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PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **February/March 2025**

MARK SCHEME

Maximum Mark: 60

Published

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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
^	information missing or insufficient for credit
AE	arithmetic error
BOD	benefit of the doubt given
CON	contradiction in response, mark not awarded
✖	incorrect point or mark not awarded
ECF	error carried forward applied
I	ignore the response

Annotation	Meaning
MO	mandatory mark not awarded
POT	power of ten error
SEEN	blank page seen
SF	error in number of significant figures
TE	transcription error
✔	correct point or mark awarded
XP	incorrect physics

Question	Answer	Marks
1(a)	how close the (measured) value is to the true value (of the quantity)	**A1**
1(b)(i)	(ρ =) m / V	**C1**
	= $31.3 \times 10^{-3} / (1.53 \times 10^{-2})^3 = 8.7 \times 10^3$ (kg m^{-3})	**A1**
1(b)(ii)	(0.5 / 31.3) or (0.01 / 1.53) % uncertainty = $(0.016 \times 100) + 3 \times (0.0065 \times 100)$	**C1**
	= 4%	**A1**
1(b)(iii)	The ranges (of the densities of A and B) overlap **or** the (calculated) density of A is within the range of the density of B **or** the difference in densities is within the uncertainty (of B)	**M1**
	(so) they could be the same	**A1**

Question	Answer	Marks
2(a)	in (rotational) equilibrium	**B1**
	sum / total of CW moments about a point = sum / total of ACW moments about the (same) point.	**B1**
2(b)(i)	The magnitudes of the moments about A are: (1700×3.0) $(660\ x)$ (1300×5) Correct magnitude of any one moment about A.	**C1**
	Correct magnitudes of a second moment about A.	**C1**
	$(1700 \times 3.0) + (660\ x) = (1300 \times 5)$ x = 2.1 m	**A1**

Question	Answer	Marks
2(b)(ii)	(Upthrust =) $11 \times 9.81 + 1300 = 1400$ (N)	**A1**
2(b)(iii)	y = Upthrust / ρgA $= 1400 / (990 \times 9.81 \times \pi \times (0.78 / 2)^2)$	**C1**
	$= 0.30$ m	**A1**
	OR [$P = F / A = 1400 / \pi \times (0.78 / 2)^2 = 2930$] $y = P / \rho g$ $= 2930 / (990 \times 9.81)$	**(C1)**
	$= 0.30$ m	**(A1)**
2(b)(iv)	line with a non-zero value of depth at distance = 0	**B1**
	A line from distance = 0 to distance = 6.0 m with a gradient that is always positive	**B1**

Question	Answer	Marks
3(a)(i)	$a = (v^2 - u^2) / 2s$ $= (22^2 - 13^2) / (2 \times 180)$	**C1**
	$= 0.88\ \text{m s}^{-2}$	**A1**
	OR [$t = (180 \times 2) / (22 + 13) = 10.3$] $180 = 13 \times 10.3 + ½\ a \times 10.3^2$ or $180 = 22 \times 10.3 - ½\ a \times 10.3^2$ or $22 = 13 + a \times 10.3$	**(C1)**
	$a = 0.88\ \text{m s}^{-2}$	**(A1)**
3(a)(ii)	$(\Delta)E = ½m(\Delta)v^2$	**C1**
	gain in KE $= ½m(v^2 - u^2)$ $= ½ \times 9400 \times (22^2 - 13^2)$	**C1**
	$= 1.5 \times 10^6\ \text{J}$	**A1**
	OR $W = Fs$ $= ma \times d$	**(C1)**
	gain in KE $= 9400 \times 0.88 \times 180$	**(C1)**
	$= 1.5 \times 10^6\ \text{J}$	**(A1)**
3(b)(i)	rate of change of momentum	**B1**
3(b)(ii)	(Force =) $(2.5 \times 10^4 - 21 \times 10^4) / 15 = -1.2 \times 10^4$ (N)	**A1**

