** |
| | remove magnet from coil OR decrease current (slowly) to zero | **(A1)** |
| 9(c)(i) | at least 3 concentric circles | **B1** |
| | closer together near the wire AND clockwise arrow | **B1** |
| 9(c)(ii) | arrows OR field reverses / is in opposite direction | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 10(a)(i) | recognisable ammeter in gap AB AND straight lines in CD AND EF | **B1** |
| 10(a)(ii) | recognisable voltmeter across 4 Ω | **B1** |
| | correct voltmeter symbol used | **B1** |
| 10(a)(iii) | $V = IR$ in any form or ($V =$) $IR$ words, symbols or numbers | **C1** |
| | ($V_{2\Omega} = 2 \times 2.5 =$) 5 V | **C1** |
| | ($I_{4\Omega} = 5 \div 4 =$) 1.3 A<br>must be clear that $I$ refers to 4 Ω<br>OR calculates $R_p = 1.33\ \Omega$ OR $4 \div 3\ \Omega$ | **C1** |
| | ($I_{6\Omega} = 2.5 + 1.3 =$) 3.8 A<br>OR ($I_{6\Omega} = 5 \div 1.33 =$) 3.8 A | **A1** |
| | Alternative route for first 3 mps | |
| | $I$ proportional to $1 \div R$ OR $I_{2\Omega} \times R_{2\Omega} = I_{4\Omega} \times R_{4\Omega}$ | **C1** |
| | $I_{4\Omega} = I_{2\Omega} \div 2$ | **C1** |
| | ($I_{4\Omega} = I_{2\Omega} \div 2 = 2.5 \div 2 =$) 1.3 A | **C1** |
| | Alternative route by potential divider | |
| | $V = IR$ in any form or ($V =$) $IR$ words, symbols or numbers | **C1** |
| | ($V_{2\Omega} = 2 \times 2.5 =$) 5 V | **C1** |
| | $V_T = 7.33 \times 5 \div 1.33$ (= 27.51 V) | **C1** |
| | ($I_{6\Omega} = 27.51 \div 7.33 =$) 3.8 A | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 10(b) | any sort of triangle symbol pointing to left in EF | **B1** |
| | a wire in CD | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 11(a) | nuclear fission – nucleus / atom splits (into two)<br>**AND**<br>nuclear fusion – two nuclei / atoms join together | **B1** |
| | **One** from<br>• {nuclear fission –large(r) mass (number) OR heavy nuclei / atoms involved OR neutrons involved / emitted}<br>**AND**<br>nuclear fusion – small(er) mass (number) OR light nuclei / atoms involved OR no neutrons<br>• fission in a nuclear reactor AND fusion in Sun / stars<br>• fission produces very radioactive / long lasting waste<br>• fission makes lighter new elements AND fusion makes heavier new elements<br>• fission at normal p / T AND fusion at high p / T<br>• fusion produces more energy (than fission) | **B1** |
| 11(b)(i) | longer half-life – radioactive substance active in body for a long time | **B1** |
| | shorter half-life – might be insufficient time for investigation OR it takes time / hours for the tracer to spread round the body | **B1** |
| 11(b)(ii) | proton numbers balance for equation<br>expected answer : $_{42}Mo \rightarrow {}_{43}Tc + {}_{-1}\beta$ | **B1** |
| | all nucleon numbers correct | **B1** |
| | correct proton and nucleon number for β-particle | **B1** |
| 11(b)(iii) | any suitable use, e.g. sterilisation of equipment, treatment of cancer, gamma for diagnosis, radiotherapy<br>NOT any link to X-rays | **B1** |

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