2025 MSHS 6091Physics
Prelim Exam Solutions

PAPER 1

1	2	3	4	5	6	7	8	9	10
C	**B**	**D**	**A**	**C**	**A**	**A**	**D**	**A**	**B**

11	12	13	14	15	16	17	18	19	20
C	**C**	**A**	**A**	**B**	**B**	**D**	**A**	**C**	**A**

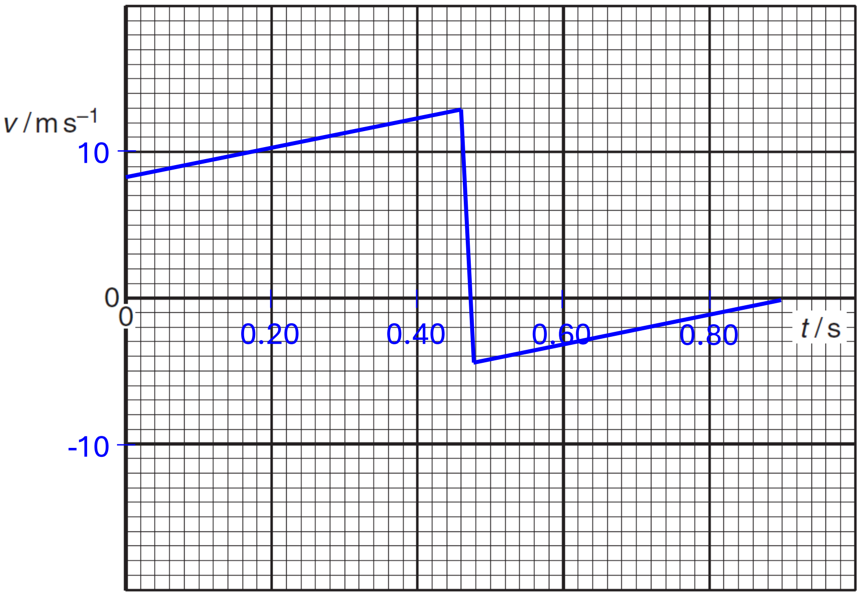
21	22	23	24	25	26	27	28	29	30
A	**A**	**D**	**B**	**D**	**A**	**A**	**A**	**A**	**D**

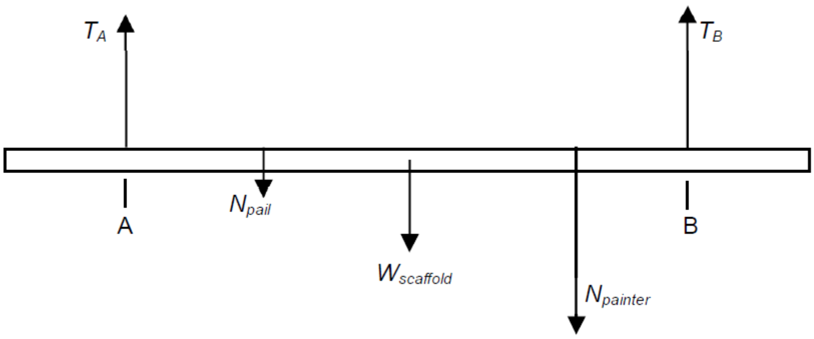
31	32	33	34	35	36	37	38	39	40
D	**C**	**D**	**B**	**D**	**D**	**B**	**A**	**D**	**B**

Deductions
U (units) – 1M for each occurrence capped at 1 M **per question**
SF (significant figures) & P (presentation) – 1M for each occurrence capped **at 1M per paper**

PAPER 2

SECTION A

1(ai)	Distance = Area under v-t graph $5 = \frac{1}{2}\left(\frac{\Delta v}{10}\right)(8.4 + 8.4 + \Delta v)$ $\Delta v^2 + 16.8\Delta v - 100 = 0$ Δv = 4.66 m/s v = 8.4 + 4.66 = 13 m/s	C1 A1
1(aii)	Acceleration = gradient of v-t graph $10 = \frac{13 - 8.4}{t}$ t = 0.46 s	C1 A1
1(b)	 reasonable shape suitable scale correctly plotted 1st and last points at (0,8.4) and (0.90,0) with non-vertical line at 0.46 s	 M1 A1 A1

