Anglo-Chinese School (Independent)
PRELIMINARY EXAMINATION 2024
YEAR 4 EXPRESS
Physics

Answer Scheme

Paper 1

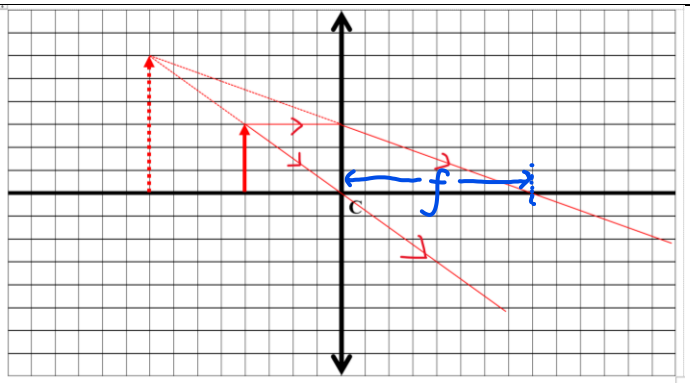
1	2	3	4	5	6	7	8	9	10
B	C	A	C	B	D	B	D	C	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	B	C	A	A	D	C	C	A	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	A	B	B	C	A	D	A	D	A
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	B	B	A	C	D	A	A	C	C

Paper 2

Section A

Q	Part		
1	**(ai)**	The velocity-time graph of the car from t = 0 s to t = 1.4 s. *Accept students who state 1.4s.*	A1
	(aii)	Total displacement = (20 x 1.4) + ½ x (20 + 8.0) x (4.0 – 1.4) Total displacement = 28.0 + 36.4 = 64.4 m Average speed = 64.4 / 4.0 = 16 m/s	M1 A1
	(b)	The velocity-time graph of the car from t = 4.0 s to t = 7.0 s has a negative and constant gradient. (accept 1 mark only) *Many different ways of describing the motion:* • *velocity decreases constantly from 8.0 m/s to 0 m/s.* • *accept slowing down at a constant rate with a deceleration of 2.67 m/s2./decreasing uniformly from 8.0 m/s to 0 m/s.* This means that the car is undergoing a constant deceleration of 2.7 m/s^2.	B1 B1

		Accept: The car decelerated uniformly from the speed of 8.0 m/s to 0 m/s. At 0 m/s, the car is at rest. *Accept: The car decelerated uniformly at a lower rate as compared to time from 1.4 s to 4.0 s.*	
2	**(a)**	The moment of a force about a pivot is the product of the force F and the perpendicular distance d from the pivot to the line of action of the force.	B1
	(b)	At equilibrium, take moment about the pivot, Sum of anti-clockwise moment = Sum of clockwise moment = 0.472 kg x 10 N/kg x (6.2/100) m = 0.29 Nm 4.72 x 6.2 = 29 Ncm accepted **Note: Mass ≠Weight (Hence 0.472 kg≠ 4.72 N)** Accept Direction: ~~Downwards~~ Clockwise	B1 M1 A1
	(c)	**ΔF** x (1.8/100) = 0.29 (allow e.c.f from (b)) ΔF = 16 N	M1 A1
3	**(ai)**	$F/(5.0 \times 10^{-5}) = 1.2 \times 10^{6}$ Pa F = 60 N	M1 A1
	(aii)	As oil cannot be compressed, the **same pressure** from piston **R** will be transmitted equally to piston **S**. With a <u>larger cross-sectional area for piston **S**</u>, it will experience a larger force **F** due to **P = F/A**. where the $\mathbf{P_R = P_S}$ $\mathbf{F_R/A_R = F_S/A_S}$ In other words, we can see that **P_S is a multiplier of P_R**. This ratio is given by the ratio of **A_S to A_R. This is known as Pascal's Principle.**	B1 B1
	(b)	Since the liquid cannot be compressed, the volume of oil displaced in piston R must be equal to the volume of oil displaced in piston S. A_R x d_R = A_S x d_S $(5.0 \times 10^{-5}\ m^2)$ x d_R = $(1.5 \times 10^{-3}\ m^2)$ x (0.20/1000 m) x 2 dR = 0.012 m = 1.2 cm = 12 mm Or Principle of Conservation of Energy F_R x d_R = F_S x d_S 60 x d_R = 1800 x (0.20/1000 m) x 2 d_R = 0.012 m {where Fs = P x As = $(1.2 \times 10^{6}$ Pa) x $(1.5 \times 10^{-3}\ m^2) = 1800N$} there are 2 pistons	M1 A1 M1 A1

