



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

PHYSICS

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Paper 4 Extended Theory

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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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This document consists of **9** printed pages.

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)	tangent on graph OR gradient OR ($a =$) $\Delta v \div \Delta t$ or $(v - u) \div t$	C1
	accept gradient increases; not gradient decreases	C1
	values from tangent or line 13 to 14 m / s ²	A1
1(b)(i)	gradient changes OR graph is curved	B1
1(b)(ii)	mass of space rocket <u>decreases</u> OR gravitational field strength decreases	B1
1(c)	area under graph OR (distance =) <u>average</u> speed \times time	C1
	4550 \times 100 OR (4100 + 5000) \div 2 \times 100	C1
	4.5/4.55/4.6 \times 10 ⁵ m	A1

Question	Answer	Marks
2(a)(i)	($KE =$) $\frac{1}{2} \times m \times v^2$	C1
	$\frac{1}{2} \times 0.020 \times 350^2$	C1
	1200 J	A1
2(a)(ii)	($\Delta h =$) $KE \div mg$ OR $1200 \div (0.020 \times 10)$ OR $1225 \div (0.020 \times 10)$	C1
	6000/6100 m	A1
2(b)(i)	(force of) air resistance acts downwards	M1
	adds to gravitational force/resultant force increases/deceleration increases/deceleration $> g$	A1
2(b)(ii)	(kinetic energy) to gravitational potential energy	B1
	(kinetic energy) to thermal/internal energy	B1

Question	Answer	Marks
3(a)(i)	$(p =) h \times \rho \times g$ or $5.0 \times 1000 \times 10$	C1
	50 000 (Pa)	C1
	(total pressure = $50\,000 + 1.0 \times 10^5 =$) 1.5×10^5 Pa	A1
3(a)(ii)	1.5×10^5 Pa	B1
3(b)	(rises because) density of gas is less than density of OR resultant upward force on bubble	B1
	(as bubble rises) pressure (of gas in bubble) decreases	B1
	(volume of bubble increases because) $p \times V = \text{constant}$ OR $V \propto 1 \div p$	B1

Question	Answer	Marks
4(a)	more energetic molecules escape/evaporate	B1
	less energetic molecules remain	B1
	average <u>kinetic</u> energy of molecules decreases OR temperature depends on <u>kinetic</u> energy	B1
4(b)	convection	B1
	surface/colder water more dense OR contracts	B1
	(cold water) sinks OR warmer water rises	B1
4(c)(i)1	difference between the maximum temperature and minimum temperature it can measure	B1
4(c)(i)2	distance moved by the thread per °C OR per unit temperature change	B1
4(c)(ii)	(range) increases and less expansion/increase in volume (of mercury per unit temperature rise)	B1

Question	Answer	Marks
5(a)(i)	path shows three or more straight line sections	B1
	with sudden changes of direction and at least two different lengths	B1
5(a)(ii)	air molecules travelling in random (directions)	B1
	collide with the smoke particle	B1
5(b)	(average) speed of the molecules decreases	B1
	molecules collide less often (on the piston and the walls of the cylinder)	B1
	smaller momentum change molecules (on collision)	B1
	piston now has a greater force on its right-hand side OR pressure less than atmospheric	B1

Question	Answer	Marks
6(a)	attempt at compressions and rarefactions	B1
	at least one compression labelled and at least one rarefaction labelled	B1
	wavelength and labelled λ	B1
6(b)(i)	(it/frequency remains) constant	B1
6(b)(ii)	(it/wavelength) decreases	B1
6(c)	320 to 350 m / s	B1

Question	Answer	Marks
7(a)	one side of wave(front) slows down before the other side	B1
	wave(front) slews around OR bends at boundary	B1
	bends towards the normal OR bends towards the side that slows first	B1
7(b)	$(n =) c \div v$ OR $(3.0 \times 10^8) \div (1.9 \times 10^8)$	C1
	1.6	A1

Question	Answer	Marks
8(a)(i)	straight line from tip of O to tip of I	B1
	dotted line/lens marked at 3.0 cm from O	B1
8(a)(ii)	Any one of: paraxial ray from tip of O refracting at lens to tip of I paraxial ray to I from lens and ray from O to meet it at lens	B1
8(a)(iii)	(focal length) in range 2.2 cm to 2.6 cm	B1
8(a)(iv)	real and light pass through it/projected on to screen/rays converge	B1
8(b)	(focused rays) set fire to curtain	B1

Question	Answer	Marks
9(a)	$(R =) V \div I$ OR $12 \div 0.15$	C1
	80Ω	A1
9(b)(i)	increases	B1
9(b)(ii)	(voltmeter reading) decreases OR less p.d. across variable resistor	B1
	more p.d. across 20Ω /fixed resistor	B1
9(c)(i)	<u>1.5 J</u> of (electrical) energy supplied in driving charge around the circuit	B1
	energy per unit charge OR per coulomb	B1
9(c)(ii)	8	B1

Question	Answer	Marks
10(a)(i)	there is a reading OR shows //V/p.d.	M1
	then returns to zero/centre	A1
10(a)(ii)	S/south-pole at the right-hand end which attracts the magnet	B1
	opposes the change (causing the deflection)	B1
10(b)(i)	(turns ratio or $N_P \div N_S =) V_P \div V_S$ OR $240 \div 12$	C1
	20 OR $20 \div 1$ OR 20:1	A1
10(b)(ii)	diode underlined	B1

Question	Answer	Marks
11(a)(i)	β (-particles)	B1
11(a)(ii)	α (-particles)	B1
11(a)(iii)	γ (-rays)	B1
11(b)(i)	downward <u>curve</u>	B1
11(b)(ii)	3 (half-lives identified) OR $168 \div 56$	C1
	$1 \div 8$ OR 9.0×10^5 (Rn) atoms remain	C1
	$(7.2 \times 10^6 - 9.0 \times 10^5 =) 6.3 \times 10^6$ (α -particles emitted)	A1