

Secondary 4 Express Preliminary Examination 2026
Physics 6091
Answer Keys and Marking Scheme

PAPER 1 – 40 M

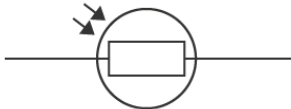
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
D	B	A	D	B	A	C	C	D	D
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	C	B	D	C	B	B	D	A	B
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	C	B	C	A	B	C	C	C	A
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
C	C	D	B	B	A	B	C	B	A

PAPER 2 SECTION A – 70 M

1a	40 s	B1
1b	From 48 s to 54 s, the weight is greater than the lift (or upward force) of the airplane. The resultant force hence airplane moves upward but at constant deceleration, eventually coming to a momentary rest. From 54 to 60 s, the airplane moves downward at constant acceleration. [3 points – 2 marks, 2 points – 1 mark]	B2
1c	$a = \frac{2.0 - (-4.0)}{66-60}$ $= 1.0 \text{ m/s}^2$	C1 A1
2a	$F-45 = 90(1.5)$ $F = 180 \text{ N}$	C1 A1
2b	$\frac{180(40)}{E} = \frac{60}{100}$ $E = 12\,000 \text{ J}$	C1 A1
2c	The perpendicular distance between the line of action of weight through G and the rear wheel decreases. This causes the anticlockwise moment about the rear wheel to decrease.	B1 B1

3a	The internal kinetic energy of water molecules increases.	B1
3b	Convection	B1
3c	Particles in the hotplate gain kinetic energy and vibrate more vigorously. They collide into adjacent glass particles and transfer energy to them.	B1 B1
3d	$P = \frac{4.8}{\pi(0.040)^2}$ $= 950 \text{ Pa (2 sf only)}$	M1 A1
4a	Ultrasound is a longitudinal wave where the particles vibrate in parallel to the direction of ultrasound wave motion.	B1
4b	$d = \frac{1500(0.032 \times 10^{-3})}{2}$ $= 0.024 \text{ m}$	C1 A1
4c	Ultrasound works by reflection of sound, while X rays work by penetration and absorption.	B1
5ai	A region where an electric charge experiences an electric force.	B1
5aii	At least 3 lines to show attraction between charges Point from + to –	B1 B1
5bi	During rubbing, electrons from the hair are transferred to the comb. With more protons than electrons, the hair becomes positively charged.	B1
5bii	Negative charges in the foil are repelled away, inducing positive charges on the side nearer to the comb. The attractive force between the opposite charges is greater than the weight of the foil, the foil moves up towards the comb.	B1 B1
6a	The work done by a source to drive a unit charge around a complete circuit.	B1
6b	$V = 2.0 \times 1.5$ $= 3.0 \text{ V}$	B1
6c	$9.0 - 3.0 = 6.0 \text{ V [ecf from 6b]}$ $R = \frac{6.0}{2.0+2.0}$ $= 1.5 \Omega$	B1 A1

6d	The new wire has higher resistance, hence, the effective resistance of the circuit increases.	B1
	This leads to a smaller current and potential difference in the light bulbs. Light bulbs are less bright.	B1
7a	When the fuse blows and/or switch is opened, the heating coils are completely disconnected from the live wire X at high potential.	B1
	This prevents electric shock if a person touches it.	B1
7b	$I = \frac{2000}{230}$ $= 8.7 \text{ A}$	M1
	Total current = $8.7 + 8.7 = 17.4 \text{ A}$	M1
	Suitable as the 20 A fuse rating is just slightly higher than the current in the circuit.	A1
7c	Earth wire	B1
	The shower system does not have a metallic casing / is non-metal.	B1
8a	The current flowing in the copper wire produces magnetic fields around it, which interacts with the magnetic field of the u shaped magnet.	B1
	This results in a downward force which causes the wire to move down.	B1
8b	Arrow drawn from right to left in the wire between the poles	B1
8c	Increase the emf (reject add more batteries) / Increase current / Attached iron around wire / Change to a stronger magnet	B1
9a	As the wheel spins, it causes a continuous change to the magnetic fields between the poles of the electromagnet.	B1
	(By Faraday's law,) this causes an induced emf in the wheel, which in turns induces a current in the wheel.	B1
9b	(By Lenz's law,) the induced current creates a magnetic field that opposes the rotation of the wheel.	B1
9c	Iron is a soft magnetic material/easy to magnetise, the strength of the electromagnet increases.	B1
9d	The energy in the kinetic store of the metal wheel is transferred mechanically to the internal stores of the metal wheel and the surroundings.	B1 B1

