Sec 4E Express (Physics) Prelim Exam Marking Scheme 2019

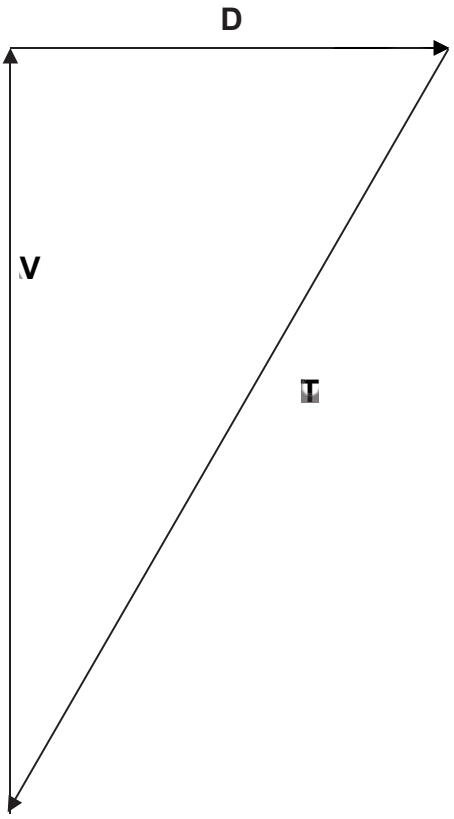
P1 MCQ:

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

P2 Section A:

1

scale 1 cm : 50 N **[A1]**
Correct diagram **[M1]**
upthrust, V = 520 N ± 10 N **[A1]**
force, D = 300 N ±10 N **[A1]**



2(a) Pressure = $(1.0 \times 10^5) + (15 \times 1000 \times 10)$ **[M1]**
= 250 000 Pa **[A1]**

2(b) $P_1V_1 = P_2V_2$
$V_2 = P_1V_1 / P_2$
= (250 000)(0.3) / (100 000) **[M1]**
= 0.75 m^3 **[A1]**

2(c) As the balloon increases in volume, this causes the number of air molecules per unit volume decreases. **[A1]**
The frequency of the air molecules colliding with the inner wall decreases. **[A1]**

3(a) The air at the top is cooled and the cold air contracts, becomes more dense and sink. **[A1]**
The warmer air at the bottom rises up to replace the sunken cool air. This cycle continues to setup a convection current to bring the temperature down quickly and uniformly. **[A1]**

3(b) The coolant at solid state absorb a lot more heat from the content to change to liquid state. It will then absorb more heat to increase its temperature. **[A1]**
Coolant at liquid state only absorb a limited amount of heat from the content to increase its temperature. Therefore, coolant at solid state absorb more heat from the content. **[A1]**

3(c) total energy lost by food = total energy absorb by coolant
= $ml_f + mc\Delta\theta$
= $(0.2 \times 2.1 \times 10^5)$ **[M1]** + (0.2 x 3820 x 13) **[M1]**
= 51 932 J
= 51 900 J **[A1]**

4(a) anticlockwise **[A1]**

4(b) When the glass block is rotated further, the angle of incidence becomes more than the critical angle **[A1]** and the laser undergoes total internal reflection. **[A1]**

4(c)(i) Angle AOB = $\tan^{-1}$ (1.68 / 1.50)
= 48.2° **[M1]**
c = 180° – 90° – 48.2° = 41.8° **[A1]**

4(c)(ii) n = 1/sin c
= 1 / sin 41.8°
= 1.50 **[A1]**

5(a) Frequency remains the same. **[A1]**
Speed decreases. **[A1]**

5(b) f = 10 / 2 = 5 Hz
λ = 9 / 3 = 3 cm
Speed = $f\lambda$ = 5 x 3 **[M1]**
= 15 cm/s **[A1]**

5(c) Speed remains the same.
Wavelength reduce by half. **[A1]**

6(a) Electrons are attracted from earth by the positively charged sphere as unlike charges attract. **[A1]**
The flow of electrons which carry negative charges is detected by the galvanometer and hence there is a deflection. **[A1]**
The electrons remain attracted by the positively-charged sphere and they stay in the metal plate. There is no flow of electrons and the galvanometer needle return to zero. **[A1]**

6(b) Use a positively-charged sphere with higher magnitude of charge. **[A1]**
OR
Bring the sphere closer to the plate.

