



BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2026
SECONDARY FOUR EXPRESS / G3
Pure Physics 6091
Mark Scheme Papers 1 & 2

Paper 1

1	A
2	A
3	B
4	B
5	A
6	C
7	D
8	C
9	A
10	D

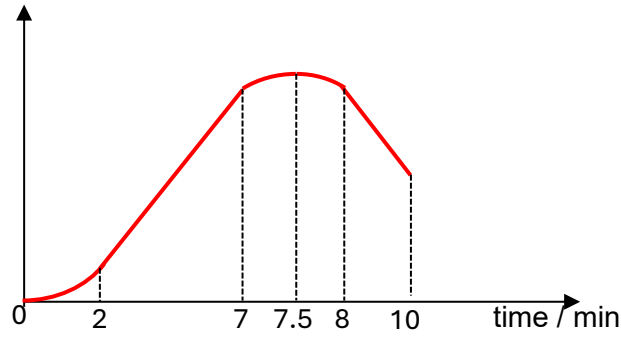
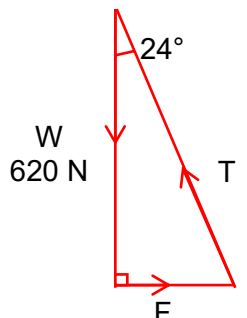
11	B
12	B
13	B
14	D
15	B
16	C
17	A
18	C
19	A
20	D

21	C
22	C
23	D
24	D
25	D
26	C
27	C
28	C
29	A
30	C

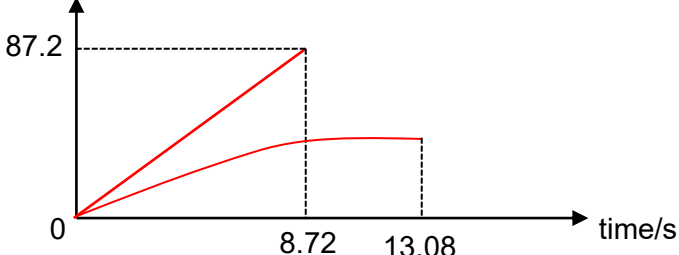
31	D
32	A
33	C
34	D
35	C
36	A
37	B
38	A
39	B
40	C

