PHYSICS **0625/42**

Paper 4 Extended Theory **October/November 2016**

MARK SCHEME

Maximum Mark: 80

Published

This document consists of **9** printed pages.

NOTES ABOUT MARK SCHEME SYMBOLS & 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 be 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.

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. 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

A C mark 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.

underlining   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.

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 being penalised more than once for a particular mistake, but **only** applies to marks annotated ecf.

Sig. figs   Answers are normally acceptable to any number of significant figures ⩾ 2. Any exceptions to this general rule will be specified in the mark scheme. In general, accept numerical answers, which, if reduced to two significant figures, would be right.

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 Deduct one mark if the only error in arriving at a final answer is because given or errors previously calculated data has clearly been misread but used correctly..

Fractions   e.g. ½, ¼, 1/10 etc are only acceptable where specified.

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.

Question	Answer	Marks
1(a)(i)	constant gradient OR straight line	B1
1(a)(ii)	calculation of gradient (a = 4 / 2 =) 2.0 m/s^2	C1 A1
1(a)(iii)	decreases / becomes zero	B1
1(b)	area or s = (av)v x t use of any triangle or trapezium (total distance =) 54–66 (m) (total distance =) 58–62 m	C1 C1 C1 A1

Question	Answer	Marks
2(a)(i)	(K.E. =) ½mv^2	B1
2(a)(ii)	scalar AND direction does not matter	B1
2(b)(i)	p = mv in any form OR mv (p= 200 × 2.5 =) 500 kg m/s	C1 A1
2(b)(ii)	500 – (50 × 4.0) or 500 – 200 (v= 300 / 200 =) 1.5 m/s (in) same direction (as original motion)	C1 A1 B1
2(b)(iii)	(during collision kinetic energy transferred to) elastic / strain energy (elastic) energy transferred to kinetic energy **or** returned to car(s)	M1 A1

Question	Answer	Marks
3(a)(i)	vacuum / mercury vapour	**B1**
3(a)(ii)	(arrowed) line between mercury surfaces	**B1**
3(a)(iii)	(distance stays the) same	**B1**
3(b)(i)	(760 – 15 =) 750 (mm Hg)	**B1**
3(b)(ii)	$p_1V_1 = p_2V_2$ in any form OR p_1V_1/V_2 correct substitution of 12.0 and 4.0 correct calculation of p_2 from cand's p_1 and correct V_1 and V_2 (reading = 760 – 45 = 715 =) 720 mm Hg	**C1** **C1** **A1** **B1**

Question	Answer	Marks
4(a)	(output) power = VI in any form OR VI (power = 240×23 =) 5500 (W) efficiency = output (power) / input (power) (efficiency = 5520 / 16 200 =) 0.34 or 34%	**C1** **C1** **C1** **A1**
4(b)	chemical OR potential	**B1**
4(c)	relevant environmental pro or con, e.g. no / less air pollution, no / less greenhouse gases OR visual / noise impact / pollution, injure birds, deforestation, conserves non-renewables relevant economic pro or con, e.g. no fuel cost or expensive to install (compared to other types of generation)	**B1** **B1**

© UCLES 2016

Question	Answer	Marks
5(a)(i)	in ice, molecules in fixed positions AND in water, positions change	B1
5(a)(ii)	in ice, molecules <u>vibrate</u> AND in water, molecules move around (and vibrate)	B1
5(b)(i)	m/ρ OR $\rho = m/V$ in any form $(V = 51\,000/920 =)\ 55\,m^3$	C1 A1
5(b)(ii)	mL OR $Q = mL$ in any form $(Q = 51\,000 \times 3.3 \times 10^5) = 1.7 \times 10^{10}\,J$	C1 A1
5(c)	thermocouple	B1

Question	Answer	Marks
6(a)(i)	1 tick 4th box NOT extra tick(s)	B1
6(a)(ii)	1 tick 2nd box NOT extra tick(s)	B1
6(b)	1 tick 2nd box NOT extra tick(s)	B1
6(c)(i)	$1300 \leqslant v \leqslant 1700\,m/s$	B1
6(c)(ii)	$v = f\lambda$ in any form OR $(\lambda =)\ v/f$ candidate's (i) / 12 000 evaluated	C1 A1
6(d)	any 2 wavelengths same as original 3 wave fronts curved AND concave up 3 part circles, 2 emanating from gap, must reach about 45° each side of centre line	B1 B1 B1

Question	Answer	Marks
7(a)	rectangle and diagonal line with end parallel to length of rectangle	**B1**
7(b)	first 2 rows of D both 0 last 2 rows of D both 1 each row of column E logical OR of (column C and candidate's column D)	**B1** **B1** **B1**
7(c)	two single inputs 0 AND 1 two correct single outputs 1 AND 0	**B1** **B1**

Question	Answer	Marks
8(a)	ultra-violet written above / below ultrasound radio written above / below earthquake	B1 B1
8(b)(i)	3.0×10^8 m / s	B1
8(b)(ii)1	$n = C_v / C_{of}$ in any form OR $(n =)C_v / C_{of}$ 1.5	C1 A1
8(b)(ii)2	$\sin c = 1 / n$ in any form OR $(c =)\sin^{-1}(1 / n)$ 42º	C1 A1
8(b)(iii)	total internal reflection	B1

Question	Answer	Marks
9(a)	4.5 V	B1
9(b)(i)	$1 / R = 1 / R_1 + 1 / R_2$ **OR** $R_1 R_2 / (R_{1+} R_2)$ $(R =) 20 \, \Omega$	C1 A1
9(b)(ii)	adds 55 to candidate's previous line	B1
9(b)(iii)	$I = V / R$ in any form OR V / R $(I = 4.5 / 75 =) 0.060$ A	C1 A1
9(c)(i)	reference to $55 \, \Omega$ resistor	B1
9(c)(ii)	reference to $60 \, \Omega$ resistor	B1

Question	Answer	Marks
10(a)	proton (+)e neutron zero / neutral / no / none / nothing α-particle (+)2e β-particle – e γ-ray zero / neutral / no / none / nothing	**B3**
10(b)(i)	into page	**B1**
10(b)(ii)	clearly 180° from **b i**	**B1**
10(b)(iii)	none	**B1**

Question	Answer	Marks
11(a)	$9.6 \times 10^8 / 8$ 1.2×10^8 (atoms)	**C1** **A1**
11(b)	160 – 16 OR 144 (144 / 8 + 16 = 18 + 16 =) 34 counts / minute	**C1** **A1**