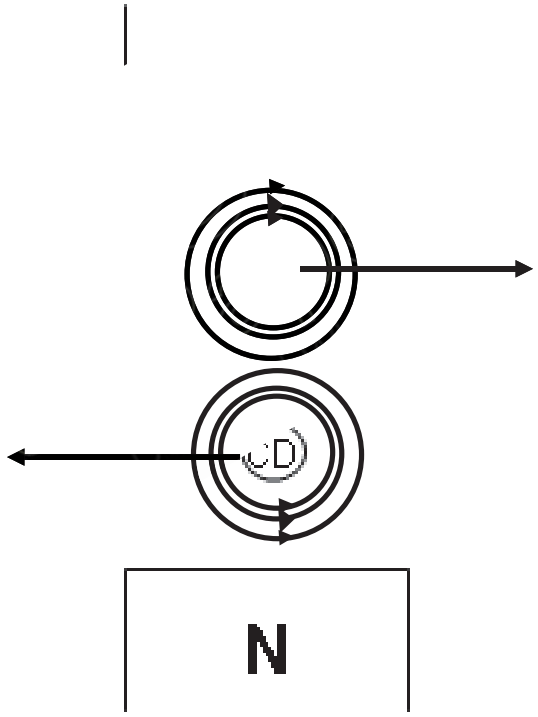
6(c) The galvanometer deflect momentarily to the other side. **[A1]**

7(a)(i) R_{eff} $= (1/6 + 1/3)^{-1}$
$= 2\ \Omega$
Emf $= 3A \times 2\Omega$ **[M1]**
$= 6V$ **[A1]**

7(a)(ii) $I = 6V / 3\Omega = 2A$ **[A1]**

7(b) The potential difference across PQ is $1A \times 2\Omega = 2V$. So potential at Q is 6V -2V = 4V
The potential difference across PS is $2A \times 1\Omega = 2V$. So potential at S is 6V - 2V = 4V. **[M1]**
Since Q and S has same potential, potential difference is zero, so no current flow. **[A1]**

8(a)(i) concentric circles – closer (near to wire), further apart (far from wire)
8(a)(ii)



8(b)(i) deflect less to right **[A1]**

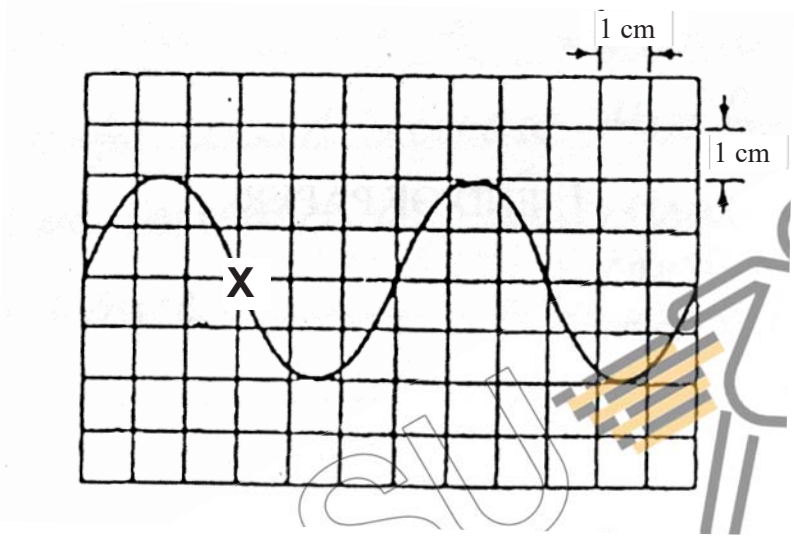
8(b)(ii) deflect to left **[A1]**

8(b)(iii) vibrate to and fro between left and right. **[A1]**

9(a)(i) A vertical line is seen on the screen. **[A1]**
When magnet moves down into the coil, there is cutting of magnetic field lines and an emf is induced in the coil. This causes the y-plates to be charged which moves the electron beam either up or down. **[A1]**
When the magnet moves up out of the coil, there is cutting of magnetic field lines in the opposite direction and an emf is induced in the opposite direction. This causes the y-plates to move the electron beam the other direction. **[A1]**