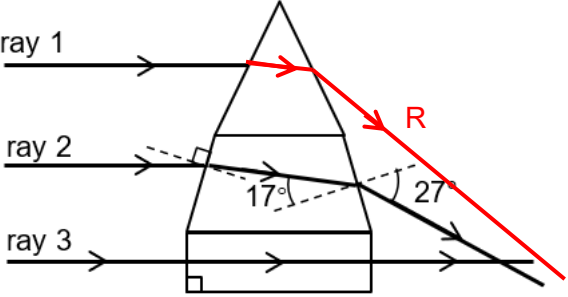
Paper 2

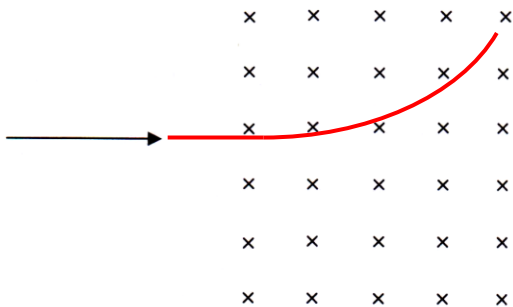
Section A

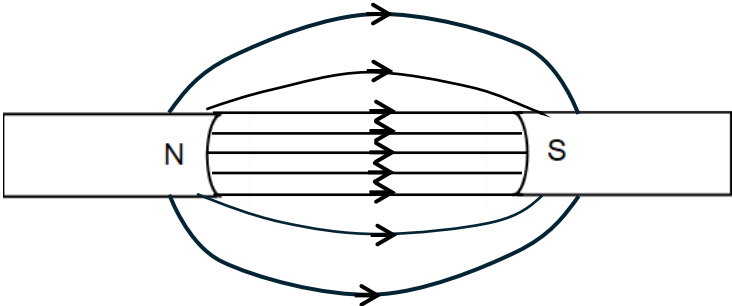
Qn	Answer	Mark	Remark
1a	$\text{acceleration} = (5-0)/(2 \times 60)$ $= 0.042 \text{ m/s}^2 \text{ (2 s.f.)}$	[1] [1]	
1b	Monorail undergoes <u>constant deceleration</u> until it <u>momentarily stops</u> at 7.5 minutes. It continues to <u>accelerate in the opposite direction</u> with the same constant magnitude.	[1] [1]	
1c	Distance from starting point = Area under graph $= \frac{1}{2} (5)(3+5)(60)$ $= 1200 \text{ m}$	[1] [1]	
1d	displacement / m  [1] – correct shape in first 7 seconds, all times labelled [1] – correct shape in last 3 seconds, graph does not return to zero		
2a	 $F = 276 \text{ N}$ $T = 679 \text{ N}$ Scale = 1cm: 100 N	[1] [1]	
2b	Weight of student and the gravitational pull of the Earth by the student OR Tension in rope due to the student's pull and the force exerted on the student by the rope.	[1]	

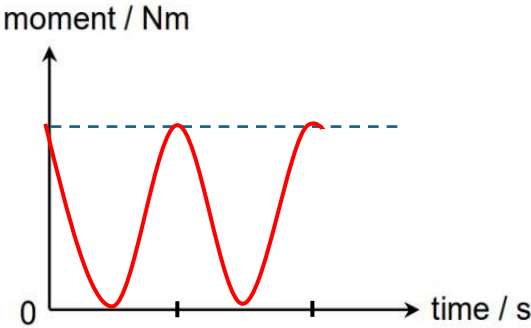
2c	As the angle decreases, the tension T is expected to increase while reaction force F will decrease.	[1]	
3ai	Weight of lorry tyre = $(75)(10)$ = 750 N Pressure in oil = $750 / 0.960$ = 780 Pa (2 s.f.)	[1] [1]	
3aii	Force on piston A = 782 (0.080) = 62.5 N Using POM, ACWM = ACM F(60) = 62.5 (10) F = 10.4 N	[1] [1]	ecf
3b	Oil is in the liquid state, in which particles are closely packed with little or no space in between. This makes oil incompressible and pressure throughout the oil remains the same. Oil particles also slide past one another, thus enabling oil to flow and take the shape of its container.	[1] [1] [1]	
3c	When oil can flow freely through the release valve, pressure in the oil cannot be effectively transmitted since oil at piston B is exposed to the atmosphere via the oil reservoir. The lorry tyre will not be able to be lifted when the handle is pressed, nor when the handle is pulled up.	[1] [1]	
4ai	1300 kg/m ³	[1]	
4aii	Pressure of trapped air = atmospheric pressure + pressure due to column of liquid = $1.01 \times 10^5 + h\rho g$ = $1.01 \times 10^5 + (0.480)(1300)(10)$ = 107 240 = 107 kPa (3 s.f.)	[1] [1]	
4bi	Glass particles nearest the warm liquid gain energy and vibrate more vigorously. They then collide with neighbouring glass particles, causing them to vibrate more vigorously too. As kinetic energy is transferred across the glass, the liquid decreases in average kinetic energy and cools until thermal equilibrium is reached.	[1] [1]	
4bii	x will decrease when glass tube is in cold room. Space between air particles will significantly decrease, causing a reduction in volume occupied.	[1] [1]	

