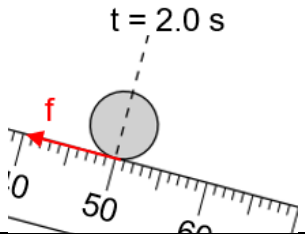
SECONDARY 4 EXPRESS
PHYSICS 6091
PRELIMINARY EXAMINATION 2025
MARKING SCHEME

Paper 1

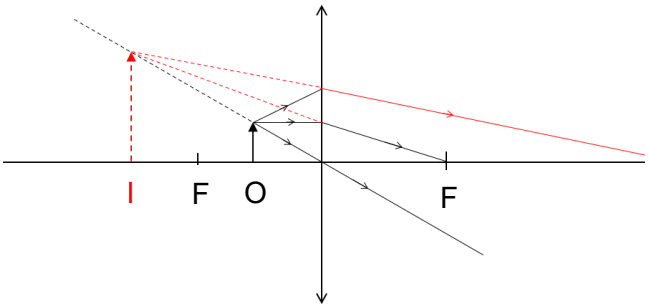
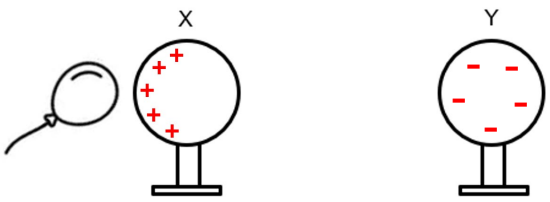
1	2	3	4	5	6	7	8	9	10
B	A	A	C	C	A	B	C	D	C
11	12	13	14	15	16	17	18	19	20
D	A	A	B	A	D	D	A	C	C
21	22	23	24	25	26	27	28	29	30
D	C	C	A	D	A	D	C	C	B
31	32	33	34	35	36	37	38	39	40
C	D	B	C	B	B	A	B	B	B

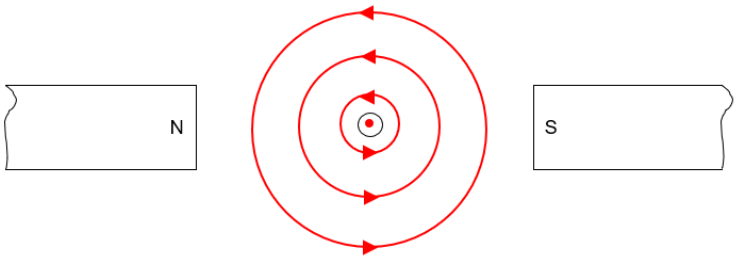
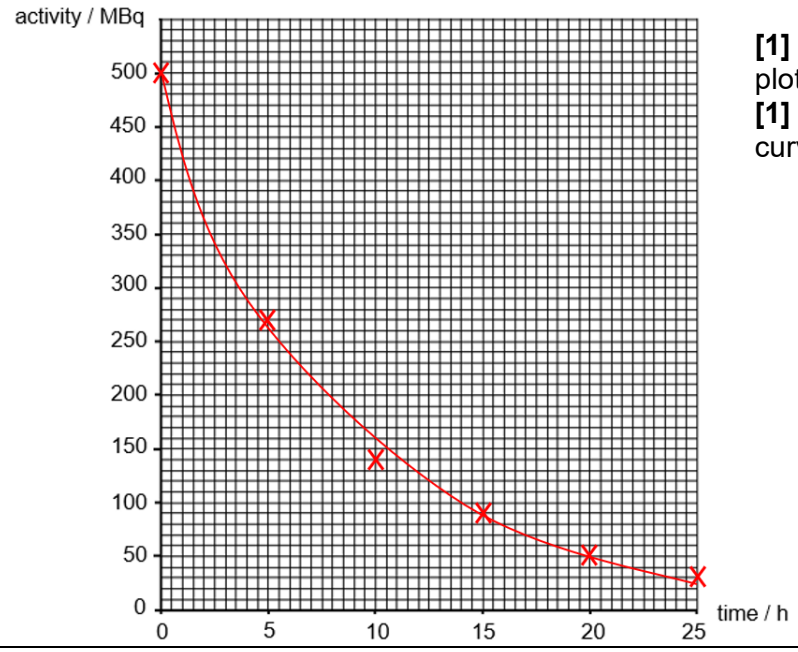
Paper 2 / Section A

