

MARK SCHEME for the May/June 2013 series

0625 PHYSICS

0625/32

Paper 3 (Extended Theory), maximum raw mark 80

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.

Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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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 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.

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e.c.f. 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 e.c.f. 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 e.c.f.

Significant Figures

Answers are normally acceptable to any number of significant figures ≥ 2 . Accept answers that round to give the correct answer to 2 s.f. Any exceptions to this general rule will be specified in the mark scheme.

Units Deduct one mark for each incorrect or missing unit from a final answer that would otherwise gain all the marks available for that answer: maximum 1 per question.

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. $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{10}$ etc. are only acceptable where specified.

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- 1 (a) $V = W \times L \times D$ in any form words, symbols or numbers C1
 use of $M = \rho V$ in any form OR ρV words, symbols or numbers C1
 $(M = 51 \times 20 \times 11 \times 1030 = 11\,556\,600 =) 1.2 \times 10^7 \text{ kg}$ A1 [3]

- (b) $p = \rho g(\Delta)h$ in any form words, symbols or numbers C1
 $(\Delta h = 60\,000 / (1030 \times 10) =) 5.8(25) \text{ m}$ A1 [2]

- (c) use of $F = pA$ in any form or pA words, symbols or numbers C1
 $(F = 60\,000 \times 32.8 \times 8.3 = 60\,000 \times 272.2 =) 1.6(33) \times 10^7 \text{ N}$ A1 [2]
 e.c.f. from (b)

[Total: 7]

- 2 (a) (i) Hooke's Law B1 [1]

- (ii) straight line (graph) / constant gradient B1
 through origin/(0,0) B1 [2]
 ignore through zero
 ignore extension proportional to load

- (b) curved extension to graph with increasing gradient, condone decreasing B1 [1]
 NOT if any part of curve is vertical/horizontal or has negative gradient

[Total: 4]

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- 3 (a) any two from:
 at surface / not within liquid (if other way round must be explicit) B1
 at any temperature / not at boiling point (if other way round must be explicit) B1 [2]
 (evaporation) causes cooling
 boiling requires a heat source
 bubbles rising
- (b) (i) viable heat source clearly described e.g. electrical/immersion heater B1
 appropriate readings e.g. V , I , t or P & t or joulemeter readings B1 [2]
 OR
 combustion heater but only with some mention of amount of fuel used B1
 correct measurement of amount of fuel used B1
- (ii) viable mass measuring device clearly described B1
 e.g. (top pan) balance/scales
 appropriate readings B1 [2]
 e.g. mass of water before and after / change of mass of water
 OR
 measuring cylinder B1
volume of water before and after / change of volume of water B1
- [Total: 6]**
- 4 (a) suitable scales (more than half each scale used, no products of 3 s, 7 s etc.) B1
 2 straight line sections, continuous 0 to 120 s, 1st section positive gradient, B1
 2nd section negative gradient B1
 section 1 straight line, from (0, 0) to (30, 900) B1
 section 2 straight line from end of section 1 to (120, 0) B1 [4]
- (b) (i) use of $a = \Delta v / t$ or $\Delta v / t$ in any form words, symbols or numbers C1
 $(a = 900 / 30 =) 30 \text{ m/s}^2$ A1 [2]
 e.c.f. from graph
- (ii) use of $s = \text{area under graph}$ (accept valid equation(s)) C1
 $(\text{distance} = 0.5 \times 900 \times 120 =) 54\,000 \text{ m}$ A1 [2]
 e.c.f. from continuous graph, if curves working must be clear
 no e.c.f. from graph if it's a single rectangle
- [Total: 8]**

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5	(a) (i) diffraction	B1	[1]
	(ii) 1 or 2 parallel waves (and part-circular ends) in outer harbour NOT part-circular ends going down 3 part-circular waves, $> 45^\circ$ each side by eye, in inner harbour allow flat below gap centred in gap, allow error up to 1λ vertically wavelength constant throughout, must have 3 extra wavefronts, judged along line of direction of wave travel in Fig. 5.1	B1 B1 B1	 [3]
	(b) (i) refraction	B1	[1]
	(ii) at least 4 parallel, straight waves joined onto original waves at least 3 straight waves, sloping down to the right OR with constant reduced λ	B1 B1	[2]
[Total: 7]			
6	(a) correct reflection of left ray AND $22^\circ \leq$ angle between right ray and surface $\leq 32^\circ$, by protractor rays projected back to form image in correct position	B1 B1	[2]
	(b) both rays refract down rays projected back to form image somewhere in water to the left of where left ray strikes surface	M1 A1	[2]
	(c) $\sin c = 1 / 1.33$ OR $\sin c / \sin r = 1 / 1.33$ OR $\sin^{-1}(1 / 1.33)$ OR $\sin^{-1} 0.75$ ($c = 48.8^\circ \Rightarrow 49^\circ$)	C1 A1	[2]
	(d) appropriate use, accept diagram accept 'endoscope', 'in medicine' is not sufficient clear diagram of the above use or t.i.r. diagram for optical fibre one from: light goes down fibre/into body illuminates internal organ light/image returns from body/organ o.w.t.t.e.	M1 A1 A1	[3]
[Total: 9]			

