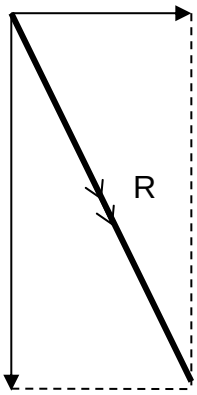
2024 S4 Physics Prelim P2 Answer

unit penalty: deduct [1] per incorrect or missing unit.
s.f. penalty: least s.f. or plus one unless stated otherwise. deduct [1] per paper.

Section A		
Qn	**Ans**	**Marks**
1(a)	Speed is a scalar with only magnitude. Velocity is a vector with both magnitude and direction. speed is scalar and velocity is a vector. [not acceptable, require explanation] define speed and define velocity. [not acceptable]	 B1
1(b)(i)	4.5 s (accept 4.3 – 4.6 s)	A1
1(b)(ii)	The firework is moving upwards from 0 to 4.5 s with decreasing velocity. (It reaches the highest point at 4.5 s) It is moving downwards after 4.5 s. [note: graph shows only 5.0s of motion] ecf for timing using b(i) answer	B1 B1
1(c)	10 m/s^2, downward 10 m/s^2, downward [note: the misconception] units is a must. cannot be negative.	B1 B1
1(d)	Draw the *resultant* correctly (with label R) Resultant = 5.5 x 10 = 55 m/s (to correct sf) (acceptable 54 – 57 m/s)  maximum 1 mark for part (d) if no double arrow for resultant velocity	M1 A1
2(a)	Gravitational force acting on Earth by the barrel.	B1
2(b)(i)	Work done = mgh = 14 x 10 x 3.2 = 450 J (2 sf)	 A1

2(b)(ii)	Energy is transferred mechanically by a force from the chemical potential store of the farmer to the gravitational potential store of the barrel. note: accept no mention of store eg. chemical potential energy to gravitational potential energy	B1
2(c)(i)	P = WD/t 75 = 450/ t t = 6.0 s	 B1 B1
2(c)(ii)	taking downwards as positive, W = mg = 140 N Resultant force = ma = 7.0 N 140 – Fu = 14 x 0.50 Fu = 133 N = 130 N (2 sf)	 M1 A1
3(a)	Water near the base is heated and <u>expands and becomes less dense</u> than the surroundings. The heated water rises and the cooler <u>denser water at the top falls</u>. Convection currents set up.	B1 B1
3(b)(i)	Wood is a poor conductor of heat. Slow down rate of heat transfer (to handle) accept: thermal insulator	B1
3(b)(ii)	Shiny surface is a poor emitter of infrared radiation annotate if student did not mention IR (do not accept reflector, absorber)	B1
3(b)(iii)	Copper is a good conductor of heat. Allows transfer of energy to water through heating.	B1
4(a)	Speed of light Decreases	B1 B1
4(b)(i)	Draw a normal at E, label with X	B1
4(b)(ii)	Read c correctly n = 1/ sin c = 1/ sin 45° = 1.4 (2 sf) allow ecf from 4(b)(i)	C1 A1
4(b)(iii)	Angle of incidence at AC is greater than critical angle. Total internal reflection occurs at E and there is no longer any ray travelling along EC. (describe)	B1
4(c)(i)	Obeys laws of reflection (accept other properties found in the textbook eg transverse waves) (not acceptable to mention ‘does not require medium’)	B1

4(c)(ii)	$V = f\lambda$ $3.0 \times 10^8 = f\ (690 \times 10^{-9})$ $f = 4.3 \times 10^{14}$ Hz	 M1 A1
5(a)	I varies linearly with V (resistance is constant) and passes through origin for the resistor. [Do not accept: I is directly proportional to V (only)] describe the features of the graph	B1
5(b)	7.0 V. do not accept 7 V must have unit	A1
5(c)	R = V/I = 8/5.2 =1.5 Ω (choose a point that can be read accurately from the grid provided) (accept if V = 4 V and I = 2.6 A) Rx = 1.5 x 2 /9 = 0.33 Ω (2 sf)	C1 A1
5(d)	Q = I x t = P/V x t = 12/6 x 12 x 3600 (C1 is for either correct sub for P/V or correct conversion) = 86 000 C Accept if student use I = 4.4 A (from graph). Q = 190 000 C.	 C1 A1
6(a)	V_{out} = 600/(600 + 8000) x 12 = 0.84 V	C1 A1
6(b)(i)	V = 12 V – 8.0 V = 4.0 V	B1
6(b)(ii)	4/12 = 8000/ (R + 8000) R = 16000Ω	A1
6(c)	When light is dim, Vout is low and when light is bright, V_{out} is high. The light will switch on when the light is bright.	B1 B1
7(a)	First finger – magnetic field Second finger – current	 A1
7(b)(i)	split-ring commutator carbon brush(es)	 A1
7(b)(ii)	Interaction of magnetic field from current and permanent magnet produces an upward force at the side of coil near to N-pole, while the side of the coil near to S-pole acts downward. (or using Fleming's LHR) The pair of forces create a turning effect (couple) about the axle.	B1 B1

