

GCE

Physics B (Advancing Physics)

H157/01: Foundations of physics

Advanced Subsidiary GCE

2021 Mark Scheme (DRAFT)

This is a DRAFT mark scheme. It has not been used for marking as this paper did not receive any entries in the series it was scheduled for. It is therefore possible that not all valid approaches to a question may be captured in this version. You should give credit to such responses when marking learner's work.

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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
	Benefit of doubt given
	Contradiction
	Incorrect response
	Error carried forward
	Level 1
	Level 2
	Level 3
	Transcription error
	Benefit of doubt not given
	Power of 10 error
	Omission mark
	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 ≥ 2 sf
	b		0.0021 kg $\div 2.0 \times 10^{-26}$ to get $\sim 1.1 \times 10^{23}$ atoms	1 1	ALLOW conversion of 2.0×10^{26} kg to g
	c		Linear distance $\sqrt[3]{1.1 \times 10^{23}}$ ($\sim 4.5 \times 10^7$ atom lengths) 1 cm / linear distance = atom linear size (~ 0.2 nm)	1 1	Look for: cube root and 1/ operations
			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		$650 \text{ nm} = 5 \times 10^{-6} \times \sin\theta$ $\sin\theta = 0.13$ $\theta = 0.13 \times 180 \div \pi$ or calculator to get 7.5°	1 1 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	
			$= 1.184 \times 10^{-27}$	1	
			$\sim 1.2 \times 10^{-27} \text{ Ns}$		
	b		-2p	1	ALLOW $-2.4 \times 10^{-27} \text{ Ns}$ ALLOW left / away from sail ALLOW positive value
	c		Momentum is conserved so sail must have opposite change in momentum / momentum change = +2p	1	ALLOW - sail applies force to photon (to reflect it) - so Newton 3 says force on sail
			Force is change of momentum in unit/given time	1	
			Total	5	

Question			Expected Answer	Mark	Rationale/Additional Guidance
24	a		Add lens power	1	ALLOW correct use of lens formula
			$= 1.6 \text{ m}^{-1}$	1	
	b		Move it to the left / closer to the lens	1	
	c		Smaller	1	
			brighter	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:	1	correct answer only								
		<table><tr><td>100</td><td>17.2</td><td>2.8</td></tr><tr><td>150</td><td>15.8</td><td>4.2</td></tr><tr><td>200</td><td>14.4</td><td>5.6</td></tr></table>	100			17.2	2.8	150	15.8	4.2	200	14.4	5.6
100		17.2	2.8										
150		15.8	4.2										
200	14.4	5.6											
	d		Any mass ÷ compression e.g. 0.1 ÷ 2.8 = 0.3571...	1	ALLOW >2sf								
			Use of 9.81 e.g. = 0.3504 ...	1									
			Correct unit e.g. 0.35(04) N/cm or 35 N/m	1									
	e		Less compression (for the same force)	1	ALLOW spring constant of the system increases when number of springs increases								
			Because load is spread between more springs	1									
			Total	9									

Question		Expected Answer	Mark	Rationale/Additional Guidance
26	a	66 cm	1	
	b	$(22 \text{ fps} \Rightarrow) = 1.0 \div 22 \text{ s per frame}$ $= 0.0454545 \dots \text{ s}$ $(= 0.045 \text{ s } 2\text{sf})$	1 1	
	c	$s = d \div t$ $= 12 \div 0.045$ $= 264 \text{ cm.s}^{-1}$	1 1	ALLOW $\times 22 \text{ fps}$ ALLOW 2.64 m s^{-1} ALLOW $220 + 44 \text{ cm s}^{-1}$
	d	$a = \Delta v \div \Delta t$ Evidence of $\Delta v = 44 \text{ cm.s}^{-1}$ between frames $= 44 \div 0.045$ $= 9.68 \text{ m s}^{-2}$	1 1 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	

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