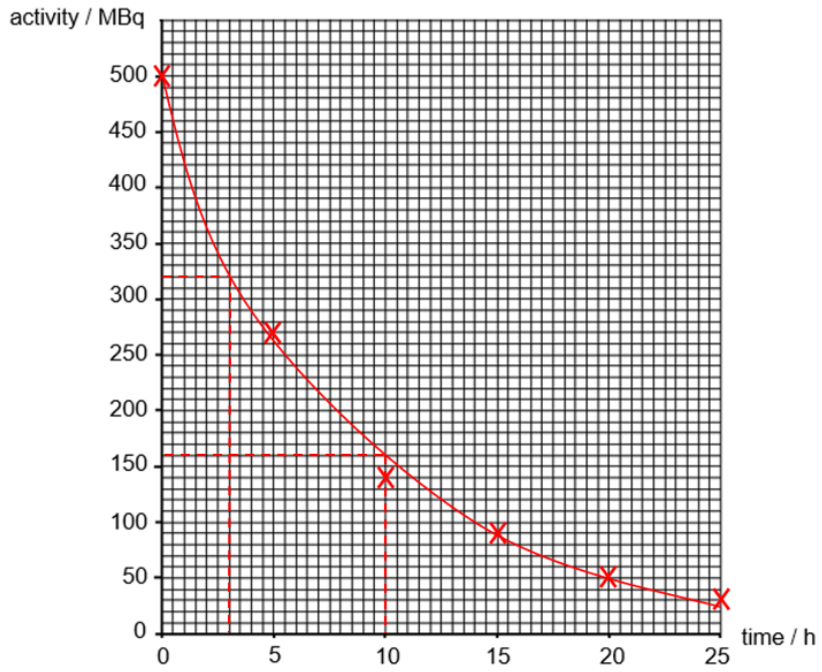
- To penalise 1m for SF for the whole paper 2
- To penalise 1m for units for the whole paper 2

1	(a)		distance travelled per unit time increases OR speed is increasing.	[1]
	(b)		average speed = total distance / total time = 80 / 2.0 OR 0.80 / 2.0 = 40 cm/s OR 0.40 m/s	 [1] [1]
	(c)		air resistance increases weight remains constant	[1] [1]
	(d)			[1]
2	(a)		product of applied force and the perpendicular distance from the pivot to the line of action of the force	[1]
	(b)		moment = Fd = 7800 x 0.050 = 390 Nm	 [1] [1]
	(c)		perpendicular distance is reduced	[1]
3	(a)		force acting per unit area (Reject: force over area)	[1]

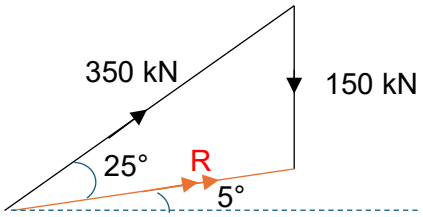
	(b)		molecules move at high speed in constant random directions / possess kinetic energy molecules hit the walls of the syringe and exert a force on the walls of the syringe, resulting in a pressure as P=F/A	**[1]** **[1]** **[1]**
	(c)		pressure inside the plunger after plunger stops moving = pressure due to weight + atm. pressure = $(20/1.5 \times 10^{-4}) + 1.0 \times 10^{5}$ = $1.3 \times 10^{5} + 1.0 \times 10^{5}$ = 2.3×10^{5} Pa	**[1]** **[1]**
4	**(a)**		According to the Principle of Conservation of Energy, as the block falls, it loses GPE. This is transferred to the elevator which rises, after gaining GPE. Therefore, the electric motor does little work to lift the empty elevator. OR The elevator's **weight** is balanced by the **weight** of the concrete block. (mass is not accepted as it is directly from the question and needs to relate to force) Hence, the resultant force is very close/equals to zero. Therefore, the electric motor does little work to lift the empty elevator.	**[1]** **[1]** **[1]** **[1]**
	(b)		P = E/t = mgh / t = (5800 x 25) / 28 = 5200 W	**[1]** **[1]**
5	**(a)**	**(i)**	E = Pt = IVt = 3.5 x 24 x 10 = 840 J	**[1]** **[1]**
		(ii)	Q = mcΔθ = 2.8 x 0.39 x (320 - 20) = 330 J (2sf)	**[1]** **[1]**
		(iii)	The energy supplied is gained not only by the metal tip but also by the wire heated and the surrounding air particles.	**[1]**
	(b)		Electrons move around (diffuse through the metal) They pass on energy to other parts of the metal through collisions with other atoms or electrons.	**[1]** **[1]**
6	**(a)**		Tungsten filament works by joule heating, hence, energy is transferred via heating to the surrounding air particles and very little is transferred as light (propagation of EM waves) while fluorescent lamp produces light not due to heating effect.	**[1]** **[1]**
	(b)		X-rays or gamma	**[1]**
	(c)		f = v/λ = $(3.0 \times 10^{8}) / (3.6 \times 10^{-7})$ = 8.3×10^{14} Hz	**[1]** **[1]**
7	**(a)**	**(i)**	It refracts / bends towards the normal. OR Its speed slows down.	**[1]**
		(ii)	It bends / refracts away from normal OR	**[1]**

