Candidate Name:	Class:	Index No:

DUNMAN SECONDARY SCHOOL

where ...... discernment, discipline, daring, determination & duty become a part of life.

PRELIMINARY EXAMINATION 2016
SEC 4 EXPRESS
PURE PHYSICS
5059 Paper 2

1 hour 45 minutes
0800 – 0945

14 September 2016
Wednesday

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black ink.
You may use an HB pencil for any diagrams, graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Section B
Answer all questions. **Question 14** has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
At the end of the examination, fasten all your work securely together and submit **Section A** and **B separately**. The number of marks is given in brackets [ ] at the end of each question or part question.

This question paper consists of **21** printed pages including the cover page.

Section A (50 marks)
Answer **all** questions in this section.

1 John and Jeremy were staying at a high-rise building but on different floors as shown in Fig. 1.1. The height difference between the two floors is 10 m.

When John dropped Ball A freely, he started his stopwatch. Two seconds later, Jeremy dropped Ball B freely.

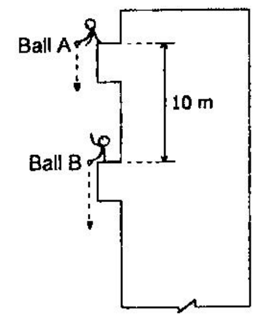


Fig. 1.1

(a) Sketch and label the speed-time graphs of both balls for the first 5.0 s in Fig. 1.2, according to John's timing as recorded by his stopwatch. You may assume that there is no air resistance as the balls fall and the acceleration due to gravity is $10 m/s^2$. [3]

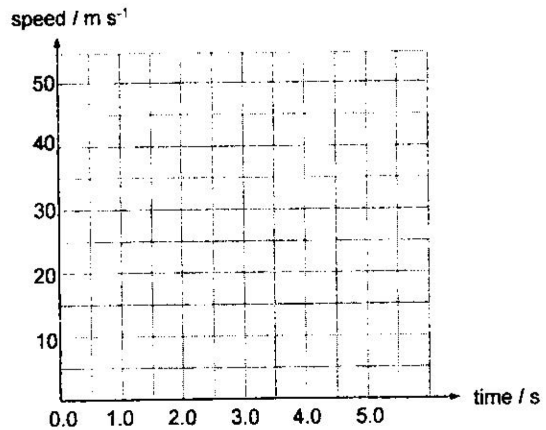


Fig. 1.2

(b) What is the height difference between the two balls at time t = 5.0 s?

height difference = ...[2]

2 Fig. 2.1 shows the top view of a point object acted upon by two forces. The forces are acting in the horizontal plane.

Fig. 2.1

(a) In the space provided below, use a scaled diagram to calculate the magnitude of the resultant force acting on the object.

magnitude of resultant force = ... [4]

(b) The object moves with an acceleration of 2.1 m/s^2 in the direction of the resultant force. Calculate the magnitude of the resistive force acting on the object if the weight of the object is 40 N.

magnitude of resistive force = ... [2]

3 Fig. 3.1 shows a mercury manometer connected to a large vessel containing some neon gas.

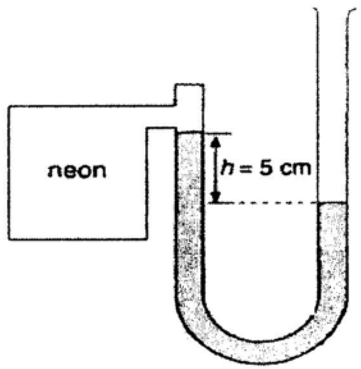


Fig. 3.1

The atmospheric pressure is 76.0 cm Hg and the acceleration of free fall g is 10.0 m/s^2.

The mercury in the manometer has a density of 13 600 kg/m^3.

(a) Calculate the pressure (in Pa) of neon gas inside the vessel.

pressure = ... [2]

(b) Using ideas about molecules, explain why the pressure of neon gas in the vessel falls when the temperature decreases.

....

....

