
PHYSICS

5054/21

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.

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)(i)	pressure due to mercury (in tube) is greater than pressure due to atmosphere (+ small height of mercury)	B1
	(resultant) force downwards and mercury flows out of tube	B1
1(a)(ii)	vacuum or nothing or mercury vapour	B1
1(b)	height of mercury column mentioned	C1
	height of mercury column <u>above level in dish measured</u>	A1
	candidate suggests use of $p = h \rho g$ and h in metres (m)	B1

Question	Answer	Marks
2(a)	mgh and $\frac{1}{2} mv^2$	B1
2(b)	$\frac{1}{2} mv^2 = mgh$ or $v^2 = 2gh$ or $v^2 = 2 \times 10 \times 380$ or $v^2 = 7600$	C1
	$(v =) \sqrt{2gh}$ or $\sqrt{2 \times 10 \times 380}$	C1
	87 m / s	A1
2(c)(i)	both the g.p.e. and the k.e. are proportional to mass or mass cancels out in the equation or they accelerate at the same rate / g	B1
2(c)(ii)	air resistance (force) is a smaller proportion of weight (for heavier coin)	B1
	acceleration of heavier coin greater / less affected by air resistance	B1

Question	Answer	Marks
3(a)	any three from: molecules / they are further apart forces between molecules / them smaller molecules / they move in straight lines (between collisions) potential energy of molecules / them greater gas molecules move freely/randomly but liquid molecules slide over each other	B3
3(b)	(molecules separated against) intermolecular forces / bonds	B1
	work is done as molecules separate or bonds broken or latent heat supplied	B1

Question	Answer	Marks
4(a)	(A:) ultraviolet (radiation) (B:) infra-red (radiation) (C:) microwaves any two correct	C1
	all three correct	A1
4(b)	gamma-rays and gamma-rays	B1
4(c)	X-rays pass through flesh and not (to the same extent) through bone	B1
	X-rays detected photographically or (digital) detector behind bone	B1
	no / less exposure / detection reveals bone or exposure / detection reveals break	B1

Question	Answer	Marks
5	two pairs of results from the line and separated by $\geq 50 \text{ cm}^3$	B1
	or $(\rho) = m / V$ use of results to obtain gradient or any <u>mass</u> / <u>corresponding</u> volume	C1
	$W = mg$ or $(\rho =)$ gradient / g or $0.00881 \text{ (N / cm}^3) \leq \rho \leq 0.00895 \text{ (N / cm}^3)$	C1
	$0.000881 \text{ kg / cm}^3 \leq \rho \leq 0.000895 \text{ kg / cm}^3$ or $0.881 \text{ g / cm}^3 \leq \rho \leq 0.895 \text{ g / cm}^3$	A1

Question	Answer	Marks
6(a)(i)	$(I =) P / V$ or $60 / 240$	C1
	0.25 A	A1
6(a)(ii)	$(R =) V / I$ or $240 / 0.25$	C1
	960 Ω	A1
6(b)(i)	3.0 V	B1
6(b)(ii)	resistance is smaller	B1
	(filament at a) lower temperature	B1
6(b)(iii)	current surge (due to lower resistance when cold)	B1

Question	Answer	Marks
7(a)(i)	(atomic particle) Q	B1
7(a)(ii)	$+1.6 \times 10^{-19} \text{ C}$	B1
7(b)	(atomic particle) Q and (atomic particle) S	B1
7(c)(i)	(atomic particle) R	B1

Question	Answer	Marks
7(c)(ii)	(atomic particle) S	B1
7(c)(iii)	beta-(particle) emission	B1
7(c)(iv)	99 / 33 or 3 half-lives	C1
	$1 / 2^3$ or 1 / 8 (remain)	C1
	7 / 8	A1

Question	Answer	Marks
8(a)	<u>surround</u> the component with a box or use of iron mentioned	B1
	<u>surround the component with (a box of) iron</u>	B1
8(b)(i)	solenoid and d.c. power supply and switch	B1
	core	B1
	<u>iron</u> core	B1
8(b)(ii)	named or described use	B1
	what happens when electromagnet is switched on	B1
	<u>current</u> causes magnetisation or description of what happens when electromagnet is switched off	B1

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Question	Answer	Marks
8(c)(i)	ammeters deflects / shows a reading	B1
	magnetic field lines cut by solenoid or changing magnetic field in coil	B1
	e.m.f. / voltage <u>induced</u>	B1
8(c)(ii)	no deflection and no (magnetic) field lines cut or constant field	B1
8(c)(iii)	larg(er) deflection	B1
	opposite deflection	B1
	field lines cut in opposite sense or opposite change in (magnetic) field or field lines cut faster	B1

Question	Answer	Marks
9(a)	it is less dense (than the cooler water)	B1
	it floats on the cooler water / cooler water cannot move up / cooler water remains on the bottom	B1
9(b)(i)	copper / metal is a good (thermal) conductor	B1
9(b)(ii)	vibrating atoms / ions / particles / molecules or electrons gain energy	B1
	atoms / ions / particles / molecules hit the electrons or electrons travel (a long distance through the copper)	B1
	electrons hit / transfer energy to (distant) atoms / ions / particles / molecules	B1

Question	Answer	Marks
9(b)(iii)	it contracts or its density increases	B1
	it sinks	B1
	less dense / warmer water rises or sets up a convection current	B1
9(c)	14(°C) or 0.25 (kg) or 250 / 1000 (kg) seen	C1
	$(Q =) mc\Delta t$ or $0.25 \times 4200 \times (21 - 7)$ or $0.25 \times 4200 \times 14$	C1
	14 700 J or 15 000 J	A1
9(d)(i)	any two from: molecules / they move in clusters	B1
	slide over each other molecules / they move throughout the liquid	B1
9(d)(ii)	average speed / <u>kinetic</u> energy decreases	B1

Question	Answer	Marks
10(a)	$3.0 \times 10^8 \text{ m/s}$	B1
10(b)	red orange yellow green blue indigo violet (any order)	B1
10(c)(i)	(–)6.(0) cm	B1

Question	Answer	Marks
10(c)(ii)	any two rays drawn from: paraxial ray that refracts and seems to come from F_1 ray through the optical centre of lens ray that aims for F_2 but refracts and emerges paraxially	B2
	rays traced back to point	B1
	(point) labelled I and rest of image drawn down to the principal axis	B1
10(c)(iii)	1.7–1.9 cm	B1
10(c)(iv)	candidate's 10(c)(iii) / 3.0 evaluated	B1
10(c)(v)	any two from: a real image can be projected on to a screen light actually passes through a real image on same side (of lens) as object or on opposite side of <u>mirror</u> to object	B2
10(c)(vi)	correction of short-sight / myopia	B1
10(d)	light travels more slowly in glass or light changes speed	B1
	one side / left-hand side of wavefront slows down first	B1
	wavelength decreases or wavefront travels a shorter distance in the same time	B1