

# Marking scheme for 2024 Physics Prelim

## Paper 1

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

## Paper 2

### Section A

Qn	Mark Scheme	Marks	Sub-total
[-1] <i>per section</i> for any errors in sig. fig. or unit.			
1(a)	a = F/m OR 28000 / 25000  1.1 m/s <sup>2</sup>	B1  A1	[2]
(b)	The forward force is equal to the air resistance / opposing forces acting in the opposite direction.  Resultant force is zero, hence acceleration is zero.	B1  B1	[2]
2(a)	mass and weight of hammer is larger than feather  weight equals resultant force which is the product of mass and acceleration ( $F_R = ma$ , $W = ma$ )  acceleration is equal since $F_{\text{hammer}} / m_{\text{hammer}} = F_{\text{feather}} / m_{\text{feather}}$	B1  B1  A1	[3]
2(b)(i)	v = u + at OR 1.6 x 1.5  2.4 m/s	B1  B1	[2]
2(b)(i)	Straight line from origin with positive gradient with v = 2.4 m/s at t = 1.5s indicated	B1	[1]

Qn	Mark Scheme	Marks	Sub-total
2(b)(iii)	$\frac{1}{2} \times 1.5 \times 2.4$ OR distance travelled = area under the graph 1.8 m	C1 A1	[2]
3(a)	The principle of moments states that the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments <b>about the same pivot</b>  When object is in equilibrium	B1  B1	[2]
3(b)	The body is in equilibrium, Taking moments about point P, Anti clockwise moment = Clockwise moment $F \times 150 = 70 \times 15$ $F = 7.0 \text{ N}$	B1 A1	[2]
3(c)	Weight of chair acting from centre of gravity passes through pivot  No resultant moment produced  OR line of action of weight acting slightly to the left of pivot, producing anticlockwise restoring moment	C1  A1	[2]
4(a)	Pressure is the force acting per unit area	A1	[1]
4(b)	$P_{\text{gas}} + P_{\text{mercury}} = P_{\text{atm}}$  $P_{\text{mercury}} = h\rho g$ OR $0.16 \times 1.4 \times 10^4 \times 10$  $1.0 \times 10^5 - (0.16 \times 1.4 \times 10^4 \times 10)$ $= 77600$ $= 78000 \text{ Pa}$	B1  B1  A1	[3]
4(c)(i)	8.0cm	A1	[1]
4(c)(ii)	Gas molecules move faster and gain kinetic energy as the gas is heated  Gas molecules collide against the mercury surface more frequently with greater force, increasing pressure exerted on the right column of mercury  Mercury column on right falls and mercury column on left rises until gas pressure is equal to atmospheric pressure, i.e. equilibrium	B1  C1  A1	[3]
5(a)	$\sin i / \sin r = 1.5$ OR $\sin 60 / \sin r = 1.5$  $35^\circ$	M1  A1	[2]
5(b)	$n = 1/\sin c$	M1	

Qn	Mark Scheme	Marks	Sub-total
	critical angle = $41.8 = 42^\circ$	A1	[2]
5(c)	The angle of incidence of the light ray at KL is more than the critical angle and undergoes total internal reflection.	B1	[2]
	The angle of incidence of the light at LM is less than the critical angle and undergoes refraction, bending away from the normal.	B1	
6(a)	Brownian motion is due to the random continuous motion of invisible air molecules moving a high speed	B1	[2]
	colliding against the illuminated smoke particles	B1	
6(b)	Large particles have greater inertia	B1	[2]
	More difficult to move the larger particles as the force exerted by invisible air molecules is not large enough	B1	
6(c)	The smoke particles rise in a zig zag motion as the surrounding air is heated and becomes less dense, and sinks in a zig zag motion when the surrounding air is cooler and denser.	B1	[1]
7(a)	$I = V/R$ OR 6.0/15 0.40 A	B1 A1	[2]
7(b)	Current in B = 0.25A $R = 6 / 0.25$ $24\Omega$	B1 A1	[2]
7(c)	As the lamps are non-ohmic, lamp Q has a smaller potential difference across it when connected in series, hence smaller resistance.	B1	[1]
8(a)	The fuse melts and breaks the circuit when current exceeds the fuse rating.	B1	[1]
8(b)(i)	$I = P/V = 1500/240$ 6.3A	A1	[1]
8(c)(ii)	7.0A	A1	[1]
9(a)	Electrons are transferred from the cloth to the plastic due to charging by friction.	B1	[1]
	Cloth loses electrons to become positively charged, plastic gains electrons to become negatively charged.	B1	[1]
9(b)	Metals have free electrons and can move within the metal easily OR good conductor of electricity	B1	[1]
9(c)	$E = Pt = 100 \times 5.0 \times 10^6 = 5.0 \times 10^8 \text{ J}$	B1	[1]
	e.m.f. = $E/Q = (5.0 \times 10^8 / 4.0) = 1.3 \times 10^8 \text{ V}$	B1	[1]