9(a)(ii) The vertical line becomes longer. **[A1]**

9(b)



9(c) T = 6 x 0.5 = 3 s **[M1]**
f = 1/3 = 0.333 Hz **[A1]**

Section B

10(a)(i) m = 8900 x 5000 x 3.0 x 10^{-4} **[M1]**
= 13 350 kg
= 13 400 kg **[A1]**

10(a)(ii) number = 133500 N / 9000N **[M1]**
= 14.83 = 15 **[A1] (accept 16) ecf 10a(i)**

10(b)(i) R = 0.075 x 5 = 0.375Ω
pd = 500A x 0.375 Ω
= 187.5 = 188 V **[A1]**

10(b)(ii) power loss = I^2R
= 500A x 500A x 0.375Ω **[M1{**
= 93 750 W
= 93 800 W **[A1]**

10(b)(iii) cost = 24h x 93.75kW x $0.22 **[M1]**
= $495 **[A1]**

10(c)(i) Aluminium wire has a much lower density than copper, about 3 times lower. **[A1]** The number of towers used to support 5km of the wire can be reduced by 3 times. **[A1]**

10(c)(ii) The resistance of steel is too high compare to aluminium and copper. This will incur lots of power loss. **[A1]**

11(a) The kinetic energy is converted into thermal, sound **[A1]** and gravitational potential energy **[A1]** as it stops.

11(b)(i) GPE = 700 x 10 x 3 **[M1]**
= 21 000 J **[A1]**

11(b)(ii) KE = ½ x 700 x 40^2
= 560 000 J **[M1]**

KE = GPE + loss
Loss = KE – GPE
Friction x distance = KE – GPE
Friction = (KE – GPE) / distance
= (560 000 – 21 000) / 40 **[M1]**
= 13 475 N
= 13 500 N **[A1]**

11(c) Texture (size of the small stones) of the escape lane, weight of car, **[A1]**

12 EITHER

12(a)(i) having a high potential **[A1]**

12(a)(ii) maintain at zero potential **[A1]**

12(b)(i) When a current of larger than 4.0 A passes through the appliance, the large current is not large enough to blow the 30 A fuse. **[A1]**
The large current can then cause over heating in the appliance and may lead to fire. **[A1]**

12(b)(ii) When there is a fault in the appliance, the metal case may become live. With the absence of earth wire, the current is not able to flow between the metal case to the earth terminal to blow the fuse or trip the ELCB. **[A1]**
If a user touches the metal case, large current will flow through the user between the metal case and the earth and may lead to electric shock. **[A1]**

12(c) When large current trip a circuit breaker, we do not need to replace the circuit breaker. But we will need to replace a fuse if it is blown by a large current. **[A1]**

12(d)

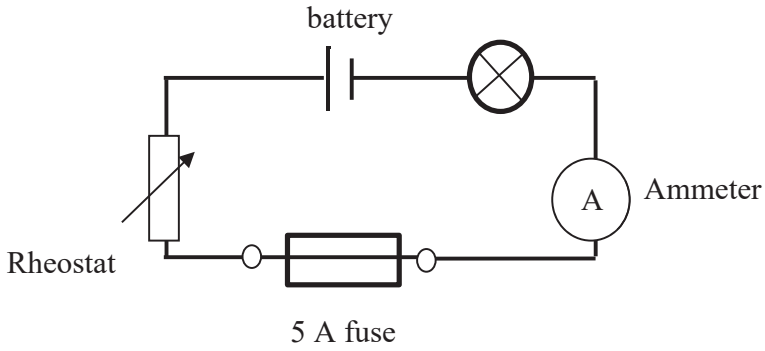


Diagram [A1]

1. Adjust rheostat to give the largest resistance and minimum reading in ammeter.
2. Adjust rheostat slowly to decrease the resistance and increase the ammeter reading to 4 A.
3. Adjust rheostat slowly to **increase the ammeter reading by 0.1A each time. [A1]**

4. Repeat step 3 until **bulb goes off.** When the bulb goes off, this indicates that the fuse has blown.
5. The reading on the ammeter just before the bulb goes off is the current which blows the fuse. **[A1]**