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- 7 (a) ($P_i =$) $260 \times 2 \times \text{length} \times \text{breadth}$ ($= 260 \times 0.1$), words, symbols or numbers C1
 note: gets this mark if omits factor of 2
 $(P_i = 2 \times 260 \times 0.25 \times 0.2 =)$ 26 W A1 [2]
- (b) ($P_o = 0.95 \times 20 =$) 19 (W) B1
 efficiency = output (energy) / input (energy)
 accept power for energy
 $E =$ candidate's P_o /candidate's P_i evaluated ($= 0.73$ or 73%), accept fraction (19/26) C1
 0.73% or bald 73 gets unit penalty A1 [3]
- (c) A OR B in series with C connected across 20 V M1
 parallel combination of A and B only A1 [2]
- (d) $1/R = 1/R_1 + 1/R_2$ OR $R = R_1 R_2 / (R_1 + R_2)$ in any form OR $R_1 R_2 / (R_1 + R_2)$ C1
 words, symbols or numbers
 12Ω A1 [2]
- [Total: 9]**
- 8 (a) at least 3 complete circles/ellipses, roughly centred on X M1
 spacing greater as radius increases A1
 at least 1 arrow to show clockwise field, no contradiction B1 [3]
- (b) use of compass/suspended small magnet B1
 observe needle/magnet on one field line B1
 observe needle/magnet on another field line B1
 mark on card OR needle/magnet shows direction of field B1 [4]
- OR
 (sprinkle) iron filings o.w.t.t.e. M1
 tap card A1
 direction/alignment of iron filings show field B1
 use compass/suspended small magnet to show field direction B1
- (c) wire X/Y is in a magnetic field / any reference to magnetic fields M1
 accept description involving poles that clearly implies fields B1
 current carrying conductor in field / fields interact/cut/combine/overlap B1 [2]
- (d) top box only ticked B1 [1]
- [Total: 10]**

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- 9 (a) first box only ticked in each line 2 × B1 [2]
- (b) (i) output/V/I/power increases M1
greater (rate of change of) field/flux
OR sensible reference to $V_1 / V_2 = N_1 / N_2$ OR V_1 proportional to V_2 A1 [2]
- (ii) output/V/I/power zero M1
accept nothing happens **NOT** no change
field/flux does not change
ignore transformers only work with a.c./don't work with d.c. A1 [2]
special case for answer about what happens at moment of switching on/off:
correct statement of some output etc. for short time M1
change of field/flux A1
- [Total: 6]**

10 (a)

	hydrogen-1	deuterium	tritium
no.of protons	1	1	1
no. of neutrons	0	1	2
no. of electrons	1	1	1

proton line correct B1
neutron line correct, do not accept blank for 0 B1
electron line correct B1 [3]

(b) ignore any reference to background radiation throughout this part

- (i) beta / fast moving electrons B1 [1]
- (ii) any two from:
beta stopped by 5 mm/thick Al / beta not stopped by 0.5 mm/thin Al B1
alpha stopped by 0.5mm/thin Al B1 [2]
accept stopped by paper
gamma not stopped by 5 mm or more/thick Al
ignore any reference to range in air
- (c) (i) fusion / thermonuclear (reaction) B1 [1]
- (ii) (energy) released B1 [1]
- (d) fission B1 [1]

[Total: 9]

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- 11 (a) (i) electrons B1 [1]
ignore β
- (ii) to heat cathode or produce thermionic emission o.w.t.t.e.
i.e. any mention of heating/providing energy and production/emission
of electrons B1 [1]
NOT heater/filament emits electrons
- (iii) air would stop/weaken (electron) beam OR electrons have no collisions B1 [1]
- (b) X-plates B1
zero (p.d.)/off NOT zero current
Y-plates B1 [2]
alternating (p.d.) OR description
condone a.c.

[Total: 5]