....[2]

4 A car of mass 1200 kg travelling at a speed of 3.5 m/s reaches a rough incline as shown in Fig. 4.1. X is the bottom of the incline and Y is a point 45 metres vertically above the ground. The car maintains its speed as it travels up the incline. The distance along the incline between X and Y is 70 metres.

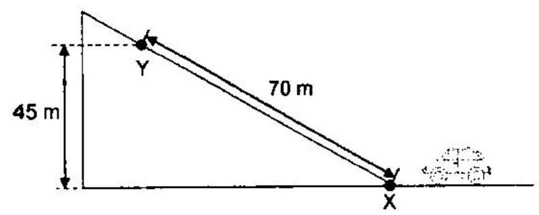


Fig. 4.1

(a) Calculate the rate of energy gain by the car as it travels from X to Y.

rate of energy gained = ... [3]

(b) Calculate the total energy of the car at Y.

total energy = ... [2]

(c) The car's engine outputs a constant power of 50 kW during the journey. Calculate the work done against friction in moving the car from X to Y.

work done against friction = ... [2]

5 Fig. 5.1 shows two aluminium blocks which are identical except that one is painted white and the other painted black. Both blocks weigh 50 N each and are placed on a table. The initial temperatures of both cubes are 80 °C.

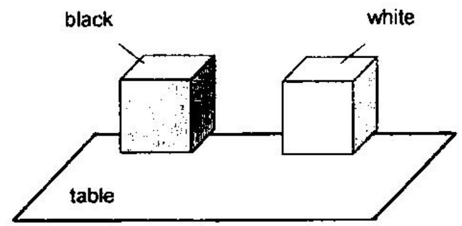
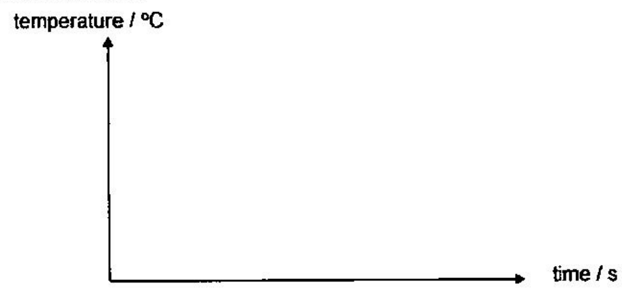


Fig. 5.1

(a) The specific heat capacity of aluminium is 0.90 J/(g°C) and the temperature of the room is 30 °C. Calculate the thermal energy given out by the black painted aluminium block as it cools down to room temperature.

thermal energy = ...[2]

(b) Sketch the temperature-time graph for both blocks. Label your graph clearly with appropriate information.



[2]

6 A monochromatic light ray is directed towards a semi-circular glass prism as shown in **Fig. 6.1**. When the light ray reaches A, the direction of the refracted ray is along the tangent of the prism. P is the centre of BD.

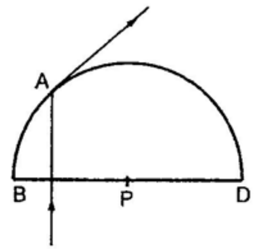


Fig. 6.1

(a) Indicate clearly on **Fig. 6.1**, the critical angle of the glass prism. Label the angle **C**. [1]

(b) If the refractive index of the prism is 1.50, calculate the critical angle of the prism.

critical angle = ...[2]

7 Fig. 7.1 shows the setup of an experiment using the echo method to find the speed of sound in air. An ultrasound transmitter was used to emit a single pulse towards a wall 0.38 km away. Fig. 7.2 shows the wave pattern captured by a microphone connected to a cathode-ray oscilloscope (C.R.O.) placed near the ultrasound transmitter. Assume that the ultrasound transmitter and the microphone are at the same distance from the wall.

