OCR

Oxford Cambridge and RSA

GCE

Physics B (Advancing Physics)

H157/01: Foundations of physics

Advanced Subsidiary GCE

2021 Mark Scheme

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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1.   Annotations

Annotation	Meaning
BOD	Benefit of doubt given
CON	Contradiction
✖	Incorrect response
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
TE	Transcription error
NBOD	Benefit of doubt not given
POT	Power of 10 error
^	Omission mark
SF	Error in number of significant figures
✔	Correct response
?	Wrong physics or equation

2.   Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
reject	Answers which are not worthy of credit
not	Answers which are not worthy of credit
Ignore	Statements which are irrelevant
Allow	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Section A: MCQs

Question			Answer	Marks	Guidance
1			A	1	
2			D	1	
3			A	1	
4			B	1	
5			D	1	
6			D	1	
7			B	1	
8			C	1	
9			A	1	
10			C	1	
11			D	1	
12			D	1	
13			D	1	
14			B	1	
15			C	1	
16			B	1	
17			C	1	
18			A	1	
19			A	1	
20			B	1	
			Total	**20**	

SECTION B

Question			Expected Answer	Mark	Rationale/Additional Guidance
21	a		0.1 nm	1	**ALLOW** 0.05 to 0.2 **REJECT** anything with >= 2sf
	b		0.0021 kg	1	**ALLOW** conversion of 2.0×10^{26} kg to g
			$\div 2.0 \times 10^{-26}$ to get $\sim 1.1 \times 10^{23}$ atoms	1	
	c		Linear distance $\sqrt[3]{1.1 \times 10^{23}}$ ($\sim 4.5 \times 10^{7}$ atom lengths)	1	Look for: cube root and 1/ operations
			1 cm / linear distance = atom linear size (~ 0.2nm)	1	
			Total	**5**	

Question			Expected Answer	Mark	Rationale/Additional Guidance
22	a		coherence/coherent	1	
	b		d = 1 / 250		
			$= 4.0 \times 10^{-3}$ mm	1	correct answer only
	c		650 nm $= 5 \times 10^{-6} \times \sin\theta$	1	
			$\sin\theta = 0.13$	1	
			$\theta = 0.13 \times 180 \div \pi$ *or* calculator to get 7. 5°	1	
			Total	**5**	

Question			Expected Answer	Mark	Rationale/Additional Guidance
23	a		$p = h \div \lambda$ $= 6.63 \times 10^{-34} \div 5.6 \times 10^{-7}$ $= 1.184 \times 10^{-27}$ $\sim 1.2 \times 10^{-27}$ Ns	1 1	
	b		$-2p$	1	**ALLOW** -2.4×10^{-27} Ns **ALLOW** left / away from sail **ALLOW** positive value
	c		 Momentum is conserved so sail must have opposite change in momentum / momentum change $= +2p$ Force is change of momentum in unit/given time	1 1	**ALLOW** • sail applies force to photon (to reflect it) • so Newton 3 says force on sail
			Total	**5**	

Question			Expected Answer	Mark	Rationale/Additional Guidance
24	a		Add lens power $= 1.6$ m^{-1}	1 1	**ALLOW** correct use of lens formula
	b		Move it to the left / closer to the lens	1	
	c		Smaller brighter	1 1	
			Total	**5**	
			Total Section B	**20**	

SECTION C

Question			Expected Answer	Mark	Rationale/Additional Guidance
25	a		Elastic / obey Hooke's law	1	State property **ALLOW** strong, tough, ductile **REJECT** malleable
			(So that) returns to shape, won't break, won't crack	1	Explain
	b		Reduce parallax error / read scale accurately	1	
	c		Data in table: | 100	17.2	**2.8**
150	15.8	**4.2**
200	14.4	**5.6**		1	correct answer only
	d		Any mass ÷ compression *e.g.* 0.1 ÷ 2.8 = 0.3571…	1	
			Use of 9.81 *e.g.* = 0.3504 …	1	
			Correct unit *e.g.* 0.35(04) N/cm or 35 N/m	1	**ALLOW** >2sf
	e		Less compression (for the same force)	1	
			Because load is spread between more springs	1	**ALLOW** spring constant of the system increases when number of springs increases
			Total	9	

Question			Expected Answer	Mark	Rationale/Additional Guidance
26	a		66 cm	1	
	b		(22 fps =>) = 1.0 ÷ 22 s per frame	1	
			= 0.0454545 … s	1	
			(= 0.045s 2sf)		
	c		s = d ÷ t		
			= 12 /÷ 0.045	1	**ALLOW** x 22 fps
			= 264 cm.s^{-1}	1	**ALLOW** 2.64 m s^{-1} **ALLOW** 220 + 44 cm s^{-1}
	d		a = Δv ÷ Δt		
			Evidence of Δv = 44 cm.s^{-1} between frames	1	
			= 44 ÷ 0.045	1	
			= 9.68 m s^{-2}	1	
	e		ANY 1 FROM: • lighter ball • taller drop • use more fps • improved lighting / contrast background	1	**ALLOW** answers that improve precision as defined in 'Language of measurement' i.e. If more precise, repeating the experiment will give results that are closer together **ALLOW** suggestion to improve the picture quality
			Total	9	

Question			Expected Answer	Mark	Rationale/Additional Guidance
27	a		Energy (provided by the cell)	1	**ALLOW** Work done by cell
			Per unit charge (passing through)	1	
	b		$V = E - Ir$		
			$0.799 = 0.825 - 7.04 \times 10^{-6} \times r$	1	
			$r = (0.825 - 0.799) \div 7.04 \times 10^{-6}$	1	
			$= 3690\ \Omega$	1	
	ci		Treated as anomalies because:	1	
			do not fit the (rest of the) pattern		
			not on the line (which is predicted by established theory)		
			if the student knows of conditions that changed during the experiment that make these points invalid		
	cii		Not treated as anomalies because:	1	
			are in a clear pattern (despite not on a line)		
			show a trend (increasing negative gradient despite not on a line)		
			can't be excluded without knowing more about experimental conditions		
	d i		0.82 V	1	**ALLOW** 3sf **ALLOW** 0.81-0.83

d ii		gradient calculation = in range 2800 – 3300 Ω	1 1		

e		**ANY answer/reason PAIR FROM**:
		
		   • That value was only calculated with one point
		
		   • Using the graph gradient gives a better, 'averaged' result / reduces effect of random error
		
		OR
		
		   • The graph has a curve to it / systematic effect
		
		   • The line averages-out this effect / a single point is affected by this vs the line (allow better or worse)
		
		OR
		
		   • (worse because) The gradient is too shallow
		
		   • Because I excluded the final points
			2	**ALLOW**
				   • internal resistance probably not constant
				   • so graph probably represents a more realistic value for the p.d.s /currents generated	

		Total **Total Section C** **Total Sections B & C**	12 30 50		