Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education (9–1)

PHYSICS **0972/41**

Paper 4 Extended Theory **October/November 2018**

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 October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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.

NOTES ABOUT MARK SCHEME SYMBOLS & OTHER MATTERS

B marks	are independent marks, which do not depend on other marks. For a B mark to be scored, the point to which it refers must be seen specifically in the candidate's answer.
M marks	are method marks upon which accuracy marks (A marks) later 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 A marks can be scored.
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 he 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.
A marks	A marks are accuracy or answer marks which either depend on an M mark, or which are one of the ways which allow a C mark to be scored. A marks are commonly 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.
Brackets ( )	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>	Underlining indicates that this <u>must</u> be seen in the answer offered, or something very similar.
OR / or	This indicates alternative answers, any one of which is satisfactory for scoring the marks.
e.e.o.o.	This means "each error or omission".
o.w.t.t.e.	This means "or words to that effect".
Ignore	This indicates that something which is not correct or irrelevant is to be disregarded and does not cause a right plus wrong penalty.
Spelling	Be generous about spelling and use of English. If an answer can be understood to mean what we want, give credit. However, do not allow ambiguities, e.g. spelling which suggests confusion between reflection / refraction / diffraction or thermistor / transistor / transformer.
Not/NOT	This indicates that an incorrect answer is not to be disregarded, but cancels another otherwise correct alternative offered by the candidate, i.e. right plus wrong penalty applies.

ecf	meaning "error carried forward" is mainly applicable to numerical questions, but may in particular circumstances be applied in non-numerical questions. This indicates that if a candidate has made an earlier mistake and has carried an incorrect value forward to subsequent stages of working, marks indicated by ecf may be awarded, provided the subsequent working is correct, bearing in mind the earlier mistake. This prevents a candidate from being penalised more than once for a particular mistake, but **only** applies to marks annotated ecf.
Significant	Answers are normally acceptable to any number of significant figures ≥ 2. Any exceptions to this general rule will be specified in the mark scheme.
Units	Deduct one mark for each incorrect or missing unit from an answer that would otherwise gain all the marks available for that answer: **maximum 1 per question**. No deduction is incurred if the unit is missing from the final answer but is shown correctly in the working. Unless listed here or stated in the mark scheme for the question, do not accept derived units e.g. kg m / s^2 for N is NOT acceptable. The following are acceptable alternatives: N m for J, J / s or N m / s for W, N / m^2 for Pa, N s and kg m / s are both acceptable for momentum and impulse. Beware: J is NOT acceptable for moments. Condone wrong use of upper and lower case symbols e.g. pA for Pa. Annotate with U. For more than one unit error in a question, underline with a wavy line to indicate an error which has not been penalised.
Arithmetic errors	Deduct one mark if the **only** error in arriving at a final answer is clearly an arithmetic one. Regard a power-of-ten error as an arithmetic error.
Transcription errors	Deduct one mark if the only error in arriving at a final answer is because previously calculated data has clearly been misread but used correctly.
Fractions	Allow these only where specified in the mark scheme.
Crossed out work	Work which has been crossed out **and not replaced but can easily be read**, should be marked as if it had not been crossed out.
Use of **NR**	Use this if the answer space for a question is completely blank or contains no readable words, figures or symbols.

Question	Answer	Marks
1(a)(i)1	(4800 / 120 =) 40 m / s	**B1**
1(a)(i)2	(*v* =) gradient of any part of straight line	**C1**
	Value between 50 and 60 m / s	**A1**
1(a)(ii)	At *t* = 20 s, acceleration > zero / acceleration is taking place / greater acceleration than at 100 s	**B1**
	At *t* = 100 s, acceleration = zero / 0	**B1**
1(b)(i)	(*F* =) *ma* OR $5.6 \times 10^5 \times 0.75$	**C1**
	4.2×10^5 N	**A1**
1(b)(ii)	Speed / velocity decreases (with time) OR slowing down OR negative acceleration OR Rate of decrease of speed / velocity	**B1**

Question	Answer	Marks
2(a)	$P \times 1.5$	**B1**
2(b)(i)	($W \times 1.0$ OR 210×1.0 =) 210 N m	**B1**
2(b)(ii)	$P \times 1.5 = 210$ OR $P = 210 / 1.5$	**C1**
	140 N	**A1**
2(b)(iii)	$P + Q = 210$ OR $140 + Q = 210$ OR $Q \times 1.5 = 210 \times 0.5$ OR $Q = 210 \times 0.5 / 1.5$ OR $P \times 0.5 = Q$	**C1**
	Q = 70 N	**A1**

Question	Answer	Marks
3(a)	Energy cannot be created or destroyed OR energy can only be transferred from one form to another OR total energy remains constant	**B1**
3(b)(i)	Chemical (energy) to kinetic (energy) AND / OR potential (energy)	**B1**
	Any **one** of: Kinetic (energy) to potential (energy) OR gravitational (energy) Potential (energy) OR gravitational (energy) to kinetic (energy) Kinetic (energy) to thermal (energy) OR heat (energy)	**B1**
3(b)(ii)1	(momentum =) mv OR 4.0×12	**C1**
	48 kg m / s or N s	**A1**
3(b)(ii)2	(average force =) momentum change / time OR $m(v – u) / t$ OR $(mv – mu) / t$ OR $F = ma$ AND $a = (v – u) / t$ OR 48 / 0.60	**C1**
	80 N	**A1**