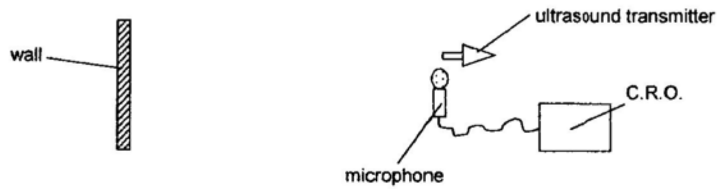


Fig. 7.1

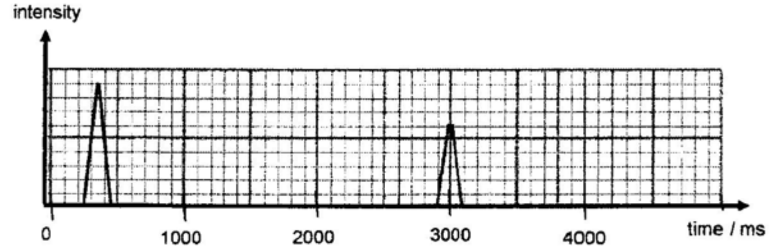


Fig. 7.2

(a) From the graph, state the time at which the **emitted** pulse was at its peak.

time = ... [1]

(b) Calculate the speed of sound.

speed of sound = ... [3]

8 Fig. 8.1 shows two identical conducting spheres mounted on insulating stands. Both spheres are positively charged, but one sphere is at a higher potential than the other. The spheres are connected by a conducting wire and a galvanometer.

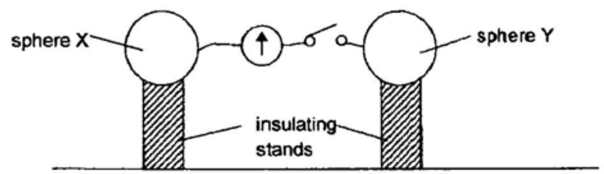


Fig. 8.1

(a) When the switch is closed, the galvanometer deflects to the left. Using ideas about the flow of electrons, state and explain which sphere is at a higher potential.

....

....

.... [2]

(b) The switch is opened. State and explain what happens when sphere X is earthed.

....

....

.... [2]

9 Fig. 9.1 is a circuit containing a 12 V cell, an ammeter, a variable resistor and a light bulb. Assume that the light bulb is an ohmic conductor.

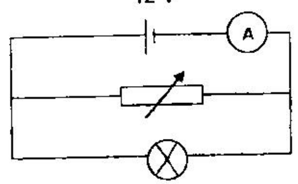


Fig. 9.1

When the variable resistor is set at 15 Ω, the ammeter reads 4.1 A.

(a) Calculate the current through the light bulb.

current through the light bulb = ... [2]

(b) Calculate the resistance of the light bulb.

resistance of the light bulb = ... [1]

(c) The resistance of the variable resistor is reduced to 5.0 Ω. State and explain the changes, if any, to the brightness of the light bulb.

....

....

.... [2]

10 A straight wire AB is moved across a magnetic field as shown in Fig. 10.1.

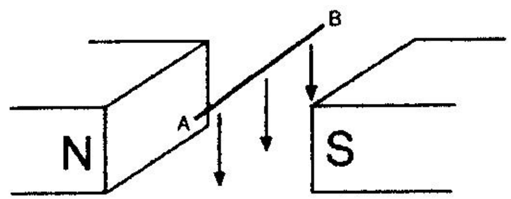


Fig. 10.1

(a) On Fig. 10.1, draw the direction of the current in the wire AB when it is moved across the magnetic field. [1]

(b) State two factors which determine the value of the induced e.m.f. measured between A and B.

....

....

.... [2]

(c) The wire AB is then replaced by a single loop of a wire which rotated with constant speed in the magnetic field as shown in Fig. 10.2.

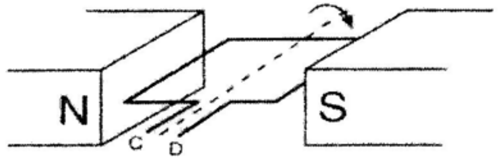


Fig. 10.2

On the grid provided below and using appropriate scales, sketch a graph of the e.m.f. induced across CD (the two ends of the loop) against time t. You should assume t = 0 s for the coil in the position shown, t = 10 s after one complete revolution, the voltage generated is 2.0 V and the magnetic field within which the coil rotates is uniform. [2]

11 To produce sound, an electric guitar senses the vibrations of the strings electronically and routes an electronic signal to an amplifier and speaker. The sensing occurs in a magnetic pickup coil mounted under the strings on the guitar's body. Fig. 11.1 shows a simple magnetic pickup coil. This pickup coil consists of a bar magnet wrapped with as many as 7,000 turns of fine wire.

