
PHYSICS**5054/22**

Paper 2 Theory

October/November 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.

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)	weight is directly proportional to mass or $W = mg$	B1
	a larger force acts on the more massive body or $a = F/m$ or $a = W/m$	B1
	mass cancels or acceleration inversely proportional to mass	B1
1(b)(i)	$(\Delta v =) at$ or 1.6×1.5	C1
	2.4 m/s	A1
1(b)(ii)	2.4 marked on y-axis and straight line from (0, 0) to (1.5, 2.4)	B1
1(b)(iii)	$\frac{1}{2} \times 2.4 \times 1.5$ or area under the graph mentioned / attempted	C1
	1.8 m	A1

Question	Answer	Marks
2(a)(i)	$(F =) pA$ or $3.8 \times 10^5 \times 6.1 \times 10^{-4}$	C1
	230 N	A1
2(a)(ii)	force on other side of piston due to air / atmospheric pressure or pressure of trapped air decreases as valve opens (and air enters the tyre)	B1
2(b)	molecules collide <u>with walls / piston / pump / surface</u>	B1
	number of molecules per unit volume increases (as volume decreases)	B1
	more collisions per unit area or more frequent collisions / collide more often	B1

Question	Answer	Marks
3(a)(i)	(nuclear) <u>fusion</u> (reactions) or nuclei fuse	B1
	small <u>nuclei</u> / hydrogen <u>nuclei</u> joining together (and release energy) or larger <u>nucleus</u> produced	B1
3(a)(ii)	infra-red (radiation) or ultraviolet (radiation) or (visible) light	B1
3(b)	black surfaces are (good) absorbers	M1
	of (infra-red) radiation / heat / (visible) light / thermal energy	A1

Question	Answer	Marks
4(a)	any two from: only occurs at the surface / no bubbles produced occurs at any temperature produces cooling	B2
4(b)	molecules escape (from liquid)	B1
	fast(est) molecules / molecules with great(est kinetic) energy escape or slow(est) molecules / molecules with small(est kinetic) energy remain or (average) speed of remaining molecules decreases or molecules gain (kinetic) energy and escape	B1
4(c)(i)	rate of evaporation increases (with increasing area)	B1
4(c)(ii)	rate of evaporation decreases with decreasing temperature or takes too much time	B1

Question	Answer	Marks
5(a)	vibration / oscillation of <u>particles</u> or energy transfer or compressions and rarefactions	B1
	vibration / oscillation (of particles) parallel to energy travel direction / propagation direction	B1

Question	Answer	Marks
5(b)(i)	$(\lambda =) v / f$ or 1500 / 42 000	C1
	0.036 m or 3.6 cm	A1
5(b)(ii)	(ultrasound) vibrates (the cleaning fluid / jewellery)	B1
	dirt shaken off	B1

Question	Answer	Marks
6(a)(i)	4.0 V c.a.o.	B1
6(a)(ii)	$(V =) 12 - 4.0$ or 8.0 or $4.0 / 700$ or 5.7×10^{-3}	C1
	$(R =) V / I$ or $8.0 \times 1 / (4.0 / 700)$ or $700 \times (8.0 / 4.0)$ or $12 / (4.0 / 700)$ or 2100 (Ω)	C1
	1400 Ω	A1
6(b)	resistance of LDR decreases	B1
	current increases or p.d. across 700 Ω resistor / oscilloscope increases or p.d. across LDR decreases	M1
	trace moves up the screen	A1

Question	Answer	Marks
7(a)(i)	current and <u>magnetic field</u> / <u>magnetic flux</u> (experiences a force) or the two <u>magnetic fields</u> interact	B1
7(a)(ii)	three separate approaches I / II / III	
7(a)(ii)I	B to A	B1
	left-hand rule mentioned / described	B1
	or	