		60 N : 1800 N 1: 30 Hence (0.20 x 2) x 30 = 12 mm *There are two piston S.*	
4	**(a)**	Source A: Softer due to lower pressure, as the amplitude of a wave is directly proportional to pressure of air. Lower pitch of sound due to lower frequency as shown in the graph as compared to Source B. **Or** Source B: Louder due to higher pressure, as the amplitude of a wave is directly proportional to pressure of air. Higher pitch of sound due to higher frequency shown in the graph as compared to Source A.	B1 B1 B1 B1 B1 B1 B1 B1
	(bi)	Rarefaction	B1
	(bii)	One wavelength	B1
5	**(ai)**	 1m for every two points: -solid line for object (correct height and distance) -dotted for image (correct distance) -correct principal ray 1 drawn -correct principal ray 2 drawn (penalise for missing arrowheads and ruler – max 1m) f = 4.0 cm h_i = 3.0 cm	M2 A1 A1

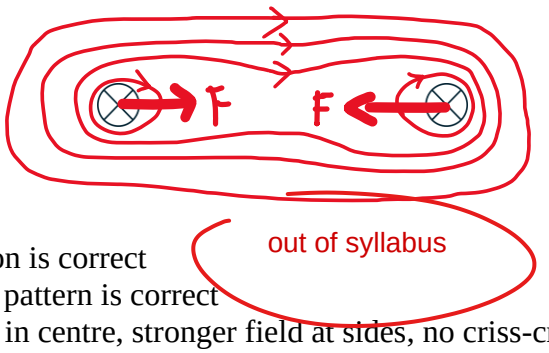
<table>
<tr><td></td><td>(aii)</td><td>The image height / size will decrease. / nearer to the lens
(note: it remains upright and virtual)
(award e.c.f. based on diagram drawn)</td><td>B1</td></tr>
<tr><td></td><td>(b)</td><td>X – Ultraviolet
Y – Infra-red</td><td>A1
A1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>(a)</td><td>It is the work done by an electrical source to drive a unit charge around a complete circuit.</td><td>B1</td></tr>
<tr><td></td><td>(b)</td><td>V = IR
= (0.50)(12.0) = 6.0 V</td><td>M1
A1</td></tr>
<tr><td></td><td>(ci)</td><td>Read off the graph the value of I when V = 6.0 V
(since it is in parallel with the resistor R)
I_2 = 2.5 A</td><td>

A1</td></tr>
<tr><td></td><td>(cii)</td><td>$I_1 = I_2 + I_3$ = 3.0 A
(accept ecf)</td><td>A1</td></tr>
<tr><td></td><td>(ciii)</td><td>V across L = 12.0 V – 6.0 V = 6.0 V
Resistance of L = V/I = (6.0 V)/(3.0 A) = 2.0 Ω
(1m for method if R=V/I, and use I=3.0 but wrong V)
(accept ecf for I_1)
(accept if correctly use Reff method)</td><td>M1
A1</td></tr>
<tr><td></td><td>(d)</td><td>Lightbulb L will be less bright.</td><td>B1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>(ai)</td><td>I = P/V
= 840/240 = 3.5 A</td><td>M1
A1</td></tr>
<tr><td></td><td>(aii)</td><td>5A
(4A is not a typical household fuse rating)</td><td>A1</td></tr>
<tr><td></td><td>(b)</td><td>
<table>
<tr><th>Electrical Fault</th><th>Tick</th></tr>
<tr><td>The live wire was in contact the neutral wire</td><td></td></tr>
<tr><td>The live wire was in contact with the ground wire</td><td>✓</td></tr>
<tr><td>The neutral wire was in contact with the metal casing</td><td></td></tr>
<tr><td>The neutral wire was in contact with the ground wire</td><td></td></tr>
<tr><td>The ground wire was disconnected from the ground</td><td>✓</td></tr>
</table>
1m for each correct ✓
For incorrect ✓, max 1m
For every 2 incorrect ✓, - 1m
</td><td>A2</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