12 OR

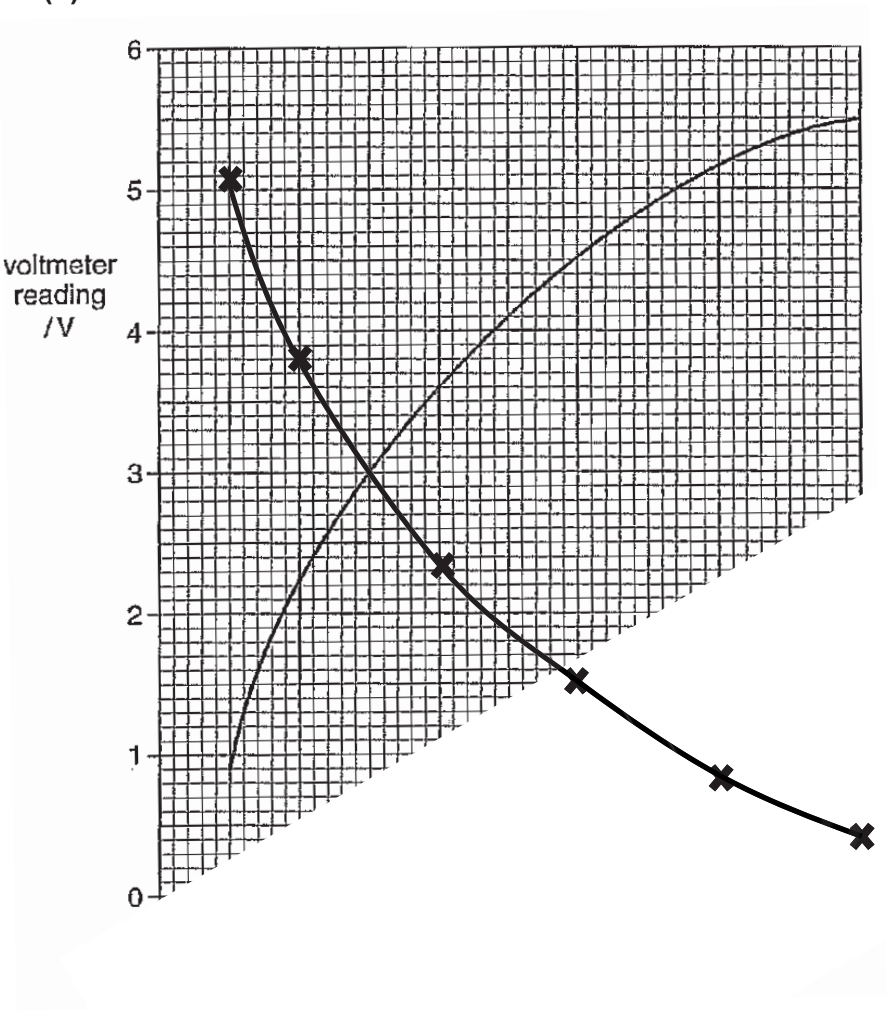
12(a) When temperature increases, the resistance of thermistor decreases. **[A1]**
The potential difference across the thermistor decreases.
Since the emf remains constant, the potential difference across the resistor increases. **[A1]**
Therefore the voltmeter reading increases.

12(b) At 40°C, pd across resistor = 3.6V

Current = 3.6V / 1600Ω = 0.00225 A **[M1]**

R of thermistor = (6V-3.6V) / 0.00225 A **[M1]**
= 1070 Ω **[A1]**

12(c)



12(d)

Apparatus:

a. Retort stand
b. Beaker
c. Plastic sheet
d. Laboratory thermometer
e. Wire gauze
f. Tripod
g. Bunsen burner

[A1]

Procedures:

1. Setup as shown in diagram. Use water use temperature of about 5 °C
2. Wrap the thermistor in a plastic sheet to prevent water from entering the thermistor and immerse it into the beaker of water. **[A1]**
3. Heat the water.
4. When thermometer shows 10°C, record the voltmeter reading.
5. Repeat step 4 for every increase in 10 °C until thermometer reaches 100 °C.**[A1]**
6. Tabulate Temperature of Thermistor (T) and voltmeter reading of resistor (V).
7. Plot a graph of V against T.