**Cambridge International Examinations**
Cambridge International General Certificate of Secondary Education

**PHYSICS** **0625/41**

Paper 4 Extended Theory **May/June 2016**

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.

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NOTES ABOUT MARK SCHEME SYMBOLS AND OTHER MATTERS

| | |
|---|---|
| M marks | are method marks upon which further marks 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 marks can be scored. |
| B marks: | are independent marks, which do not depend on other marks. For a B mark to scored, the point to which it refers must be seen specifically in the candidate's answers. |
| A marks | In general A marks are awarded for final answers to numerical questions.<br>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 normally awarded.<br><br>It is very occasionally possible to arrive at a correct answer by an entirely wrong approach. In these rare circumstances, do not award the A marks, but award C marks on their merits. However, correct numerical answers with no working shown gain all the marks available. |
| 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<br>A C marks is not awarded if a candidate makes two points which contradict each other. Points which are wrong but irrelevant are ignored. |
| 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. |
| <u>underlining</u> | indicates that this <u>must</u> be seen in the answer offered, or something very similar. |
| OR / or | indicates alternative answers, any one of which is satisfactory for scoring the marks. |
| e.e.o.o. | means "each error or omission". |
| o.w.t.t.e. | means "or words to that effect". |
| Spelling | Be generous about spelling and use of English. If an answer can be understood to mean what we want, give credit. However, beware of and do not allow ambiguities, accidental or deliberate: e.g. spelling which suggests confusion between reflection / refraction / diffraction / thermistor / transistor / transformer. |
| Not/NOT | 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. |
| Ignore | Indicates that something which is not correct or irrelevant is to be disregarded and does not cause a right plus wrong penalty. |

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|---|---|
| ecf | meaning "error carried forward" is mainly applicable to numerical questions, but may in particular circumstances be applied in non-numerical questions.<br>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 being penalised more than once for a particular mistake, but **only** applies to marks annotated ecf. |
| 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. |
| 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. |
| Arithmetic errors | Deduct one mark if the **only** error in arriving at a final answer is clearly an arithmetic one. |
| Transcription errors | Deduct one mark if the only error in arriving at a final answer is because given or previously calculated data has clearly been misread but used correctly.. |
| Fractions | (e.g. ½) Allow these only where specified in the mark scheme. |
| Crossed out work | 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. |
| Use of **NR** | (# key on the keyboard) Use this if the answer space for a question is completely blank or contains no readable words, figures or symbols. |

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| Question | Answer | Mark |
|---|---|---|
| 1(a) | From time zero, line of constant positive gradient, not necessarily from origin<br>Horizontal line from end of sloping line<br>Line of steeper positive gradient from end of horizontal line | **B1**<br>**B1**<br>**B1** |
| 1(b) | (distance =) area under graph stated<br><br>$0.5 \times 7.5 \times 3.3$ (= 12.375)<br>+ $12.5 \times 3.3$ (= 41.25)<br>+ $0.5 \times 5 \times 3.3$ (= 8.25)<br><br>OR ½ (a + b)h<br>= $0.5 \times (25 + 12.5) \times 3.3$<br><br>OR $(25 \times 3.3) – (0.5 \times 12.5 \times 3.3)$<br><br>62 m | **C1**<br><br>**C2**<br><br>**(C1)**<br>**(C1)**<br><br>**(C2)**<br><br>**A1** |
| | | **Total: 7** |

| Question | Answer | Mark |
|---|---|---|
| 2(a)(i) | (momentum =) mv OR $70 \times 20$<br>= 1400 kg m / s OR N s | **C1**<br>**A1** |
| 2(a)(ii) | same numerical answer as **(a)(i)** with either unit OR 1400 kg m / s | **B1** |
| 2(b) | (a = ) change of velocity / time OR (v – u) / t OR 20 / 0.2<br><br>100 m / $s^2$ | **C1**<br>**A1** |
| 2(c) | (F =) ma OR $70 \times 80$<br>5600 N | **C1**<br>**A1** |
| 2(d) | Force / impact on passenger or dummy less (than without seat belt / airbag)<br>Passenger less likely to be injured / hurt / damaged | **M1**<br>**A1** |

