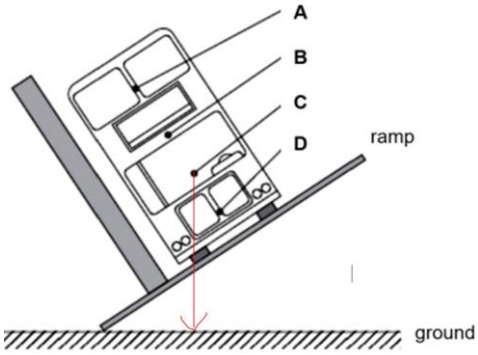
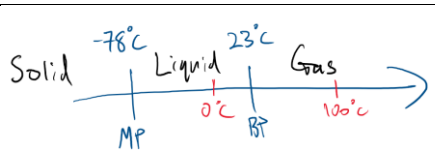
Serangoon Garden Secondary School
4NA Science(Physics) (5105) Prelim 2022
Mark Scheme

PAPER 1

Qn	Ans	Explanation
1	C	
2	B	Reading on vernier scale = 1.56 cm Diameter of one ball bearing = 1.56 cm / 3 = 0.52 cm
3	D	Speed is represented by the gradient (slope or steepness) of a distance-time graph Consider how in option D, the distance increases by the same amount every second.
4	C	F_R = 4000 – 1000 = 3000 N a = F_R / m = 3000 / 1200 = 2.5 m/s^2
5	C	
6	C	
7	C	The piston moves to the right because the air expands. The air expands because the molecules move about faster and further apart. The molecules **do not** change in size. The molecules also do not increase in number, as it is a sealed cylinder.
8	B	As the ice continues to be heated, it continues to gain thermal energy. The thermal energy gained is used to overcome the forces of attraction between molecules. The molecules do not gain kinetic energy, hence there is no change to the temperature of the ice.

9	D	
10	D	The temperature of the liquid decreases because of evaporation. When the more energetic particles in the liquid escape into the air, it leaves behind the less energetic particles. This **decreases the average kinetic energy** of the particles in the liquid.
11	A	
12	B	Distance between 2 successive wavefronts is one wavelength. Hence, X to Y is **two** wavelengths. One wavelength = 1.6 cm / 2 = 0.8 cm
13	C	
14	C	All EM waves travel at the speed of light!
15	B	Speed = distance travelled / time taken = (400 x 2) / 2.5 = 320 m/s *(distance travelled is 400 x 2 because the sound travels to the wall and back in 2.5 s!)*
16	B	Conventional current flows from positive to negative. Electron flow flows from negative to positive (electrons are repelled from negative terminal of battery and attracted towards positive terminal)
17	C	In a series circuit, **sum of p.d. across components = p.d. across whole circuit (e.m.f. of battery)** p.d. across identical resistors are the same (in a series circuit). So, $V_{resistor} + V_{lightbulb} + V_{resistor} = V_{emf}$ $1.0 + V_{lightbulb} + 1.0 = 6.0$ $V_{lightbulb} = 6.0 - 2.0$ $= 4.0$ V

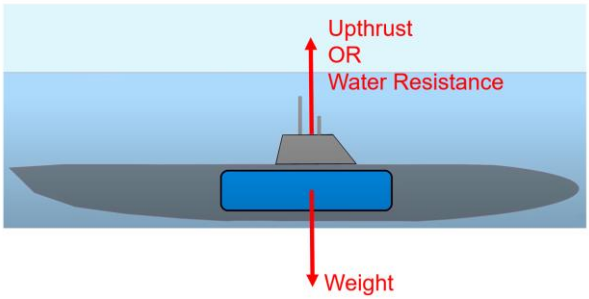
18	D	First, find p.d. across 4.0 Ω branch: V = RI = (4.0)(1.0) = 4.0 V Since p.d. across parallel branches are equal, p.d. across 2.0 Ω resistor = 4.0 V so, $I_{2.0\Omega}$ = V / R = 4.0 / 2.0 = 2.0 A
19	C	
20	B	The fuse must be connected to the live wire!

