

Marking Scheme
Physics (6091) Preliminary Examination 2025

Mark scheme will use these abbreviations

/	alternatives
+	statements on both sides of the + are needed for that mark
R	reject
A	accept (for answers correctly cued by the question)
lg	ignore as irrelevant
ref	with reference to
ecf	error carried forward
AW	alternative wording (where responses vary more than usual)
AVP	alternative valid point
ORA	or reverse argument
OWTTE	or words to that effect
<u>underline</u>	actual word given must be used by candidate (grammatical variants excepted)
()	the word / phrase in brackets is not required but sets the context

Accept 2 or 3 sf

Paper 2 – Section A

Qn	Marking Scheme	Marks	Marker's Report
1a	$\frac{F}{A} = P = \frac{F}{A}$ $P = \frac{5.0}{2.0 \times 10^{-4}}$ $P = 25\,000 \text{ Pa}$ $\frac{F}{0.080 \times 10^{-4}} = 25\,000 \text{ Pa}$ $F = 0.20 \text{ N}$	1 1	
1bi	change of vol. at piston = A x d = 0.00020 x 0.0060 = 0.0000012 m ³	1	Accept 1.2 cm ³ and 1.2 ml
1bii	Molecules in water are closely packed with little space between them ...and cannot be pushed closer hence the volume remains the same <u>/thus cannot be compressed.</u>	1 1	
1biii	Vol = A x d 0.0000012 = 0.0000080 x d d = 0.15 m speed = 0.15/1 speed = 0.15 m/s	1 1	Accept alternative methods <u>WD = WD</u> <u>WD = ½ mv² (to explain not to use this method in the future)</u> Accept 15 cm/s

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Qn	Marking Scheme	Marks	Marker's Report
2a	The point which the weight of the object appears to act on.	1	
2b	<i>Pivot marked at C</i>	1	
2c	moment = $F \times \perp d$ moment = 500×0.40 moment = 200 Nm	1 1	
2d	When a system is in equilibrium, the sum of clockwise moment is equal to the sum of anticlockwise moment about the same pivot.	1	
2e	moment = $F \times \perp d$ $200 = T \times 2.0 \text{ m}$ $T = 100 \text{ N}$	1 1	
2f	Contact force acting at C, upwards Or Friction acting at C, leftwards	1	
		8	

Qn	Marking Scheme	Marks	Marker's Report
3a	The container is made from non-metals/cardboard/plastic which are poor conductors of heat. The layer of corrugated cardboard traps pockets of air which are poor conductors of heat. The lid prevents heated air from moving out of the cup restricting/preventing the formation of convection current. /the lid reduces the rate of evaporation	1 1 1	
3b	E to reach $100^\circ\text{C} = mc\theta$ $E = 1.6(4200)(75)$ $E = 504\,000 \text{ J}$ E to vaporise 0.90 kg of water = ml $E = 0.90 \times 2.3 \times 10^6$ $E = 2\,070\,000 \text{ J}$ Total E = $504\,000 + 2\,070\,000$ = 2 574 000 = 2 600 000 J	1 1 1	
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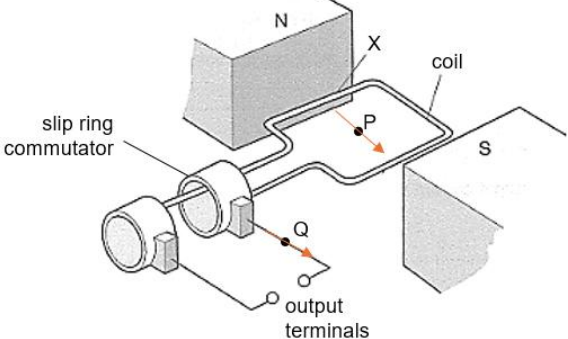
Qn	Marking Scheme	Marks	Marker's Report
4a	'ultra-sound' should be replaced with 'ultraviolet (waves/rays)' 'infra-red waves' and 'microwaves' should swap positions 'visible light' is missing and should be after 'ultraviolet (waves/rays)' and before 'infra-red waves'	1 1 1	OWTTE
4b	<i>Any acceptable</i> E.g. security screening, industrial defect detection, sterilisation.	1	
		4	

