Xinmin Sec 2023 Prelim 4E Physics 6091/02

Section A

<u>Sectio</u> Qns	Answers	Remarks
1a	Two vertical forces that are seemingly equal in length [B1]	Do not accept NCF/NRF,
Id	Weight	accept friction (with
	Upthrust F/U	• •
		water) or (water)
		Accept reasonable
		symbols
1bi	The weight of the block is equal [A1] to the weight of liquid displaced by the block.	Upthrust = Weight of block (from 3a) Upthrust = Weight of liquid displaced (from question) So, W block = W liquid
		displaced
1bii	The weight of water displaced is equal [A1] to the weight of diesel	W block in water = W block in
	displaced.	diesel
		So, W _{water displaced} = W
		diesel displaced
1c	W water displaced = W diesel displaced	From 3bii
	$\begin{array}{llllllllllllllllllllllllllllllllllll$	g will cancel off
	p water x v water z p diesel x v liquid D $[/2 IOI III = pv]$	
	$\rho_{\text{water}} \times 75\% \times V_{\text{block}} = \rho_{\text{diesel}} \times 86\% \times V_{\text{block}}$ [M1]	[1 for relating V _{liquids} to
	$(1000) (0.75) = (\rho_{\text{diesel}}) (0.86)$	V _{block}]
	ρ _{diesel} = 872 kg/m ³ [A1]	V _{block} will cancel off
		FULL MARKS IF NO WORKING BUT CORRECT ANSWER
		Total 6m
2ai	direction of over-turning moment is clockwise [A1]	
2aii	clockwise moments	
	= (U x 36) + (T x 20) = (400k x 36) + (45k x 20) = 15 300 kNm [M1]	
	anti-clockwise moment	
	= (W x 20) = (400k x 20) = 8000 kNm	
	resultant moment = 15 300 – 8000 = 7300 kNm [A1]	
2b	Put the heavier cargo at the lower decks and lighter cargo at the	Lowers the CG
-	upper decks. [A1]	
	shire accession for a	Total 4m
3a	P = ρgh = 1000 x 10 x 2 = 20 000 Pa [M1]	
ou	$F = PA = 20\ 000 \times 0.02\ [M1] = 400\ N\ [A1]$	
3b	Upward forces = Downward forces	
	Normal contact forces by slabs	
	= Force by water + Weight = 400 + 19 [M1]	
	= 419 N [A1] upwards [A1]	T (10
40	The water at the bottom, percent the bester is bested and average	Total 6m
4a	- The water at the bottom, nearest the heater is heated and expands . - This water becomes less dense and rises .	Any 2 points for [1m]
	- The comparatively cooler and denser cooler water at the top is	
	displaced and sinks to come near the heater.	
	- The process repeats and convection currents are set up.	
4b	[A1] Styrofoam / cork / rubber / plastic	Accept any possible
	[B1] This material contains air pockets. Air/rubber/plastic is a poor	answers.
	conductor of heat, so heat loss by conduction is reduced.	
4c	[A1] White and smooth/shiny/glossy	Accept any light colours
	[B1] Light colours and smooth textures are poor emitters of heat,	besides white.
	so heat loss by radiation is reduced.	Total 6m
		Total off

5a	30°C 0.5 mV 66°C 0.5 / 30 x 66 [M1]	
	= 1.1 mV [A1]	
5b	The higher the temperature T, (the lower the resistance of the thermistor) the smaller the potential difference across it. [A1]	Accept opposite / vice versa.
	(emf divides amongst resistors in series proportionately)	Total 3m
6a	50 complete waves are produced in 1 second. [B1]	
6b	5 waves - 30 m $\rightarrow \lambda = 6$ m [M1] v = f $\lambda = 50 \times 6 = 300$ m/s [A1]	
6c	The more shallow the water / the smaller the depth of water (the smaller the wavelength) the slower the wave / the lower the speed of the water waves. [A1]	
6d	 keep the shape of the wave and draw a stepped difference between UV and YZ (not sloping but horizontal and higher) OR keep the shape of pool and draw the waves within YZ as becoming closer and closer [B1] 	
		Total 5m
7a	critical angle $\angle c = 40^{\circ}$ [M1] $n = \frac{1}{\sin \angle c} = \frac{1}{\sin 40} = 1.56$ [A1]	
7b	angle of refraction $\angle r = 90 - 70 = 20^{\circ}$ [M1] $n = \frac{\sin \angle i}{\sin \angle r} \Rightarrow \angle i = \sin^{-1} (n \sin \angle r) = 32.1^{\circ}$ [A1]	
	$\sin 2r$ $\sin 2r$	Total 4m
8ai	[B1] When peeled, electrons transfer from side M to side N. [B1] Side M loses electrons and becomes positively-charged ; side N gains electrons and becomes negatively-charged .	Accept opposite ie from N to M
8aii	[B1] Side M and side N are of opposite charges. Since unlike charges attract, the cling wrap can stick onto itself.	Accept opposite ie M - ve, N +ve
8b	[A1]	Accept possible alternatives
8c	Make the cling wrap less taut OR	Accept possible
	Use a bigger bowl	alternatives Total 6m
9a	X area of rod : X area of pipe	
	$\pi \left(\frac{D}{2}\right)^2$: $\pi \left(\frac{2D}{2}\right)^2 - \pi \left(\frac{D}{2}\right)^2$	[1 for changing diameter to radius]
	$\frac{D^2}{4} \qquad \qquad : \qquad D^2 - \frac{D^2}{4}$	[1 for squaring radius to find area]
	$\frac{D^2}{4} \qquad \qquad$	
	1:3 [A1] OR 0.333	FULL MARKS IF NO WORKING BUT CORRECT ANSWER

