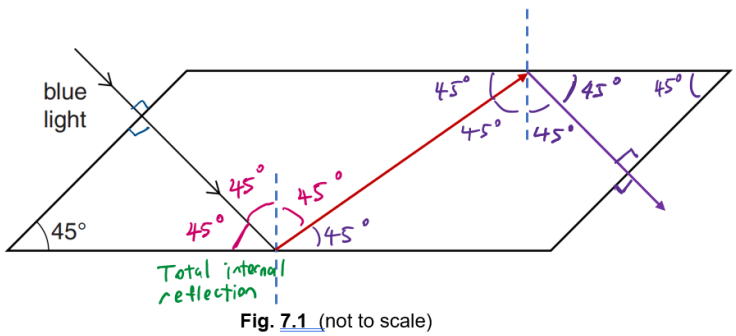
PRESBYTERIAN HIGH SCHOOL
SCIENCE DEPARTMENT
MARKING SCHEME

Subject: Physics Paper 2 Exam: Preli
Setter: Year: 2024
Level: Sec 4 Express

Section A (70 marks)

Q/N		Suggested Answer	Sub-total	Total
1	a	speed is a **scalar quantity** and velocity is **a vector quantity**. **OR** Speed is defined as distance travelled per unit time. Velocity is defined as the rate of change of displacement.	B1	1
	b	Change in velocity = -22 – 25 = - 47 m/s **OR** Change in velocity = 22 – (-25) = 47 m/s acceleration = (v – u) / t = 47/0.013 = 3600 m/s^2	M1 A1	2
	c	Resultant force, F = ma = (0.16)(3600) = 576 N or 580 N **allow for e.c.f**	 A1	1
2	a	mass of concrete = (1750)(4 x 3 x 0.1) = 2100 kg W = mg = (2100)(10) = **<u>21 000 N</u>**	 A1 A1	2
	b	Total CM = Total ACM F x 0.5 = 21 000 x 1 **<u>F = 42 000 N</u>**	 M1 A1	2
	c	total upward force = 42 000 + 21 000 = **<u>63 000 N</u>** **allow for e.c.f**	A1	1
3	a(i)	$(G.P.E)_T + (K.E)_T = (K.E)_B$ (85)(10)h + ½ (85)(2)^2 = ½ (85)(30)^2 h = 44.8 m or 45 m	 M1 A1	2
	a(ii)	All **energy** in the gravitational potential store of the skier is **transferred to the kinetic store**. OR **No energy is transferred to the internal** store of skier and the surroundings **due to work done against friction.**	B1	1
	b	WD against opposing force = K.E F x 33 = ½ (85)(30)^{2,} F = 1159 N = 1160 N (3 s.f) or 1200 N	 M1 A1	2

4	a(i)	Force = pressure × area = (3.8 × 10^5) (6.1 ÷ 100^2) = 232 N or 230 N	M1 A1	2
	a(ii)	**force on other side of piston due to air / atmospheric pressure** OR **pressure of trapped air decreases as valve opens (and air enters the tyre)**	B1	1
	b	The temperature rise of the air will **increases** the **average speed of the air molecules or K.E of the molecules** inside the pump. This means the **speed and frequency of collision by air molecules on the walls** of piston and pump will also increase, causing **an increase in the average force exerted** by air molecules on walls of piston, **increasing the air pressure inside the pump.**	B1 B1	2
5	A	amplitude = 1.5 cm	B1	1
	b(i)	Distance between A and B about = λ/4 = 38 cm λ = 38 x 4 = 152 cm V = f λ = (1/0.8) (152) = 190 cm/s ≈ 200 cm/s	M1 M1	2
	b(ii)	Distance between A and B could be 5λ/4, or 9λ/4 etc…	B1	1
6	a	Some **reflect** (some**) pass into new material or** (some) **absorbed** by material	B1 B1	2
	b	Time interval = 0.03 ms = 0.03 × 10^{-3} s distance between emitter and the child = 1500 x (0.03 × 10^{-3}) /2 = 0.023 m	M1 A1	2
7	a	The light ray is **not refracted** when it enters the glass block at **right angle such that the angle of incidence is zero.**	B1	1
	b	 **Fig. 7.1** (not to scale)		3