Question	Answer	Marks
4(a)	mass = 0.25 (kg) OR $\rho = m / V$	**C1**
	volume = ($\pi \times 0.03^2 \times 0.1 = 2.8 \times 10^{-4}$ (m^3))	**C1**
	density = ($0.25 / 2.8 \times 10^{-4}$) = 890 kg / m^3	**A1**
	OR	
	mass = 250 (g) OR $\rho = m / V$	
	volume = ($\pi \times 3^2 \times 10$ =) 280 cm^3	
	density = (250 / 280 =) 0.89 g / cm^3	
	OR	
	$\rho = F / A = h\rho g$	
	$\rho = F / Ahg$ OR $2.5 / \pi \times 0.03^2 \times 0.1 \times 10$	
	= 890 kg / m^3	
4(b)(i)	manometer	**B1**
4(b)(ii)	(P =) hdg OR $0.02 \times 800 \times 10$	**C1**
	160 Pa	**A1**
4(b)(iii)	Value of h stays the same	**M1**
	Difference in height not dependent on cross-sectional area of tube OR Pressure of a liquid column depends only on values of h, d and g	**A1**

Question	Answer	Marks
5(a)(i)	2 different metals labelled	**B1**
	2 junctions between different metals	**B1**
	Correctly connected meter	**B1**
5(a)(ii)	Any **two** of: Suitable for high temp measurement OR has wide range Has low value of thermal capacity OR absorbs only a small quantity of thermal energy / heat Measures temperature at a point OR small size Responds quickly Can be used for remote sensing	**B2**
5(b)(i)	More sensitive	**B1**
	Thread moves <u>further</u> (for same expansion)	**B1**
5(b)(ii)	More sensitive	**B1**
	Greater expansion / more liquid (from bulb)	**B1**

Question	Answer	Marks
6(a)	Any **three** from: Temperature (of liquid / water) Surface area (of liquid / water) Draught / wind / movement of air (over surface) Temperature of surroundings Humidity (of surrounding air)	**B3**
6(b)	**Any two** from: More energetic / faster molecules escape Less energetic / slower molecules remain OR remaining water is colder Thermal energy / heat flows from body / skin to colder water (and person feels colder) OR (for one mark each) (Evaporation requires) latent heat of vaporisation Thermal energy / heat flows from body / skin	**B2**

Question	Answer	Marks
7(a)	Light of a single colour / wavelength / frequency	**B1**
7(b)(i)	Reflected wavefronts:	
	In air, at least 3 wavefronts parallel to each other.	**B1**
	Same spacing as incident wavefronts	**B1**
	Reflecting at same angle with surface as incident wavefronts	**B1**
7(b)(ii)	Refracted wavefronts:	
	In glass, at least 3 wavefronts parallel to each other AND continuous with incident wavefronts, unless drawn to right of incident wavefronts.	**B1**
	Smaller wavelength than incident wavefronts AND equally spaced.	**B1**
	At smaller angle with surface than incident wavefronts and rotated clockwise compared to incident wavefronts	**B1**
7(c)	Rope drawn with **two** of: Amplitude labelled Wavelength labelled Crest and trough labelled	**B2**

Question	Answer	Marks
8(a)	Particles / molecules / water / medium vibrate	**B1**
	Vibration is in the direction travel of the wave	**B1**
	Has compressions and rarefactions	**B1**
8(b)(i)	Value in range from 900 m / s to 2000 m / s	**B1**
8(b)(ii)	$v = f\lambda$ in any form OR (λ =) v / f OR answer to **(b)(i)** / 800	**C1**
	correct evaluation with unit (m)	**A1**

Question	Answer	Marks
9(a)	2 lamps with correct circuit symbol, in parallel, with correct connection to battery	**B1**
9(b)(i)	(12 / 6.0 =) 2.0 A	**B1**
9(b)(ii)	(P =) IV OR 2.0×12	**C1**
	OR (P =) I^2R OR $2.0^2 \times 6.0$	**(C1)**
	OR (P =) V^2 / R OR $12^2 / 6.0$	**(C1)**
	24 W	**A1**
9(c)	(E =) IVt OR Pt in any form OR 36×20	**C1**
	$= 36 \times 20 \times 60 \times 60$	**C1**
	$= 2.6 \times 10^6$ J	**A1**

Question	Answer	Marks
10(a)	(soft) iron	**B1**
10(b)(i)	Alternating / changing magnetic field in primary (coil)	**B1**
	Alternating / changing (magnetic) field in core (and in secondary coil) OR (magnetic) field lines / flux link secondary	**B1**
	e.m.f / voltage induced (in secondary coil)	**B1**
10(b)(ii)	$V_P / V_S = N_P / N_S$ in any form OR ($V_P =$) $V_S \times N_P / N_S$ OR $78 \times 560 / 910$	**C1**
	48 V	**A1**
10(c)	Lower current	**B1**
	(Power loss from cables =) I^2R so lower current means less power loss OR less heat loss	**B1**

Question	Answer	Marks
11(a)	$^{14}_{6}$C on left-hand side	**B1**
	$^{14}_{7}$ on right-hand side (ignoring letter after or before $^{14}_{7}$)	**B1**
	N after $^{14}_{7}$ on right-hand side	**B1**
	+ $^{0}_{-1}$e on right-hand side OR – $^{0}_{-1}$e on left-hand side	**B1**
11(b)	Not α because count-rate with paper increase	**B1**
	Not β because count-rate with aluminium increase	**B1**
	is γ because count rate reduces with lead only OR does not reduce with paper or aluminium	**B1**