



## Cambridge International AS & A Level

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**PHYSICS**

**9702/22**

Paper 2 AS Level Structured Questions

**May/June 2020**

**MARK SCHEME**

Maximum Mark: 60

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<p><b>Published</b></p>
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Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

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

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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This document consists of **14** printed pages.

**6** Calculation specific guidance

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** Guidance for chemical equations

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.

**Abbreviations**

/	Alternative and acceptable answers for the same marking point.
( )	Bracketed content indicates words which do not need to be explicitly seen to gain credit but which indicate the <b>context</b> for an answer. The context does not need to be seen but if a context is given that is incorrect then the mark should not be awarded.
—	Underlined content must be present in answer to award the mark. This means either the exact word or another word that has the same technical meaning.

**Mark categories**

<b>B</b> marks	These are <u>independent</u> marks, which do not depend on other marks. For a <b>B</b> mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer.
<b>M</b> marks	These are <u>method</u> marks upon which <b>A</b> marks later depend. For an <b>M</b> mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer. If a candidate is not awarded an <b>M</b> mark, then the later <b>A</b> mark cannot be awarded either.
<b>C</b> marks	These are <u>compensatory</u> marks which can be awarded even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known them. For example, if an equation carries a <b>C</b> mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the <b>C</b> mark is awarded. If a correct answer is given to a numerical question, all of the preceding <b>C</b> marks are awarded automatically. It is only necessary to consider each of the <b>C</b> marks in turn when the numerical answer is not correct.
<b>A</b> marks	These are <u>answer</u> marks. They may depend on an <b>M</b> mark or allow a <b>C</b> mark to be awarded by implication.

**Annotations**

<b>✓</b>	Indicates the point at which a mark has been awarded.
<b>X</b>	Indicates an incorrect answer or a point at which a decision is made not to award a mark.
<b>XP</b>	Indicates a physically incorrect equation ('incorrect physics'). No credit is given for substitution, or subsequent arithmetic, in a physically incorrect equation.
<b>ECF</b>	Indicates 'error carried forward'. Answers to later numerical questions can always be awarded up to full credit provided they are consistent with earlier incorrect answers. <u>Within</u> a section of a numerical question, ECF can be given after AE, TE and POT errors, but <b>not</b> after XP.
<b>AE</b>	Indicates an arithmetic error. Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
<b>POT</b>	Indicates a power of ten error. Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
<b>TE</b>	Indicates incorrect transcription of the correct data from the question, a graph, data sheet or a previous answer. For example, the value of $1.6 \times 10^{-19}$ has been written down as $6.1 \times 10^{-19}$ or $1.6 \times 10^{19}$ . Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
<b>SF</b>	Indicates that the correct answer is seen in the working but the final answer is incorrect as it is expressed to too few significant figures.
<b>BOD</b>	Indicates that a mark is awarded where the candidate provides an answer that is not totally satisfactory, but the examiner feels that sufficient work has been done ('benefit of doubt').
<b>CON</b>	Indicates that a response is contradictory.
<b>I</b>	Indicates parts of a response that have been seen but disregarded as irrelevant.
<b>M0</b>	Indicates where an A category mark has not been awarded due to the M category mark upon which it depends not having previously been awarded.

<b>^</b>	Indicates where more is needed for a mark to be awarded (what is written is not wrong, but not enough). May also be used to annotate a response space that has been left completely blank.
<b>SEEN</b>	Indicates that a page has been seen.

Question	Answer	Marks
1(a)	(velocity =) change in displacement / time (taken)	<b>B1</b>
1(b)	units of $F$ : $\text{kg m s}^{-2}$	<b>C1</b>
	units of $k$ : $\text{kg m s}^{-2} / [\text{m}^2 \times (\text{m s}^{-1})^2]$ $= \text{kg m}^{-3}$	<b>A1</b>
1(c)	$P = Fv$	<b>C1</b>
	$4.8 \times 10^4 = 0.24 \times 5.1 \times v^3$	<b>C1</b>
	$v = 34 \text{ m s}^{-1}$	<b>A1</b>

Question	Answer	Marks
2(a)(i)	$\text{area} = ut + \frac{1}{2}(v - u)t$ <b>or</b> $\text{area} = vt - \frac{1}{2}(v - u)t$ <b>or</b> $\text{area} = \frac{1}{2}(u + v)t$	<b>A1</b>
2(a)(ii)	displacement	<b>A1</b>
2(b)(i)	$u = 15 \sin 60^\circ (= 13 \text{ m s}^{-1})$	<b>C1</b>
	$t = 15 \sin 60^\circ / 9.81$	<b>C1</b>
	$= 1.3 \text{ s}$	<b>A1</b>
2(b)(ii)	the force in the horizontal direction is zero	<b>B1</b>
2(b)(iii)	(velocity =) $15 \cos 60^\circ = 7.5 \text{ (m s}^{-1}\text{)}$ <b>or</b> (velocity =) $15 \sin 30^\circ = 7.5 \text{ (m s}^{-1}\text{)}$	<b>A1</b>
2(c)(i)	$p = mv$ <b>or</b> $0.40 \times 7.5$ <b>or</b> $0.40 \times 4.3$	<b>C1</b>
	$\Delta p = 0.40 (7.5 + 4.3)$ $= 4.7 \text{ kg m s}^{-1}$	<b>A1</b>
2(c)(ii)	force = $4.7 / 0.12$ <b>or</b> $0.40 \times [(7.5 + 4.3) / 0.12]$ $= 39 \text{ N}$	<b>A1</b>