8(a)	As the copper rod rolls down, there is cutting of magnetic flux, by Faraday's Law of EMI, an emf is induced in the rod. OR There is an increase in the area of circuit (including rod. Rail & voltmeter) and hence an increase in magnetic flux linking the circuit (rod and wires), by Faraday's Law of EMI, an emf is induced in the rod.	B1 B1 B1 B1
8(b)	deflect more The rod rolls faster, increase in the rate of change of magnetic flux	B1
8(c)	The circuit is closed, there is induced current. By Lenz's Law, the direction of the induced current opposes the change (downward movement) producing it. This slows down the movement.	B1 B1
9(a)(i)	80°C	A1
9(a)(ii)	26 min	A1
9(b)(i)	P = IV = 2.5 x 50.0 = 130 W (2 sf)	 A1
9(b)(ii)	energy supplied = 125 x 9 x 60 = 67500 J 0.80 Pt = mL_f 0.80 x 125 x 9 x 60 = 200 L_f L_f = 270 J/g	B1 C1 A1
9(c)	Lv is larger than Lf. (in the ratio of 14:9) The time taken needed for the change in state is longer.	B1 B1
9 (d)	Straight line instead of curve No change in the melting and boiling point.	B1 B1
9 (e)	Internal energy is an energy store that is made up of the total kinetic energy associated with the random motion of the particles and the total potential energy between the particles in the system (wax).	 B1
10(a)	Tick in alpha (least) and gamma (most)	A1
10(b)(i) 1.	The exact time when a nucleus decay cannot be pre-determined	B1
10(b)(i) 2.	Not triggered/ affected by external factors such as temperature and pressure.	B1
10(b)(ii)	$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$ 1 mark for correct values for Am and Np 1 mark for correct values for He	 A1 A1
10(c)	Emits alpha which will not penetrate through the detector.	B1

10(d)(i)	Since half-life is the average number of years for the radioactive substance to decay to half of its original amount, the half-life is 400 years	C1 A1
10(d)(ii)	The decrease in activity is insignificant comparing to the half-life and the lifespan of 10 years.	 B1
11(a)(i)	S N N S	B1
11(a)(ii)	Place the compass near the north pole of the bar magnet Mark the end points of the compass needle on the paper eg X and Y Move the compass so that one end of the compass coincides with one of the marked points. Mark a third point at the other end of the compass needle. Continue doing this until the compass reaches the south pole. Join the dots smoothly to get one magnetic field line.	B1 B1 B1
11(b)(i)	As iron is a magnetic material, the bar magnet will magnetise the pieces of iron with an opposite pole on the side facing the magnet. Unlike poles attract.	B1 B1
11(b)(ii) 1.	Electrons transferred from woollen cloth to rod. Rod has excess negative charges.	B1
11(b)(ii) 2.	The electrons on the upper surface of aluminium will be repelled by the rod, leaving more positive charges on upper surface and more negative charges on lower surface. There is a force of attraction on the upper surface and force of repulsion on the lower surface. However, the upper surface is closer to the rod and so attraction is stronger. Hence, the aluminium foil is attracted.	B1 B1 B1
12 (a)	When a body is in equilibrium, sum of clockwise moments about a pivot is equal to sum of anticlockwise moments about the same pivot.	B1
12(b)(i)	Take moments about the pivot, F x 1.2 = 185 x 0.40 + 1100 x 1.8 F = 1700 N	 C1 B1
12(b)(ii)	F = 1700 +185 +1100 = 2990 N = 3000 N (2 sf)	A1
12(c)(i)	P = hpg = (242 – 82)/1000 x 13600 x 10 = 22 000 Pa (2 sf)	C1 A1

12(c)(ii) 1.	No change in distance	B1
12(c)(ii) 2.	Distance h increases	B1
12(d)	As temperature increases, average kinetic energy/ speed increases. Frequency of collisions increases and greater force exerted onto walls of the cylinder for each collision.	B1 B1