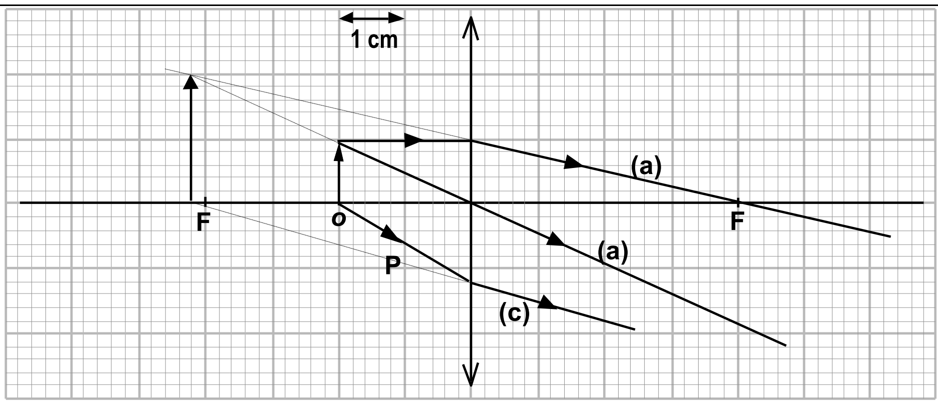
2(a)	 all correct any 3 correct	A2 A1
2(bi)	Taking moments about point A, sum of anti-clockwise moments = sum of clockwise moments T_B x 4.0 = 4.0 x 10 x 1.0 +25.0 x 10 x 2.0 + 60.0 x 10 x 3.6 T_B = 675N	 C1 A1
2(bii)	Sum of forces acting on scaffold = 0 N Upward forces = downward forces $T_A + T_B$ = 4.0g + 25.0g + 60.0g T_A = 89 x 10 - 675 = 215 N	 C1 A1
2(c)	As the painter walks towards point A, the tension in rope A will increase and the tension in rope B will decrease. By considering the moment of the forces about point A, as x decreases, the sum of clockwise moment decreases. (Since the beam is in equilibrium), tension in rope B must also decrease. Hence the tension in rope A increases, as total downward force remains the constant.	 B1 B1 B1

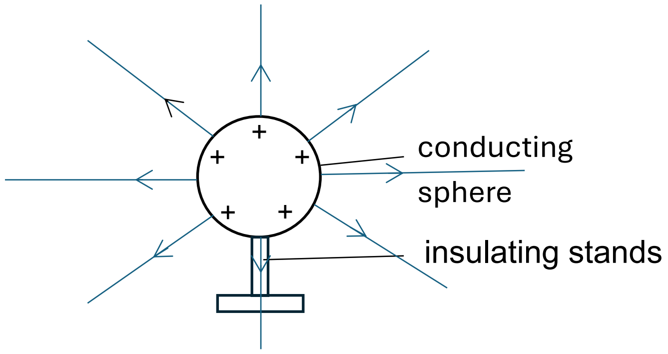
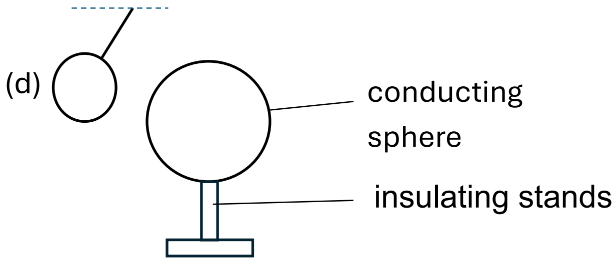
3(a)	height difference = 32 - 15 = 17 cm P_{gas} = 76 + 17 = 93 cmHg $P_{gas} = \rho gh$ = 13600 x 0.93 x 10 = 126000 Pa	 M1 A1

3(b)	The number of gas molecules per unit volume is equal both at the bung and at the walls. Hence, the frequency of collision of the gas molecules per unit area against the walls and the bung are equal, exerting equal force per unit area, which is the same gas pressure.	B1 B1 B1
3(c)	Use a liquid of smaller density. For any gas pressure increase, the height increase will be more because the density is lesser, according to the formula $P = \rho gh$.	B1 B1

4(a)	During the change in state, energy is being transferred to the internal potential store of the molecules. Since there is no increase in energy in the internal kinetic store, temperature remains constant.	B1
4(bi)	Energy transferred from flame = Energy transferred to soup $(Pt) \times 30\% = ml_v$ $(300)(3.0)(3600)(0.30) = m(2.26 \times 10^6)$ $m = 0.430$ kg	C1 A1
4(bii)	When high flame is used, large amount of soup will be vaporized in 3 hours. Hence a large amount of energy will be wasted in preparing the soup.	B1
4(ci)	• Meat is a poor conductor of heat. If it is too thick, its interior might not be fully cooked. • To increase the size of contact area between the meat and the soup. Either one of the above.	B1
4(cii)	The layer of oil helps to reduce the rate of evaporation from the soup. This reduces the energy transferred from the soup to the surroundings.	B1
4(ciii)	Let *n* be no. of slices of meat Energy transferred from soup = Energy transferred to meat slices	 C1

