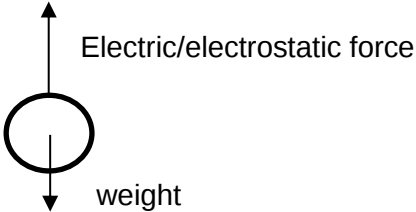


EXAM ANSWERS

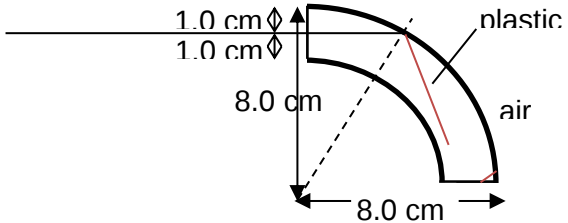
Year:	2022
Exam:	Prelim
Level/Stream:	4 Express
Subject:	Pure Physics 6091/02
s.f./d.p.:	No limit to deduction of s.f. & deduct 1 mark per s.f./d.p mistake

Paper 2 Section A

Qn	Answers	Marks	Comments
1a	Electric charge is a <u>scalar quantity</u> , as it has magnitude but <u>no direction</u> .	B1	Both needed for 1 mark
1bi	Average velocity is calculated by taking the <u>total displacement over total time</u> while average speed is the <u>total distance travelled over the total time taken</u>. The displacement of the particle is smaller as the <u>straight line distance between X and Y</u> is shorter than the <u>curved path from X to Y</u> which is the distance travelled.	B1 B1	1 mark for differentiating velocity and speed
1bii		B1 B1	1 mark for both forces correctly labelled 1 mark for the upward arrow larger than downward arrow

2a	$\frac{0.5 \times 6.8 \times 2 - 0.5 \times 3.4 \times 1.0}{2}$ $= 5.1 \text{ m}$ downward	C1 A1 A1	Give max 1 mark if added 2nd mark not given if negative sign included Last mark given only if observed from working
2bi	$A = 6.8 / 2.0$ $= 3.4 \text{ m/s}^2$	C1 A1	
2bii	$M = w/g$ $= 15/10$ $= 1.5 \text{ kg}$ Resultant Force = 1.5×3.4 $= 5.1 \text{ N}$ Tension = $15 + 5.1$ $= 20.1 = 20 \text{ N (2sf)}$	 C1 A1	Give ECF if 2bi is incorrect
2c	Initial velocity/acceleration is the same but line will continue with decreasing gradient v will reach zero after 2.0s.	B1	Marks are given as long as curve shape is correct
3a	Work done = $14.5/100 \times 4.7$ $= 0.68 \text{ J}$	C1 A1	
3b	Since it is slower, there must have <u>been less force applied</u> which <u>means less work done</u> on the trapped air. Or	B1	

	<u>More thermal energy is lost</u> to the surroundings as there is <u>more time for the energy to be conducted/radiated away</u> *must mention longer time not just more thermal energy lost		
4a	The air particles are moving <u>randomly</u> at <u>high speeds</u> .	B1	
4b	0.1 MPa = 100000 Pa	B1	
4bii	Pressure at 40m underwater = $40 \times 1025 \times 10 + 100000$ = 410 000 + 100000 = 510 000 Pa Based on graph time = 26-28 minutes	C1 A1	Maximum 1 mark if student did not add atmospheric pressure and got 30-32 min
5a	For an object <u>in equilibrium</u> , the <u>sum of clockwise moments about a pivot is equal to the sum of anti-clockwise moments about the same pivot.</u>	B1 B1	
5bi	Sum of CM = sum of ACM $0.45W + 19 \times 1.3 + 1.85W = 2.6 \times 22$ $2.3 W + 24.7 = 57.2$ $2.3 W = 32.5$ $W = 14.1$ = 14 N (2sf)	C1 A1	1 mark for correct substitution
5bii	$F + 22 = 19 + 28$ $F = 25 \text{ N upwards}$	B1	Give full ECF

7d		C1 A1	
8a	Particles in the stream of water with the <u>same charge as the charged rod will be repelled away</u> while those of the <u>opposite charge will be attracted</u>. As the <u>force of attraction is stronger than the force of repulsion due to a shorter distance</u>, the <u>water will move towards the charged rod</u>.	B1 B1 B1	
8bi	As the electric field line directions are by convention the <u>same direction as what would happen to a positive test charge</u>, thus <u>B is positively charged, while A is negatively charged</u>.	C1 B1	
8bii	The field lines for both cannot intersect with one another Or	B1	Did not accept both have lines/arrows

	The distance between the field lines indicate the strength of the electric/magnetic field		Did not accept force in lieu of field strength
9a	The soft iron inside the reed switch will be <u>attracted towards each other</u> . As both strands of soft iron become <u>induced magnets</u> , they will have <u>opposite poles in the middle</u> of the glass which attract each other.	B1 B1	
9b	As the temperature rises, the <u>resistance of the thermistor decreases</u> . Thus the <u>current in the circuit increases</u> . This <u>increases the magnetic field strength of the coil</u> which causes the <u>reed switch to be attracted to each other thus closing the switch</u> .	B1 B1	
10a	When the current flows through the coil, the circular magnetic field around the coil (or CD or AB) interacts with the magnetic field of the permanent magnet. This causes a downward force on CD (or next to South pole) and an upward force on AB (or next to North pole). The resulting clockwise moment causes the coil and the pointer to rotate (or turn) clockwise.	B1 B1 B1	
10b	Both rods will move/accelerate to the right.	B1 B1	FLHR must be mentioned in full

