Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education (9–1)

PHYSICS (9–1) **0972/41**

Paper 4 Extended Theory **May/June 2019**

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.

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

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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)	change of velocity per unit time **OR** $\frac{v-u}{t}$	**B1**
1(b)	line starts at origin **and** is asymptotic to *x*-axis	**B1**
	increasing gradient initially **and** no decrease	**B1**
	constant **and** clearly positive gradient finally	**B1**
1(c)(i)	no external forces **OR** isolated system	**B1**
	sum of momenta / (total) momentum remains constant	**B1**
1(c)(ii)	rocket <u>gains</u> (upward) momentum	**B1**
	(ejected) gas <u>gains</u> equal (quantity of) momentum in opposite direction **OR** momentum of gas <u>decreases</u> by equal amount	**B1**

Question	Answer	Marks
2(a)	(*W* =) *mg* **OR** $3.4 \times 10^3 \times 10$	**C1**
	3.4×10^4 N	**A1**
2(b)(i)	moment = *Fx* in any form **OR** (moment) = *Fx* **OR** 0.50 (seen)	**C1**
	$3.4 \times 10^4 \times (1.8 – 1.3)$ **OR** $3.4 \times 10^4 \times 0.50$	**C1**
	1.7×10^4 N m	**A1**
2(b)(ii)	1. (the point) where (all) the mass can be considered to be concentrated	**B1**
	2. $1.7 \times 10^4 / (1.3 + 0.70)$ **OR** $1.7 \times 10^4 / (2.0)$	**C1**
	8.5×10^3 N	**A1**
2(c)	(moment / it) increases	**B1**
	perpendicular distance (between P and line of action of) *W* increases	**B1**

Question	Answer	Marks
3(a)	(air) molecules / they move / collide	**B1**
	(air) molecules / they collide with cube / (upper) surface (of cube) / wall	**B1**
	impulse exerted (on surface) **OR** momentum change (of molecules)	**B1**
3(b)(i)	$p = h\rho g$ in any form **OR** (p =) $h\rho g$ **OR** $0.028 \times 1500 \times 10$	**C1**
	420 Pa	**A1**
3(b)(ii)	$F = pA$ in any form words, symbols or numbers **OR** (F =) pA **OR** 420×4.0^2 **OR** 420×0.040^2 **OR** 420×16 **OR** $420 \times 1.6 \times 10^{-3}$	**C1**
	0.67 N	**A1**
3(c)(i)	$W = Fd$ in any form words, symbols or numbers **OR** (W =) Fd **OR** 0.67×0.034	**C1**
	0.023	**A1**
3(c)(ii)	lifting liquid as well **OR** friction between liquid and container / pipe	**B1**

Question	Answer	Marks
4(a)(i)	$E = mc\,(\Delta)T$ in any form words, symbols or numbers **OR** $(E =)\ mc\,(\Delta)T$ **OR** $0.23 \times 0.72 \times 550$	C1
	91 J	A1
4(a)(ii)	1. $t = E\,/\,P$ in any form words, symbols or numbers **OR** $(t =)\ E\,/\,P$ **or** 91 / 2.4	C1
	38 s	A1
	2. (thermal) energy is used to increase the temperature of / lost to cylinder / piston / heater / surroundings	B1
4(b)(i)	it / piston moves to the <u>right</u> / <u>away</u> <u>from</u> <u>heater</u> **OR** <u>accelerates</u> (to right)	M1
	pressure (of gas) greater / pressure greater (on left) / <u>resultant</u> force to right	A1
4(b)(ii)	$V_2 = p_1V_1\,/\,p_2$ in any form **OR** $(V_2 =)\ p_1V_1\,/\,p_2$ **OR** $2.9 \times 10^5 \times 1.9 \times 10^{-4}\,/\,1.0 \times 10^5$	C1
	$5.5 \times 10^{-4}\ m^3$	A1

Question	Answer	Marks
5(a)(i)	any **two** from: occurs throughout the liquid **OR** bubbles formed occurs at one temperature / boiling point does not produce cooling **OR** unaffected by draught / surface area / humidity	B2
5(a)(ii)	(more) energetic molecules escape (from the liquid) **OR** molecules gain energy and escape **OR** molecules overcome intermolecular forces / break bonds	B1
	average speed decreases **OR** molecules with less (kinetic) energy left behind	B1
	temperature of liquid decreases	B1
	(thermal) energy conducted / gained from skin / body **OR** (thermal) energy lost by skin / body	B1
5(b)	molecules touching **OR** no space between molecules	B1
	large (repulsive / intermolecular) forces (when moved closer)	B1

