Secondary 4 Express Preliminary Examination 2025
Physics 6091
Answer Keys and Marking Scheme

PAPER 1 – 40 M

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

PAPER 2 SECTION A – 70 M

1a	The gradient of the graph is not constant.	B1
1b	$v = \frac{60 - 20}{2.4 - 1.4}$ $= 40$ m/s	C1 A1
1c	Speed (velocity) of the ball increases, **air resistance increases until it balances the weight** of the ball. Since **resultant force is zero**, ball moves at maximum constant speed (velocity).	B1 B1
2ai	Zero resultant force	B1
2aii	Constant speed	B1
2b	The resultant force is **equal to the frictional force**. (Or **opposite** to velocity) The box will **decelerate** constantly and comes to a **stop**.	B1 B1
2c	The other force is the reaction force of the **ground on the box**, which is **equal and opposite** to the weight.	B1 B1
3a	$KE = \frac{1}{2} \times 1.2 \times 10^6 \times 0.040^2$ $= 960$J	C1 A1

3bi	$a = \frac{0.040}{0.60}$ $= 0.066667\ m/s^2$ $F = 1.2 \times 10^6 \times 0.066667$ $= 80000N$ $= 80kN$	 M1 M1 A1
3bii	$960 = 80000 \times d$ $d = 0.012m$ [ecf from 3a]	C1 A1
4a	**4.2 J of energy** is transferred into the internal store of **1 g** of water to raise its temperature by **1°C**.	B1
4b	$Q = 250 \times 4.2 \times 30$ $= 32000J(2sf)$	C1 A1
4c	$100 \times 10 \times 60 = m \times 334$ $m = 180g$	C1 A1
5ai	Using a measuring tape, measuring the distance between two wavefronts.	B1
5aii	3.8 m	B1
5aiii	$v = \frac{3.8}{4.0}$ $= 0.95m/s$ [ecf from 5aii]	C1 A1
5b	The speed of wave **decreases** when the depth decreases nearer to shore. Since **frequency is constant**, wavelength decreases.	B1 B1
6a	Electrons in Q is **induced** on the side near to P. Therefore, the positively charged sphere **P moves towards Q** because unlike charges attract.	B1 B1
6b	**Electrons in Q move into P** until both spheres are equally charged. **P then moves away from Q** because like charges repel.	B1 B1
7a	$V = 2.0 \times 9.0$ $= 18\ V$	C1 A1
7b	$I = \frac{4.0}{3.0}$ $= 1.3\ A(2sf)$	C1 A1

7c	**Effective** resistance of the circuit **increases**, leading to a **smaller current and potential difference** in the light bulb. Light bulb is less bright.	B1 B1
8a	When the alternating current changes repeatedly, the polarity at X **alternates between North and South poles**. This causes the magnet to move left and right due to **attraction and repulsion**. As the paper cone **vibrates**, a **series of compressions and rarefactions** are produced, and sound is transferred in the form of longitudinal wave.	B1 B1 B1
8bi	**No continuous sound** is produced (because the paper cone does not vibrate). [Accept only one sound can be heard.]	B1
8bii	The sound becomes **louder** (due to greater vibration).	B1
9a	Due to the **changing magnetic field linking the coil**, **an emf is induced** in the coil and current flows to the ammeter.	B1 B1
9b	The ammeter reading increases and oscillates at a higher frequency. This is due to the rate of rotation of the spindle increases, leading to **greater rate of change of magnetic field**.	B1 B1
9c	$M = 50 \times 0.30$ $= 15$ Nm	C1 A1
10ai	5.36 m 1.24 m	B1
10aii	$s = \frac{5.36 + 1.24}{1.50}$ $= 4.40$ m/s [ecf from 10ai]	C1 A1
10aiii	$GPE = 50 \times 10 \times 6.6$ $= 3300$ J	C1 B1
10aiv	The energy in the **gravitational potential store of boy** is transferred mechanically to his **kinetic store** from O to A. [reject from O to B] As the trampoline stretches from A to B, the energy in the kinetic store is transferred mechanically to the **elastic potential store of the trampoline**.	B1 B1
10bi	2.50 s	B1

10bii	From t = 1.50 to 1.75 s, his average velocity is $\frac{0.098-(-1.24)}{0.25}=8.88\text{m/s}$ which is greater compared to $\frac{2.57-0.98}{0.25}=6.36\text{m/s}$ from t = 1.75 s to 2.00 s. Since the velocity is decreasing, the boy is going through deceleration.	B1 B1
11a	The **nuclear force** within the nucleus is not enough to bind the nucleons together.	B1
11b	It has **2 neutrons and 2 protons** (identical to a helium nucleus).	B1
11c	$^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}\alpha$ B1 – balanced equation B1 – correct reactant and products	B2
11d	**Decay of radium is spontaneous** as it decays due to its unstable nucleus. **No neutron is directed at radium** to start the reaction which occurs in nuclear fission.	B1 B1
11e	$100 \div 2 \div 2 \div 2 = 12.5$ g $8.3 \times 3 = 24.9$ days	C1 A1
11f	Alpha particles are **highly ionising** and can damage the cells that are near them. This could cause cell death, cell mutation or even cancer.	B1 B1

PAPER 2 SECTION B – 10 M

12a	When light moves from the **optically less dense air to optically denser water**, the speed of light **decreases**.	B1 B1
12b	$n = \frac{\sin 20}{\sin 15}$ $= 1.321$ $1.321 = \frac{\sin 60}{\sin r}$ $r = 40.9°$	C1 A1
12c	The angle of incidence in the optically denser medium such that the angle of refraction in the optically less dense medium is 90°.	B1
12d	$1.321 = \frac{1}{\sin c}$ $c = 49.2°$ [ecf from 12b]	M1

	The angle of incidence of ray 2 is 40.9°. As this angle is less than the critical angle, ray 2 will exit the water droplet and bend away from the normal.	B1 B1
12e	Add water into a beaker (or any curved container). Placing an object at less than twice the focal length of the water will produce a magnified image.	B1 B1
13a	With the fixed resistor, the potential difference across it can be varied within a range. This allows the alarm bell to be switched on or off.	B1 B1
13b	90 Ω	B1
13c	$V = \frac{50}{50+90} \times 20$ $= 7.14$ V	C1 A1
13d	When the temperature increases, the resistance of the thermistor decreases. By potential divider rule, the potential difference across the resistor increases, activating the bell.	B1 B1
13e	$P = \frac{20^2}{50+90}$ $= 2.86$ W	B1 B1
13f	The change in output voltage is not significant.	B1