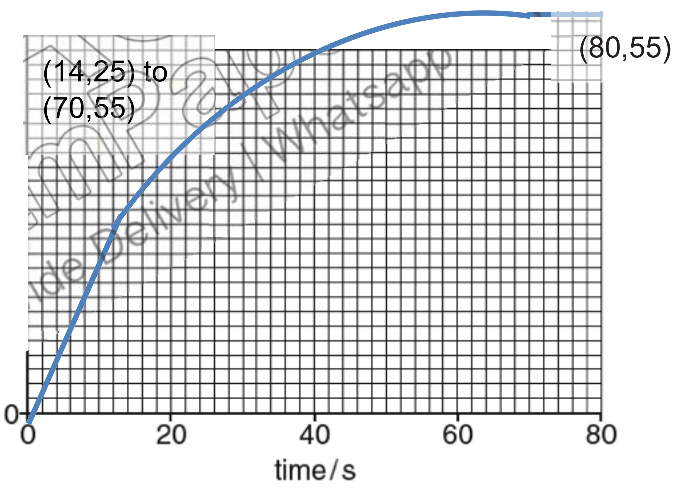
Answers:

1	2	3	4	5	6	7	8	9	10
C	D	B	B	A	C	D	A	D	C
11	12	13	14	15	16	17	18	19	20
D	B	C	B	B	B	C	B	A	B
21	22	23	24	25	26	27	28	29	30
B	D	C	C	B	A	B	D	B	B
31	32	33	34	35	36	37	38	39	40
C	B	C	D	D	C	B	D	A	A

Methodist Girls' School
Physics Sec 4 Preliminary Examination 2019
Marking Scheme

Section A

Question	Answer		Mark
1(a)(i)	(1.24 + 1.14 + 1.16) ÷ 3 = **1.18 s**		A1
1(a)(ii)	- find time interval between 21 (appropriate no.) drops of water hitting the ground, t		B1
	- find the average timing for the time interval between two drops using T_1 = t/20 = t / (no.of drops - 1)		B1
1(b)(i)	GPE = mgh = 0.001 x 10 x 12		C1
	= **0.12 J**		A1
1(b)(ii)	KE = GPE		
	½ mv^2 = 0.12		
	½ (0.001) v^2 = 0.12		C1
	v = **15.5 m/s** OR **15 m/s**	e.c.f.	A1
1(b)(iii)	Velocity will **remain unchanged.**		B1
	As ½ mv^2 = mgh, m will be cancelled in this equation. As, height and g remain unchanged, v calculated will be the same.		B1
	OR Acceleration due to free fall is constant, therefore, all masses falls with the same velocity.		
2(a)(i)	a = v–u / t = 25 / 14		C1
	= **1.79 m/s²** OR **1.8 m/s²**		A1
2(a)(ii)	B1 – shape from 14 to 80 s		
	B1 – correct coordinates		



Question	Answer		Mark
2(b)(i)	force backwards on driver / car		B1
	OR force produced by seat belt		
2(b)(ii)	mass of bag resists change from state of motion		B1
	OR bag has inertia		
3(a)	weight = mg = 40 000 x 10 = **400 000 N**		A1
3(b)(i)	F = ma = 40 000 x 1.25		C1
	= **50 000 N**		A1
3(b)(ii)	resultant F = Thrust – weight		
	50 000 = Thrust – 400 000		C1
	Thrust = **450 000 N**	e.c.f.	A1
3(c)	As the fuel is used up, the **total mass (weight) of the rocket and fuel decreases**,		

