Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

PHYSICS (9–1) **0972/31**

Paper 3 Core Theory **May/June 2022**

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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>‘List rule’ guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6	<u>Calculation specific guidance</u> Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	<u>Guidance for chemical equations</u> Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Examples of how to apply the list rule

State **three** reasons…. [3]

A

1	Correct	✓	**2**
2	Correct	✓	
3	Wrong	✗	

B (4 responses)

1	Correct, Correct	✓, ✓	**3**
2	Correct	✓	
3	Wrong	ignore	

C (4 responses)

1	Correct	✓	**2**
2	Correct, Wrong	✓, ✗	
3	Correct	ignore	

D (4 responses)

1	Correct	✓	**2**
2	Correct, CON (of 2.)	✗, (discount 2)	
3	Correct	✓	

E (4 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct, Wrong	✓	

F (4 responses)

1	Correct	✓	**2**
2	Correct	✓	
3	Correct CON (of 3.)	✗ (discount 3)	

G (5 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1	Correct	✓	**2**
2	Correct	✗	
3	CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1	Correct	✓	**2**
2	Correct	✗	
3	Correct CON (of 2.)	✓ (discount 2)	

NOTES ABOUT MARK SCHEME SYMBOLS & OTHER MATTERS

M marksare method marks upon which further marks depend. For an M mark to be scored, the point to which it refers **must** be seen in a candidate's answer. If a candidate fails to score a particular M mark, then none of the dependent marks can be scored.

B marks	are independent marks, which do not depend on other marks. For a B mark to scored, the point to which it refers must be seen specifically in the candidate's answers.
A marks	In general A marks are awarded for final answers to numerical questions. If a final numerical answer, eligible for A marks, is correct, with the correct unit and an acceptable number of significant figures, all the marks for that question are normally awarded. It is very occasionally possible to arrive at a correct answer by an entirely wrong approach. In these rare circumstances, do not award the A marks, but award C marks on their merits. However, correct numerical answers with no working shown gain all the marks available.
C marks	are compensatory marks in general applicable to numerical questions. These can be scored even if the point to which they refer are not written down by the candidate, **provided subsequent working gives evidence that they must have known it.** For example, if an equation carries a C mark and the candidate does not write down the actual equation but does correct substitution or working which shows that they knew the equation, then the C mark is scored. A C mark is not awarded if a candidate makes two points which contradict each other. Points which are wrong but irrelevant are ignored.
Brackets ( )	around words or units in the mark scheme are intended to indicate wording used to clarify the mark scheme, but the marks do not depend on seeing the words or units in brackets e.g. 10 (J) means that the mark is scored for 10, regardless of the unit given.
<u>Underlining</u>	indicates that this <u>must</u> be seen in the answer offered, or something very similar.
OR / or	indicates alternative answers, any one of which is satisfactory for scoring the marks.
o.w.t.t.e.	means 'or words to that effect'.

Question	Answer	Marks
1(a)(i)	0.3(0) (cm^3)	**A3**
	(average volume of one drop) = 60 ÷ 200	**(C2)**
	total volume = number of drops × (average) volume of one drop	**(C1)**
1(a)(ii)	226.5 (s)	**A2**
	180 (+ 46.5 =)	**(C1)**
1(a)(iii)	1.1 (s)	**A2**
	time for one drop = total time ÷ no of intervals	**(C1)**
1(b)	84 (cm^3)	**B1**

Question	Answer	Marks
2(a)(i)	9.3 (m/s)	**A2**
	any indication on graph or in working of vertical line from 10.0 s	**(C1)**
2(a)(ii)	(car) A (has greater acceleration)	**M1**
	(speed-time graph/line) has greater gradient OR is steeper	**A1**
2(b)(i)	<u>speed</u> (of car) is steady OR <u>speed</u> is constant	**B1**
	(at) 16 <u>m/s</u>	**B1**
2(b)(ii)	240 (m)	**A3**
	(distance =) ½ × 16 × 30	**(C2)**
	distance travelled = area under graph OR (d =)speed × time OR ½ × b × h	**(C1)**

Question	Answer	Marks
3(a)(i)	24 (cm^2)	**A2**
	(area in contact with ground) =length × width OR 12 × 2(.0)	**(C1)**
3(a)(ii)	(weight =) 8.4 (N)	**A2**
	(weight =) mass × g OR 0.84 × 10	**(C1)**
3(b)	(pressure =) 6(.0) (N/cm^2)	**A3**
	(pressure =) 24 ÷ 4(.0)	**(C2)**
	(pressure =) force ÷ area	**(C1)**

