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PHYSICS **0625/41**

Paper 4 Extended Theory **October/November 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.
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 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.

underlining — indicates that this must 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.

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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	Marks
1(a)(i)	Straight line from origin to (4.5 s, 7.2 m/s) Tolerance in plotting: ½ a square	**B2**
1(a)(ii)	Use of area stated or implied by numbers used OR average speed × time OR s = (u+v)/t/2 OR vt/2 OR 0.5 × 4.5 × 7.2 16(.2) m	**C1** **A1**
1(b)	Rises from origin and curves with decreasing gradient Finishes horizontal	**B1** **B1**
1(c)	Speed is scalar Velocity is vector Speed has magnitude/size/value (only) Velocity has magnitude/size/value and direction OR velocity has direction; speed does not	**B1** **B1**
	Total:	**8**

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Question	Answer	Marks
2(a)(i)	(P =) hdg OR 15 × 1000 × 10 1.5×10^5 or 150 000 Pa or N / m^2 or 150 kPa or kN / m^2	C1 A1
2(a)(ii)	(F =) PA OR 150 000 × 6000 9.0 x 10^8 N / 9.0 × 10^5 kN	C1 A1
2(a)(iii)	Same value as (a)(ii) or 9.0 × 10^8 N	B1
2(b)	Weight of tanker has to be equal to upward force of water Depth (below surface) is / becomes less OR Tanker rises (Tanker rises) because pressure / force on bottom of tanker is greater OR because upthrust greater OR At same depth as in river, pressure / force on bottom of tanker is higher so tanker rises	B1 M1 A1
	Total:	8

Question	Answer	Marks
3(a)	(Molecules / they) collide with / hit walls of container OR rebound from walls of container Change of momentum OR Rate of change of momentum occurs OR F = (mv – mu) / t	B1 B1
3(b)(i)	(760 + 120 =) 880 mmHg	B1
3(b)(ii)	Same value as (b)(i) or 880 mmHg	B1
3(b)(iii)	New pressure = (760 + 240 =) 1000 (mmHg) PV = constant OR $P_1V_1 = P_2V_2$ OR 12 × 880 = V × 1000 11 cm^3	C1 C1 A1
	Total:	**7**

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Question	Answer	Marks
4(a)	Evaporation Molecules with higher / highest (kinetic) energy OR that gain enough energy escape (from the liquid surface) Molecules remaining in liquid have low / lower (kinetic) energy OR Energy for evaporation came from remaining liquid	**B1** **B1** **B1** **B1**
4(b)	Greater decrease in temperature and / or volume than in (a). Fan removes vapour / blows vapour away / reduces humidity / reduces return of vapour to liquid, allowing more molecules to escape OR faster / more evaporation	**B1** **B1**
4(c)	Metal is a <u>good</u> (thermal) conductor so passes heat <u>to</u> the liquid or <u>from</u> the surroundings (raising its temperature)	**B1** **B1**
	Total:	**8**

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Question	Answer	Marks
5(a)	Molecular arrangement: Ice: in lattice / regular / arranged / orderly / fixed in place Water: random / irregular / not arranged / not orderly Molecular movement: Ice: vibrate Water: move (around) or slide over each other	**B2**
5(b)(i)	d = m / V in any form OR (m =) Vd OR 1800 × 0.025 × 920 = 41 000 kg	**C1** **A1**
5(b)(ii)	(H =) mL OR 41 400 × 3.3 × 10^5 1.4 x 10^{10} J OR 1.4 × 10^7 kJ OR 1,4 × 10^4 MJ	**C1** **A1**
Total		**6**

Question	Answer	Mark
6(a)(i)	300 – 360 m / s	**B1**
6(a)(ii)	20 Hz – 20 kHz	**B1**
6(b)(i)	v = fλ OR (f =) v / λ OR (a)(i) / 0.022 Correct answer: e.g. 330 m / s gives 15 000 Hz	**C1** **A1**
6(b)(ii)	Vertical dotted lines midway (by eye) between each pair of compressions OR to right or left of compressions shown with correct spacing (by eye)	**B1**
6(b)(iii)	(At rarefactions) molecules have above normal separation / far apart / spread out Pressure (of air) is below normal / low OR Molecules exert below normal / low pressure	**B1** **B1**
	Total:	**7**

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Question	Answer	Marks
7(a)(i)	Ray continues through first face, without bending, to sloping face Ray reflected vertically down at sloping face	**M1** **A1**
7(a)(ii)	Prism drawn with correct orientation in square Correct reflection to produce emergent ray	**M1** **A1**
7(b)	Tick in box 2 Tick in box 6	**B1** **B1**
	Total:	**6**

Question	Answer	Marks
8(a)	12 V	**B1**
8(b)	(I =) V/R 12 / 8 OR 1.5 (A) (W =) IVt OR 1.5 × 12 × 40 (× 60) OR (W =) I^2Rt OR $1.5^2 \times 8 \times 40$ (× 60) OR W = V^2t / R OR $12^2 \times 40$ (× 60) / 8 43 000 J	**C1** **C1** **C1** **A1**
8(c)	Chemical (energy) to electrical (energy) (in battery) Electrical (energy) to thermal / heat (energy) (in resistor)	**B1** **B1**
	Total:	**7**

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Question	Answer	Marks
9	Mention of overheating or fire seen anywhere	B1
	Mention of electric shock or electrocution seen anywhere	B1
	Any two of:	
	Fire / overheating: if thin / extension cable carries too large a current OR because thin / extension cable has no fuse.	
	Fire / overheating due to extension cable being coiled (so that escape of heat is prevented)	
	Electric shock / electrocution (of gardener) if unsuitable socket lets in moisture / gets wet	B2
	Electric shock / electrocution (of gardener) if tape repair lets in moisture / gets wet	
	Electric shock / electrocution if cable is cut by mower and no circuit-breaker	
	Total:	**4**

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Question	Answer	Marks
10(a)	(Wire) moves vertically or down (page) Moves up (page) OR Magnetic field is into the page OR (Fleming's) left hand-rule applies	**C1** **A1** **B1**
10(b)	Moves up and down (page) / vibrates up and down (page) (Vertical) force on wire alternates OR due to interaction of field of magnet and alternating field (of current)	**B1** **B1**
	Total:	**5**

Question	Answer	Marks
11(a)(i)	(Region) where a force acts on a charge	**B1**
11(a)(ii)	Direction of the force acting on a <u>positive</u> charge	**B1**
11(b)	At least 4 radial equally spaced straight lines drawn from surface of sphere Arrows on lines pointing away from sphere	**B1** **B1**
11(c)(i)	Charges on sphere attract electrons (from earth) OR There is a p.d. between the sphere and earth	 **B1**
11(c)(ii)	$I = Q/t$ in any form OR Q/t OR $20 \times 10^{-6}/(20 \times 60)$ 1.7×10^{-8} A OR $I = Q/t$ in any form OR Q/t OR $20/(20 \times 60)$ 0.017 μA	**C1** **A1** **(C1)** **(A1)**
	Total:	**7**

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Question	Answer	Marks
12(a)(i)	Atomic number OR number of protons OR proton number	**B1**
12(a)(ii)	94	**B1**
12(b)	$^{237}_{93}Np$ $+ \, ^{4}_{2}\alpha$	**B1** **B1**
12(c)	(No of Am atoms remaining = $8 \times 10^{14} - 6 \times 10^{14}$) = 2×10^{14} 4×10^{14} (Am atoms remain after) 470 yrs or 1 half-life (2×10^{14} Am atoms remain after) 940 yrs or 2 half-lives	**C1** **C1** **A1**
	Total:	**7**

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