PEARSON EDEXCEL A-LEVEL PHYSICS · 9PH0

PHYSICS



MARK SCHEME

TOPIC 2: MECHANICS

MOMENTS

SCORE	PERCENTAGE
/85	%

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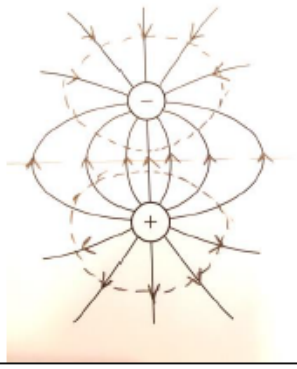
Mark Scheme

Q1.

Question Number	Answer	Mark
*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) **Either** Initial momentum is zero Nucleus and alpha particle have equal momentum (1) (accept $m_n u_n = m_\alpha u_\alpha$ or $p_n = p_\alpha$) alpha particle and (1) nucleus move in opposite directions Mass of alpha (1) particle < mass of nucleus (therefore $v_n < v_\alpha$) (1) **Or** The nucleus and alpha particle exert an equal but opposite force on (1) each other. (1) Mass of alpha particle < mass of nucleus (1) Acceleration of nucleus < acceleration of alpha particle Force/acceleration acts for same time so Δv for nucleus is smaller for (1) nucleus	**4**
	Total for question	**4**

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(a)	• Replace Work W by force × distance (1) • Replace distance ÷ time by velocity v (1) • Use $v = r \times$ Angular velocity (1) • Recognise $F \times r$ is the moment of F (1)	Alternative method: Consider one revolution of axle , Load rises $2\pi r$ Work done = $2\pi rF$ Time taken = $2\pi \div \omega$ Power = Work ÷ time= $2\pi rF \div 2\pi/\omega$ to give reqd eq	**4**

Question Number	Acceptable answers	Additional guidance	Mark
(b)(i)	• Arrow away from + charge **Or** arrow towards − charge (1) • At least 3 Equipotential lines, perpendicular to field lines (1) • Symmetrical about vertical/horizontal axis **and** not touching/crossing (1)	MP3 dependent on lines being perpendicular in MP2 	**3**

Question Number	Acceptable answers	Additional guidance	Mark
(b)(ii)	• Use of $F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2}$ **(1)** • $F = 0.036$ (N) **(1)**	Example of calculation: $F = 8.99\times10^{9}\,\text{Nm}^2\text{C}^{-2}\,\frac{(0.1\times10^{-6}\text{C})^2}{(0.05\text{m})^2}$ $F = 0.036\text{N}$	**2**

Question Number	Acceptable answers	Additional guidance	Mark
(c)	• Use of moment = $F\,x$ **(1)** • Expression for correct moment **(1)** • Use of power = moment of force x angular velocity **(1)** • Only realistic possibility is pond pump and $P = 0.6$W (calculated answer could also be force and then comparison with b(i)) **(1)**	Show that value gives 3.2×10^{-3} Nm and 0.64 W Example of calculation: Moment $= 0.036\text{N}\times0.04\text{m}\times2 = 2.89\times10^{-3}\,\text{Nm}$ Power $= 2.89\times10^{-3}\,\text{N m}\times200\text{s}^{-1} = 0.58\text{W}$	**4**

Q3.

Question number	Acceptable answers	Additional guidance	Mark
	• Recognises that weight acts at midpoint of diving board 1.8 (m) from X **(1)** • Use of moment = perpendicular force x distance **(1)** • Total clockwise moment = 3150 Nm **(1)** • Recognises that clockwise moment = anticlockwise moment **(1)** • F=3500 N **(1)**	Example of calculation: Total clockwise moment = (680x3.6)+(390x1.8) = 3150 Nm F = 3150/0.9 = 3500 N	**5**

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
	• take one moment around P	(1)	either person or paving slab	
	• Use of $W = mg$	(1)		
	• Use of weight/mass of paving slab at centre point	(1)	e.g. distance to P = 30 cm	
	• It would tip because the moment of the weight of person is 103 N m / 10300 N cm and is larger than the moment of the weight of slab 93 N m / 9300 N cm	(1)	Example of calculation: Moment of weight of person = 70 kg×9.81 N kg^{-1}×0.15 m = 103 N m Moment of weight of paving slab = 310 N ×0.30 m = 93 N m	4

Q5.