Qn	Marking Scheme	Marks	Marker's Report
5a	Potential difference across two points is the work done when a unit charge passes through two points on the circuit. <i>Is the work done to drive a unit charge passes through two points on the circuit.</i> <i>Is the work done to drive a unit charge passes through/across a component.</i>	1	OWTTE
5b	$I = Q/t$ $I = 30/0.25$ $I = 120 \text{ A}$ $P = IV$ $P = 120 \times 7.5 \times 10^8$ $P = 9.0 \times 10^{10} \text{ W}$	1 1	Accept alternative method of: $WD = V \times Q$ $P = WD/t$
		3	

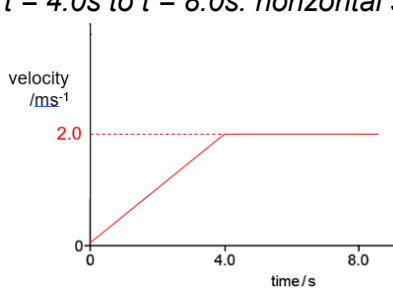
Qn	Marking Scheme	Marks	Marker's Report
6ai	$R_T = V/I$ $R_T = 12/0.0015$ $R_T = 8000 \Omega$ $R_T = R_{LDR} + 5000$ $R_{LDR} = 3000 \Omega$	1 1	
6aai	$V_{LDR} = 12 \times \frac{3000}{8000}$ $V_{LDR} = 4.5 \text{ V}$	1 1	

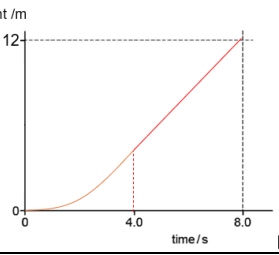
6b	V across LDR when bright = $12 \times \frac{1000}{6000} = 2.0 \text{ V}$ V across resistor when bright = $12 \times \frac{5000}{6000} = 10 \text{ V}$ The electronic needs a pd > 8.0 V to trigger, therefore it needs to be placed across QR.	1 1 1	
		7	

Qn	Marking Scheme	Marks	Marker's Report
7ai	South pole	1	
7aii	When current passes through the coil and it becomes an electromagnet. An unlike pole is induced closer to R in the iron armature causing it to be attracted to R. The armature rotates about the pivot and pushes the contacts together completing the circuit of the motor and turning it on.	1 1	
7b	Steel is a hard magnetic material and loses its magnetism slowly. Thus, when switch S is opened, the steel core still attracts the iron armature and the motor remains on.	1 1	
		5	

Qn	Marking Scheme	Marks	Marker's Report
8a 8bi		1 1	ecf
8bii	Using RHFR at X, with the thumb as the force pointing upwards and index finger pointing along the direction of magnetic field, the middle finger is the direction of the current.	1	
8c	To allow for continuous sliding contact between the coil and the external circuit and preventing the entangling of wires.	1	
		4	

Qn	Marking Scheme	Marks	Marker's Report
9a	${}_{64}^{149}\text{X} \rightarrow {}_{65}^{149}\text{Y} + {}_{-1}^0\text{e} + {}_0^0\gamma$ <i>nucleus Y correct</i> <i>Beta particle and gamma ray correct</i>	1 1	Accept 'β' in place of 'e'
9bi	20 counts per sec	1	
9bii	Allow acceptable <i>concrete, lights, sunlight</i>	1	
9biii	<i>Shows indication of removal of background radiation</i> Removing background: 0h – 60 1h – 30 2h – 15 Half-life = 1.0 h	1 1	
		6	

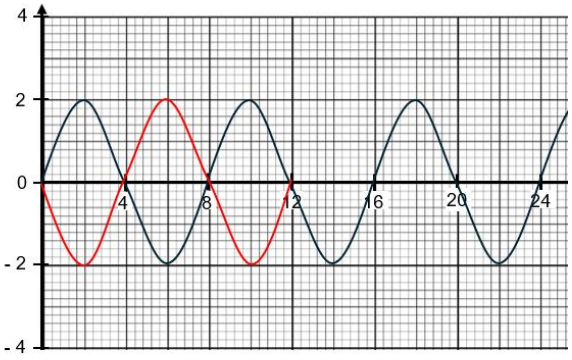
Qn	Marking Scheme	Marks	Marker's Report
10a	$w = mg$ $w = 65 (10)$ $w = 650 \text{ N}$	1	
10bi	$F_R = ma$ $F_R = 65 (0.50)$ $F_R = 33 \text{ N}$	1 1	
10bii	<i>weight acting vertically downwards</i> <i>normal contact force vertically upwards</i>	1	Accept correct values
10biii	Force on the women by floor = 33 + 650 = 683 N = 680 N (2sf)	1	
10ci	$a = \frac{V_F - V_I}{t}$ $0.50 = \frac{V_F - 0}{4.0}$ $V_F = 2.0 \text{ m/s}$	1	
10cii	<i>t = 0s to t = 4.0s: straight line with positive gradient.</i> <i>t = 4.0s to t = 8.0s: horizontal straight line</i> 	1 1	