Qn	Mark Scheme	Marks	Sub-total
10(a)(i)	Ammeter connected in series Voltmeter connected in parallel	B1 B1	[2]
10(a)(ii)	$E = IVt$ OR $6.0 \times 2.0 \times 5.0$  60J	B1  A1	[2]
	$E = mgh = 0.10 \times 10 \times 0.80$  0.8 J	B1  A1	[2]
10(b)(i)	Change in magnetic flux linking the coil  Induced emf / voltage according to Faraday's Law	B1  B1	[2]
10(b)(ii)	The induced current flows in a direction to produce an opposing magnetic field and a force in the opposite direction of motion  thereby creating an opposing moment and causing the coil to turn slower as the mass falls.	B1  B1	[2]
11(a)	<ul style="list-style-type: none"> <li>Lamp A</li> <li>For same length, tungsten wire has a higher resistance per unit length of <math>1.8 \times 10^{-2} \Omega/\text{m}</math> compared to that of Copper (<math>2.8 \times 10^{-3} \Omega/\text{m}</math>)</li> <li>A is coiled and is longer and has smaller cross-sectional area of <math>3.1 \times 10^{-6} \text{ m}^2</math>, hence largest resistance</li> </ul>	C1 B1  B1	[3]
11(b)	Principle of conservation of energy states that energy cannot be created or destroyed but only transferred from one store to another.  All the energy from the internal (thermal) store of the filament is transferred by propagation of waves in the form of light AND by heating  to the internal (thermal) store of the surrounding air molecules.	B1  B1  B1	[3]
11(c)(i)	$E = P t$ $= 50 \text{ W} \times 0.18 \text{ s}$ $= 9.0 \text{ J}$	M1 A1	[2]
11(c)(ii)	Energy supplied to filament = energy gain by filament (Copper) $9.0 = m c_p \Delta \theta$ $9.0 = m (378) (1085 - 30)$ $m = 2.3 \times 10^{-5} \text{ kg}$	M1 A1	[2]

## Section B

Qn	Mark Scheme	Marks	Sub-total
[-1] <i>per section</i> for any errors in sig. fig. or unit.			
12(a)(i)	Current flows through the solenoid and it becomes magnetized.  Solenoid attracts the iron armature by magnetic induction.  Contacts touch, forming a closed circuit for current to flow through motor.	B1  B1  B1	[3]
(a)(ii)	Iron can be magnetized and demagnetised easily, making it suitable for an electromagnet.  Steel is difficult to magnetize and demagnetize. (iron can be magnetized and demagnetized more easily <u>than steel</u> )	B1  B1	[2]
(b)	N-pole marked on right side	A1	[1]
(c)(i)	The alternating current in the primary coil produces a changing magnetic field  The changing magnetic field causes a change in the number of magnetic field lines going through the secondary coil to change with time continuously and an induced emf in the secondary coil. The induced current lights up the bulb.	B1  B1	[2]
(c)(ii)	$N_s / N_p = V_s / V_p = I_p / I_s$ $4/12 = 3/9 = 0.25 / I_s$  0.75A	M1  A1	[2]

13(a)(i)	Sound waves with a frequency of higher than audible range (more than 20 kHz)	B1	[1]
13(a)(ii)	Some of the sound waves are reflected at the boundary. (some pass through or are absorbed)	B1	[1]
13(a)(iii)	$t = 0.03/1000 \text{ s}$  $s = 2d/t \quad \text{OR} \quad 1500 = 2d / (0.03 / 1000)$  $d = 0.023 \text{ m}$	B1  B1  A1	[3]

13(a)(iv)	Sound is transmitted from the emitter as a longitudinal wave  in which the surrounding air molecules and the human tissue vibrate in a series of compressions and rarefactions	B1  B1	[2]
13(b)(i)	Transverse wave / travel at $3.0 \times 10^8$ m/s in a vacuum / more penetrating / ionising	B1	[1]
13(b)(ii)	$v = f\lambda$ OR $3.0 \times 10^8 = f \times 2.0 \times 10^{-9}$ $f = 1.5 \times 10^{17}$ Hz	B1 A1	[2]