

Anglo-Chinese School (Barker Road)**2023 Sec 4 Exp Physics (6091) Preliminary Examination Marking Scheme****Paper 1**

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

Paper 2

Overall remarks:

- Students who give answers in fractions will get 1 mark deducted off the whole paper.
- 1 mark is deducted for every different incorrect unit.

		Answers	Marks	Examiner's Comments
1	a	Velocity changes from positive to negative. Line goes below x-axis. after time t, velocity becomes negative.	B1	Do not accept: line is negative (line cannot be negative) velocity is below x-axis (velocity can be negative but cannot be below x-axis)

1	b	$a = (v-u) / t$ $-10 = (0 - 20) / t$ time = $20 / 10 = 2 \text{ s}$	A1	
1	c	$a = (v-u) / t$ $-10 = (v - 0) / (6-2)$ $v = -40 \text{ m/s}$	B1	must have -ve sign
1	d	Height = $\frac{1}{2} \times 4 \times 40 - \frac{1}{2} \times 2 \times 20$ = 60 m	M1 A1	
2	a	Resultant force is zero. Resultant moment is zero OR Sum of clockwise moments about a pivot is equal to sum of anticlockwise moments about the same pivot. (pivot must be mentioned)	B1 B1	Common misconception: resultant force is upwards “Word” pivot must be present
2	b	Taking moments about rear wheel, $T_2 \times 4 = 18\,000 \times (4 - 0.8)$ $T_2 = 14\,400 \text{ N}$ $T_1 = 18\,000 - 14\,400$ = 3 600 N	M1 A1 A1	
3	a	$F = pA$ = $140\,000 \times 0.012$ = 1680 N	M1 A1	
3	b	Liquid pressure + atmospheric pressure = gas pressure $h\rho g + 100\,000 = 140\,000$ $h\rho g = 40\,000$ $(0.80 - 0.30) \times \rho \times 10 = 40\,000$ $\rho = 8000 \text{ kg/m}^3$ OR 8 g/cm^3	M1 A1	Need to convert 50 cm to 0.5 m to work in SI units
3	c	KE increase and speed of molecules increase Frequency of collision of molecules with piston walls increases Total force of collision increases Force per unit area increases	B1 B1 B1	

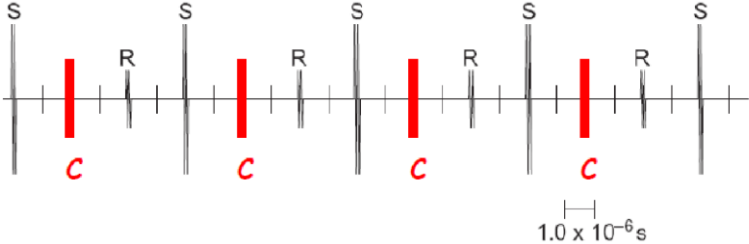
		Gas pressure increases Resultant pressure outwards (and pushes piston to the left) *1 mark for every 2 points		
4	a	Energy cannot be created or destroyed but can only be converted from one form to another form (total amount of energy in an isolated system remains constant)	B1	
4	bi	GPE = mgh = 0.5 x 10 x 13 = 65 J	M1 A1	
4	bii	Total energy at end + energy converted to heat due to slope friction = Total energy at start GPE at C + 10.7 = GPE at A + KE at A $mgh + 10.7 = mgh + \frac{1}{2}mv^2$ $0.5 \times 10 \times 13 + 10.7 = (0.5 \times 10 \times 7.5) + (\frac{1}{2} \times 0.5 \times v^2)$ $\frac{1}{2} \times 0.5 \times v^2 = 38.2$ $v = 12.4 \text{ m/s}$	M1 A1	
4	c	No energy to overcome air resistance or converted to sound energy	B1	Do not accept if answer is not specific - no energy loss (must be specific to which form of energy is energy lost to)
5	ai	$Q = mc\Delta\theta$ $Pt = mc\Delta\theta$ $450 \times t = 2 \times 900 \times (100 - 25)$ $t = 300 \text{ s OR } 5 \text{ mins}$	M1 A1	
5	a ii	D. Highest melting point so it can withstand the heat/wont melt so easily		