	(1.0) (4200) (97 – 82) = (0.020) (3500) (82 – 27) n n = 16.4 Maximum no. of slices is 16.	A1
4(d)	Energy will be transferred from the soup to mixian which will reduce temperature of the soup significantly. This might result in the meat not able to reach 82 °C subsequently.	B1

5(a)	 Ray through optical centre drawn correctly and ray through focal point drawn correctly. Arrows included for light rays. Dotted lines used for construction.	B1 B1
5(b)	Magnification = 2 / 1 = 2	A1
5(c)	Ray P extends backwards from lens to base of image. Light ray from lens forms a straight line to the base of image.	B1

6(a) **6(b)**	At least 4 charges At least 4 lines (originate from centre)  	B1 B1
6(c)	Negative charges nearer to sphere Attractive force stronger than repulsive force	B1 B1
6(d)	 Aluminum drawn displaced to the left Negative charges move from aluminum to sphere, resulting in net positive charge of both objects.	 B1 B1
6(d)	Copper is a non-magnetic material whereas steel is a magnetic material. Steel will magnetise and interfere with the function of the solenoid.is this excess? Can delete?	B1

7(a)	total resistance = 20 kΩ current = 12 / 20 mA or potential divider formula p.d. = [12 / 20] × 12 = 7.2 V	C1 A1
7(b)	parallel resistance = 3 kΩ total resistance 8 + 3 = 11 kΩ current = 12 / 11 × 10^3 = 1.09 × 10^{-3} or 1.1 × 10^{-3} A	C1 A1
7(ci)	LDR resistance decreases total resistance (of circuit) is less hence current increases	M1 A1
7(cii)	resistance across XY is less less proportion of 12 V across XY hence p.d. is less	M1 A1

8(a)	Inserting the iron core gives rise to rate of change of flux within the solenoid and e.m.f is induced in solenoid induced e.m.f. opposes applied d.c. emf so current smaller/acts to reduce current	M1 A1
8(b)	$\frac{V_S}{V_P} = \frac{N_S}{N_P}$ $\frac{V_S}{240} = \frac{350}{5600}$ V_S = 15 V $I_S = P / V_S$ = 90 / 15 = 6.0 A	C1 C1 A1

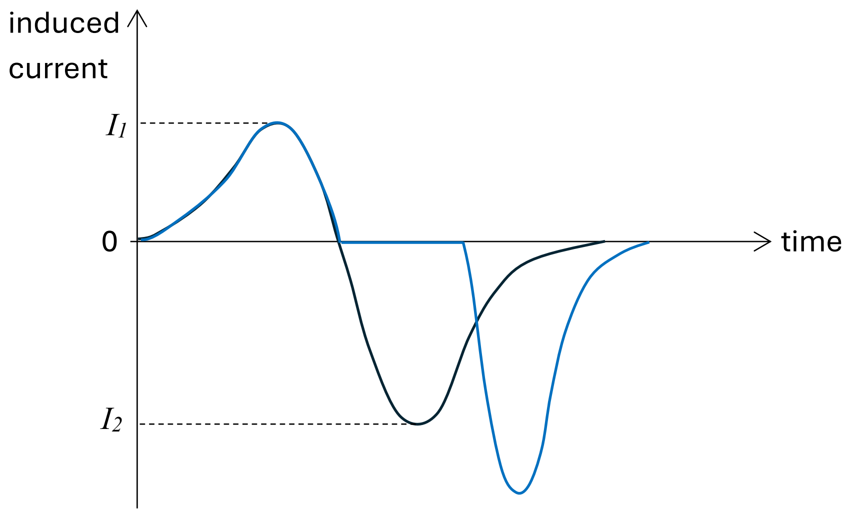
9(a)	Number of half-lives elapsed = 45/15 = 3	 A1
9(b)	Initial activity of 6.0 cm^3 blood = ((5 x 2) x 2) x 2 = 40 Let V be volume of blood $\frac{V}{6} = \frac{32 \times 10^3}{40}$ $V = 4800\ cm^3$	C1 A1
9(c)	The half-life of 15 hours is short and hence the source will not remain inside the body for a long time.	B1