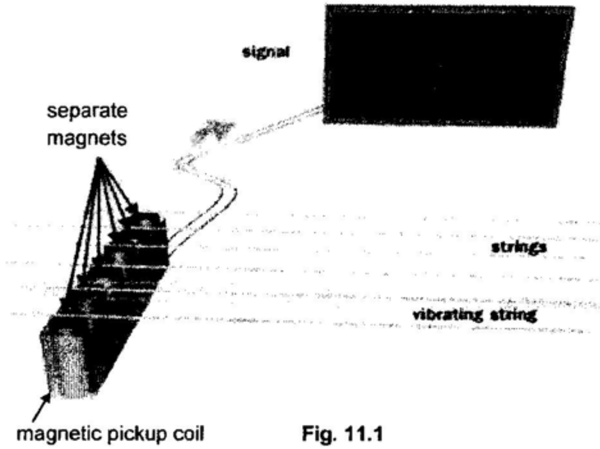


Fig. 11.1

Fig. 11.2 shows the side view of a magnetic pickup coil. It consists of a pickup coil wrapped around a permanent magnet. Note that the magnetic pickup coil is fixed in position during the vibration of the string. The portion of a guitar string as shown in the enlarged Fig. 11.3 can be magnetized.

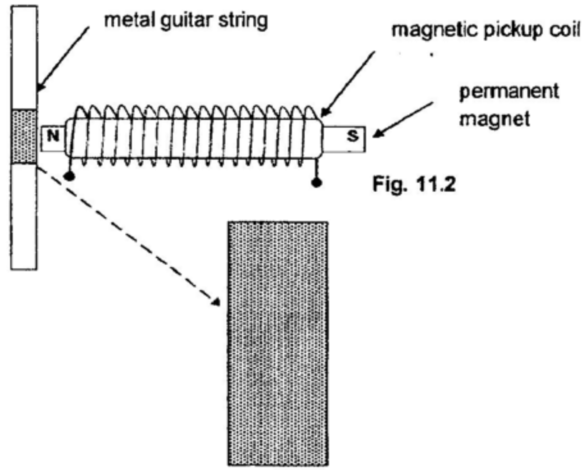


Fig. 11.2

Fig. 11.3

(a) Indicate on the Fig. 11.3, the pole of the induced magnet on the portion of the guitar string nearest to the permanent magnet. [1]

(b) When the guitar string is plucked, it vibrates at a certain frequency, f. Explain how the vibration of the guitar string induces an alternating electromotive force (e.m.f) in the pickup coil.

....

....

....

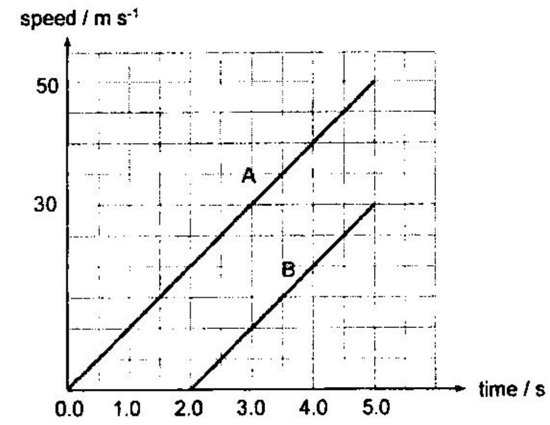
....[2]

End of Section A

4 Pure Physics Preliminary Examination 2016

Answer Scheme

1(a)



- Correct lines with A and B labelled [B1]
- A and B suggested acceleration at 10 m/s^2 [B1]
- B starts 2 sec later [B1]
- -1mark for curve A or B