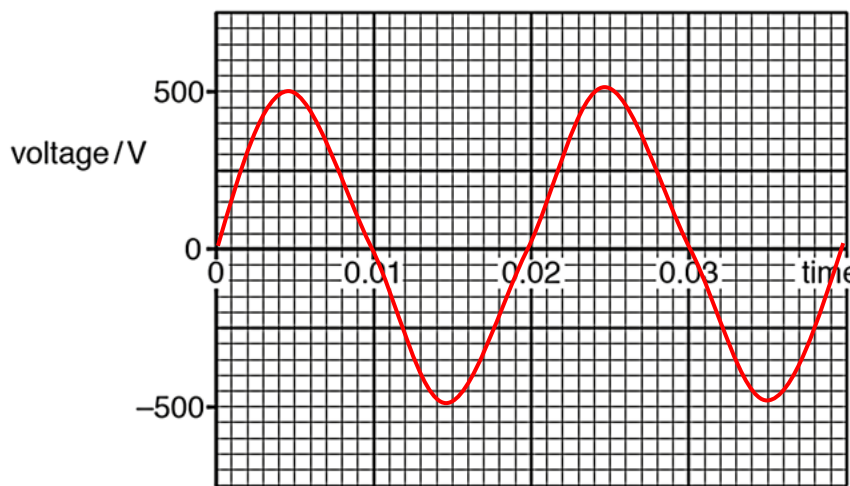
4biii	Density of liquid increases as the liquid contracts. Since hydrostatic pressure difference (hpg) remains the same, height h is expected to decrease as density ρ increases.	[1] [1]	
5ai	Energy cannot be created nor destroyed. It can only be transferred from one store to another. The total amount of energy in an isolated system remains constant.	[1]	
5aii	At the top of the cliff, the stationary pebble has only energy in the gravitational potential store. This is the total amount of energy in the system. As the pebble drops, since energy cannot be created or destroyed, part of the energy in the gravitational potential store is transferred to the kinetic store, making the pebble drop faster. Just before hitting the bottom, almost all of the energy in the gravitational potential store has been transferred to kinetic store. Pebble is at its maximum speed.	[1] [1] [1]	
5b	Using PCOE, Total energy at top = total energy at bottom GPE = KE $m(10)(380) = \frac{1}{2} (m)(v^2)$ $v = 87.2 \text{ m/s}$	[1] [1]	
5c	1. Height of cliff is a quarter lower than the earlier cliff. Ignoring air resistance, height of this cliff can be calculated using PCOE. GPE = KE $m(10)(h) = \frac{1}{2} (m)(87.2 / 2)^2$ $h = 95 \text{ m}$ (i.e. $\frac{1}{4}$ of 380 m) OR 2. Wind or updraft or air resistance could have reduced the maximum speed of the pebble. No change to the cliff height. velocity /ms⁻¹  0 8.72 13.08 time/s Cliff height = area under graph $380 = \frac{1}{2} (t)(87.2)$ Original time taken $t = 8.72 \text{ s}$	[1] [1] [1] OR [1] [1]	

	$380 = \frac{1}{2} (8.72)(u) + (u)(8.72 / 2)$ $u = 43.6 \text{ m/s (i.e. } \frac{1}{2} v)$	[1]	
6a	density = mass / volume $1.04 = \text{mass} / 150$ mass = 156 g	[1]	
6b	$Q_{\text{supplied}} = m_s c_s \Delta \theta_s + m_l v + m_w c_w \Delta \theta_w$ $= m(2200)(120-100) + m(2260000) + m(4200)(100-60)$ $= 2,432,400m$ $Q_{\text{gain}} = m_m c_m \Delta \theta_m$ $= (0.156)(3900)(60-4)$ $= 34070.4 \text{ J}$ $Q_{\text{supplied}} = Q_{\text{gain}}$ $2,432,400m = 34070.4$ $m = 0.0140 \text{ kg}$	[1] [1] [1]	
6c	Heat from the steam is transferred via infrared radiation to the cold milk. Heat is also transferred via conduction from the steam bubbles to the cold milk.	[1] [1]	
7a	$n = \sin i / \sin r$ $= (\sin 27) / (\sin 17)$ $= 1.55$	[1] [1]	
7bi	 Need to show that: 1. R bends in the prism 2. Focal length is now further	[1]	
7bii	Any two of the following: 1. Radio waves 2. Microwaves 3. Infrared waves	[1]	
7biii	Speed of light in a given medium is inversely proportional to its refractive index ($n = c / v$). Since red light has lower refractive index than blue light, its speed is thus greater than that of blue light.	[1] [1]	