		All angles indicated correctly Total internal reflection along bottom edge Total internal reflection along top edge and emerge out	M1 B1 B1	
8	a	The sphere will become **positively charged** as **negative charges will flow from the sphere to the earth/ground.**	B1 B1	2
	b	The sphere will **become less positively charged or neutral** as **negative charges will flow from earth/ground into sphere**.	B1	1
9	a	Total cost = (0.2 kW x 24 h) x \$ 0.30 = \$ 1.44	M1 A1	2
	b	Total current = 120/230 + 40/230 + 40/230 = 0.87 A	 A1	1
	c	1A fuse rating	A1	1
		The switches are placed along the live wire so that the **electrical appliances will not be "live" or at high electric potential even if the switch is open.**	 B1 B1	2
10	a	The copper wire placed in an external magnetic field will **experiences a force**, **resulting from the interaction between the magnetic fields of the magnet and current-carrying copper wire.**	B1 B1	2
	b	To the left	B1	1
11	a	V_s = (44000 / 4000) x 25 = 275 kV Using $I_pV_p = I_sV_s$, $100 \times 10^6 = I_s \times 275000$ I_s = <u>364 A (3 s.f.) or 360 A</u>	 M1 A1	2
	b	Electrical power is transmitted at a **high voltage** so that the **transmission current will be low**. This reduces **power loss due to heating effect** [1] in the transmission cables.	B1 B1	2
	c	20MW = power loss $I^2R = 20 \times 10^6$ R = 151	M1 A1	2
12	a	Size of ice cube, size of bowl, temperature of surroundings	B1	1

	b	Polystyrene, as the rate of melting is slower. e.g The mass of water collected after 25 min is 30 g without lid for polystyrene, and 79 g without lid for paper cupboard.	B1 B1	2
	c	With lid, air is trapped within the box. Air is a poor thermal conductor which reduces the rate of energy transfer through conduction. The lid can reflect some of the radiation from external sources, such as sunlight or warm objects nearby, reducing the amount of radiation that reaches the ice. OR With lid, thermal energy gained through radiation is reduced.	B1 B1	2
	d	Bag should be painted as white because white surface is poor absorber of infra-red radiation. This will slow down the rate of energy transfer by radiation and the melting of ice.	B1 B1	2
	e	Cooling of water from 25 ^{o}C to 0 ^{o}C: Q = 0.5 x 4.2 x 10^3 x 25 = **52500 J** Freezing of water: Q = 0.5 x 3.4 x 10^5 = **170 000J** Cooling of ice from 0 ^{o}C to -3 ^{o}C: Q = 0.5 x 2.1 x 10^3 x 3 =**3150 J** Total Q = **225 650 J = 226 000 J**	 M1 M1 A1	3
13	a(i)	atoms 3 and 4	A1	1
	(ii)	atoms 3 and 5	A1	1
	b	daughter nucleus has 1 more proton and 1 less neutron than the parent nucleus	B1	1
	c(i)	➢ cosmic rays from outer space. (natural) ➢ Radon gas in the air (natural) ➢ Waste products from nuclear power stations (Man- made) ➢ Some building materials, like granite, contain radioactive elements. (Man-made)	Any two B1	2
	(ii)	The half-life of a radioactive isotope the is the time taken for the number of radioactive nuclei to decay to half of its original value. OR time taken to halve (number of) nuclei/atoms/activity/count (rate)	B1	1
	(iii)1.	count rate, at time = 0, due to the sample on its own = 49 – 22 = 27 counts/minute	 A1	1
	(iii)2.	Use 27/2 or 27/4 or 27/8 half-life from 80 to 90 days	B1 B1	2
	d(i)	(background count-rate is) reduced Not to zero as some gamma-rays in background count can still penetrate the lead casing.	B1 B1	2
	d(ii)	Not sensible	M1 A1	2

		All the beta-radiation would be absorbed or no beta-radiation reaches the detector		
		Section B: 10 marks for each question		
14	a	kinetic energy = ½ (0.16)(8.8)^2 = 6.2 J	 A1	1
	b(i)	 time = 0.88 seconds	A1	1
	b(ii)	distance travelled = ½ (8.8)(0.88) = 3.872 m Allow for e.c.f	M1 A1	2
	c(i)	energy in the kinetic store of the ball is **transferred to internal store of the ball as well as internal store of the surrounding.** Some of the energy in the kinetic store of the ball is **transferred to the surrounding air in the form of sound waves**.	 B1 B1	2
	c(ii)	acceleration = (0 – 9)/(1.84 – 1.80) = - 225 m/s^2 F = ma = (0.16)(225) = 36 N	 M1 A1	2
	d	smaller time to drop to zero velocity / hit ground line not straight or velocity does not change uniformly or gradient not constant smaller area under (first part of) graph less distance travelled // slower final velocity // initial downward gradient steeper	B1 B1	2
15	a	A source has an e.m.f. of 9 V means that **9 J of work done by the source to move each unit charge** (1 C) around a complete circuit.	B1 B1	2
	b(i)	Charge = current x time = 1.5 x 600 = 900 C	 A1	1
	(ii)	Total resistance = 9 / 1.5 = 6.0 Ω Resistance of cylinder = 6 -4 = 2.0 Ω	 A1	1
	c	 New resistance of cylinder = 2 x 4 = 8.0 Ω New current = 9 / (8 + 4) = 0.75 A Time = charge / current = 900 / 0.75 = 1200 s	M1 M1 A1	3
	d(i)	 As the **current and e.m.f. decrease**, **the temperature** of the metal filament also **decreases**. This results in a **decrease in the resistance of the filament lamp**.	 B1 B1	2
	(ii)	greater than 0.75 A.	 B1	1