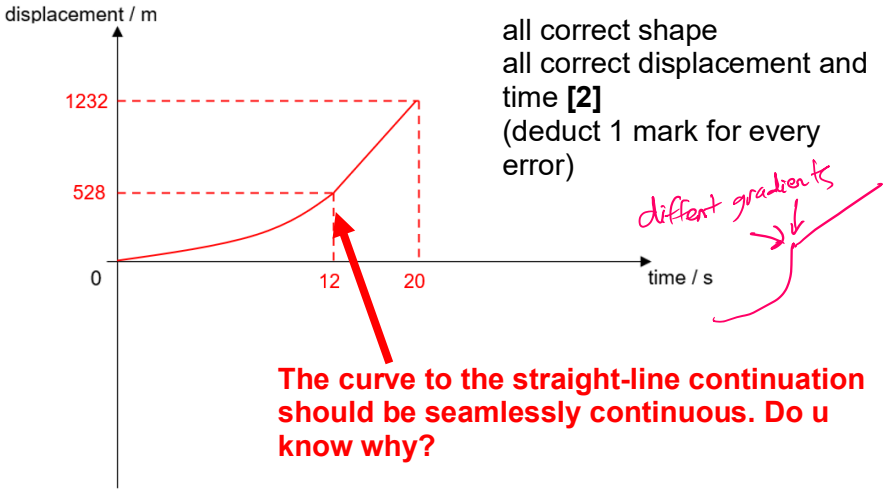
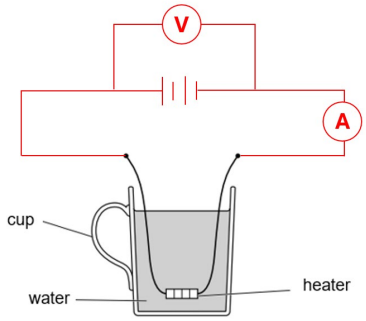
			Its speed increases.	
	(b)			**[1]** for correct completion of rays **[1]** for correct drawing of image with label To penalise [1] if the rays/image are not drawn in dotted lines.
8	**(a)**	**(i)**	Electrons move from hair to balloon, resulting in more protons than electrons on the hair.	**[1]**
		(ii)	The balloon is negatively charged. Unlike charges caused electrostatic forces of attraction between the positively charged hair and negatively charged balloon. Therefore, the hair is pulled towards the balloon.	**[1]** **[1]**
	(b)	**(i)**		**[1]**
		(ii)	With the negatively charged balloon held next to sphere X, electrons move from the left side of sphere X to sphere Y. The left side of X has more protons than electrons. (OR through the drawing on the diagram.)	**[1]** **[1]**
9	**(a)**		The volume increases. / More sound is produced. Resistance between C and Q increases OR Voltage is increased by potential divider formula.	**[1]** **[1]**
	(b)		Amplitude increases. Frequency remains constant.	**[1]** **[1]**

10	**(a)**		Top magnet S pole at bottom and N pole on top Like poles repel while unlike poles attract. Repulsive force leads to the top magnet floating above the bottom magnet.	**[1]** **[1]**
	(b)		Iron is a **magnetically soft** material which can be induced magnetically. Once it is placed on top of the bottom magnet, it become magnetically induced and gets attracted to the bottom magnet.	**[1]** **[1]**
11	**(a)**		Y to X	**[1]**
	(b)	**(i)**	 Wire – at least 3 circular lines with distance between them increasing **[1]**; arrow direction ACW **[1]**	
		(ii)	Magnetic field of the current flowing in wire XY interacts with the magnetic field of magnet. This creates a region of weaker magnetic field above the wire and a stronger magnetic field below wire. An upward **resultant** force is produced on the wire.	 **[1]** **[1]**
	(c)		It will move faster / higher.	**[1]**
	(d)		The direction of the current and hence the force will alternate. This makes the wire moves up and down continuously / vibrate up and down.	**[1]** **[1]**
12	**(a)**	**(i)**		**[1]** for correct plotting of points **[1]** for best-fit curve

