Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/21**

Paper 2 AS Level Structured Questions **May/June 2020**

MARK SCHEME

Maximum Mark: 60

Published

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.

[Turn over

Annotations

✓	Indicates the point at which a mark has been awarded.
X	Indicates an incorrect answer or a point at which a decision is made not to award a mark.
XP	Indicates a physically incorrect equation ('incorrect physics'). No credit is given for substitution, or subsequent arithmetic, in a physically incorrect equation.
ECF	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. Within a section of a numerical question, ECF can be given after AE, TE and POT errors, but **not** after XP.
AE	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.
POT	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.
TE	Indicates incorrect transcription of the correct data from the question, a graph, data sheet or a previous answer. For example, the value of 1.6×10^{-19} has been written down as 6.1×10^{-19} or 1.6×10^{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.
SF	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.
BOD	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').
CON	Indicates that a response is contradictory.
I	Indicates parts of a response that have been seen but disregarded as irrelevant.
M0	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.

^	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.
SEEN	Indicates that a page has been seen.

Question	Answer	Marks
1(a)	(work =) force × displacement	**C1**
	units: kg m s^{-2} × m = kg m^2 s^{-2}	**A1**
1(b)(i)	units of *Q*: As	**C1**
	units of *C*: kg^{-1} m^{-2} A^2 s^4	**A1**
1(b)(ii)	**1.** e.g. reading scale from different angles (wrongly) interpolating between scale readings/divisions	**B1**
	2. e.g. zero error wrongly calibrated scale	**B1**

Question	Answer	Marks
2(a)	(resultant) force proportional to rate of change of momentum	**B1**
2(b)(i)	arrow drawn vertically downwards from point X	**B1**
2(b)(ii)	$s = ut + \frac{1}{2}at^2$ $h = \frac{1}{2} \times 9.81 \times 0.81^2$	**C1**
	$= 3.2$ m	**A1**
2(b)(iii)	$d = 5.4 \times 0.81$ $= 4.4$ m	**A1**
2(c)(i)	downward pointing arrow labelled weight	**B1**
	upward pointing arrow labelled air resistance	**B1**
2(c)(ii)	air resistance increases	**B1**
	weight constant **or** resultant force decreases	**B1**
	(so) acceleration decreases	**B1**
2(c)(iii)	gravitational potential energy to thermal/internal energy	**B1**

Question	Answer	Marks
3(a)	resultant force (in any direction) is zero	**B1**
	resultant torque/moment (about any point) is zero	**B1**
3(b)(i)	**1.** $T \sin 53° = 2.4$ $T = 3.0$ N	**A1**
	2. $F = T \cos 53°$ **or** $F^2 = T^2 - 2.4^2$ $F = 1.8$ N	**A1**
3(b)(ii)	$\sigma = T / A$ **or** $\sigma = F / A$	**C1**
	$A = \pi d^2 / 4$ **or** $A = \pi r^2$	**C1**
	$\sigma = 3.0 \times 4 / [\pi \times (0.50 \times 10^{-3})^2]$ $= 1.5 \times 10^7$ Pa	**A1**
3(c)(i)	$h = 75 - 75 \sin 53° = 15$ cm	**A1**
3(c)(ii)	$(\Delta)E = mg(\Delta)h$ **or** $(\Delta)E = W(\Delta)h$	**C1**
	$(\Delta)E = 2.4 \times 15 \times 10^{-2}$ $= 0.36$ J	**A1**
3(c)(iii)	$E = ½mv^2$	**B1**
	$0.36 = ½ \times (2.4 / 9.81) \times v^2$	**C1**
	$v = 1.7$ m s^{-1}	**A1**

Question	Answer	Marks
4(a)(i)	vibrations (of particles) are parallel to direction of energy propagation	**B1**
4(a)(ii)	waves meet/overlap (at a point)	**B1**
	(resultant) displacement is sum of individual displacements	**B1**
4(b)(i)	$\lambda = ax / D$	**C1**
	$= (3.7 \times 10^{-4} \times 4.3 \times 10^{-3}) / 2.3$	**C1**
	$= 6.9 \times 10^{-7}$ (m) = 690 nm	**A1**
4(b)(ii)	• no change to fringe separation/fringe width/number of fringes • bright fringes are darker • dark fringes are brighter *Any two marking points, 1 mark each*	**B2**

Question	Answer	Marks
5(a)(i)	$R = \rho L / A$	C1
	$A = (2.6 \times 10^{-8} \times 59) / 3.4 = 4.5 \times 10^{-7}$ m^2	A1
5(a)(ii)	I = 1.8 / 3.4 = 0.53 A	A1
5(a)(iii)	$I = Anvq$ v = 0.53 / $(4.5 \times 10^{-7} \times 6.1 \times 10^{28} \times 1.60 \times 10^{-19})$	C1
	= 1.2×10^{-4} m s^{-1}	A1
5(b)(i)	(cross-sectional) area/A is less	M1
	(I, n, e the same so) average drift speed is greater	A1
5(b)(ii)	(area is less so) more resistance/R	M1
	(I is the same, so) more power/P	A1
	or	
	($P = I^2\rho L / A$ so) $P \propto 1 / A$	(M1)
	(A is less so) more P	(A1)
5(c)(i)	180 Ω and 90 Ω resistors shown connected in parallel	B1
5(c)(ii)	resistors connected in parallel labelled as 180 Ω and 90 Ω **and** the other resistor labelled as 30 Ω	M1
	V_{OUT} or 8.0 V labelled across the two resistors in parallel	A1

Question	Answer	Marks
6(a)(i)	$E = \Delta V / \Delta d$	C1
	$E = (180 + 120) / (2.0 \times 10^{-2})$ $= 1.5 \times 10^{4}$ N C^{-1}	A1
6(a)(ii)	vertically downwards	B1
6(b)(i)	number of protons = 92	A1
	number of neutrons = 146	A1
	number of electrons = 90	A1
6(b)(ii)	$F = EQ$	C1
	$= 1.5 \times 10^{4} \times 2 \times 1.60 \times 10^{-19}$ $= 4.8 \times 10^{-15}$ N	A1
6(b)(iii)	number of α-particles = 2	A1
	number of β^- particles = 2	A1