Question	Answer	Marks
3(a)	(work done =) force $\times$ displacement in direction of the force	<b>B1</b>
3(b)(i)	1. $(\Delta)E = mg(\Delta)h$	<b>C1</b>
	$= 0.42 \times 9.81 \times 78$ $= 320 \text{ J}$	<b>A1</b>
	2. $E = \frac{1}{2}mv^2$	<b>C1</b>
	$(\Delta)E = \frac{1}{2} \times 0.42 \times 23^2$ $= 110 \text{ J}$	<b>A1</b>
3(b)(ii)	work done = $320 - 110$ (= 210 N)	<b>C1</b>
	average resistive force = $210 / 78$ $= 2.7 \text{ N}$	<b>A1</b>
3(c)	downward sloping line from (0, $g$ ) to a non-zero value on the time axis	<b>M1</b>
	line is curved with a gradient that becomes less negative <b>and</b> the line meets $t$ -axis at time $t < T$	<b>A1</b>

Question	Answer	Marks
4(a)	progressive waves transfer energy <b>or</b> stationary waves do not transfer energy	<b>B1</b>
4(b)(i)	0.32 m	<b>A1</b>
4(b)(ii)	$v = \lambda / T$ <b>or</b> $v = f\lambda$ <b>and</b> $f = 1 / T$	<b>C1</b>
	$v = 0.32 / 0.020$ <b>or</b> $50 \times 0.32$  $= 16 \text{ m s}^{-1}$	<b>A1</b>
4(b)(iii)	450° <b>or</b> 90°	<b>A1</b>
4(b)(iv)	(P has) maximum downward displacement at 0.005 s	<b>B1</b>
	returns to original position/point (at 0.010 s)	<b>B1</b>
4(c)(i)	(position where) zero amplitude	<b>B1</b>
4(c)(ii)	2	<b>A1</b>
4(c)(iii)	180°	<b>A1</b>
4(c)(iv)	string drawn between X and Y with one antinode midway along the string	<b>B1</b>



Question	Answer	Marks
5(a)	Hooke's (law)	<b>B1</b>
5(b)(i)	$\sigma = F / A$	<b>C1</b>
	$= 36 / (4.1 \times 10^{-7})$	<b>A1</b>
	$= 8.8 \times 10^7 \text{ Pa}$	
5(b)(ii)	Young modulus = $\sigma / \epsilon$ <b>or</b> $F / A\epsilon$	<b>C1</b>
	$\epsilon = 8.8 \times 10^7 / (1.7 \times 10^{11})$	<b>A1</b>
	$= 5.2 \times 10^{-4}$	
5(c)	$R = \rho L / A$	<b>C1</b>
	$\Delta R = \rho \Delta x / A$	<b>C1</b>
	$= 3.7 \times 10^{-7} \times 0.12 \times 10^{-3} / (4.1 \times 10^{-7})$	
	$= 1.1 \times 10^{-4} \Omega$	<b>A1</b>
5(d)	remove the force/ $F$ and wire returns to original length	<b>B1</b>

Question	Answer	Marks
6(a)(i)	energy is dissipated in the internal resistance/ $r$	<b>B1</b>
6(a)(ii)	<b>1.</b> $I = Q/t$	<b>C1</b>
	$= 750 / 1500$	<b>A1</b>
	$= 0.50 \text{ A}$	
	<b>2.</b> $V = W/Q$ <b>or</b> $V = W/It$	<b>C1</b>
	$= 5700 / 750$ <b>or</b> $5700 / (0.50 \times 1500)$	<b>A1</b>
	$= 7.6 \text{ V}$	
	<b>or</b>	
	$V = P/I$ <b>and</b> $P = W/t$	<b>(C1)</b>
	$V = 3.8 / 0.50$	<b>(A1)</b>
	$= 7.6 \text{ V}$	
	<b>3.</b> $r = (7.8 - 7.6) / 0.50$	<b>C1</b>
	$= 0.40 \Omega$	<b>A1</b>
6(b)(i)	90 $\Omega$ and 45 $\Omega$ resistors shown connected in parallel	<b>B1</b>
6(b)(ii)	the resistors connected in parallel labelled as 90 $\Omega$ and 45 $\Omega$ with the other resistor labelled as 20 $\Omega$	<b>M1</b>
	$V_{\text{OUT}}$ or 3.6 V labelled across the 20 $\Omega$ resistor	<b>A1</b>

Question	Answer	Marks
7(a)(i)	P = 0 <b>and</b> Q = 39	<b>A1</b>
	R = (+)1 <b>and</b> S = 20	<b>A1</b>
7(a)(ii)	weak (nuclear force/interaction)	<b>B1</b>
7(b)	charge of quark(s) = (+) $2e/3$	<b>B1</b>
	up/u (quarks)	<b>B1</b>