



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

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**PHYSICS**

**0625/42**

Paper 4 Extended Theory

**May/June 2016**

MARK SCHEME

Maximum Mark: 80

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**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 will not enter into discussions about these mark schemes.

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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 <b>must</b> 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, <b>provided subsequent working gives evidence that they must have known it</b> . 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 normally awarded. 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. An A mark following an M mark is a dependent mark.
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.
<u>Underlining</u>	Underlining indicates that this <u>must</u> 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.
e.e.o.o.	This means "each error or omission".
o.w.t.t.e.	This means "or words to that effect".
Ignore	This indicates that something which is not correct or irrelevant is to be disregarded and does not cause a right plus wrong 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 <b>only</b> applies to marks annotated ecf. <b><u>Always annotate ecf if applied.</u></b>
c.a.o.	correct answer only
Significant figures	Answers are normally acceptable to any number of significant figures $\geq 2$ . 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.  Condone wrong use of upper and lower case symbols, e.g. pA for Pa.  Derived units are acceptable e.g. N/m <sup>2</sup> for Pa, even kg m/s <sup>2</sup> for N
Arithmetic errors	Deduct one mark if the <b>only</b> error in arriving at a final answer is clearly an arithmetic one. Regard a power-of-ten error as an arithmetic error.
Transcription errors	Deduct one mark if the only error in arriving at a final answer is because previously calculated data has clearly been misread but used correctly.
Fractions	Allow these only where specified in the mark scheme.
Crossed out work	Work which has been crossed out <b>and not replaced but can easily be read</b> , should be marked as if it had not been crossed out.
Use of <b>NR</b>	(# 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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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	accelerate / speed up } any } } decelerate / slow down / } two come to rest / stop } from change direction / path curves } four	<b>B2</b>
1(b)(i)	$a = (v-u)/t$ in any form or $(v-u)/t$ {(60 – 0)/ 16 or 60/ 16 = } $3.8 \text{ m/s}^2$	<b>C1</b> <b>A1</b>
1(b)(ii)	(average speed) = (tot) dist / (tot) time (100 / 1.85 = ) 54 m/s	<b>C1</b> <b>A1</b>
1(b)(iii)	to reduce (air) resistance / drag OR to lower centre of mass  to increase acceleration / speed / resultant force OR smaller (frontal) area / better aero(dynamic) shape OR to improve stability / balance	<b>B1</b>  <b>B1</b>
		<b>Total: 8</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	momentum = $mv$ (=) 30 000 kg m/s OR N s	<b>C1</b> <b>A1</b>
2(b)(i)	impulse same as momentum change 27 000 kg m/s OR N s	<b>C1</b> <b>A1</b>
2(b)(ii)	$F = \text{impulse(mom ch)} / t$ in any form OR $\text{impulse(mom ch)} / t$ ( $F = 27\,000 / 0.6 =$ ) 45 000 N	<b>C1</b> <b>A1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(b)(iii)	momentum loss truck A same as momentum gain truck B/impulse  (final mom truck A= candidate's <b>(a)</b> – candidate's <b>(b)(i)</b>  ( $v = 3000/6000 = ) 0.50$ m/s	<b>C1</b>  <b>C1</b>  <b>A1</b>
		<b>Total: 9</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)	internal energy of surroundings } Box 4 internal energy of wires of motor } Box 5	<b>B1</b> <b>B1</b>
3(b)	(change of g.p.e. =) $mgh$ ( $800 \times 10 \times 50 = ) 400\,000$ J OR 400 kJ	<b>C1</b> <b>A1</b>
3(c)	electrical energy generated } any sensible use of electrical energy } three } } sensible economic comment } from } } sensible environmental comment } four	<b>B3</b>
		<b>Total: 7</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)(i)	$P = h\rho g$ in any form or $h\rho g$ ( $15 \times 1020 \times 10 =$ ) 150 000 Pa/ 150 kPa	<b>C1</b> <b>A1</b>
4(a)(ii)	250 000 Pa / 250 kPa	<b>B1</b>
4(a)(iii)	use of $P = F/A$ in any form or PA ( $253\,000 \times 1.2 \times 0.8 =$ ) 240 000 N	<b>C1</b> <b>A1</b>
4(b)	weight of <u>lid</u> } any (there is a) pressure <u>inside box</u> } OR upthrust on <u>lid</u> } two moment of force changes } from friction (of hinge) } five drag of water }	<b>B2</b>
		<b>Total: 7</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)	larger saucepan AND greater area	<b>B1</b>
5(b)	bubbles form } any boiling occurs throughout the liquid } one not influenced by surface area/ } humidity/ draught } from boiling occurs at one temp } five boiling requires heat }	<b>B1</b>
5(c)(i)	molecules move apart/ separate/ escape NOT move faster/ more KE (intermolecular) forces/ bonds broken/ overcome	<b>B1</b> <b>B1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(c)(ii)	$m = E/l_v$ in any form or $E/l_v$ $920 \times 300 / 2.3 \times 10^6$ 0.12 kg OR 120 g	<b>C1</b> <b>C1</b> <b>A1</b>
		<b>Total: 7</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(a)(i)	35°	<b>B1</b>
6(a)(ii)	$\sin i / \sin r = n$ OR $\sin i / \sin r = 1/n$ in any form $\sin r = 1.56 \times \sin 35$ OR $(\sin 35) / 1.56$ $r = 63^\circ$	<b>C1</b> <b>C1</b> <b>A1</b>
6(b)(i)	<u>angle of incidence</u> when angle of refraction = 90°	<b>B1</b>
6(b)(ii)	$\sin c = 1/n$ in any form $c = 40^\circ$	<b>C1</b> <b>A1</b>
6(c)(i)	refraction	<b>B1</b>
6(c)(ii)	frequency                      Box 2 only	<b>B1</b>
		<b>Total: 9</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(a)	appropriate use, accept from diagram sensible diagram of: X-ray machine and package, luggage etc. good extra detail	<b>M1</b> <b>A1</b> <b>A1</b>
7(b)	radio waves in air to      Box 4 only ultrasound in air to      Box 1 only X-rays in vacuum to      Box 4 only	<b>B1</b> <b>B1</b> <b>B1</b>
		<b>Total: 6</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
8(a)	connect <u>d.c.</u> supply (to terminals/circuit) switch on connect <u>a.c.</u> supply (to terminals/circuit) withdraw rod from solenoid / reduce current	<b>B1</b> <b>B1</b> <b>M1</b> <b>A1</b>
8(b)	$I_p V_p = I_s V_s$ OR $(I_s =) I_p V_p / V_s$ $(0.2 \times 240 / 12 =) 4.0$ (A) fuse blows / does not blow	<b>C1</b> <b>A1</b> <b>B1</b>
		<b>Total: 7</b>