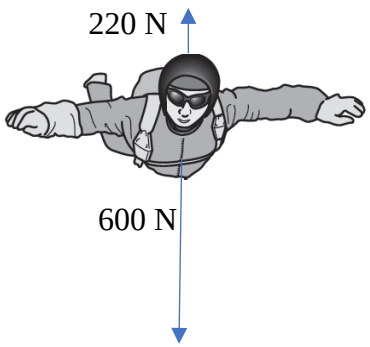
8	**(a)**	$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$	A2
	(bi)	No smoke: **ionising <u>current</u>** when **alpha emission** hits the detector Smoke: alarm sound when **smoke absorbs alpha emission** and **ionising current is disrupted**.	B1 B1
	(bii)	Relatively low penetrating power / relatively high ionising effect Use proper terminology.	B1
	(c)	1728/432 = 4 half-lives $800/2^4$= 50 Bq	M1 A1
	(d)	20 counts/min Note: 1 Bq ≠ 1 count/min. Bq is a unit for radioactivity (no. of disintegrations/second) and not **detection** of radioactivity by GM counter.	A1
9	**(a)**	Conduction in liquid molecules The liquid molecules in the hotter region will move faster and collide with the other neighbouring cooler region. Convection currents in the soup The hotter liquid molecules expands, rise up the soup to the surface as they are less dense while the cooler liquid molecules of the soup sinks to the bottom of the glass bowl as they are denser.	B1 B1 B1 B1
	(b)	During heating, the thermal energy from the microwave is transferred to the soup. The liquid particles move faster, hence there is an increase in the particles' kinetic energy. The increase in average kinetic energy of the particles increases the temperature of the soup. The potential energy of the liquid particles increases with the increase in the average separation of the particles. The sum of the kinetic store and potential store of the particles gives the internal store of the particles. Hence, the internal store of the particles increases. **Old Syllabus:** Accept students stating: The increase in average kinetic energy of the particles increases the temperature of the soup only without the increase in PE. Hence, the internal store of the particles increases.	 B1 B1

		New Syllabus: Accept: The potential energy of the liquid particles increases with the increase in the average separation of the particles. Hence, the internal store of the particles increases.	
	(c)	$Q = mc\Delta\vartheta$ = (750/1000) kg x 4200 J / (kg °C) x (80 – 26) °C Q = 170 100 J ≈170 000 J	M1 A1
	(d)	Energy required to raise the temperature of an object by 1°C is given by: For the soup: Qsoup=msoup×csoup = 0.75×4200=3150 J/°C For the glass bowl: Qbowl=mbowl×cbowl = 0.6×750=450 J/°C The glass bowl requires 450 J of energy to increase its temperature by 1°C. The soup requires 3150 J of energy to increase its temperature by 1°C. Since the microwave energy is being transferred to both the soup and the glass bowl at the same rate, the glass bowl, which requires lesser energy per degree of temperature increase, will experience a faster temperature rise compared to the soup. **OR** Since the pyrex glass bowl requires **lesser energy** than the soup to raise to the same amount of temperature. Hence, pyrex glass bowl's temperature will rise faster than the soup. Q = 170 000 J (soup) Q = (600/1000) kg x 750 J / (kg °C) x (80 – 26) °C = 24300 J (pyrex glass bowl) **OR** Since the pyrex glass bowl has **a lower specific heat capacity** as compared to the soup to raise, the pyrex glass bowl's temperature will rise faster than the soup.	B1 B1 B1
10	**(ai)**	The copper rod will **roll to the left**. When switch is closed, a **current flows** through the rod, **generating a magnetic field** that **interacts** with the **uniform magnetic field** to generate a force on the rod. By Fleming's left hand rule, since the **current is upward** and uniform **magnetic field points into the page**, the direction of the generated force is to the left.	B1 B1 B1

