
PHYSICS

5054/22

Paper 2 Theory

May/June 2019

MARK SCHEME

Maximum Mark: 75

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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This document consists of **10** 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)	reading / volume with water / liquid alone or use displacement can filled (to spout)	B1
	subtracted from reading (of volume) with object (submerged) in cylinder or place rock in displacement can and measure volume of overflow with measuring cylinder	B1
1(b)	(d =) M / V algebraic or numerical	C1
	7.8 g / cm^3	A1
1(c)	$350 \times 51 / 39$ or (density of Cu =) $350 / 39$ or 9.0 (g / cm^3) seen	C1
	460 g	A1
1(d)	(density) decreases and volume increases / object expands or molecular explanation of expansion	B1

Question	Answer	Marks
2(a)	force per unit area	B1
2(b)	(P=) dgh algebraic or numerical	C1
	$0.16 \times 1.4 \times 10^4 \times 10$ or 22 400 (Pa) seen	C1
	$7.8 \times 10^4 \text{ Pa}$	A1
2(c)(i)	7.5 – 8.0 cm	B1

Question	Answer	Marks
2(c)(ii)	(molecules) move faster / have more <u>kinetic</u> energy	B1
	(molecules) hit sides / walls / mercury / container	B1
	(molecules) hit harder or more often / more frequently / more violently / vigorously or (molecules) create large(r) pressure / large(r) force or eventually (molecules) exert same pressure as air	B1

Question	Answer	Marks
3(a)	middle ray angle of incidence labelled c	B1
3(b)	angle of incidence (of right-hand ray only) greater than the critical angle	B1
3(c)(i)	$(n =) \sin i / \sin r$ algebraic or numerical	C1
	1.3	A1
3(c)(ii)	$\sin c = 1 / n$ algebraic or numerical	C1
	answer in range 49° to 50.3°	A1

Question	Answer	Marks
4(a)	$1.15 - 1.25 \times 10^{-6}$ (m)	B1
4(b)	infra-red	B1
4(c)	$(f = v / \lambda)$ algebraic or numerical	C1
	$3 \times 10^8 / 1.2 \times 10^{-6}$	C1
	2.5×10^{14} Hz	A1

Question	Answer	Marks
5(a)	negative charge / electrons / experience repulsive force (from dome)	B1
	negative charge / electrons are earthed / move to earth	B1
5(b)	D at start or E at end	C1
	D C B E	A1

Question	Answer	Marks
6(a)	$(I =)V / R$ algebraic or numerical	C1
	0.4(0) A	A1
6(b)	current in Q is 0.25 (A) or (total resistance) $6 / 0.25$ or $6 / 0.65$ or $9.2(3 \Omega)$ seen	C1
	24Ω	A1
6(c)(i)	correct circuit with two lamps ammeter and battery in series	B1
6(c)(ii)	(total) resistance increases or (each) lamp has lower p.d. across it	B1

Question	Answer	Marks
7(a)	current direction in copper wire correct on any part of diagram	B1
7(b)	current and <u>magnetic</u> field create a force or current (in wire) creates a <u>magnetic</u> field	B1
	left-hand rule mentioned or used or interaction of magnetic fields of magnet and current (catapult effect)	B1

Question	Answer	Marks
7(c)	(electric) motor or any device that contains a motor	B1
	(loud)speaker or any device that contains a loudspeaker	B1

Question	Answer	Marks
8(a)	<u>filament</u> is heated / hot (emits electrons) or thermionic emission occurs at the filament	B1
	cylinder / anode attracts / accelerates <u>electrons</u>	B1
8(b)	connect a battery / p.d. / voltage / power supply across plates	B1
	electrons deflect / attract towards positive / away from negative or field is from positive to negative	B1

Question	Answer	Marks
9(a)(i)	10.2–10.4 (cm) or 50 (km) or 15 (km) seen	C1
	51–53 km	A1
	direction (0)72–74° or N 72–74 °E etc.	B1
9(a)(ii)	(distance) has no direction or (distance) is a scalar	B1
9(a)(iii)	changes direction or goes round a corner	B1
	velocity changes or velocity depends on direction or acceleration / force is towards the centre of circle / centripetal	B1

Question	Answer	Marks
9(b)(i)	distance travelled before brakes applied (after seeing emergency)	B1
9(b)(ii)	any 2 of <ul style="list-style-type: none"> • poor tyre surface • poor road conditions, e.g. rain, ice • high speed (of car) or good aerodynamic car shape or tail wind • large mass / weight of car • driver applies less force to pedal / less braking force 	B1B1
9(c)(i)	(KE =) $\frac{1}{2}mv^2$ algebraic or numerical	C1
	$\frac{1}{2} \times 1200 \times 30^2$	C1
	540 000 J	A1
9(c)(ii)	(a=) F / m algebraic or numerical	C1
	1.5 m / s ²	A1
9(c)(iii)	friction (produces thermal energy) or kinetic energy changes to heat or work done against friction	B1

Question	Answer	Marks
10(a)	<i>metal tip</i> 1000 °C	B1
	<i>solder</i> 200 °C	B1
10(b)(i)	(E=) VIt algebraic or numerical	C1
	790 J	A1

Question	Answer	Marks
10(b)(ii)	(Q=) mcT algebraic or numerical	C1
	$2.3 \times 300 \times 0.39$	C1
	270 J	A1
10(c)(i)	electrons <u>move</u> around or electrons diffuse through (metal)	M1
	pass on energy to other parts / hit atoms or other electrons / (transfer energy) in all directions	A1
10(c)(ii)	hot air / heated air rises	B1
	(hot air) less dense (than cold air)	B1
10(d)(i)	two different metals	B1
	complete circuit with meter in series and one junction labelled H on hot tip	B1
10(d)(ii)	ANY TWO from <ul style="list-style-type: none"> • can measure rapid temperature changes • can measure high temperatures • is small in size • has a small heat capacity • can give electrical signal / be read by computer 	B1 B1

Question	Answer	Marks
11(a)(i)	gravity or gravitational attraction	B1
11(a)(ii)	Any 2 from: <ul style="list-style-type: none"> • high pressure • (very) high temperature • high particle density 	B1 B1

Question	Answer	Marks
11(b)(i)	proton and 92	B1
	neutron and 143	B1
11(b)(ii)	same number of protons	B1
11(b)(iii)	neutron hits / absorbed by uranium / nucleus	B1
	<u>nucleus</u> splits or smaller <u>nuclei</u> formed and emits more neutrons	B1
11(b)(iv)	fusion – coming together and fission splitting up or fission involves large particles / nuclei and fusion small nuclei or in fusion nuclear waste / products are less radioactive / dangerous or no / few neutrons produced in fusion	B1
11(b)(v)	90 proton number of Th	B1
	231 and 4 nucleon numbers	B1
11(c)(i)	P marked where beam of alpha-particles hits screen	B1
11(c)(ii)	fewer flashes (as one moves from centre) or very few / only some flashes on same side as source / on left	B1
11(c)(iii)	Any 2 bullet points from <ul style="list-style-type: none"> • <u>nucleus</u> is small or atom (mostly empty) space • most mass of atom in nucleus or mass is concentrated in small point / region or nucleus is dense or nucleus is massive • charge concentrated in small region or (positive) charge found in nucleus or nucleus has all the (positive) charge of the atom 	B1 B1