Question Number	Acceptable answers		Additional guidance	Mark
	• Take a correct moment about pivot P	(1)	eg T.6.cos20 or sin70 If cos20's are absent from both sides of equation then can still credit 4 marks Example of Calculation: $T \times 6(\text{m}) \times \cos 20 = 3.05 \times 10^{4}(\text{kg}) \times 9.81(\text{ms}^{-2}) \times 0.5(\text{m}) \times \cos 20$ $T = 24.9\text{kN}$	4
	• Converts the mass to weight of beam ie ×9.81 seen	(1)		
	• Appreciates centre of mass 0.5 m from P	(1)		
	• $T = 25$ kN	(1)		

Q6.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	An explanation that makes reference to the following points: • Fleming left hand rule force will cause force on left hand side of coil into page **Or** right hand side of coil out of page **(1)** • The coil will turn clockwise as shown in the plan view (MP2 dependent on MP1) **(1)**	allow 1 mark for statement "rotates clockwise because of FLHR"	**2**
(ii)	• Moment of F around pivot = $F \times w/2$ **(1)** • Use of $F = BIl$ **(1)** • Moment due to F on both sides = $2 \times BIl \times w/2$ **(1)** • As N turns and $l \times w = A$; Total moment = $BAIN$ **(1)**	alt: Use of Torque of a couple = $F \times w$ then MP1 and 3 This equation should be substituted into a product with a "distance" to be awarded 'use of'	**4**

Q7.

Question Number	Acceptable answers	Additional guidance	Mark
	B		**1**

Q8.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)(i)	• no net force on bridge (1) • no net moment of force about any point (1)	Alternative wording that implies these 2 points will be accepted	**(2)**
(a)(ii)	• use of $W = mg$ to find the weight of the bridge (1) • use of moment = $F x$ (1) • applies principle of moments (1) • F_A = 43610 N (1) • applies equilibrium of forces or applies principle of moments about a different point to obtain F_B = 45990 N (1)	<u>Example of calculation:</u> W = mg = 8500 kg × 9.8 N kg^{-1}= 83300 N Taking moments about A, Clockwise moments = (1500 N × 4 m) + (4800 N × 6.5 m) + (83300 N × 9.5 m) Anticlockwise moments = F_A × 19 m 19 N × F_A = 828550 Nm F_A = 828550 Nm/19 m = 43610 N $F_A + F_B$ = 1500 N + 4800 N + 83300 N F_B = 89600 N – 43610 N = 45990 N	**(5)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)(i)	• resonance occurs when the bridge is forced into oscillation at its natural frequency (1) • this results in an increasing amplitude of oscillation of the bridge, which may damage the bridge (1)		**(2)**
(b)(ii)	• energy was transferred from the oscillating bridge to the dampers (1) • this energy was dissipated in the dampers (and not returned to the bridge) (1) • hence the <u>amplitude</u> of oscillation was kept small (1)		**(3)**

(b)(iii)	• as the viscosity of the fluid increased the fluid would offer greater resistance to movement [accept reverse argument] (1) • a greater resistance to movement would result in a greater energy dissipation (1)			**(2)**

Mark Scheme

Q1.

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Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• the point through which the weight (of a body) acts **(1)** **Or** The point around which the mass is equally distributed **Or** if supported at/below this point the body would be in equilibrium	alt. the point at which the entire mass can be assumed to be located.	**1**

Q3.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	• use of $T = \frac{2\pi}{w}$ (1) • 1.7×10^{-3} rad s^{-1} or $\frac{\pi}{1800}$ rad s^{-1} (1)	Example of calculation: $w = \frac{2\pi}{(60 \times 60)\ s}$	**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)	• recognises weight acts halfway along hand (1) • uses correct angle between the two positions (1) • determines change in vertical height (= 0.008 m) (1) • use of $\Delta E = mg\Delta h$ (1) • work done = 1.1 (mJ) (1)	Example of calculation: $W = 0.014\ \text{kg} \times 9.81\ \text{N kg}^{-1} \times (2 \times 0.04 \sin 6^\circ\ \text{m})$ $W = 1.1 \times 10^{-3}\ \text{J}$	**(5)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)	• use of $P = VI$ (1) • use of $P = \frac{W}{t}$ AND 65% (1) • t = 141 s (1)	Example of calculation: $P = 1.5\ \text{V} \times 8.0 \times 10^{-6}\ \text{A} = 1.2 \times 10^{-5}\ \text{W}$ $t = \frac{1.1 \times 10^{-3}\ \text{J}}{0.65 \times 1.2 \times 10^{-5}\ \text{W}} = 141\ \text{s}$	**(3)**

Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	• Take a correct moment about pivot P (1) • Converts the mass to weight of beam ie ×9.81 seen (1) • Appreciates centre of mass 0.5 m from P (1) • $T = 25$ kN (1)	eg T.6.cos20 or sin70 If cos20's are absent from both sides of equation then can still credit 4 marks Example of Calculation: $T \times 6(\text{m}) \times \cos 20 = 3.05 \times 10^{4}(\text{kg}) \times 9.81(\text{ms}^{-2}) \times 0.5(\text{m}) \times \cos 20$ $T = 24.9\text{kN}$	4

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	• this results in an increasing amplitude of oscillation of the bridge, which may damage the bridge	(1)		
(b)(ii)	• energy was transferred from the oscillating bridge to the dampers	(1)		**(3)**
	• this energy was dissipated in the dampers (and not returned to the bridge)	(1)		
	• hence the <u>amplitude</u> of oscillation was kept small	(1)		
(b)(iii)	• as the viscosity of the fluid increased the fluid would offer greater resistance to movement [accept reverse argument]	(1)		**(2)**
	• a greater resistance to movement would result in a greater energy dissipation	(1)		