
PHYSICS

9702/22

Paper 2 AS Level Structured Questions

May/June 2018

MARK SCHEME

Maximum Mark: 60

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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PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)	rate of change of momentum	B1
1(b)	kgms^{-2}	A1
1(c)	units for Q : As and for r : m	C1
	units for $\varepsilon = (\text{As} \times \text{As}) / (\text{kgms}^{-2} \times \text{m}^2)$ $= \text{A}^2\text{kg}^{-1}\text{m}^{-3}\text{s}^4$	A1

Question	Answer	Marks
2(a)	<u>sum/total</u> momentum (of a system of bodies) is constant or <u>sum/total</u> momentum before = <u>sum/total</u> momentum after	M1
	for an isolated system or no (resultant) external force	A1
2(b)(i)	$(p =) mv$ or $(3.0M \times 7.0)$ or $(2.0M \times 6.0)$ or $(1.5M \times 8.0)$	C1
	$3.0M \times 7.0 = 2.0M \times 6.0 \sin \theta + 1.5M \times 8.0 \sin \theta$	C1
	$\theta = 61^\circ$	A1
	or (vector triangle method)	
	momentum vector triangle drawn	(C1)
	$\theta = 61^\circ$ (2 marks for $\pm 1^\circ$, 1 mark for $\pm 2^\circ$)	(A2)
	or (use of cosine rule)	
	$p = mv$ or $(3.0M \times 7.0)$ or $(2.0M \times 6.0)$ or $(1.5M \times 8.0)$	(C1)
	$(21M)^2 = (12M)^2 + (12M)^2 - (2 \times 12M \times 12M \times \cos 2\theta)$	(C1)
$\theta = 61^\circ$	(A1)	
2(b)(ii)	$(E =) \frac{1}{2}mv^2$	C1
	ratio = $(\frac{1}{2} \times 2.0M \times 6.0^2) / (\frac{1}{2} \times 1.5M \times 8.0^2)$ = 0.75	A1

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Question	Answer	Marks
3(a)	time = 12s	A1
3(b)	distance (up slope) = $\frac{1}{2} \times 12 \times 18$ (= 108)	C1
	distance (down slope) = $\frac{1}{2} \times 12 \times 6$ (= 36)	C1
	displacement from A = 108 – 36 = 72m	A1
3(c)	$v = u + at$ or $a = \text{gradient}$ or $a = \Delta v / (\Delta)t$	C1
	$a = 6 / 12 = 0.50 \text{ (ms}^{-2}\text{)}$ (<i>other points from the line may be used</i>)	A1
	or	
	$v^2 = u^2 + 2as$ and $u = 0$ or $v^2 = 2as$	(C1)
	$a = 6.0^2 / (2 \times 36) = 0.50 \text{ (ms}^{-2}\text{)}$	(A1)
	or	
	$s = ut + \frac{1}{2}at^2$ and $u = 0$ or $s = \frac{1}{2}at^2$	(C1)
	$a = 2 \times 36 / 12^2 = 0.50 \text{ (ms}^{-2}\text{)}$	(A1)
	or	
	$s = vt - \frac{1}{2}at^2$	(C1)
	$a = 2 \times (6 \times 12 - 36) / 12^2 = 0.50 \text{ (ms}^{-2}\text{)}$	(A1)

Question	Answer	Marks
3(d)(i)	$F = 70 \times 0.50 (= 35)$	C1
	frictional force = $80 - 35$ $= 45 \text{ N}$	A1
3(d)(ii)	$\sin \theta = 80 / (70 \times 9.81)$	C1
	$\theta = 6.7^\circ$	A1
3(e)(i)	$f_0 = (900 \times 340) / (340 + 12)$	C1
	$= 870 \text{ Hz}$	A1
3(e)(ii)	speed/velocity (of sledge) decreases and (so) frequency increases	B1

