

Secondary 4 Express Preliminary Examination 2024
Physics 6091
Answer Keys and Marking Scheme

PAPER 1 – 40 M

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

PAPER 2 SECTION A – 70 M

1ai	Speed only has magnitude, but velocity has both magnitude and direction .	B1
1aii	$a = \frac{30 - 40}{27 - 23} \quad [\text{accept any two points from the linear part of the graph}]$ $= -2.5 \text{ m/s}^2$ Ans: 2.5 m/s²	B1 B1
1bi	Accept any point between t = 11 s to 19 s.	B1
1bii	The friction between object and surface is greater than any forward force which causes the resultant force to be negative. By F = ma, the object has a negative acceleration, in the same direction of the resultant force.	B1 B1
2ai	Product of force and perpendicular distance between the force and the pivot.	B1
2aii	$M = 0.30 \times 45$ $= 13.5 \text{ Nm}$	M1 B1
2bi	As the man moves up the ladder, the perpendicular distance between his weight and O increases, producing a clockwise moment. Therefore, the total clockwise moments of his weight and the weight of the ladder increases.	B1 B1
2bii	O	B1

2biii	The weight of the ladder produces an anticlockwise moment about L. For the ladder to balance, there must be an equal clockwise moment about L.	B1
	A normal reaction force between the ladder and the ground will produce a clockwise moment about L.	B1
3ai	Air molecules are always in continuous and random motion .	B1
	They collide with the wall of the piston, exerting a force per unit area . This gives rise to pressure.	B1
3aii	As temperature of air increases, air molecules move faster and collide with the piston more frequently with greater force .	B1
	The air pressure inside the syringe increases and become greater .	B1
3b	Water molecules in hot water have a higher average kinetic energy than cool water.	B1
	Therefore, they only need to absorb just a little more latent heat to overcome intermolecular attractive forces and escape from the water.	B1
3c	Energy in the potential store increases when ice molecules move further apart as they overcome the intermolecular attractive forces .	B1
	However, the energy in kinetic store of ice remains the same because the motion of non-melted ice remains the same.	B1
4a	F T F T Every 2 correct – 1 mark	B2
4b	Rope wave is a transverse wave while ultrasound is a longitudinal wave. [accept other correct difference]	B1
5a	The angle of incidence is zero. / The ray is travelling along the normal. / The ray is entering the boundary at 90°.	B1
5b	Light must move from an optically denser medium to an optically less dense medium.	B1
	Angle of incidence must be greater than critical angle.	B1
5c	$n = \frac{1}{\sin 42^\circ}$ $= 1.49$	M1 A1

6a	The inverse of gradient gives the resistance of the filament. Therefore, N has a greater resistance because it has a smaller gradient. [only B1 if student compares I using same pd]	B1 B1
6b	N has a longer length of wire coiled into a filament./ N has a smaller cross-section area.	B1
6ci	$I = 0.15 + 0.09 = 0.24 \text{ A}$	B1
6cii	$Q = 0.24 \times 10 \times 60$ $= 144 \text{ C}$ [ecf from 6ci]	M1 A1
7a	$I = \frac{40000}{240}$ $= 167 \text{ A}$	M1 A1
7b	$T - (610+70)(10) = (610+70)(2.3)$ $T = 8360 \text{ N}$	M1 A1
7c	energy supplied $= 40000 \times 4$ $= 160000 \text{ J}$ GPE $= (610+70)(10)(13)$ $= 88400 \text{ J}$ efficiency $= \frac{88400}{160000} \times 100\%$ $= 55.3\%$	M1 M1 A1
7d	The casing of the lift is made of metal. If the live wire accidentally touches the metal casing, the lift will be at high voltage. If a person touches the lift, the current will flow from the live wire to the ground via the earth wire. This prevents the person from getting electric shock.	B1 B1
8a	Downward arrow on the spoke that is touching the mercury	B1
8b	The current flowing in the spoke produces magnetic fields around it. These magnetic fields interact with the magnetic fields of the permanent magnet and produce a force.	B1 B1
8ci	Anticlockwise	B1
8cii	Using Fleming's left hand rule, the forefinger points from North to South, the middle finger point down as the current, the thumb points to the right.	B1
9a	Small x $\rightarrow$ as x increases, temperature decreases linearly Large x $\rightarrow$ as x increases, temperature decreases non-linearly	B1 B1
9b	Q has a larger cross-sectional area, more time is required for the rod to gain enough energy to increase the temperature by 1°C.	B1 B1