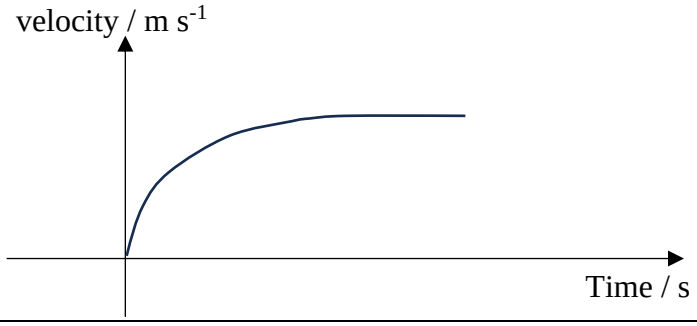
<table>
<tr><td></td><td>(aii)</td><td>
<table>
<tr><th>Adjustment to set-up</th><th>Direction of movement</th><th>Speed of movement</th></tr>
<tr><td>The current from the power source is increased</td><td>No change</td><td>increases</td></tr>
<tr><td>Both the direction of the uniform magnetic field AND the direction of the current from the power source are reversed</td><td>No change</td><td>No change</td></tr>
</table>
</td><td>B1

B1</td></tr>
<tr><td></td><td>(bi)</td><td> 

- Direction is correct
- Overall pattern is correct
(weak field in centre, stronger field at sides, no criss-cross)</td><td>B1
B1</td></tr>
<tr><td></td><td>(bii)</td><td>Arrow points inward toward each other.
(e.c.f. from bii: follow S field to W field)</td><td>B1</td></tr>
<tr><td></td><td>(c)</td><td>Copper rod A and B move to the left, but A moves slower than B.
Both rods will experience the motor effect to the left. But the two rods attract each other, and this attractive force is in the opposite direction (right) as the motor effect for A but in the same for B (left)
Accept any other reasonable answer or phrasing to the same effect (e.g. copper rod A doesn't move/moves to the right, while B moves to the left, until A and B touch and both move to the left together)</td><td>B1

B1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>11 Either</td><td>(a)</td><td>Air resistance is zero B1
or No air resistance acts (at first) on sky-diver.
or Weight of sky diver is much larger than air resistance.</td><td>B1</td></tr>
<tr><td></td><td>(b)</td><td> 
</td><td>600 N force drawn must be longer in length as compared to 220 N. [B1]

Correct Values [B1]</td></tr>
</table>

	(ci)	When the air resistance acting against the sky-diver equals his weight, the sky-diver starts to travel at a **maximum** constant speed, this is known as terminal velocity.	B1
	(cii)		Correct shape [B1] No need values
	(ciii)	W = mg = 600 kg x 10 N/kg = 600 N **From the graph,** when W = 600 N, the speed is 5.0 m/s. Hence terminal velocity is 5.0 m/s.	M1 M1 A1
	(civ)	From the graph, Air resistance = 700 N Resultant force = **700 – 600 = 100 N** a = F/m = 100/60 = **1.7 m/s^2** a = F/m = 100/60 = 1.7 m/s^2 **(upwards)**	 M1 A1 A1
11 OR	**(a)**	The alternating current in the primary coil generates an **alternating magnetic field** The **soft iron core** directs the alternating magnetic field **into the secondary coil** The **changing magnetic flux linkage / magnetic field** in the secondary coil gives rise to an induced e.m.f. across the coil.	B1 B1 B1
	(bi)	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$ $V_s = \frac{N_s}{N_p} \times V_p = \frac{2400}{1000} \times 240\ V = 576\ V$	M1 A1
	(bii)	$I_p V_p = I_s V_s$ $I_s = \frac{I_p V_p}{V_s} = \frac{(6.00)(240)}{576} = 2.50\ A$ *Accept e.c.f.*	M1 A1
	(biii)	$P = I^2 R$ $= (2.50)^2(24.0) = 150\ W$ *Accept e.c.f.*	M1 A1

	(c)	Lamination reduces the transfer of **energy** to the **internal store** by **eddy currents** (which are local induced electric currents that flow in loops.) OR Lamination cuts off the path taken by **eddy currents**, keeping these induced currents small and **reducing energy loss to heat**.	B1