	According to FLHR , as the current flows down, the magnetic field is into the paper, the thumb which represents motion is pointed to the right.		No credit for contradicting the direction.
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Paper 2 Section B

Qn	Answers	Marks	Comments
11ai	$E = Pt$ $= 2000 \times 158$ $= 316000 \text{ J (accept } 320\,000 \text{ J)}$	C1 A1	
11aii	Energy input = 316000 Energy output = $0.75 \times 74.5 \times 4200 + 0.01 \times 2260000$ $= 257275$ Efficiency = $257275/316000$ $= 81\% \text{ or } 81.4\% \text{ (2sf)}$	B1 B1	1 st mark is given only if the energy output working is correct. 2 nd mark can be given as long as it is calculated output/input (from 10bi). Credit given for displaying output/input

11bi	The student should only use the shaved ice <u>once it starts melting</u> but not completely liquid.	B1	
11bii	Energy output = $(800-11.2)/1000 * 334\ 000$ = 263 459.2 J Efficiency = $263\ 459.2/316000$ = 83% or 83.3% (accept 2 or 3 sf)	C1 A1	Accept 82.3% if 320000 is used as the input.
11biii	The <u>temperature difference is lower between 0°C and room temperature</u> as compared to 100°C and room temperature. So the <u>rate of thermal energy gain/loss is smaller.</u>	B1	Both points needed
11ci	Double insulation means that the <u>electrical cables are insulated from the internal components</u> and the <u>internal components are insulated from the external casing.</u>	B1 B1	All must be mentioned.
11dii	The kettle <u>may not be waterproof</u> which means water can go inside the kettle and <u>cause a short circuit/electrical fire if it comes to contact with the wires.</u>	B1	
12ai	As the coil rotates, <u>the magnetic flux linkage between the coil and the magnets change</u> Or	B1	Concept of induced EMF

	As the coil rotates, it <u>cuts the magnetic field lines between the magnets</u>, an EMF is induced in the coil. Every <u>180° turn</u>, the <u>induced EMF in the coil reverses direction as the coil moves in the opposite direction</u>. As the <u>induced current flows as the coil is a closed circuit</u>.	B1 B1	Concept of alternating Concept of load which turns EMF to current
12aii	Slip rings are connected to each side of the coil to maintain electrical contact and ensure induced current flows (to external circuit).	B1	
12aiii	When the transformer is disconnected, the circuit connected to the slip rings is no longer closed, thus there is <u>no induced current flowing in the circuit</u>. Hence, by Lenz' Law there is <u>no magnetic effect opposing the rotation of the coil which produces the induced current</u> (or no opposing force).	B1 B1	Accept "there is induced emf" in place of "no induced current".
12bi	Magnetic field lines (North Pole on the right side)	B1	Straight lines with correct arrows within solenoid

12bii	Peaks at t_1 and t_2 (one must be positive the other negative) Peak at t_2 must have twice the amplitude compared to t_1	B1 B1	
12biii	The amplitude of both the peaks at t_1 and t_2 will be higher.	B1	
13EITHER			
ai	As the light intensity <u>increases</u>, the resistance of the <u>LDR decreases</u>. This causes the fraction $(6000/6000 + R_{\text{thermistor}})$ to <u>increase</u>, thus the voltmeter reading $V = 12 \times (6000/6000 + R_{\text{thermistor}})$ increases. Or As the total resistance decreases, the <u>current across the circuit increases</u>. Thus as $V = R \times I$, the voltmeter reading increases.	C1 A1	Must explain how V is determined
aii	Total resistance of buzzer and resistor $1/R = 1/1440 + 1/6000$ $R = 1160$ $4.5 = 12 (1160/1160 + R)$	B1 B1	2 nd and 3 rd mark can be given if

	$5220 + 4.5 R = 13920$ $R = 1930$ (accept 1900 2sf)	B1	formula is correct
bi	Potential difference across a component is the work done in driving a unit charges across it.	B1	

bii	The claim is correct The resistance of the components can be found as $R = V/I$ <u>Both the filament lamp and thermistor have a pd of 10.7 V and current of 0.77A</u>, hence R is also the same.	B1 B1	Must quote current of 0.77 A
13biii	As the three components are in series, all have the same current flowing through. V lamp = 3.0V V thermistor = 9.0V Total pd supply = 3 + 6 + 9 = 18.0 V (accept 18V)	C1 A1	1st mark for either V lamp or V thermistor correct.

13OR			
ai		B1	Particles at maximum and minimum pressure should have zero displacement
a ii	The frequency of the wave is equal to $\frac{330}{24} = 14$ <u>Hz</u>. Which is <u>below the human audibility range of 20-20000Hz</u>, thus it cannot be heard.	B1 B1	
a iii	No it still cannot be heard. The sound wave will be <u>faster and have a larger wavelength</u>, but it will <u>continue to have the same frequency</u>. Thus it still <u>cannot be heard by the swimmer</u>.	B1 B1	Give full ECF from a ii

bi	Ultrasound waves are reflected by the kidney back to the ultrasound scanner. By measuring the <u>time difference between the ultrasound coming back from the left and right side of the kidney.</u> The diameter w can be calculated as <u>$2w = \text{time difference} \times \text{speed of ultrasound}$</u>.	B1 B1	
bii	Bone tissues have less liquid than the other tissues. Thus the particles in bone tissues are relatively <u>more closely packed</u>. Since sound travels through the collisions of particles, particles in bone <u>tissues collide more frequently</u> and transmits sounds at a faster rate.	B1 B1	Advised to state why the particles are more closely packed
biii	Ultrasound are not <u>ionizing</u> as compared to X-rays thus <u>do not cause cell damage</u>.	B1	Must state ionizing in the answer