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| Question | Answer | Mark |
|---|---|---|
| | | Total: 9 |

| Question | Answer | Mark |
|---|---|---|
| 3(a)(i) | (P =) hdg OR 1.5 × 850 × 10<br>OR<br>mg / area of base OR 850 × 2.4 × 1.5 × 1.5 × 10 / (2.4 × 1.5)<br>13 000 Pa or N/$m^2$ | C1<br><br>(C1)<br>A1 |
| 3(a)(ii) | P = F/A OR (F =) PA OR 12 750 × 1.5 × 2.4 OR 12 750 × 3.6<br>46 000 N<br>OR<br>(Force = ) weight of oil = mg = 2.4 × 1.5 × 1.5 × 850 × 10<br>46 000 N | C1<br>A1<br><br>(C1)<br>(A1) |
| 3(b) | (46000 / 10 = ) 4600 kg<br>OR m = Vd = (2.4 × 1.5 × 1.5) × 850 = 4600 kg | <br>B1 |
| 3(c)(i) | (density of brass) greater than that of oil / 850 kg / $m^3$<br>OR brass denser <u>than oil</u> | <br>B1 |
| 3(c)(ii) | (It won't sink as average) density of wood + key less than density of oil | B1 |
| | | Total: 7 |

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| Question | Answer | Mark |
|---|---|---|
| 4(a) | Gas molecules (very) far apart OR empty space between gas molecules<br>Molecules of liquid (very) close together / compact OR are touching (each other) | **B1**<br>**B1** |
| 4(b)(i) | Faster / more energetic water molecules evaporate / escape / leave<br>Slower / less energetic molecules remain (so temperature is lower) | **B1**<br>**B1** |
| 4(b)(ii) | Water in wide container AND has water with larger surface (area)<br>Rate of evaporation higher / faster / quicker<br>OR higher chance of evaporation | **B1**<br><br>**B1** |
| | | **Total: 6** |

| Question | Answer | Mark |
|---|---|---|
| 5(a) | One of 1, 2 or 3:<br>1 Molecules move faster OR have more k.e. / momentum<br>2 Molecules hit walls more often / more frequently<br>3 Molecules hit walls with greater force / impulse / harder | **B1** |
| 5(b) | 1 mark for each of 1, 2 and 3 in **(a)** not given as answer to **(a)** | **B2** |
| 5(c)(i) | PV = constant OR $P_1V_1 = P_2V_2$ OR $98 \times 4800 = P \times 7200$<br>65 kPa | **C1**<br>**A1** |
| 5(c)(ii) | To prevent the balloon bursting (as its volume increases)<br>OR to reduce the pressure inside the balloon<br>OR pressure difference between inside and outside balloon rises | **B1** |
| | | **Total: 6** |

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| Question | Answer | Mark |
|---|---|---|
| 6(a) | Method 1:<br>Long distance / distance in field measured with the tape<br>One student fires pistol at one end (of this distance)<br>Student at other end starts stop-watch on seeing smoke / light from pistol and st /<br>ops stop-watch on hearing sound of pistol<br>speed = (measured) distance / (measured) time<br>Method 2:<br>Distance of 50 m or more from a vertical wall measured with the tape<br>Student 1 fires pistol at this distance from the wall<br>Student 2 standing next to student 1 starts stop-watch on hearing pistol and stops stop-watch on hearing echo<br>speed = 2 × (measured) distance / (measured) time | <br>**B1**<br>**B1**<br><br>**B1**<br>**B1**<br><br><br>**(B1)**<br>**(B1)**<br><br>**(B1)**<br>**(B1)** |
| 6(b)(i) | v = fλ OR (λ = ) v / f OR 1500 / 200<br>7.5 m | **C1**<br>**A1** |
| 6(b)(ii) | 1 (frequency) does not change<br>2 (speed) decreases | **B1**<br>**B1** |
| | | **Total: 8** |