Question	Answer		Marks
4(a)	(useful energy transfers:)	kinetic (energy)	**B1**
	in either order	gravitational potential (energy)	**B1**
	(wasted energy transfer:)	thermal (energy)	**B1**
4(b)	50 (N cm)		**A3**
	2.5 × 20		**(C2)**
	(moment of force =) force × (perpendicular) distance (of force from pivot)		**(C1)**

Question	Answer	Marks
5(a)	any **three** from: (moving) air has kinetic energy OR wind has kinetic energy (moving) air / wind turns turbine/blades turbine turns generator (rotating) <u>generator</u> produces/generates electricity	**B3**
5(b)	any **two** from: (wind is) renewable (energy source) no greenhouse gases / CO_2 produced (during operation) no SO_2 OR acidic gases produced (during operation) OR no nitrous oxides produced	**B2**
5(c)	any **two** from: large(r) area of land needed OR dilute energy source intermittent/inconsistent/unreliable supply OR cannot work if wind too strong/weak (possible) harm to (migrating) birds difficult to maintain (particularly if off-shore)	**B2**

Question	Answer	Marks
6(a)(i)	conduction	**B1**
6(a)(ii)	1 80 (°C)	**B1**
	2 170 (°C)	**B1**
	3 26 (minutes)	**B1**

Question	Answer	Marks
6(b)	(solid:) particles/molecules any **three** from: (are) fixed in place/position/arrangement regular spacing / pattern / arrangement vibrating close together	**B3**
	(gas:) particles/molecules any **three** from: (are) moving randomly at high speed colliding (with each other/walls) randomly arranged/no pattern (relatively) far apart	**B3**

Question	Answer	Marks
7(a)(i)	8.0 (cm)	**B1**
7(a)(ii)	1.5 (cm)	**B1**
7(b)(i)	wavefronts at different angle to boundary	**B1**
	wavefronts towards left **AND** all with smaller wavelength	**B1**
7(b)(ii)	refraction	**B1**

Question	Answer	Marks
7(c)(i)	ultraviolet OR X-rays OR gamma rays	**B1**
7(c)(ii)	correct use for wave in **(c)(i)**	**B1**

Question	Answer	Marks
8(a)	first method (use of plotting) compass(es)	**B1**
	idea of mark arrow position OR move compass in direction of arrow	**B1**
	start from different position(s) OR join up marks/draw lines (to show pattern)	**B1**
	OR alternative method (use of plotting) compass(es)	**(B1)**
	place number of compasses around magnet	**(B1)**
	idea that arrows line up to show pattern	**(B1)**
8(b)	(metal bar XY/it is soft) iron OR magnetic material/bar/metal	**B1**
	(so XY) must be unmagnetised	**B1**
	(because end X of XY or bar) attracts to (both) N pole and S pole	**B1**

Question	Answer	Marks
9(a)	(current/reading/it) increases	**B1**
	(because circuit) resistance decreases	**B1**
9(b)	0.75 (A)	**A3**
	6(.0) ÷ 8(.0)	**(C2)**
	V= IR or (I =) V/R	**(C1)**
9(c)	28 (Ω)	**A2**
	(total resistance =) $R_1 + R_2$ OR 20 + 8(.0)	**(C1)**
9(d)	tick in 2nd box (magnetic)	**B1**
	tick in 3rd box (heating)	**B1**

Question	Answer	Marks
10(a)	any **four** from: Earth wire keeps case at zero volts/earth (potential) (so) user not electrocuted (live wire touching metal case produces) large current (in fuse/earth wire) (causes) fuse to melt isolating appliance from supply OR (so) no current in appliance OR disconnects/breaks the circuit prevent(s/ing electrical) fire/overheating (in cables/appliance)	**B4**

Question	Answer	Marks
10(b)	1920 (V)	**A3**
	Vs / 240 = 560/70 OR Vs = (560/70) × 240 OR Vs = 240 × 8 OR 560/70 = ? / 240	**(C2)**
	Vs/Vp = Ns/Np in any form	**(C1)**

Question	Answer	Marks
11(a)	alpha (particles) not emitted	**M1**
	any **one** from idea that count rate for paper is similar to count rate for air OR if alpha emitted count rate for paper would decrease/be less (than 480)	**A1**
11(b)	gamma (rays) emitted	**M1**
	any **one** from idea that count rate for (10 mm) lead is less (than count rate for (2 mm) aluminium/air/paper owtte) OR (most/some of) gamma (rays) are absorbed by lead	**A1**