10a	1 neutron from the nucleus of iodine becomes a proton. An electron is emitted during the decay.	B1 B1
10b	${}_{53}^{131}\text{I} \rightarrow {}_{54}^{131}\text{Xe} + {}_{-1}^0\text{e} + {}_0^0\gamma/\text{energy}$ Correct reactant and products Correct nucleon and proton numbers [accept if gamma/energy is not included in the equation]	B1 B1
10ci	Building materials / Waste products from nuclear power station / Radon gas / Rocks / Food that contains potassium	B1
10cii	$5300 - 220 = 5080 \text{ counts/min}$ $3 \text{ half-lives} \rightarrow 5080 \div 2 \div 2 \div 2 = 635 \text{ counts/min}$	C1 A1
10d	Gamma rays. It has high penetrating ability so it can pass through human tissue easily.	B1
11a		B1
11b1	As light intensity increases, the resistance of the LDR decreases.	B1
	By the potential divider formula, the voltage across the LDR decreases.	B1
11b2	As the sum of voltage across LDR and fixed resistor is 6.0 V, the voltage across the fixed resistor increases.	B1
11c	$I = \frac{6.0}{800+1000}$ $= 0.0033 \text{ A}$	C1 A1
11d	$V_{\text{out}} = \frac{4000}{800+4000} \times 6.0$ $= 5.0 \text{ V}$ The output voltage is 5.0 V, which is more than 3.0 V. Therefore, the LED would be turned on.	M1 A1 B1
11e	From 0 V to about 1.5 V, the resistance is infinitely high.	B1
	From 1.5 V to 3.9 V, the resistance decreases as the voltage increases.	B1

11f	LED is more energy efficient than filament. Or LED can be adjusted to operate at desired surrounding brightness.	B1
-----	--	----

PAPER 2 SECTION B – 10 M

12a	650 °C	B1
12b	0 s to 600 s: Solid particles gain energy and vibrate more vigorously about their fixed positions. 600 s to 100 s: Particles gain sufficient energy to overcome the intermolecular forces of attraction, thus beginning to slide past each other.	B1 B1
12c	$Q = 0.300(880)(650)$ $= 170\,000$ (2sf) or $172\,000$ J (3sf)	C1 A1
12d	$P = \frac{171600}{600}$ $= 290$ W (2sf) or 286 W (3sf) [ecf from 12c]	C1 A1
12e	$286(400) = 0.300L_f$ $L_f = 380000$ J/kg (2sf) or 381000 J/kg (3sf) [ecf from 12d]	C1 A1
12f	Heat capacity of the ceramic container / heater are not considered. OR Some energy is transferred into the internal store of the surroundings due to absence of lid.	B1
13a	The ratio of the speed of light in vacuum to the speed of light in the medium.	B1
13b	$2.42 = \frac{\sin 45^\circ}{\sin r}$ $r = 17.0^\circ$	C1 A1
13c	$2.42 = \frac{3.0 \times 10^8}{v}$ $v = 1.2 \times 10^8$ m/s (2sf) or 1.24×10^8 m/s (3sf)	C1 A1

13d	Show that angle of incidence at AB = 28.0° Since light is travelling from optically denser diamond to optically less dense air, and angle of incidence is greater than critical angle, the light ray will be total internally reflected at AB.	M1 B1
13e	Higher refractive index will lead to a smaller critical angle. More light rays will strike at an angle greater than critical angle. Therefore, more total internal reflection.	B1 B1
13f	Refractive index of sweat and grease is greater than that of air. OR The critical angle of light in diamond into sweat and grease increases, leading to fewer total internal reflection.	B1