		Smallest specific heat capacity so temperature will rise fastest for the same amount of thermal energy supplied Any 1 point – 1 mark	B1 B1	
5	b	$Q = ml_v$ $5\,190\,000 = 2.3 \times l_v$ $l_v = 5\,190\,000 / 2.3$ $= 2\,256\,522 \text{ J / kg}$	M1 A1	Units must be present. Common mistake was J/ kg / deg celsius which is for specific heat capacity
6	a	wavelength = $35 / 7$ $= 5 \text{ cm}$	A1	
6	b	period = $2.5 / 5$ $T = 0.5$ Frequency = $1 / \text{period}$ $= 1 / T$ $= 1 / 0.5$ $= 2 \text{ Hz}$ OR $v = 25 / 2.5 = 10 \text{ cm/s}$ $v = \text{frequency} \times \text{wavelength}$ $10 = f \times 5$ $f = 2 \text{ Hz}$ OR $2.5 \text{ s} \rightarrow 5 \text{ complete waves}$ $1 \text{ s} \rightarrow 5/2.5 = 2 \text{ complete waves (frequency} \rightarrow \text{no. of complete waves in 1 s)}$ $f = 2 \text{ Hz}$	M1 A1	
7	a	Using graph For P, When current = 0.15 A in P, V across P = 2.7 V		

		Since P and Q are in parallel, V across Q = V across P = 2.7 V Using graph, When V across Q = 2.7 V, current in Q = 0.09 A Total current = 0.15 + 0.09 = 0.24 A	M1 A1	
7	b	V across resistor = 4.5 – 2.7 = 1.8	A1	
7	c	$((\rho L/A) \text{ of P }) / ((\rho L/A) \text{ of Q}) = 18/3$ $A = \frac{1}{4} \pi D^2$ Since diameter of P is twice diameter of Q, $A_P = 4A_Q$ Since resistivity ρ is the same, $(L_P / 4A) / ((L_Q / A) = 6$ $(L_P / L_Q) = 6 \times 4 = 24$	M1 A1	
8	ai	$1 / R = 1 / 1800 + 1 / 9000$ $R = 1500 \Omega$	B1	Must see working
8	aii	$I = V / R$ $= 4.5 / 1500$ $= 0.003 \text{ A}$	B1	Must see working
8	b	Light intensity increases, resistance of LDR decreases Effective resistance of circuit decreases [Current increases OR ammeter reading increases] Either one	B1 B1	The word “effective” is important because the LDR’s resistance is one of two resistors present in the circuit. The ammeter reading measures the circuit’s current.
9	a	A : North B: South	B1	

9	b	Magnetic field of current interacts with magnetic field of magnet Downward force acting on PQ Upward force acting on RS [Forces act at a distance from the axis of coil] optional Coil rotates anticlockwise (ECF based on magnetic poles in 9(a))	B2	3 Pts – 2 marks 2 Pts – 1 mark 1 Pt – 0 mark Need to state clearly direction of force on each side of coil (use Flemming's left hand rule to determine direction of force)
9	c	Ensure the current in the circuit reverses for every half revolution	B1	
9	d	Due to inertia / momentum , the coil continues to turn though current is not flowing in coil in vertical position.	B1	
10	a	Ratio of turns = Ratio of voltage $3300 / 220 = 15$ *$1500 / 100 = 15$ Select M as Primary coil K as Secondary coil	M1 A1	
10	b	Power in Secondary = 0.75 x Power in Primary $15\,000 = 0.75 \times I \times V$ $15\,000 = 0.75 \times I \times 3300$ $I = 6.06\text{ A}$	M1 A1	75% efficient means output power is 75% of input power
10	c	To ensure maximum magnetic flux linkage of primary coil with secondary coil by concentrating magnetic field lines. Accept if a student is able to mention one of the two bolded ideas.	B1	
11	ai	The refractive index is the ratio of the speed of light in vacuum to the speed of light in the medium	B1	
	aii	Total internal reflection	A1	

	aiii	For total internal reflection to occur in the core, light has to travel from an optically denser to a less dense medium (optically must be present) Hence, the cladding has a lower refractive index .	B1	
	aiv	1. The speed of light is lower in the optical fibre than in the air since the optical density of the optical fibre is higher than that of air. 2. The path of green light is shorter (straight path) than that of violet light (jagged path) for the same distance between the transmitter and receiver.	B1 B1	
	bi	When $r = 90^\circ$, $i = 40^\circ$, this is the critical angle Total internal reflection will occur and the light ray is reflected back into the glass or water.	B1 B1	
	bii	$n = 1/\sin c$ $n = 1/\sin 50^\circ$ $n = 1.31$ Award 1 mark to students who use $i = 40$ and $r = 30$ as data and substituted correctly. (No other angles are allowed)	M1 A1	Remarks: Students should examine graphs carefully when selecting data points. $i = 40$ and $r = 30$ is not an exact point and hence only 1 mark is awarded.
	biii	The graph (gradient) for glass will be less steep since the amount of bending will be lesser hence angle of refraction will be lower for each angle of incidence. Marking point: State how the graph for glass would change: gradient less steep, gentler slope Explain: bending less (from normal), angle of refraction is smaller as compared to when light emerges to air.	B1	
12	a	Sound wave of above 20 kHz. (frequency is implied) OR Sound wave of high frequency above human audibility range	B1	