8ai	resistance = $200\ \Omega$	[1]	
8aii	temperature = $50\ ^\circ\text{C}$	[1]	
8bi	effective circuit resistance = $(1/100 + 1/1000)^{-1} + 200$ = $290.9\ \Omega$ Using Ohm's Law, $I = 6.0/290.9$ = $0.021\ \text{A}$ (2 s.f.)	[1] [1]	Ecf from 8ai
8bii	Effective resistance of $100\ \Omega$ and $1000\ \Omega$ resistors = $(1/100 + 1/1000)^{-1}$ = $90.9\ \Omega$ Using potential divider concept, $V = 90.9 / (90.9 + 70) \times 6.0$ = $3.39\ \text{V}$ Hence, $P = V^2/R$ = $(3.39)^2/1000$ = $0.011\ \text{W}$ (2 s.f.)	[1] [1]	Ecf from 8aii
8c	Increase in temperature will lead to a decrease in resistance in the thermistor. Since the thermistor and the $100\ \Omega$ resistor are in series (potential divider circuit), the potential difference across the lamp will be higher. With a higher potential difference across the lamp, the power output is greater and the lamp is brighter.	[1] [1] [1]	
9a	The emission of radiation by a radioactive nuclide is unpredictable and it is not possible to determine when it will happen.	[1]	
9bi	Alpha particle	[1]	
9bii	$\text{Po}_{84}^{210} \rightarrow \text{Pb}_{82}^{206} + \alpha_2^4$	[1]	
9biii		[1]	
9c	Initial count rate without background radiation = 20736 Count rate after 140 days with out background radiation = 10368 Ratio = $20736 / 10368 = 2$ Hence, half-life of polonium-210 = 140 days	[1] [1]	

9di	Destroying cancerous cells in radiotherapy during cancer treatment. OR any other medical treatment	[1]	
9dii	Half-life: Iridium-192 should have a shorter half-life so that it makes it safer to handle. Penetrating ability: Due to presence of gamma emission that is highly penetrative, this isotope can be used to penetrate deeper and target a specific spot in the human body. Ionising ability: Iridium-192's gamma rays also have low ionising ability, making it less likely to harm healthy cells in the vicinity of the cancerous cells.	[1] [1] [1]	
10ai	 direction + pattern must both be correct.	[1]	
10aii	Rotation is anticlockwise. In the position shown on Fig. 10.1, arm AB experiences a downward force while CD experiences an upward force. As the coil rotates to vertical position, there is hardly any force that act on the coil. Due to momentum, the coil continues to move. Past the vertical position, the split-ring commutator will reverse the direction of current in the arm AB. This ensures that the force acting on the arm AB is now upwards, hence allowing the coil to continuously rotate anticlockwise.	[1] [1] [1] [1]	

10aiii		[1]	
10aiv	With thicker wire, the resistance of the wire is reduced. By Ohm's Law, the current in the wire will increase since e.m.f. of the battery has remained the same. The force acting on the coil thus increases, making the coil rotate faster.	[1] [1]	
10b	Energy consumed = $(0.050)(7 \times 30)$ $= 10.5 \text{ kWh}$ Cost = 10.5×29.72 $= 312.06 \text{ cents}$ $= \\$3.12$	[1] [1]	
11a	Coil A. It is the primary coil of a step-down transformer (and will have more turns than coil B).	[1]	
11b	• With high voltage, current flowing in the overhead power lines will be reduced, in line with Ohm's Law. • Using $P = I^2R$, with less current, there will be less Joule heating and hence less energy will be dissipated in the power lines. OR • Power lines need not be so thick, hence will be cheaper	[1] [1]	
11c	$N_B / N_A = V_B / V_A$ $50 / N_A = 240 / 25\,000$ $N_A = 5200 \text{ turns (2 s.f.)}$	[1] [1]	

11di		[1]	
	Must have the following: – one complete wave in 0.02 s – voltage consistently reaches 500 V and -500 V		
11dii	Faraday's Law of electromagnetic induction <u>states that the magnitude of the induced e.m.f in a circuit is directly proportional to the rate of change of magnetic flux in the circuit.</u> With frequency halved, the rate of change in magnetic flux is also halved, causing the induced e.m.f. to also be proportionally reduced to 250 V, in line with Faraday's Law.	[1] [1]	
11dihi	When the wings come into contact with the earthed pole, the swallow's legs will be at <u>very high voltage</u> while its <u>wings will be at nearly 0 V</u>. The <u>large potential difference</u> enables <u>current to flow</u> through the swallow, causing deadly electric shock.	[1] [1]	