Moments

Mark Scheme 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Forces, Density & Pressure
Sub Topic	Moments
Paper Type	Theory
Booklet	Mark Scheme 2

Time Allowed: **53 minutes**

Score: **/44**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1	**(a)**	**(i)**	distance = $2\pi nr$	B1	
		(ii)	work done = F x 2 πnr *(accept e.c.f.)*	B1	**[2]**
	(b)		total work done = 2 x F x $2\pi nr$	B1	
			but torque $T = 2Fr$	B1	
			hence work done = T x $2\pi n$	A0	**[2]**
	(c)		power = work done/time (= 470 x 2π x 2400)/60)		
			= 1.2×10^5 W	A1	**[2]**
			Total		**[6]**

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2	**(a)**		force x perpendicular distance ..... M1 (of the force) from the pivot A1	[2]
	(b)		no resultant force (in any direction) ..... B1 no resultant moment (about any point) B1	[2]
	(c)	**(i)**	correct direction in both B1	[1]
		(ii)	moment = 150 x 0.3 = 45 N m (1 sig. fig. -1) A1	
		(ii)	torque = 45 N m i.e. same is (i) A1	
		(ii)	45 = 0.12 x T ..... C1 T = 375 N A1	[4]

3	**(a**		the point where (all) the weight (of the body) is considered / seems to act	M1 A1	[2]
	(b)	**(i)**	vertical component of T (= 30 cos 40°) = 23 N	A	[1]
		(ii)	the <u>sum</u> of the clockwise moments about a <u>point</u> equals the <u>sum</u> of the anticlockwise moments (about the same point)	B1	[1]
		(iii)	(moments about A): 23 × 1.2 (27.58) = 8.5 × 0.60 + 1.2 × W working to show W = 19 or answer of 18.73 (N)	M1 M1 A1	[3]
		(iv)	(M = W / g = 18.73 / 9.81 =) 1.9(09) kg	A1	[1]
	(c)		(for equilibrium) resultant force (and moment) = 0 upward force does not equal downward force / horizontal component of T not balanced by forces shown	B1 B1	[2]

4	(a) (i)	point at which whole weight of body	M1	
		may be considered to act	A1	[2]
	(ii)	sum of forces in any direction is zero	B1	
		sum of moments about any point is zero	B1	[2]
	(b)	*either*:		
		T and W have zero moment about P	M1	
		so F must have zero moment, i.e. pass through P	A1	[2]
		or:		
		if all pass through P, distance from P is zero for all forces (M1)		
		so sum of moments about P is zero (A1)		
	(c) (i)	$F\cos\alpha = T\cos\beta$	B1	[1]
	(ii)	$W = F\sin\alpha + T\sin\beta$	B1	[1]
	(iii)	$2W = 3T\sin\beta$	B1	[1]

5	(a) (i)	lines normal to plate and equal spacing (at least 4 lines)	B1	
		direction from (+) to earthed plate	B1	[2]
	(ii)	$E = 160/0.08$	M1	
		$= 2.0 \times 10^3$ V m^{-1}	A0	[1]
	(b) (i)	correct directions with line of action of arrows passing through charges	B1	[1]
	(ii)	force $= Eq$	C1	
		$= 2.0 \times 10^3 \times 1.2 \times 10^{-15}$		
		$= 2.4 \times 10^{-12}$ N	A1	[2]
	(iii)	couple = force × perpendicular separation	M1	
		$= 2.4 \times 10^{-12} \times 2.5 \times 10^{-3} \times \sin 35°$		
		$= 3.4(4) \times 10^{-15}$ N m	A1	[2]
	(iv)	either **rotates** to align with the field or **oscillates** (about a position) with the positive charge nearer to the earthed plate/clockwise	M1	
			A1	[2]