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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(a)	ball gets –ve charge (from –ve plate) –ve(ly charged ball) attracted to +ve / repelled from –ve	<b>B1</b> <b>B1</b>
9(b)	electrons from L to R	<b>B1</b> <b>B1</b>
9(c)	Q = It in any form or Q/t correct use of f = 4 Hz or T = 0.25 s (I =) $3.4 \times 10^{-9}$ A	<b>C1</b> <b>C1</b> <b>A1</b>
		<b>Total: 7</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(a)	$P=V^2/R$ in any form or $V^2/P$ ( $240^2/1000 =$ ) $58 \Omega$	<b>B1</b> <b>B1</b>
10(b)	( $120^2/1000 =$ ) $14 \Omega$	<b>B1</b>
10(c)	$P=V I$ in any form or $P/V$ ( $2000/240 =$ ) $8.3 \text{ A}$	<b>B1</b> <b>B1</b>
		<b>Total: 5</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
11(a)	86 protons (in nucleus) 134 neutrons (in nucleus) 86 electrons (surrounding nucleus/in orbit)	<b>B1</b> <b>B1</b> <b>B1</b>
11(b)	${}^4_2\alpha$ ${}^{84}_{84}\text{Po}$ ${}^{216}_{84}\text{Po}$	<b>B1</b> <b>B1</b> <b>B1</b>
11(c)	220/55 <b>or</b> 4 (half-lives) <b>or</b> 720/16 45 counts/s	<b>C1</b> <b>A1</b>
		<b>Total: 8</b>