Question	Answer	Marks
4(a)(i)	distance moved by wavefront/energy during one cycle/oscillation/period (of source) or <u>minimum</u> distance between two wavefronts or distance between two <u>adjacent</u> wavefronts	B1
4(a)(ii)	(position where) maximum amplitude	B1
4(b)(i)	$\lambda = 4 \times 0.045$ (= 0.18 (m) or 18 (cm))	C1
	$v = f\lambda$	C1
	$f = 340/0.18$ = 1900 Hz	A1
4(b)(ii)	distance = $\lambda/2$ (= 0.09 (m) or 9 (cm))	C1
	time = $0.09 / 0.0075$ = 12 s	A1
	or	
	$t = 4.5/0.75$ and $t = 13.5/0.75$	(C1)
	time = $18 - 6$ = 12 s	(A1)

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Question	Answer	Marks
5(a)	$\rho = m/V$	C1
	$= (560/9.81)/(1.2 \times 0.018)$	A1
	$= 2600 \text{ kg m}^{-3}$	
5(b)	$(\Delta)p = 940 \times 9.81 \times 1.2$	C1
	(upthrust =) $940 \times 9.81 \times 1.2 \times 0.018 = 200 \text{ N}$	A1
5(c)(i)	tension = $560 - 200$ $= 360 \text{ N}$	A1
5(c)(ii)	$P = Fv$	C1
	$= 360 \times 0.020$	A1
	$= 7.2 \text{ W}$	
5(d)(i)	upthrust decreases	B1
	tension (in wire) increases	M1
	power (output of motor) increases	A1
5(d)(ii)	there is work done (on the cylinder) by the upthrust or GPE of oil decreases (as it fills the space left by cylinder and so total energy is conserved)	B1

Question	Answer	Marks
6(a)(i)	<u>sum of</u> current(s) into junction = <u>sum of</u> current(s) out of junction or (algebraic) sum of current(s) at a junction is zero	B1
6(a)(ii)	charge	B1
6(b)(i)1.	$E = I^2 R t$ or $E = V I t$ or $E = (V^2 / R) t$	C1
	$E = 2.5^2 \times 2.0 \times 5.0 \times 60$ or $5.0 \times 2.5 \times 5.0 \times 60$ or $(5.0^2 / 2.0) \times 5.0 \times 60$ $= 3800 \text{ J}$	A1
6(b)(i)2.	p.d. = $8.0 - (2.0 \times 2.5)$ $= 3.0 \text{ V}$	A1
6(b)(ii)	$I_X = 3.0 / 15 = 0.20 \text{ (A)}$	C1
	$I_Y = 2.5 - 0.20 = 2.3 \text{ (A)}$	C1
	$R_Y = 3.0 / 2.3$ $= 1.3 \Omega$	A1
	or	
	$R_T = 3.0 / 2.5 = 1.2 (\Omega)$ or $(8.0 / 2.5) - 2.0 = 1.2 (\Omega)$	(C1)
	$1 / 1.2 = 1 / 15 + 1 / R_Y$	(C1)
	$R_Y = 1.3 \Omega$	(A1)

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Question	Answer	Marks
6(b)(iii)1.	Z has larger radius/diameter/(cross-sectional) area	B1
	Z has (material of) smaller resistivity/greater conductivity	B1
6(b)(iii)2.	current/ I (in battery) increases	M1
	($P = EI$ so) power/ P (produced by battery) increases	A1

Question	Answer	Marks
7(a)	circle(s) drawn only around β^- and $\bar{\nu}$ symbols	B1
7(b)	(electron) <u>antineutrino</u>	B1
7(c)	kinetic (energy)	B1
7(d)	Y has one more proton (and one less neutron)/X has one less proton (and one more neutron) or Y has more protons (and fewer neutrons)/X has fewer protons (and more neutrons) or a neutron changes to a proton or the number of protons increases	M1
	(so) not isotopes	A1
7(e)	up down down changes to up up down or udd \rightarrow uud or down changes to up or d \rightarrow u	B1