BUKIT MERAH SECONDARY SCHOOL
SECONDARY 4 EXPRESS PHYSICS

Preliminary Examinations 2024 ANS

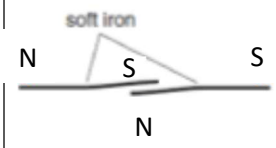
Paper 1

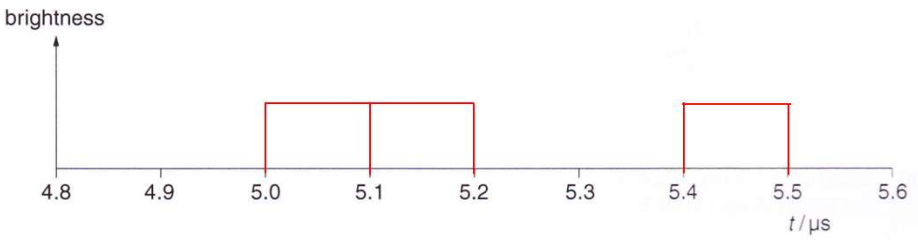
1	**A**	**11**	**C**	**21**	**C**	**31**	**B**
2	**C**	**12**	**C**	**22**	**D**	**32**	**A**
3	**B**	**13**	**C**	**23**	**B**	**33**	**A**
4	**D**	**14**	**C**	**24**	**B**	**34**	**D**
5	**D**	**15**	**A**	**25**	**C**	**35**	**B**
6	**C**	**16**	**D**	**26**	**C**	**36**	**C**
7	**C**	**17**	**B**	**27**	**C**	**37**	**B**
8	**B**	**18**	**B**	**28**	**C**	**38**	**D**
9	**D**	**19**	**A**	**29**	**B**	**39**	**B**
10	**D**	**20**	**D**	**30**	**A**	**40**	**B**

Paper 2

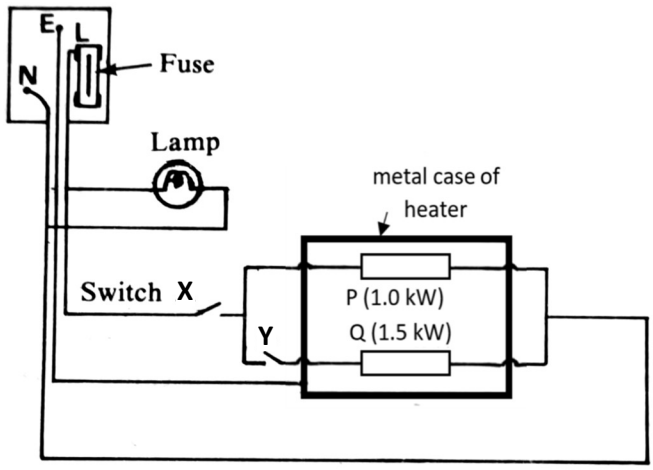
Q/no	**Ans**	**Marks Allocation**
1a	Taking moments about the pivot at rope B, sum of anticlockwise moments = sum of clockwise moments Tension A × 1.8 = 60 × 0.6 + 100 × 0.9 Tension A = $\frac{60 \times 0.6 + 100 \times 0.9}{1.8} = \mathbf{70\ N}$ Tension B = 100 + 60 – 70 = **90 N**	 **1** **1** **1**
1b	He should suspend this second bird cage **directly below rope A**. Taking moments about the pivot at rope A, since there is **no perpendicular distance between the pivot and the weight of the second bird cage, there will not be an additional turning effect about A**, hence it will not increase the tension in Rope B. *i.e. suspending the second bird cage directly below rope A only increases the tension in rope A by 30 N.*	**1** **1**
2a	$P = P_{atm} + hpg$ = 100000 + (100/1000) x 1000 x 10 **= 101 000 Pa**	 **1** **1**
2b	Water level will <u>rise in left arm and drop in right arm</u> (until the water levels on both sides are at the same level).	**1**
2c	When air leaks from the pipe, number of air molecules in the pipe decreases. This causes the <u>frequency of collision</u> between air molecules and walls of the pipe to <u>decrease</u> and the air <u>pressure inside the pipe decrease.</u>	 **1**