	thrust remains the same, resulting in an **increase in resultant force**.	B1
	Hence, **resultant force and acceleration will increase**.	B1
4(a)	Density of bulb A greater than the density of the water (and sinks) AND Density of bulb E less than the density of water (and float)	B1
4(b)(i)	Water / Glass is a poor conductor of heat OR water / glass conducts heat at a slow rate OR water / glass has a high (specific) heat capacity	B1
4(b)(ii)	The **water expands and becomes less dense** when temp increase.	B1
	Bulb B now has a greater density than the water (and sinks) OR Weight of bulb B more than buoyancy forces / upthrust	B1
5(a)	The principle of moment states that **for an object in equilibrium**,	B1
	the **sum of clockwise moments about a point** is equal to the **sum of anti-clockwise moments about the same point**.	B1
5(b)(i)	Moment = 7.2 x 1.5	C1
	= **10.8 Ncm (0.108 Nm)**	A1
5(b)(ii)	*F* = 10.8 / 9.0 e.c.f.	C1
	= **1.2 N**	A1
6(a)(i)	Pressure = Force / Area	
	= 50 / 1.5	C1
	= **33.3 N/cm^2** OR **3.33 x 10^5 N/m^2 (Pa)** OR **333 kPa**	A1
6(a)(ii)	*F* = Pressure x area	
	= 33.3 x 5.0 e.c.f.	C1
	= **167 N** OR **170 N**	A1
6(b)	the displaced volume of oil remains the same, as the larger piston with larger cross-sectional area results in a smaller d	B1
	OR Work done = Fd and when work done is constant, distance is small when force is large	
7(a)	resistance (of X) decreases	B1
	current (in coil) increases or more voltage across coil and either relay switch closes or circuit (to bell) complete	B1
7(b)(i)	V = 1.5 $\times 10^{-3} \times$ 2000	C1
	= **3.0 V**	A1
7(b)(ii)	12 – 3 = **9.0 V** e.c.f.	B1
7(b)(iii)	I flowing through bell = 12 / 200 = 0.06 A or 60 mA	C1
	I in battery = 1.5 + 60 mA or 0.0015 +0.06 A = **61.5 mA or 62 mA** = **0.0615 A or 0.062 A**	A1
8(a)	motor / fan AND lamp	B1
8(b)	motor / fan speed decreases / slows down	B1
8(c)	hazard: live wire touching case **AND** user gets electric shock / burns OR electrical fire due overheating / wire gets hot	B1
	safety feature: case is earthed OR connect earth wire to the metal case	B1
9(a)	lines that are further apart shows **weaker** magnetic field strength OR lines that are closer shows **stronger** magnetic field strength	B1
9(b)	magnetic field goes through soft iron OR no field through paper clips **paper clips lose their (induced) magnetism / cannot be magnetised**	B1

Section B

10(a)	vibrate / oscillate in the same direction or parallel to transfer of energy or wave			B1
10(b)	sound travels faster in solid (earth) compared to air			B1
10(c)(i)	Distance	= 330 x 0.10		C1
		= **33 m**		A1
10(c)(ii)	Speed	= 33/0.02		
		=**1650 m/s**		A1
10(d)	As the sound wave <u>bends away from the normal</u> as it travels from earth to rock, its speed in rock is **faster** than earth.			B1 B1
10(e)	Wave must travel from a region of lower speed to a region of higher speed. Angle of incidence is larger than critical angle from a region of lower speed to a region of higher speed. B1			B1
10(f)	pressure increases and decreases			B1

11 **(a)** Fig. 11.1 shows an open tray for storing water.

It is noticed that the level of water inside the tray slowly decreases as water evaporates.

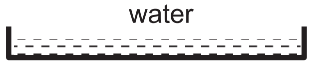


Fig. 11.1

(i) Using ideas about molecules, explain how the temperature of the water is affected when it evaporates.

11	**a**	**i**	Faster moving molecules escape from the attraction of their neighbours and leave surface of the liq. Leaving behind slower moving molecules Avg KE dec and temp dec	**B1** **B1** **B1**

....

....

....

.... [3]

(ii) Fig 11.2 shows a sheet of plastic used to cover half the surface of the water.

Fig. 11.2

State how this affects the rate of evaporation.

....

.... [1]

		ii	Rate of evaporation dec	**B1**

(b) Liquid air contains a mixture of oxygen and nitrogen. The boiling point of nitrogen is lower than oxygen. A sample of liquid air in a beaker is allowed to warm up slowly.

Fig. 11.2 shows how the reading of a thermometer in the beaker varies with time *t*.