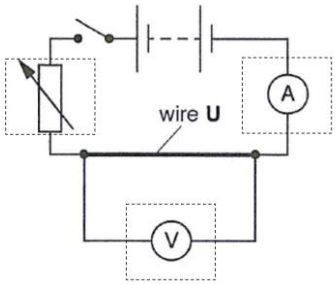
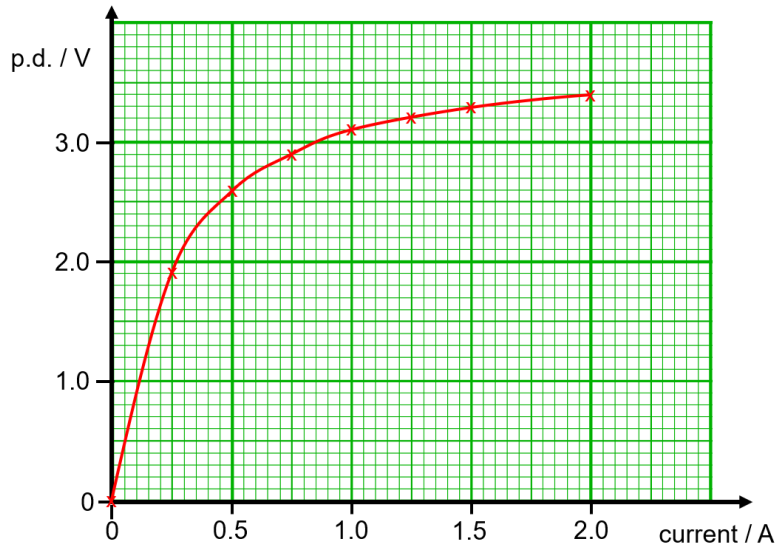
PAPER 2: Section A

Question			**Answer**	**Marks**
1	**(a)**	**(i)**	4.0 m/s	1
		(ii)	8.0 m/s	1
	(b)		Speed decreases at an increasing rate **OR** Increasing deceleration	1
	(c)		Distance travelled = area under speed-time graph = ½ x 5.0 x 8.0 = 20 m	1 1
2			Snow chains decrease the area of the tire in contact with the ground. This increases the pressure, allowing it to dig into the ice, providing better grip.	1 1
3			Since the see-saw is balanced, We use the Principle of Moments: Sum of ACW moment = sum of CW moment 240 x 1.9 = *W* x 1.2 *W* = (240 x 1.9) / 1.2 = 380 N (Award 1 m for either demonstrating POM **OR** moment = Fxd)	 1 1

4	**(a)**		60 J **Explanation:** GPE = mgh Initial GPE = (5.0)(10)(1.2) = 60 J Final GPE = 0, since h = 0 Therefore, change in GPE = 60 J	1 1
	(b)		60 J **Explanation:** As it falls, GPE is converted to KE. Just as it hits the floor, all of the GPE is converted to KE. (no energy is lost to the surrounding since air resistance is ignored) So, Final KE = change in GPE = 60 J	1
	(c)		KE = ½ mv^2 60 = ½ (5.0)v^2 v^2 = (60 x 2) / 5.0 v^2 = 24 v = $\sqrt{24}$ = 4.90 m/s	1 1

PAPER 2: Section B

Question			Answer	Marks
5	(a)		Density = mass/volume = 2 100 000 / 2400 = 875 kg/m^3	1
	(b)	(i)	Mass of water added = density x volume = 1000 x 500 = 500 000 kg New mass of submarine = 2 100 000 + 500 000 kg = 2 600 000 kg W = mg = (2 600 000 kg)(10 N/kg) = 26 000 000 N	1 1 1
		(ii)		1
		(iii)	They are equal in size	1
	(c)	(i)	longitudinal	1
		(ii)	Sound waves travel through vibration of particles. Since particles are closer together in water than in air, the vibrations are passed more quickly through the medium.	1
6	(a)		Chemical potential Energy of battery converted to Thermal Energy of water (Accept CPE → Electrical Energy → Thermal) Do not accept: "Chemical Energy", "Heat Energy"	1
	(b)		Heated water at the base of the mug expands become less dense and rises. Cooler, denser water above falls and will be heated by the heater. Cycle repeats, forming convection currents.	1 1
	(c)		(Smooth silver surfaces are) poorer emmiters of infrared radiation **OR** poorer radiators of thermal energy Reduce heat loss from the hot mug to the cooler surroundings. Helps it to keep the liquid inside the mug warm for a longer time.	1 1
	(d)	(i)	P = VI = 12 x 15 = 180 W	1 1

		(ii)	The normal operating current of the heater (15 A) is already higher than the fuse rating (12 A). Hence it is not suitable as the fuse would blow when the heater is in use normally.	1
7	**(a)**		 Ammeter and variable resistor are interchangeable. 1m for at least **one** correct symbol	2
	(b)	**(i)** **(ii)**	 1m for points plotted correctly with small x 1m for smooth curve joining all points drawn	2
		(iii)	No. current is not directly proportional to p.d. (reject "a curve")	1
		(iv)	R = V/I = 3.4 / 2.00 = 1.7 Ω	1
	(c)		To find resistance of resistors connected in parallel: $\frac{1}{R_{4\Omega+6\Omega}} = \frac{1}{4} + \frac{1}{6}$ $\frac{1}{R_{4\Omega+6\Omega}} = \frac{5}{12}$ $R_{4\Omega+6\Omega} = \frac{12}{5}$ = 2.4 Ω Combined resistance of all 3 resistors = 2.4 + 3 = 5.4 Ω	1 1