Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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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)	kg m s^{-2}	**A1**
1(c)	units for *Q*: As **and** for *r*: m	**C1**
	units for $\varepsilon = (\text{A s} \times \text{A s})/(\text{kg m s}^{-2} \times \text{m}^2)$ $= \text{A}^2\text{kg}^{-1}\text{m}^{-3}\text{s}^4$	**A1**

Question	Answer	Marks
2(a)	<u>sum</u>/<u>total</u> momentum (of a system of bodies) is constant **or** <u>sum</u>/<u>total</u> momentum before = <u>sum</u>/<u>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**
	$\theta = 61°$	**A1**
	or (vector triangle method)	
	momentum vector triangle drawn	**(C1)**
	$\theta = 61°$ (*2 marks for* ±1°, *1 mark for* ±2°)	**(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)**
	$\theta = 61°$	**(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**

Question	Answer	Marks
3(a)	time = 12 s	**A1**
3(b)	distance (up slope) = ½ × 12 × 18 (= 108)	**C1**
	distance (down slope) = ½ × 12 × 6 (= 36)	**C1**
	displacement from A = 108 – 36 = 72 m	**A1**
3(c)	$v = u + at$ **or** a = gradient **or** $a = \Delta v / (\Delta)t$	**C1**
	$a = 6 / 12 = 0.50\ (\text{m s}^{-2})$ *(other points from the line may be used)*	**A1**
	or	
	$v^2 = u^2 + 2as$ **and** $u = 0$ **or** $v^2 = 2as$	**(C1)**
	$a = 6.0^2 / (2 \times 36) = 0.50\ (\text{m s}^{-2})$	**(A1)**
	or	
	$s = ut + ½at^2$ **and** $u = 0$ **or** $s = ½at^2$	**(C1)**
	$a = 2 \times 36 / 12^2 = 0.50\ (\text{m s}^{-2})$	**(A1)**
	or	
	$s = vt – ½at^2$	**(C1)**
	$a = 2 \times (6 \times 12 – 36) / 12^2 = 0.50\ (\text{m s}^{-2})$	**(A1)**

Question	Answer	Marks
3(d)(i)	$F = 70 \times 0.50$ (= 35)	**C1**
	frictional force = 80 – 35 = 45 N	**A1**
3(d)(ii)	$\sin\theta = 80/(70 \times 9.81)$	**C1**
	$\theta = 6.7°$	**A1**
3(e)(i)	$f_0 = (900 \times 340)/(340 + 12)$	**C1**
	= 870 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)**

Question	Answer	Marks
5(a)	$\rho = m / V$	C1
	$= (560 / 9.81) / (1.2 \times 0.018)$ $= 2600\,\text{kg}\,\text{m}^{-3}$	A1
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
	$= 360 \times 0.020$ $= 7.2\,\text{W}$	A1
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.	$E = I^2Rt$ **or** $E = VIt$ **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 J	**A1**
6(b)(i)2.	p.d. = 8.0 – (2.0 × 2.5) = 3.0 V	**A1**
6(b)(ii)	$I_X = 3.0/15 = 0.20$ (A)	**C1**
	$I_Y = 2.5 - 0.20 = 2.3$ (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)**

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>anti</u>neutrino	**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**