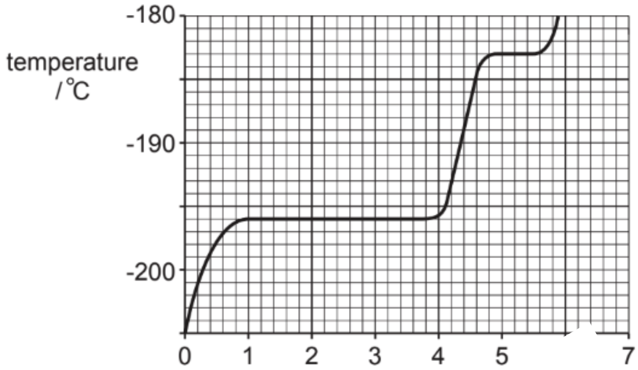
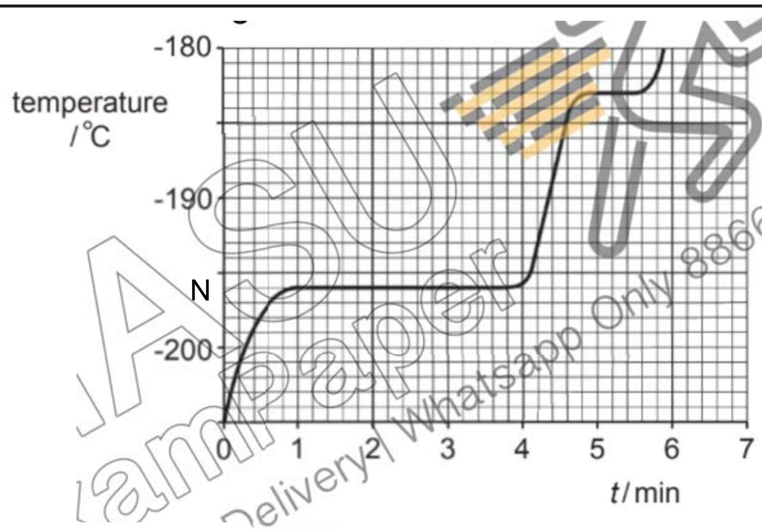


Fig. 11.2

	b	i		B1

(i) On Fig 11.2, label the boiling point of nitrogen, N on the temperature axis. [1]

(ii) The liquid air contains 200 g of liquid oxygen and 800 g of liquid nitrogen. Table 11.3 shows the table of specific heat capacity and specific latent heat of both gases.

	specific heat capacity J/(g°C)	specific latent heat of vaporisation J/g
oxygen	1.7	213
nitrogen	2.0	199

Table 11.3

Determine

(1) the thermal energy absorbed by the combined liquid air to reach the temperature at the 1 min mark.

thermal energy = ……………………..[2]

(2) the total thermal energy absorbed by the combined liquid air to reach the 4 min mark.

thermal energy = …………………...[3]

		ii	(1)Q=mc x theta =200 x 1.7 x 9 + 800 x 2 x 9 =17.5 x 10^3 J (2) Q=ml = 800 x 199 = 159 x 10^3 J Total Q = 159 + 17.5 = 177 x 10^3 J (ecf)	 **C1** **A1** **B1** **A1** **A1**

EITHER

12 Fig. 12.1 shows an electrical "wind-up" torchlight that operates through cranking a mechanical handle. The crank is turned in one direction and energy is stored in the spring internally. The torchlight then uses the energy stored in the wound-up spring to light the light bulb.

Fig 12.2 shows the simplified diagram of the mechanism within the torchlight. The spring is unwinding and N pole is moving away from the solenoid.

Fig. 12.1

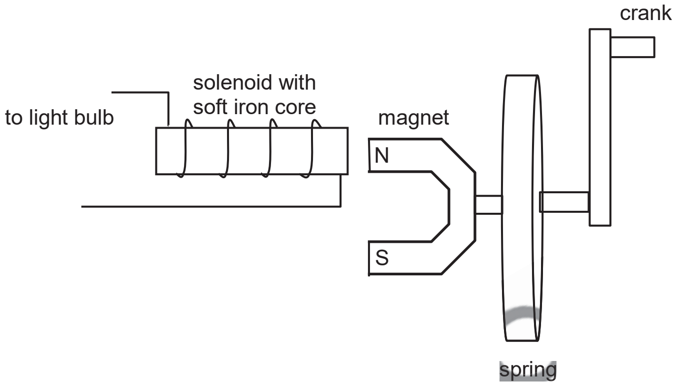
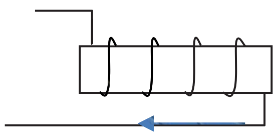


Fig. 12.2

(a) **(i)** On Fig 12.2, draw the current induced on the solenoid.