		(ii)	 to show at least 2 interval readings from the graphs and take average **[1]** half life = (10 + 3) / 2 = 5.5 h (ecf from (a)(i)) **[1]**	
		(iii)	Gamma rays can penetrate the body and will not be absorbed by the body. Hence, it can be detected by instrument.	**[1]** **[1]**
	(b)	**(i)**	Radioactive emission is random hence all three readings are not the same.	**[1]**
		(ii)	average count for all three readings = (3202 + 3140 + 3258) / 3 = 3200 3200 →1600 → 800 → 400 → 200 4 half-lives are required for the average count rate to drop to 200 counts/min. Time taken = 4 x 13 = 52 h	**[1]** **[1]** **[1]**
		(iii)	$^{123}_{53}I \rightarrow {}^{123}_{54}Te + {}^{0}_{-1}\beta$ **[1]** each; max **[2]** Note: both blanks must be correct to award **[1]**	

Paper 2 / Section B

13	**(a)**		downward weight arrow of length 2.9 – 3.1 cm correct triangle/parallelogram drawn and correct resultant force (with double arrow drawn)  304 kN (295 – 315 kN) 5° above horizontal line to the right -Resultant force needs to be double arrow to distinguish it from the component forces. -Wrong vector addition done by some students	**[1]** **[1]** **[1]** **[1]**
	(b)		As the aeroplane accelerates, the air resistance/drag (f) increases, until the <u>forward thrust equals to air resistance/drag (f) causing Resultant force to become zero</u>. Since <u>F – f =ma, the acceleration becomes zero</u>. Hence, there is no acceleration and velocity is constant. -Common mistake is to compare air resistance to weight. Air resistance is horizontal, weight is vertical, they CANNOT cancel each other out. It is the FORWARD THRUST which is cancelled by the air resistance -No mention of the F_{net}=ma which is necessary to connect resultant force to acceleration	**[1]** **[1]**
	(c)	**(i)**	From t = 0 s to t = 12 s, the aeroplane undergoes constant acceleration of <u>7.3 m/s^2</u>. From t = 12 s to t = 20 s, the aeroplane undergoes zero acceleration / constant velocity of <u>88 m/s</u>. -A complete description of motion means include all possible values to give the best description, including any speed and acceleration that can be calculated	**[1]** **[1]**

		(ii)	 all correct shape all correct displacement and time **[2]** (deduct 1 mark for every error) **The curve to the straight-line continuation should be seamlessly continuous. Do u know why?** -The curve at 12 s must have the same gradient as the start of the line at 12 s because gradient gives velocity, and the velocity at 12 s is the same.Hence, the gradient must have continuity	
14	**(a)**		 power supply with ammeter and heater in series **[1]** voltmeter in parallel with power supply or heater **[1]** -to draw using neat straight lines and neat circles -usually, the voltmeter is across the component that we want to measure, and not include the ammeter. Although it is still ok as we assume that the ammeter has ZERO resistance, so it won't "take" any P.D away from the component being measured.	
	(b)	**(i)**	P = IV = 4.5 x 12 = 54 W	**[1]**
		(ii)	E = Pt = (54/1000) x (8/60) = 0.0072 kWh	**[1]**
	(c)	**(i)**	During evaporation, molecules with higher kinetic energy AND at the water surface. are able to overcome the intermolecular forces of attraction (IMFOA) and escape into the air	**[1]** **[1]**
		(ii)	Increased surface area. More molecules with higher kinetic energy are able to come nearer to the surface for evaporation to occur. OR any other acceptable answers e.g. stirring / less humidity / presence of wind / (accompanying explanation needs to be matching)	**[1]** **[1]**

	(d)		The AIR above the hot water surface gets heated up and expands. This reduces its density and allows it to rise. The cooler, denser AIR then sinks to replace it. This helps to set up convection currents in the AIR to cool the water. -some students explained convection current in water, not reading the question carefully.	**[1]** **[1]**