9b	$resistance = \frac{resistivity \times length}{area}$	
	rodpipeR of rod = $\frac{\rho \times L}{A}$ R of pipe = $\frac{\rho \times 2L}{3A}$ = $\frac{2}{3} \times \frac{\rho \times L}{A}$ = $\frac{2}{3} \times \frac{R}{A}$ = $\frac{2}{3} \times R$ of rod	Same material = same resistivity
	Current through pipe = $\frac{3}{2}$ x Current through rod = $\frac{3}{2}$ x 6 [M1] = 9 A [A1]	Length x 2 \rightarrow higher R, lower I by 2 Area x 3 \rightarrow lower R, higher I by 3
		Allow ecf FULL MARKS IF NO WORKING BUT CORRECT ANSWER
		Total 5m
10a	[B1] The fan does not have a metal casing that can conduct electri to its user. ORThe fan has a plastic casing that can insulate electricity from its us	
10bi	[B1] wire with switch to be connected to 'live' and wire without swit to be connected to 'neutral'.	ch
10bii	[B1] in the live wire and between the switch and the pin-hole.	
10c	energy = P x t = 3 kW x 6 h = 18 kWh per day [M1] cost = 18 x 7 x \$0.30 = \$37.80 [A1]	
		Total 5m

Paper 2 Section B

Qns	Answers	Remarks
11a	[A1] AC generator	
	[B1] kinetic energy into electrical energy	
11b	energy from light transparent negative terminal positive terminal	Electron flow is opposite
	[B1] for correct circuit symbol and parallel connection	of conventional current
	[B1] for correct labelling of terminals (clue was in Fig 11a, circled in pink)	flow.
11c	maximum power $P_{max} = V_{max} \times I_{max}$	
	= 27.3 x 5.5 [M1] = 150 W [A1]	
11di	open circuit voltage V_{oc} = 32 V	When current is zero
11dii	short circuit current I _{sc} = 5.5 A	When pd is zero
11e	irradiance of 1000 W/m ² means there is	Accept explanation by
	[B1] 1000 J of (light) energy	both quantities or by
	[B1] per second (unit time), per square metre (unit area)	units
		Total 10m

12a 70 km/n - 70 km/n -19.4 m/s [A1] 12b Distance travelide 3 Area under v-t graph [M1] - (20x40) + ½(20+30)20 + (30x60) + ½(30+10)20 + (10x40) + ½(10+20)20 + (20x20) - 800 + 500 + 1800 + 400 + 400 + 300 + 400 - 4600 m [A1] 12c Average speed = total d / total t = 4600 / 220 = 20.9 m/s [A1] [B1] The car was speeding as its average speed of 20.9 m/s is higher than speed initiot 19.4 m/s. 12di WD = F x d = P xt \rightarrow F = P/d [M1] Driving force = 40 000 x 2 / 15 = 5333 = 5333 N [A1] 12di Initial energy = final energy KE1 + GPE1 = Ket [M1] (½ x 1200 x v ²) v = 285 = 16.88 = 16.9 m/s [A1] Total 10m Total 10m ETHER 13ai Power in P = I?R = (2.5 ²)(28.0) = 175 W [A1] Power in Q = I?R = (2.6 ³)(28.0) = 175 W [A1] [1] 13ai Power in P & Q. The rate of temperature rise in P is greater than the rate of temperature rise in Q. Explanation: - As tincreases, temperature of water increases. The temperature difference between the water and the surroundings increases, so temperature inde decreases. [1] 13bi Relationship between 0 and t. (In both P & Q.)]
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12b Distance travelled = Area under v-t graph [M1] 12b Distance travelled = Area under v-t graph [M1] 12c Average speed = total d value (30x60) + ½(30x10) 20 + (10x40) + ½(10x40) + ½(10x40) = 4000 m [A1] Allow ecf 12c Average speed = total d value 400 + 200 = 20.9 m/s [A1] Allow ecf 12di WD = F x d = P x t → F = PVd [M1] Priving force = 40 000 x 2/15 = 5333 = 5330 N [A1] Total nergy = final energy KEi + GPEI = Kef [M1] (½ x 1200 x 10 x 3) = (½ x 1200 x v²) v = √285 = 16.8 m × [6.9 m/s [A1] Total 10m EITHER 13ai Dever in Q = I²R = (2.5²)(28.0) = 175 W [A1] Power in Q = I²R = (2.6²)(28.0) = 175 W [A1] Power in Q = I²R = (2.6²)(28.0) = 175 W [A1] 13ai Difference between P & Q: The rate of temperature rise in P is greater than the rate of temperature rise in 0. [1] Explanation: - As t increases, temperature of water increases, 0 [1] 13b Relationship between 0 and t: (in both P & Q) As t increases, so temperature directorease. [1] 13c Q = mc0 → Q/1 = mc0/t > P = mc0/t [B1] [1] 13ci Q = mc0 → Q/1 = mc0/t > P = mc0/t [B1] [1] 13ci Q = mc0 → Q/1 = mc0			
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[B1] Some energy is lost due to leakage of magnetic field lines	13c		Any two out of four
		[B1] Some energy is lost due to leakage of magnetic field lines	

	 [B1] Some energy is lost as thermal energy due to the eddy currents induced in the iron core. [B1] Some energy is lost due to hysteresis caused by the flipping of magnetic dipoles in the iron core. 	
13di	 [B1] When a direct current is applied at the primary coil, the current and hence the magnetic field it produces does not change in magnitude nor direction. [B1] Since there is no change in magnetic flux linkage between the primary coil and the secondary coil, there will be no induced emf/current in the secondary coil. 	
13dii	 [B1] Copper is a non-magnetic material. [B1] Since there is reduced magnetic flux linkage between the primary coil and the secondary coil, the efficiency of the transformer is also reduced. 	
		Total 10m