b	6 divisions on time base. $T = 6 \times 1 \times 10^{-6} = 6 \times 10^{-6} \text{ s}$	A1	
c	Not all ultrasound is reflected from back surface. Some pass through the back. Some sound energy is absorbed by the metal. Some sound energy is spread out/scattered/dissipated/reflected in other directions. Sound energy is converted to other forms of energy like thermal energy. Any 2 points – idea of energy loss or not all energy is reflected.	B2	
d	 One pulse halfway between S and R (1 mark) Pulse height smaller than S but bigger than R (1 mark)	A2	
e	$v = f\lambda$ $4000 = 8 \times 10^6 \times \lambda$ $\lambda = 5 \times 10^{-4} \text{ m}$	M1 A1	
f	Obey laws of reflection, refraction Obey the wave equation speed = wavelength x frequency Transfer energy from one point to another point without transferring matter	B1 Either 1	Do not accept: Transfer energy from one point to another point (need to state without transferring matter)

	g	prenatal scan (not check for pregnancy → use pregnancy test kit) blast/locate kidney stone evaluate blood flow examine breast lump Any reasonable application. Reject: CT scan, medical imaging	B1	
13	EITHER			
	a	Electrons in Y will move to the side facing X as unlike charges attract. This results in a shortage of electrons on the right side of Y and electrons will move from the ground to P and then Y to neutralize the positive charges on the right side of Y. There will now be an excess of electrons on sphere Y resulting it being negatively charge.	B1 B1	Common mistake was to state the movement of positive charges which cannot move. Positive charges can only be attracted or repelled but cannot move.
	b	As there is electrons flowing up from the ground, there will thus be a current flowing down to the ground.	A1	conventional current flows in opposite direction to electron flow
	ci	During the movement of charges in P, the current produces a magnetic field. Q experiences a change in magnetic flux. By Faraday's Law, an induced emf is produced in Q and hence an induced current flow in the closed circuit causing a deflection in the galvanometer.	B1 B1	
	cii	Once the right side of Sphere Y is completely neutralized, there is no more charge movement in P. Q will no longer experience a change in magnetic flux and hence there will not be an induced emf or induced current.	B1	
	ciii	By Lenz's Law, the induced current (in Q) produces a magnetic effect to oppose change in magnetic flux. This results in a magnetic force (experienced by P and Q since like poles repel).	B1	
	d	Copper is a non-magnetic material whereas steel is a magnetic material. Steel will magnetise and interfere with the function of solenoid.	B1	
	e	The solenoid P and Q can be brought closer.	B1 state	

		There could have more turns in the solenoids Inserting a soft iron core in Q. All these could bring about a higher rate of change of magnetic flux linkage leading to a larger induced emf in Q.	any 1 B1 explain	
13	OR			
	a	The neutral wire allows current to return from the appliance to the power supply / to complete the circuit.	B1	
	b	When one lamp is blown , the other lamp will continue to work OR lamps can work independently.	B1	
	c	The appliances in the consumer unit have metallic external casings. When the live wire is connected to the metal casing, the earth wire provides the path of low resistance and direct the current away from the user.	B1 B1	Metal casing must be present Need to state clearly that earth wire has low or zero resistance
	d	Current = $5 + 15 + 30 = 50$ A Suitable fuse rating: 51 A to 55 A.	A1 A1	
	ei	Short circuit will occur and the lamps, immersion heater and cooker will not work. OR effective resistance becomes zero A large current above the fuse rating flows through the board's main fuse and blow the fuse. (It must be clear that it's the main fuse that's blown) The 5A, 15A and 30A fuses are not affected.	B1 B1 B1	No marks awarded if the word main in main fuse is missing. Need to state clearly what happens to the 5A, 15A and 30A fuses
	eii	Circuit breaker. It can be reset conveniently after the fault is corrected.	B1	Do not accept switch. Switch is to cut off current / high potential but fuse context is to cut off excessive current which only circuit breaker can do it.