
PHYSICS

5054/21

Paper 2 Theory

October/November 2018

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)	$(F =) ma$ or 35×2.6	C1
	91 N	A1
1(b)(i)	straight line from origin to dashed line / t_1	B1
	gradually decreasing gradient until the line is horizontal	B1
1(b)(ii)	area <u>under</u> the line or area between line and x-axis	B1

Question	Answer	Marks
2(a)(i)	$(p =) \rho gh$ or $940 \times 10 \times 3.3$	C1
	3.1×10^4 Pa	A1
2(a)(ii)	atmospheric pressure acts at both ends of crack	B1
2(b)	(surface) level decreases / drops	B1
	pressure (at level of crack) decreases	B1

Question	Answer	Marks
3(a)	line continues from (7.0, 0.19) and curves upwards	B1
3(b)	(extension =) 8.5 (cm)	C1
	3.1–3.2 N	A1
3(c)	(limit of proportionality is) not reached and load shared / distributed equally or tension in each spring 4.5 N or limit of proportionality now 14 N	B1
	or tension in each spring halved or tension in each spring < 7.0 N	B1

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Question	Answer	Marks
4(a)	(kinetic energy =) $\frac{1}{2}mv^2$ and m is the mass of the object	B1
4(b)(i)	($\Delta Q =$) $mc\Delta T$ or $0.60 \times 560 \times 25$	C1
	$8.4 \times 10^3 \text{ J}$	A1
4(b)(ii)	$v^2 = 2\Delta Q / m$ or $8.4 \times 10^3 = \frac{1}{2} \times 0.60 \times v^2$ or ($v^2 =$) $2.8 \times 10^4 \text{ (m}^2/\text{s}^2\text{)}$	C1
	167 m / s	A1
4(b)(iii)	some internal / thermal energy lost (to ground / air) or work done to shatter rock or rock bounces or energy used to compress ground or rock melts	B1
5(a)(i)	1 difference between maximum and minimum marked temperatures	B1
	2 distance moved by (end of) thread per unit temperature rise	B1

Question	Answer	Marks
5(a)(ii)	large bulb / quantity of mercury greater increase in volume or narrow bore greater distance / difference (for a given increase in volume)	M1A1
5(b)	traps the liquid above the constriction (so that the reading is maintained)	B1
5(c)	they / molecules gain <u>kinetic</u> energy / move faster	B1
	move apart or push each other apart	B1
	mercury expands (up the tube)	B1

Question	Answer	Marks
6(a)	(hard) steel	B1
6(b)	(place compass near to a pole and) mark a dot at further end of needle	B1
	move compass so the first end coincides with the dot and mark second dot	B1
	repeat (many times) and join up dots	B1
6(c)	magnetism <u>induced</u> in iron bar or poles <u>induced</u> on iron bar	B1
	end P becomes an N-pole	B1
	unlike poles attract or (force of) attraction greater than friction / repulsion	B1

Question	Answer	Marks
7(a)(i)	$1/R_T = 1/R_1 + 1/R_2$ or $1/R_T = 1/3.6 + 1/1.8$ or $(R_T =) R_1 R_2 / (R_1 + R_2)$ or $1.8 \times 3.6 / (1.8 + 3.6)$	C1
	1.2 (Ω)	C1
	4.0 Ω	A1
7(a)(ii)	$(I =) V/R$ or 6.0 / 4.0	C1
	1.5 (A)	A1
7(b)(i)	work done / energy (released) per <u>unit</u> charge (passed through component)	B1
7(b)(ii)	voltmeter symbol and across 2.8 Ω resistor	B1

Question	Answer	Marks
7(b)(iii)	<u>total</u> resistance increases or resistance <u>of circuit</u> / <u>parallel combination</u> increases	B1
	current (in $2.8\ \Omega$ resistor) decreases	B1

Question	Answer	Marks
8(a)	substance or matter	B1
	rest or motion	B1
8(b)(i)	(a region of space) where a mass experiences a force (due to gravitational attraction)	B1
8(b)(ii)	$(m =) \rho V$ or $1000 \times 2.4 \times 10^{-2}$ or 24 (kg)	C1
	25 (kg) or 240 (N)	C1
	250 N	A1
8(c)(i)	$(\Gamma =) Fx$ or 250×0.12	C1
	30 N m	A1
8(c)(ii)	75 N	B1
8(d)(i)	any two from: friction (between axle and cylinder) weight of rope force not perpendicular (to radius) rope wraps over itself (and increases moment)	B2

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Question	Answer	Marks
8(d)(ii)	from chemical (energy) or chemical (energy) as first term	B1
	to gravitational potential (energy) or to thermal / heat (energy) as last term	B1
	to thermal / internal (energy) / heat and thermal / internal (energy) / heat	B1
8(e)	no resultant force or forces balance / cancel or tension equals weight (of bucket) or upwards force equals downward force	B1

Question	Answer	Marks
9(a)	the <u>vibration</u> direction is parallel to the wave / energy travel direction or longitudinal waves have compressions and rarefactions or transverse waves have crests and troughs or longitudinal waves cannot be polarised	B1
9(b)(i)	$(f =) v / \lambda$ or $0.17 / 0.019$	C1
	8.9 Hz	A1
9(b)(ii)	(frequency) stays constant or does not change	B1
9(b)(iii)	(speed) decreases	B1
	(Fig. 9.1 shows that) wavelength decreases or refraction is towards normal or $i > r$ or top of wave (in shaded region) lags behind bottom of wave	B1
9(c)(i)	electromagnetic and transverse underlined	B1
9(c)(ii)	$n = \sin(i) / \sin(r)$ or $(r =) \sin^{-1}(\sin(i) / n)$ or $(r =) \sin^{-1}(\sin(60^\circ) / 1.6)$	C1
	33(°)	A1

Question	Answer	Marks
9(c)(iii)	1 $n = 1 / \sin(c)$ or $(c =) \sin^{-1}(1 / n)$ or $\sin^{-1}(1 / 1.6)$	C1
	39°	A1
	2 total internal reflection	B1
	$\theta > c$ or $57(^{\circ}) > 39(^{\circ})$ or angle of incidence greater than the critical angle	B1
	3 reflected ray at P (correct angle by eye)	B1
	light in air at 30° (by eye) to vertical surface	B1

Question	Answer	Marks
10(a)(i)	same number of protons or same number of electrons	B1
10(a)(ii)	different number of neutrons	B1
10(b)(i)	${}^4_2\alpha$	B1
	${}^{92}_{\dots}\text{U}$	B1
	${}^{235}_{\dots}\text{U}$	B1
10(b)(ii)	(no. of half-lives =) $1.2 \times 10^5 / 2.4 \times 10^4$ or 5 (half-lives)	C1
	relevant halving or $1 / 2^5$ or $1 / 32$ or $6400 / 32$	C1
	200 counts / second	A1

Question	Answer	Marks
10(b)(iii)	1 curving (only) downwards with correct curvature	M1
	no straight section (by eye) anywhere in magnetic field	A1
	2 (Fleming's) left-hand rule or motor rule or rule described or moving charge is a current	B1
10(c)(i)	splitting of a <u>nucleus</u>	B1
10(c)(ii)	neutron fired at a plutonium nucleus or plutonium nucleus absorbs neutron	B1
10(c)(iii)	1 no CO ₂ / SO ₂ / nitrogen oxides / greenhouse gases emitted or do not contribute to global warming / acid rain	B1
	2 reliable / not intermittent or smaller land area	B1