Question	Answer	Marks
7(a)(ii)II	B to A	B1
	top face of coil attracted to S-pole or top face acts as an N-pole	B1
	or	
7(a)(ii)III	B to A	B1
	more field lines under AB or fewer lines above AB	B1
7(b)	($I =$) Fx or $2 \times 9.6 \times 10^{-3} \times 0.025$ or $9.6 \times 10^{-3} \times 0.025$ or 2.4×10^{-4} (N m) or 0.024 (N cm)	C1
	4.8×10^{-4} N m or 0.048 N cm	A1
7(c)(i)	split-ring commutator or (carbon) brushes	B1
7(c)(ii)	(soft-)iron core or stronger magnet(s) or larger current or more turns or smaller resistance or greater electromotive force (e.m.f.)	B1

Question	Answer	Marks
8(a)	where / when <u>extension</u> is not directly proportional to <u>load</u> / <u>tension</u> / <u>force</u> (applied)	C1
	<u>point</u> where <u>extension</u> stops being directly proportional to <u>load</u> / <u>tension</u> / <u>force</u> (applied)	A1
8(b)(i)	the amount matter in a body or (a measure of) the inertia of a body	B1
8(b)(ii)	force (on a body)	B1
	in a gravitational field	B1
8(c)(i)	7.0 N c.a.o.	B1
8(c)(ii)	41 N / m or 0.41 N / cm	B1

Question	Answer	Marks
8(d)(i)	two separate approaches I / II	
8(d)(i)I	0.90	C1
	41×0.90 or 37 or 3.7 or $3.7 - 0.70$	C1
	3.0 kg	A1
	or	
8(d)(i)II	$1.7 - 0.97$ or 0.73	C1
	$41 \times (1.7 - 0.97)$ or 41×0.73 or 30	C1
	3.0 kg	A1
8(d)(ii)	straight line to marked point	B1
	$0 < \text{location of } y\text{-intercept} < 1.70 \text{ m}$ (intercept need not be labelled)	B1
	curve of changing / changed gradient beyond marked point	B1
8(e)	from elastic (potential energy) or strain (energy)	B1
	to kinetic (energy) or to gravitational (potential energy)	B1

Question	Answer	Marks
9(a)	temperature	B1
	at which a liquid becomes a gas / vapour	B1
9(b)	forces (between the molecules of the liquid) / bonds mentioned	B1
	move molecules apart or overcome forces (between the molecules)	B1
	work done against forces or gains (molecular) potential energy	B1
9(c)	ammeter symbol in series	B1
	voltmeter symbol across the heater / power supply	B1
9(d)(i)	$(P =) VI$ or 6.0×2.0	C1
	12 W	A1
9(d)(ii)	$(E =) Pt$ or 12×60 or $(E =) VIt$ or $6.0 \times 2.0 \times 60$	C1
	720 J	A1
9(d)(iii)	$(m =) Q / v$ or $720 / 9.0 \times 10^5$	C1
	8.0×10^{-4} kg or 0.80 g	A1
9(e)	(it / upward force) does not change	B1
	always equal to weight of piston + force due to atmospheric pressure or no resultant force or piston is not accelerating	B1

Question	Answer	Marks
10(a)	similarity: (same) number of protons	B1
	difference: (different) number of neutrons	B1
10(b)(i)	(nucleon number =) 222 – 4 or 218 or 218 – 84	C1
	134	A1
10(b)(ii)	(proton number =) 84 + 2	C1
	86	A1
10(b)(iii)	it / helium atom has two electrons (in orbit around the nucleus)	B1
10(c)(i)	2.1×10^{10} (alpha-particles)	B1
10(c)(ii)	calculated value of: 2.8×10^{10} – candidate's 10(c)(i) (atoms remain) (expected value: 7.0×10^9)	B1
10(c)(iii)	$7.0 \times 10^9 / 2.8 \times 10^{10}$ or 1 / 4	C1
	2 (half-lives) or 7.6 / 2	C1
	3.8 days	A1
10(d)	alpha-particles are (very) weakly penetrating	B1
10(d)	strongly ionising	B1
	(ionisation causes cell) mutations / cancers	B1