	Since pressure due to atmosphere and column of water is now higher than air pressure in the pipe, water levels will move as per **(b).**	**1**
2d	As the pressure of gas is only 1000 Pa, the mercury height difference in the manometer will be very small (7 mm). This reduces the sensitivity of the manometer.	**1**
3a	Radiation	**1**
3b	The shiny material will reflect infrared radiation down to the food which allows it to be cook faster. OR The shiny material reflects infrared radiation away from the outer metal case which does not get hot.	**1**
4a	t = 5.0 min	**1**
4b	Q = mcΘ Q = 0.25 x 4200 x 45 Q = 47250 J = 47000 J (2sf)	 **1**
4c	Energy gain from ice at 0 degrees to water at 0 degrees = m (336000) Energy gain from water at 0 degrees to water at 5 degrees Q = mcΘ = m (4200) (5) = m (21000) Total energy loss by tea = total energy gain by ice cubes 47250 = m (336000 + 21000) m = 47250 / 357000 m = 0.132 kg	 **1** **1**
4d	The molecules near the surface that also have a high enough kinetic energy can escape the surface of the liquid, causing evaporation. The remaining molecules have a lower average kinetic energy than before, therefore it is cooler.	**1** **1**
5a	Since object distance = image distance, focal length is half of the object distance. f = ½ x 5 x 4.0 cm = 10 cm	 **1**
5b	Rays (through centre and through focal point) Image (inverted, same size)	**1** **1**
5c	Image is formed by converging rays on the screen.	**1**
5d	Photocopier	**1**
6a	v = fλ 6100 = (4.0 x 10^6) λ λ = 1.5 mm (2 s.f.)	 **1**
6b	Distance = 3 x 1.525 = 4.6 mm	**1**
6c	v = 2d/t 6100 = (2 x 0.0040) / t t = 1.31 μs	 **1** **1**

6d	A shorter pulse 13 spaces after the emitted pulse.	**1**
7a	Electrons in metal can are attracted by the glass rod to the inner surface of can, leaving inner surface with induced negative charges, and outer surface with induced positive charges. Electrons flow from the ground to neutralise the positive charges on outer surface. This flow of charges causes the galvanometer to deflect. Galvanometer returns to zero when outer face is neutral.	**1** **1** **1**
7b	Use a negative charged rod instead or withdraw the positive charged rod	**1**
8a	12V	**1**
8bi	Total effective resistance = 6 + 4 + 5 = 15Ω V = IR 12 = I (15) I = 0.80 A	**1** **1**
8bii	V = IR V = (0.80)(4.0) V = 3.2 V	 **1**
8c	Total resistance decreases, I through battery increases (by V=IR), Therefore ammeter reading increase As I across XJ increases, PD at XJ also increase	**1** **1**
8d	The voltmeter reading will decrease.	**1**
9a		**1**
9b	When the temperature is high, the resistance of the thermistor will decrease. The current flowing in the coil increases. This increases the strength of the magnetic field of the coil. The reed switch is magnetised with unlike poles at the two ends and attract each other to close the reed switch. Current flows in the circuit so the warning lamp lights up.	**1 or** **1 or** **1** **1**
9c	As steel rods are hard magnetic material which will retain magnetism even when resistance of thermistor increases and keep the reed switch closed, the device may not be effective in informing the farmer.	**1**
10a	AC current results in a changing magnetic field at transmitter coil. There is a rate of change of magnetic flux linkage with the receiver coil. Voltage is induced at receiver coil and current flows in receiver coil.	**1** **1** **1**

10b	Soft Iron Core <u>concentrates magnetic field at the transmitter</u> coil <u>Greater rate of change of magnetic flux linkage with receiver coil</u>	**1** **1**
10c	turns ratio = 3.7/230 = 0.016	 **1**
11a	Speed of light in glass = distance / time = 1000 / 5 X 10^{-6} = 2.0 X 10^{8} m/s $n = \frac{c}{v} = \frac{3.0 \times 10^8}{2.0 \times 10^8} = 1.5$	**1** **1**
11b	$n = \frac{\sin i}{\sin r}$ $1.5 = \frac{\sin 35}{\sin X}$ $X = 22.5°$	 **1** **1**
11ci	The single pulse of light consists of three rays with different i. The first pulse that exits at t = 10.0 μs follows ray 1 path, 2nd pulse exits at 10.3 μs follows ray 2 path, 3rd pulse exits at 10.8 μs follows ray 3 path.	**1**
11cii	 Pulses from 5.0s to 5.1s, 5.1s to 5.2s and 5.4s to 5.5s 1 mark for duration of each pulse 0.1 μs and same brightness 1 mark for correct exit timing	
11ciii	Time between pulse is 0.9 μs Maximum number of pulses per second = one pulse per 0.9μs = 1/0.9X10^{-6} = 1.1 x 10^{6}	 **1** **1**