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| Question | Answer | Mark |
|---|---|---|
| 7(a)((i) | Sketch of curved optic fibre with light ray undergoing at least one total internal reflection | B1 |
| 7(a)(ii) | Light travels down (optic) fibres into or out of body | B1 |
| | To examine internal organ / part | B1 |
| | Light travels both ways into and out of body | B1 |
| | OR | |
| | To destroy (cancerous) cells | (B1) |
| | by heating | (B1) |
| | OR | |
| | Endoscope / fibre bundle inserted into body | (B1) |
| | To view internal organ body part OR for keyhole surgery | (B1) |
| 7(b) | Light in air: $3 \times 10^8$ m / s | B1 |
| | Microwaves in vacuum: $3 \times 10^8$ m / s | B1 |
| | Sound in steel: 6000 m / s | B1 |
| 7(c) | n = speed in air / speed in glass (or rearranged) | |
| | OR $1.5 = 3 \times 10^8$ / speed in glass (or rearranged) | C1 |
| | $2.0 \times 10^8$ m / s | A1 |
| | | Total: 9 |

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| Question | Answer | Mark |
|---|---|---|
| 8(a)(i) | Magnetic field at Y: 'towards the bottom of the page' ticked<br>Force at Y: 'to the left' ticked | **B1**<br>**B1** |
| 8(a)(ii) | There is a force on X<br>because of the (magnetic) field caused by Y<br>OR due to the (magnetic) field around / of Y<br>OR the (magnetic) fields due to X and Y interacting | **B1** |
| 8(b) | Change in current / field is brief / for short time / occurs as switch closes<br>Changing magnetic field / flux links with secondary coil / other coil / core OR field / flux lines cut coil<br>Causes induced voltage / current | **B1**<br>**B1**<br>**B1** |
| | | **Total: 6** |

| Question | Answer | Mark |
|---|---|---|
| 9(a)(i) | 12 Ω | **B1** |
| 9(a)(ii) | $1/R = 1/R_1 + 1/R_2$ OR $1/R = 1/12 + 1/6$<br>OR $(R =) R_1R_2/(R_1 + R_2)$ OR $(12 \times 6)/(12 + 6)$<br>4 Ω | **C1**<br>**A1** |
| 9(a)(iii) | $4 + 6 = 10\,\Omega$ | **B1** |
| 9(b)(i) | $(I = 12/10 =)$ 1.2 A | **B1** |
| 9(b)(ii) | $(E =) IVt$ OR $1.2 \times 12 \times 50$ OR $I^2Rt$ OR $1.2^2 \times 10 \times 50$<br>OR $V^2t/R$ OR $12^2 \times 50/10$<br>720 J | **C1**<br>**A1** |
| | | **Total: 7** |

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| Question | Answer | Mark |
|---|---|---|
| 10(a)(i) | Light emitting diode OR LED | **B1** |
| 10(a)(ii) |  | **B1** |
| 10(b) | column C column E<br>0 0<br>0 1<br>0 0<br>0 1<br>0 0<br>0 1<br>1 1<br>1 1 | **B3** |
| 10(c) | Replace the OR gate with an AND gate | **B1** |
| | | **Total: 6** |

| Question | Answer | Mark |
|---|---|---|
| 11(a) | 83 protons<br>131 neutrons | **B2** |
| 11(b) | $^{0}_{-1}\beta$<br>Superscript 0<br>Subscript –1<br>$^{214}_{84}Po$ | **B1**<br>**B1**<br>**B1** |
| 11(c) | (After 20 min count rate is) 360 / 2 or 180 (count / s)<br>(After 40 min count rate is) 180 / 2 or 90 (counts / s)<br>(After 60 min count rate is) 90 / 2<br>OR new count-rate = 360/(2 × 2 × 2) or 360 / 8 or 3 half-lives<br>45 (counts / s) | **C1**<br>**A1** |

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| Question | Answer | Mark |
|---|---|---|
| 11(d) | Any two points chosen from the lists below:<br>(economic):<br>high cost of storage / shielding / guarding / need to store for a long time<br>OR reduction in tourism<br>OR loss of farming produce / land<br>OR reduction of land / property values<br>(social):<br>fear of cancer / causes cancer / genetic mutations / radiation<br>sickness in people / animals<br>OR local objections<br>OR cause people to move away<br>(environmental):<br>crop mutations<br>OR leakage into water supplies<br>OR pollution of atmosphere / water supply | **B2** |
| | | **Total: 9** |

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