Question	Answer	Marks
3(b)(iii)	The change of momentum (for S and R to come to rest) is the same	**B1**
	(Average) force on R (to come to rest) is ($-21 \times 10^4 / 23 =$) 0.91×10^4 N **or** (Average) force on R (to come to rest) is less than the force on S / less than *F*	**B1**
	(S will come to rest in) less time (than R).	**B1**
	OR The change of momentum (for S and R to come to rest) is the same	**(B1)**
	Time for S to come to rest is ($-21 \times 10^4 / 1.2 \times 10^4 =$) 17.5 s (and time for R to come to rest is 23 s)	**(B1)**
	(S comes to rest in) less time (than R).	**(B1)**

Question	Answer	Marks
4(a)	(micro)wave (from the transmitter) reflects (at metal/sheet)	**B1**
	The incident and reflected waves superpose	**B1**
	(resultant) amplitude is maximum at an antinode	**B1**
	(resultant) amplitude is minimum/zero at a node	**B1**
4(b)(i)	$\lambda = c / f$ $= 3 \times 10^8 / 6.3 \times 10^9$	**C1**
	= 0.048 m	**A1**
4(b)(ii)	distance PQ = ¼λ = 0.048 / 4 = 0.012 m	**A1**

Question	Answer	Marks
4(b)(iii)	(Distance QR is the) same (as PQ) and one of: • Distance (between maxima / minima) does not depend on intensity • distance depends only on wavelength • wavelength is unchanged / constant	**B1**

Question	Answer	Marks
5(a)	$T = 5.8 \times 5.0 \times 10^{-4}$ $= 2.9 \times 10^{-3}$	**C1**
	$\lambda = vT$ or $v = f\lambda$ and $f = 1 / T$	**C1**
	$\lambda = 330 \times 2.9 \times 10^{-3}$ or $\lambda = 330 / 345$ $= 0.96$ m	**A1**
5(b)	(loudspeaker) moves away (from the microphone)	**B1**
	at an increasing speed / whilst accelerating	**B1**

Question	Answer	Marks
6(a)	$V = IR$ $= 0.85 \times 3.3 \times 10^{-3}$	**C1**
	$= 2.8 \times 10^{-3}$ V	**A1**
6(b)(i)	$(A =) \rho L / R$	**C1**
	$= 1.8 \times 10^{-8} \times 0.24 / 3.3 \times 10^{-3} = 1.3 \times 10^{-6}$ (m^2)	**A1**
6(b)(ii)	$(n =) 2.6 \times 10^{22} / (1.3 \times 10^{-6} \times 0.24) = 8.3 \times 10^{28}$ (m^{-3})	**A1**

Question	Answer	Marks
6(b)(iii)	$v = I / nAq$ $= 0.85 / (8.3 \times 10^{28} \times 1.3 \times 10^{-6} \times 1.6 \times 10^{-19})$	**C1**
	$= 4.9 \times 10^{-5}$ m s^{-1}	**A1**
	OR $v = IL / Nq$ $= 0.85 \times 0.24 / (2.6 \times 10^{22} \times 1.6 \times 10^{-19})$	**(C1)**
	$= 4.9 \times 10^{-5}$ m s^{-1}	**(A1)**
6(c)(i)	Length (of Q) is greater (than P)	**B1**
	(Average cross-sectional) area (of Q) is less (than P)	**B1**
	Resistance is proportional to length / (cross-sectional) area	**M1**
	(so) the resistance (of Q) is greater (than P)	**A1**
6(c)(ii)	A line starting from a non-zero value of drift speed at distance = 0	**B1**
	A line with an increasing positive gradient	**B1**

Question	Answer	Marks
7(a)	nucleon number of Q = 226 <u>and</u> proton number of R = 86	**B1**
7(b)	$4(u) \times 1.5 \times 10^{7}$ or $222(u) \times v$	**C1**
	$v = 4(u) \times 1.5 \times 10^{7} / 222(u)$	**C1**
	$= 2.7 \times 10^{5}$ m s^{-1}	**A1**

Question	Answer	Marks
7(c)	Any three from: • momentum • charge • nucleon number • neutron number • proton number	**B3**