(b)

Distance covered by A in 5 s= ½ x 5 x 50 = 125m

Distance travelled by B in 3 s =1/2 x 3x30 =45 m [M1] (no ecf)

Height difference = 125 – 45 – 10 = 70 m [A1]

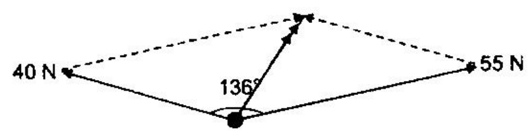
2(a)

Suitable scale used and stated [M1]

Parallelogram or triangle method attempted (with double arrows to indicate resultant force) (as shown) [M1]

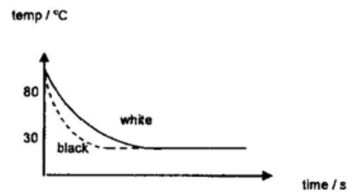
All forces (40N, 55N) and angles labelled (as shown) [M1]

By measurement from diagram, magnitude of resultant = 38 N (accept 34 N to 42 N) [A1]



	(b)	38 – f = (40/10) (2.1) f = 29.6 N (allow ecf)	[M1] [A1]

3(a)	P = atm – h ρ g = 0.71 x 13600 x10 = 9.66 x10⁴ Pa	 [M1] [A1]
(b)	When temperature decreases, the **<u>average KE of the particles decreases</u>**, speed decreases, [B1] frequency of collision on the wall decreases and with **<u>smaller force</u>**, [B1] As P = F/ A, therefore pressure decreases.	

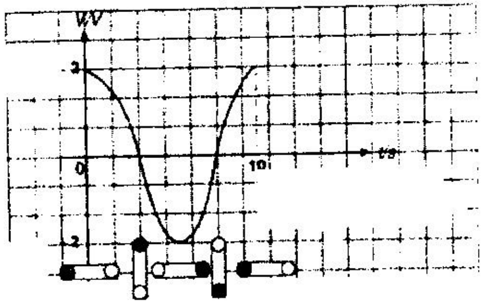
4	(a)	Calculate the rate of energy gain by the car as it travels from X to Y. Time taken to go from X to Y = 70/3.5 = 20s Rate of energy gain = (1200x10x45) / 20 = 27000 J/s	 [M1] [M1] [A1]
	(b)	Total energy of the car at Y = 1200 x 10 x 45 + 0.5 x 1200 x 3.5^2 = 547000 J (3sf)	[M1] [A1]
	(c)	Work done against friction = 50000 x 20 – 1200 x 10 x 45 = 460000 J	[M1] [A1]
5	(a)	m = 50.0 / 10 = 5.0 kg or 5000 g Q = m c θ = 5000 x 0.90 x (80 – 30) [M1] No ecf = 225 kJ **= 230 kJ (to 2 s.f.)** **[A1]** for correct ans and 2/3 s.f., no ecf	
	(b)	 Graphs with temperature reaching 30°C [B1] Correct **<u>curve</u>** graphs drawn with correct labellings [B1] -1mark for graphs that are not curve	

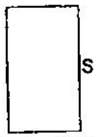
6	(a)	Critical angle = ∠ between incident light ray and line AP [B1]	
	(b)	sin C = 1 / 1.50 **[M1]** C = 41.8° [A1]	
7	(a)	Time = 350 ms or 0.35 s	[B1]
	(b)	Time taken for sound to travel to and fro = 3000 – 350 **(GIVE ECF from (a))** = 2650 ms = 2.65 s Speed = (380 x 2) / 2.65 **(Give method marks if SPEED = distance x 2 / TIME INTERVAL is seen)** = 287 m/s	 [M1] [M1] [A1]
8	(a)	Electrons travel from X to Y. Y is at a <u>higher potential</u>. **<u>(marks only given if explanation matches)</u>**	[M1] [A1]
	(b)	The electrons from the ground will flow into X. Sphere X will be neutralized.	[B1] [B1]