9c	Particles near the water bath vibrate more vigorously and collide with neighbouring particles, transferring kinetic energy to the other end.	B1
	Free electrons in the metals also move faster and collide with particles, transferring kinetic energy to the other end.	B1
9d	Energy from the rod is transferred to the surrounding through the emission of infrared radiation.	B1
	Air near the rod becomes warmer and expands and becomes less dense and rises. This forms a convection current above the rod.	B1
9e	Iron has a lower specific heat capacity, so it will require less energy compared to aluminium for the same temperature change .	B1
	For the same x away from the water bath, the temperature of the iron rod is higher than aluminium.	B1
10ai	Nuclear fission	B1
10aii	When a neutron is directed into the uranium-235 nucleus, the nucleus split into two daughter nuclei and three neutrons are emitted.	B1 B1
10aiii	${}_0^1n + {}_{92}^{235}\text{U} \rightarrow {}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + 3{}_0^1n$	B1
10b	Energy is transferred mechanically from the nuclear store of the uranium nucleus to the kinetic, internal and nuclear stores of Ba and Kr.	B1
	It is also transferred to the internal stores of the surroundings .	B1
10ci	Beta-particle can penetrate a few millimetres of aluminium .	B1
10cii	The reading will be higher as more beta-particles can pass through aluminium.	B1
10ciii	Beta-particles can penetrate human skin and be absorbed in the body.	B1
	Excessive amounts can kill cells, cause mutation and cancer and stunt children's growth. [mention at least two effects]	B1

PAPER 2 SECTION B – 10 M

11ai	Light dependent resistor (do not accept LDR)	B1
11aii	As the surrounding light intensity increases , the resistance of the LDR decreases .	B1
	Therefore, the voltage across the LDR decreases . If it is below 5.0 V , the lamp will not operate.	B1
11bi	Rate of flow of charge.	B1
11bii	$V = 13 - 8 = 5 \text{ V}$	
	$I = \frac{5}{5000}$	M1
	$= 0.001 \text{ A}$	A1

11biii	$R = \frac{8}{0.001 - 0.5 \times 10^{-3}}$ $= 16000 \, \Omega$	M1 A1
11c	Replace a fixed resistor with a higher resistance	B1
11d	The light will switch on when the surrounding is dark on a cloudy morning or afternoon. / The light will switch off when the sun rises earlier than usual / sky becomes brighter earlier than usual.	B1
12a	As the water waves propagate horizontally, the ball vibrates up and down. As the ball moves downwards, the change in magnetic flux linking the coil induces an emf in the wire, by Faraday's law. By Lenz's law, the direction of current induced is such that a South pole is induced to oppose the incoming S pole. As the ball move upwards, the change in magnetic flux of the magnet also induces an emf in the wire. However, a North pole is induced to oppose the outgoing S pole. Therefore, an alternating current is induced.	B1 B1 B1 B1
12b	The greater the speed of the water waves, the greater the speed of vibration of the ball. By Faraday's law, the magnitude of induced current increases due to a greater change of magnetic flux.	B1 B1
12ci	Friction between water and the wall of the dam and moving parts of the turbine. Therefore, energy from kinetic stores of the water is transferred to the internal stores of the wall and the turbine.	B1 B1
12cii	Singapore is surrounded by water, more feasible to install around Singapore. Hydropower requires large space and destroy habitats. / Efficient in region with difference in altitude.	B1 B1