10(ai)	Resistance of the bulb is the ratio of the potential across the bulb to the current flowing through it.	B1
10(aii)	$R = \frac{V^2}{P}$ $R = \frac{240^2}{60}$ $R = 960\ \Omega$	 C1 A1
10(b)	$R = \frac{\rho l}{A}$	

	$R = \dfrac{\rho l}{(\pi/4)d^2}$ $d = \sqrt{\dfrac{\rho l}{(\pi/4)(R)}}$ $d = \sqrt{\dfrac{(7.9 \times 10^{-7})(0.14)}{(\pi/4)(960)}}$ *d* = 0.0121 mm	C1 A1
10(c)	By varying the length and cross-sectional area of the wires so that the ratio l/A remains constant.	B1
10(d)	Filament A. It has the lowest resistance per unit length. Hence power dissipated per unit length is the lowest and it will take a longer time to break.	B1 B1

10(e)	<table><tr><td></td><td>A</td><td>B</td><td>C</td></tr><tr><td>resistance/ Ω</td><td>***960***</td><td>***960***</td><td>***960***</td></tr><tr><td>diameter/ mm</td><td>0.0129</td><td>***0.0121***</td><td>0.0113</td></tr><tr><td>length/ m</td><td>***0.158***</td><td>0.14</td><td>***0.122***</td></tr></table> All values correct Three to five values correct	 A2 A1
10(f)	Running cost = cost of electrical consumption + cost to make bulbs = ((60/1000) x 2000) x 0.172 + (2000/500) x 0.50 = $22.6	C1 A1

SECTION B

11(a)	The position with <u>greatest acceleration is Q</u>. At point Q, there is <u>no net change in magnetic flux</u> of the coil, hence there <u>will not be e.m.f. or opposing magnetic field</u> produced by the induced current to slow down the magnet. When the <u>magnet is just falling into (P) or out of the coil (R)</u>, <u>it produces a change of magnetic flux within the coil. This induces a current in the coil which produces an opposing magnetic field to slow down the magnet</u> according to Lenz's Law.	B1 B1
11(bi)	As the magnet falls through the coil, it <u>speeds up due to gravitational force</u>, this results in a greater rate of change of magnetic flux. Based on Faraday's Law, <u>greater rate of change of magnetic flux results in greater induced e.m.f. and hence current</u>.	B1 B1
11(bii)	As the N-pole of the magnet approaches the coil, <u>current flows within the coil to produce a N-pole at the top of the coil to repel</u> the falling magnet. When the S-pole of the magnet is leaving the coil, <u>current flows in the opposite direction in the coil to produce a N-pole at the bottom of the coil to attract</u> the falling magnet.	B1 B1
11(biii)	 <u>No current</u> between the two parts of the graph No change to the part representing magnet just falling into the coil. <u>Larger peak</u> and <u>shorter duration</u> for the part representing magnet falling out of the coil.	 B1 B1
11(c)	Presence of the diode allows current to flow only in one direction.	

	Hence current is unable to flow within the coil when the magnet just falls through it. Therefore, the magnet does not encounter an opposing force when it is entering the coil. However, induced current in the coil is able to flow when the magnet is leaving it. Hence, it will produce a N-pole at the bottom to slow down the magnet when it is leaving the coil.	B1 B1

12(ai)	${}^{241}_{95}\mathrm{Am} \rightarrow {}^{237}_{93}\mathrm{Np} + {}^{4}_{2}\propto$	B1
12(aii)	Number of neutrons = 237 – 93 = 144	 A1
12(bi)	The α-particles emitted by the source will ionize the air molecules to produce ions. The ions are attracted to the electrode with an opposite charge. As a result, a current flows between the electrodes.	B1
12(bii)	The smoke particles block the movement of the ions. As a result, fewer ions reach the electrodes, so the current drops.	B1
12(c)	The activity of the radioactive source remain stable for a long period of time. So, the detector needs not be replaced frequently.	B1 B1
12(d)	As β-particles have a weak ionizing power, the current flowing between the electrodes will be extremely small. So, Carbon-14 is not suitable.	B1 B1
12(e)	Due to the small amount of radioactive material used, the radiation dose from the smoke detector is very small, moreover, the emitted α-particles have low penetrating ability, so the radioactive emissions are sealed and shielded preventing harmful radiation from escaping. Hence, using the detector will not pose any health hazard.	B1 B1