[1]

	a	**i**		**B1**

(ii) Explain how the direction of the induced current in **(a)(i)** is determined.

....

.... [1]

		ii	Induced current is in direction to oppose the change causing it. OR S polarity induced in coil facing N pole of magnet to attract it.	**B1**

(b) As the spring is unwound, the magnet rotates together with the spring.

(i) Explain why electromotive force is induced in the solenoid.

....

....

.... [2]

	b	i	When magnet rotates, there is a changing magnetic field. This induces an emf when magnetic field lines are “cut” by coil/magnetic flux linkage	B1 B1

(ii) Describe the various stages of how energy is converted when the spring is unwound to the light bulb.

....

....

....[1]

		ii	KE of unwinding spring to electrical energy to light energy (bulb)	B1

(iii) Explain why the induced current is an alternating current (A.C.).

....

....

....[1]

		iii	Everytime the magnet rotates 180 deg, the current induced reverses its direction to the light bulb OR magnet moves away then moves towards coil, the current reverses its direction	B1

(c) When the spring is tightly wound, the electrical signal from the wires is applied to the input terminals of an oscilloscope. Fig 12.3 shows the trace obtained on the screen of an oscilloscope of e.m.f. vs time.

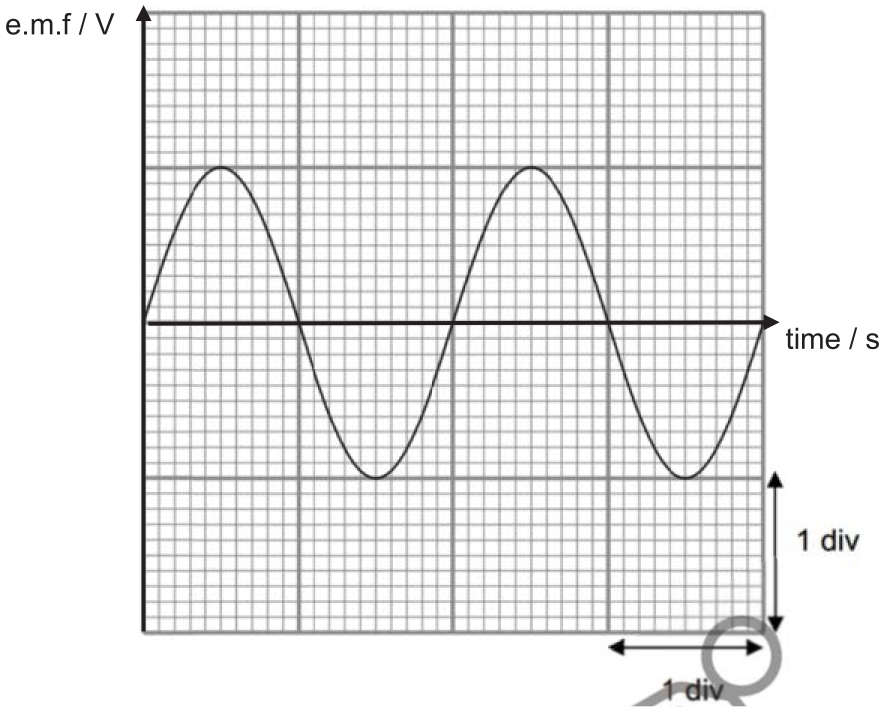


Fig 12.3

(i) The position between the magnet and the solenoid affects the strength of the e.m.f. induced in the coil.