Question	Answer	Marks
6(a)	idea of one side of wavefront enters / hits solid first **OR** wavefront does not all hit the solid all at once;	**B1**
	idea of this side slowed down first **OR** this side delayed relative to other side	**B1**
	angle of wave(front) changes **OR** different parts of wavefront delayed by different amounts	**B1**
6(b)(i)	$n = \frac{\sin i}{\sin r}$ in any form **OR** $n_1\sin\theta_1 = n_2\sin\theta_2$ **OR** $1.3 = \frac{\sin 67°}{\sin r}$ **OR** (r =)$\sin^{-1}$(sin67° / 1.3) **OR** $\sin^{-1}$(0.71)	**C1**
	45°	**A1**
6(b)(ii)	$v_{ts} = c / n$ in any form **OR** (v_{ts} =) c / n **OR** $3.0 \times 10^8 / 1.3$	**C1**
	2.3×10^8 **OR** $3.0 \times 10^8 / 1.3$	**C1**
	$\lambda = v / f$ in any form **OR** (λ =) v / f **OR** $2.3 \times 10^8 / 5.7 \times 10^{14}$ **OR** $3.0 \times 10^8 / (1.3 \times 5.7 \times 10^{14})$	**C1**
	4.0×10^{-7} m	**A1**
	OR (alternative approach)	
	$\lambda = v / f$ in any form **OR** (λ =) v / f **OR** $3.0 \times 10^8 / 5.7 \times 10^{14}$	**C1**
	5.3×10^{-7} **OR** $3.0 \times 10^8 / 5.7 \times 10^{14}$	**C1**
	$\lambda_g = \lambda_a / n$ in any form **OR** (λ_g =) λ_a / n **OR** $5.3 \times 10^{-7} / 1.3$ **OR** $3.0 \times 10^8 / (1.3 \times 5.7 \times 10^{14})$	**C1**
	4.0×10^{-7} m	**A1**

Question	Answer	Marks
7(a)	thermistor **c.a.o.**	**B1**
7(b)(i)	$V_X = V_{30}$	**B1**
7(b)(ii)	$V_X = E - V_{20}$ in any form	**B1**
7(c)(i)	$1/R_1 + 1/R_2 = 1/R_{tot}$ **OR** $(R_{tot} =)\ R_1 R_2 / (R_1 + R_2)$ **OR** $1/15 + 1/30 = 1/R_{tot}$ **OR** (15 × 30) / (15 + 30)	**C1**
	10 (Ω) **OR** 10 + 20	**C1**
	30 Ω	**A1**
7(c)(ii)	$I = V / R$ in any form **OR** $(I =)\ V / R$ **OR** 6.0 / 30	**C1**
	0.20 A	**A1**
7(d)	resistance of X decreases	**B1**
	ammeter reading / it increases **and** (total) resistance (of circuit) decreases / more voltage across 20 Ω resistor	**B1**

Question	Answer			Marks
8(a)(i)	magnetic field mentioned			**B1**
	coil / wire cuts (magnetic) field **OR** changing (magnetic) field (through coil)			**B1**
	e.m.f. / voltage induced **OR** produced by electromagnetic induction			**B1**
8(a)(ii)	(plane of coil) horizontal **OR** in position shown in diagram coil cutting magnetic field the fastest			**B1** **B1**
8(b)	current in coil	**OR**	energy supplied to / lost from lamp	**B1**
	current in (magnetic) field experiences a force		student must do more work / supply more energy / more energy needed	**B1**
	opposes the change causing it		greater force to do more work	**B1**

Question	Answer	Marks
9(a)(i)	**mark both explanation and deduction together**	
	nucleus is very small	**B1**
	very few α-particles hit or pass near to a nucleus	**B1**
9(a)(ii)	**mark both explanation and deduction together**	
	<u>nucleus</u> is charged	**B1**
	(charged) α-particles experience a force	**B1**
9(a)(iii)	**mark both explanation and deduction together**	
	centre / (small) part of atom **OR** nucleus includes most of the mass of the atom / is (very) dense	**B1**
	(α-particles move and) nucleus stays still	**B1**
9(b)	any **two** from: opposite direction (much) smaller deflection undergo deflections of similar magnitude	**B2**