11civ	Using the data, it can be seen that at longer distances (compare fig 11.4 to 11.5) the time between pulses that exit increases or the pulses will overlap Thus longer distance, will lower the rate at which pulse can enter the cable. *Note: must link distance to lower transmission rate*	**1**
12a	displacement from A = ½ (12)(18) – ½ (12)(6) = 108 – 36 = 72 m	**1** **1**
12b	The graph for t = 0 to 12 s shows positive velocity, while that for t = 12 to 24 s shows negative velocity (<u>the velocities in these two periods have different signs</u>). This shows that the sledge was <u>moving in opposite directions</u> in the two periods. The graph in t = 0 to 12 s also has a <u>steeper gradient</u>. This shows that the <u>rate of change of velocity during this period has a greater magnitude</u>. [Answer must cite the difference as observed from the graph, and interpret accordingly.]	**1** **1**
12c	At t = 12 s, the <u>acceleration</u> of the sledge (as seen from the gradient of the graph) is <u>not zero</u>. The forces on the sledge are therefore <u>not balanced</u>.	**1**
12d	From B towards A, a = (6 – 0) / (24–12) = 0.50 m s^{-2} F = ma = (70) (0.50) = 35 N NOTE: in this working, we take B towards A as the positive direction. Therefore, the velocity that is currently negative will take on its positive value. Then, apply a = (v – u)/ Δt accordingly.	**1** **1**
12ei	Work done against friction = F x d = 25 x 108 --- e.c.f. allowed from 12(a) = 2700 J	**1**
12eii	KE at A = GPE at B + WD against friction ½ (70) (18^2) = (70) (10) (108 sin θ) + 2700 8640 = 75600 sin θ Θ = 6.6°	**1** **1**
13ai	Decrease the resistance of the variable resistance Increase current Increase turn per unit length [Any 2]	**1**
13aii	Wire PQ will <u>move out of the page</u>. The <u>resultant magnetic field created by both PQ and the electromagnet will be such that the region of stronger magnetic field is in the paper while the region of weaker magnetic field is out of the paper</u>.	**1** **1**

	AND Hence the force, in the direction from the stronger to weaker magnetic field, is created.	**1**
13aiii	PQ will swing in and out of the paper as the magnetic fields / poles alternate in direction, resulting in force acting on PQ alternating in and out of paper.	**1** **1**
13b	When current flows through the coil, G is magnetised, turning into an electromagnet, inducing an opposite pole in the near end of H and attract H. This causes the needle pointer to turn clockwise about the hair spring. When light intensity increases, LDR resistance and hence overall circuit resistance decreases and the current in the circuit increases. the electromagnet becomes stronger and hence H is more strongly attracted. This results in a greater deflection/ larger rotation of the pointer.	**1** **1** **1** **1**
14a	 - Correct position of lamp [1] - Correct position of both switches X and Y [1] - No wrong wiring connection	**2**
14bi	I = P / V = 25 / 240 = 0.104 A (3 s.f.) = 0.10 A (2 s.f.) [accept either 2 or 3 s.f. answer]	**1**
14bii	E = Pt = (0.025 + 1.0 + 1.5) x 8.0 = 20.2 kW h	**1** **1**
14c	Last 2 events stated will cause the fuse to blow. When the live wire touches both the neutral or earth wires, it formed a short circuit and total effective resistance decreases and will cause a surge in current as V=IR. This surge in current will melt the fuse.	**1** **1** **1**

	When a person touches the live wire, the fuse will not melt as a person's body resistance is not low enough to cause the current in the circuit to increase till it melts the fuse.	
14d	Should the wire insulation be damaged, The exposed live wire may touch the metal casing and make it live. Without an earth wire, that can cause electric shock. The earth wire directs the current from the live wire via the casing to the ground.	 **1** **1**