10ciii	$t = 0\text{s}$ to $t = 4.0\text{s}$: curve with increasing positive gradient $t = 4.0\text{s}$ to $t = 8.0\text{s}$: straight line with constant positive gradient 	1 1	
		10	

Qn	Marking Scheme	Marks	Marker's Report
11a	Energy is transferred to the solar panel by the propagation of waves (light). Some energy is transferred into the internal store of the solar panel and some energy is transferred out of the solar panel electrically. <i>Alternatively:</i> <i>Light energy is...</i> <i>...converted to thermal energy and electrical energy.</i>	1 1 1 1	
11b	Its output is dependent on the amount of sunlight and cloud cover. /Takes up lots of space and space is limited in Singapore.	1	Do not accept: Its costly.
11ci	200 W	1	
11cii	Power is the rate of work done. Power is the work done per unit time.	1	
11ciii	$E = 200(60) + 200(60) + 0 + 0 + 0 + 0 + 800(60) + 800(60) + 600(60) + 600(60)$ $E = 192\,000\text{ J}$ $E = 190\,000\text{ J (2sf)}$	1 1	
11civ	Part ii is calculated with the assumption that the intensity of sunlight remains as stated by the table for the entire 1 min interval without changing.	1	
11cv	1. E per second falling on panel = $600\text{ J} \div 0.3$ = 2000 J 2. Surface area of cell = $2000 \div 200$ = 10 m^2	1 1	
	Total	10	

Paper 2 – Section B

Qn	Marking Scheme	Marks	Marker's Report
12a	$\sin c = 1/n$ $\sin c = 1/1.3$ $c = 50^\circ$	1	
12b	$\angle i = 28^\circ$ and labelled on diagram $1.3 \sin 28 = 1 \sin \angle r$ $\angle r = 38^\circ$ and labelled on diagram <i>light ray bends away from normal</i>	1 1 1	
12c	Ray Q is travelling from optical denser medium to an optical less dense medium . Its angle of incidence is 54° (if not stated can be show on diagram) and greater than the critical angle , hence it would undergo total internal reflection .	1 1	
12di	Red light can only exit the plastic panel at angles of incidence lesser or equal to 50° and would not exit the plastic panel at incident angles of greater than 50° Thus, light only emerges from a circular area centred on the LED.	1 1	
12dii	Blue light is slower in the plastic panel. This means the refractive index of blue light in plastic is greater than 1.3 . This means the critical angle for blue light is less than 50° and blue light would undergo TIR beyond a smaller angle of incidence making the circular area smaller.	1 1	
	Total:	10	

Qn	Marking Scheme	Marks	Marker's Report
13a	The vibration of the whistle pushes and pulls the air particles around it causing them to vibrate and in turn they push and pull the air particles around them (creating a series of compressions and rarefactions) The air particles, in turn, push and pull the diaphragm transferring energy to it. /creating a longitudinal wave that transfers energy to the diaphragm.	1 1	
13b	As the diaphragm vibrates the coil also vibrates... ...and would experience a rate of change of magnetic field lines linking it and by faraday's law, produce an induced emf and thus an output potential difference.	1 1	
13ci	The number of oscillations per unit time.	1	
13cii	$f = 1/\text{period}$ $f = 1/(8 \times 10^{-3})$ $f = 130 \text{ Hz (2sf)}$	1 1	ignoring unit conversion
13ciii	The coil would vibrate at greater frequency. As the output potential is directly proportional to the rate of change of magnetic field lines linking the coil both the frequency and the magnitude would increase.	1 1	
13civ	output potential difference /V  Fig. 13.2	1	
Total:		10	