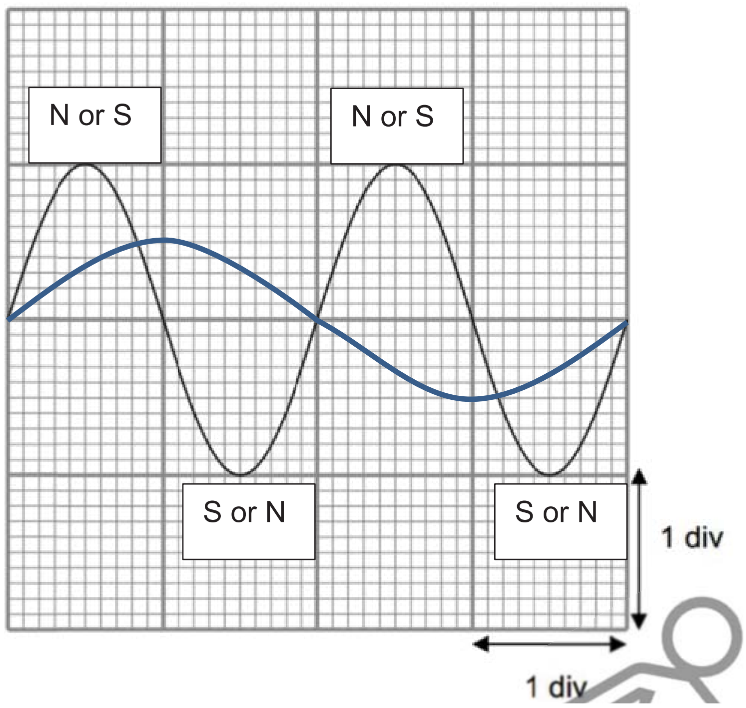
On Fig. 12.3, indicate the position of the magnet poles by labelling N and S to the corresponding trace on the oscilloscope.

[2]

(ii) After a period of time, the rotation of the unwinding spring slows down to half.

On Fig. 12.3, sketch the new electrical signal trace produced by the spring.

[2]

	b	I & ii	 B1 correct location of N B1 correct location of S B1 correct amplitude of graph B1 correct freq/shape of graph	

OR

12 **(a)** Fig 12.1 shows a simple transformer.

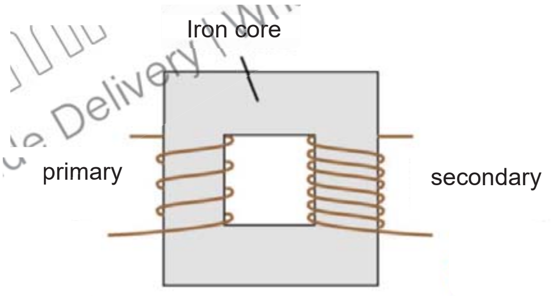


Fig. 12.1

(i) Explain how an alternating e.m.f. in the primary coil induces an e.m.f. in the secondary coil.

....

....

....

....

....[2]

	a	i	AC in pri coil produces a changing magnetic field in the soft iron core magnetic field line “cut” at sec coil induces a changing emf in sec coil	 **B1** **B1**

(ii) State and explain one method to improve the efficiency of the transformer.

....

....

....[2]

		ii	Laminated core - reduce eddy currents, reduce thermal energy loss OR Methods described in textbook and substantiated with correct effects.	**B1** **B1**

(b) Fig. 12.2 shows a consumer connected to a main electrical supply some distance away. The electrical supplier generates electrical supply at 25 kV and transmits it to the consumer that uses 20 kV. Transformer X steps up the output voltage to 275 kV.

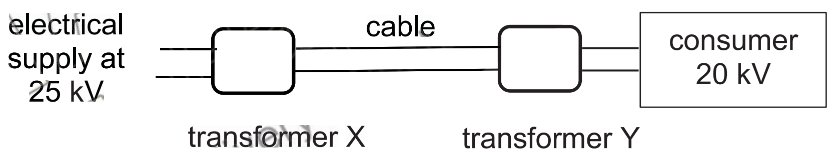


Fig. 12.2

(i) Explain why voltage is stepped up from the electrical supply and transmitted at high voltage.

....

....

....[1]

	b	i	To reduce <u>power loss</u> as thermal energy	**B1**

(ii) Determine the turns ratio for transformer X.

turns ratio = …………………[2]

		ii	Ns/Np = Vs/Vp =275k/25k =11	 **B1** **A1**

(iii) 10 MW of power is transmitted through the cable of resistance 1 Ω/km at 275 kV.

Determine the power loss per kilometre as internal energy in the cable.

power loss per km = …………………[3]

		iii	P loss = I^2R = (P/V)^2 x R = (10 x 10^6/275x10^3)^2 x 1 = 1320 W/km	 **B1** **B1** **A1**

End of Paper