9	(a)	Current through resistor = 12 / 15 = 0.80 A Current through light bulb = 4.1 – 0.80 = 3.3 A	[M1] [A1]

	(b)	Resistance of the light bulb = 12 / 3.3 = 3.64 Ω **(GIVE ECF from (a))**	[A1]
	(c)	Voltage across light bulb remains the same. Since resistance of light bulb doesn't change, by $P = V^2 / R$, power and hence brightness does not change.**(must mention power and not just current)** [B1]	[B1]

10(a)	Draw arrow from B to A (by Fleming's Right Hand Rule) [B1]
(b)	Any two of below (1m each) [B2] 1) strength of the magnetic field 2) speed with which the wire moves**(rate of change of flux not specific, NOT ACCEPTED)** 3) size of the conductor

(c)	(ii)  Correct graph [B1] Max voltage 2V and T=10s shown [B1]

11(a)	N and S poles labelled correctly in Fig. 9.3 [B1] 
11(b)	When the guitar string vibrates, the induced magnetic field on the string fluctuates, produces a changing magnetic field in the pickup coil. This causes a rate of change of magnetic flux linkage with the pickup coil. An e.m.f is induced. [B1] As the magnetic flux linkage increases and decreases when the string vibrates, this sets up an alternating e.m.f. Or According to Lenz's law, the current induced will flow in a direction as to oppose the motion causing it. [B1]

PRELIMINARY EXAMINATION 2016

SECONDARY 4 EXPRESS

PHYSICS 5059

PAPER 1

MARKING SCHEME Dunman

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

DUNMAN SECONDARY SCHOOL
SECONDARY 4 PHYSICS 5059
PRELIM EXAMS 2016 PAPER 2 SECTION B ANSWERS

12 (a)	Pressure is defined as the force acting per <u>unit</u> area.	B1
12 (bi)	HY-80 – 549 m HY-100 – 686 m	B1 for both correct
12 (bii)	The pressure **<u>increase with depth</u>**. The greater the depth the greater the pressure acting on the vessel.	B1
12 (biii)	$P = h\rho g = 288 \times 1000 \times 10 = 2880000Pa = 2.88\ MPa$	M1 A1
12 (biv)	6 000 000 = h (1000)(10) + atm pr = 10000h + 10^5 h = 590 m The vessel will dive to a maximum depth of 600 m. Hence HY-100 steel should be used.	B1 B1
12 (c)	The submarine sinks and rises by **<u>adjusting its density</u>** to the water around it. By taking in more water and expelling air, the submarine increases its mass and hence increases its density as compared to the water, causing it to sink. By expelling water and taking in more air, the submarines decreases its mass and hence decrease its density as compared to the water, causing it to rise.	B1 B1 B1

13 (a)	The coil will rotate **<u>anticlockwise</u>**	B1
13 (b)	When <u>current flows through the coil, there will be magnetic field interacting with the external magnets</u>. This will cause <u>force to be produced according to Fleming's Left hand rule.</u>	B1 B1
13 (c)	Moment due to one side of the coil = 0.6 / 2 = 0.3 Nm Force on one side of coil = 0.3 / (0.03 / 2) = 20 N	B1 B1
13 (d)	The coil has rotated 2 complete rounds.	B1
13 (e)	The moment would be zero when the <u>coil is at the vertical position.</u> This is because there is <u>no force acting on the coil at that position</u> and thus moment is zero. *-Reject momentum is zero, perpendicular distance is zero.*	B1 B1
13 (f)	The <u>amplitude of graph will decrease</u> and the speed of the coil will reduce which <u>reduce the number of cycles in the graph/frequency decreases / period increases.</u> <u>-Reject no moment/reduce in moment/decrease wavelength</u>	B1 B1

<u>14 EITHER</u>

(a)	For the same power, higher voltage results in **<u>lower current</u>**, **<u>less</u>** electrical **<u>power would be lost</u>** as heat for lower current since P = I^2R.	B1 B1
(b)	<u>Thick cables have lower resistance</u>. Hence less heat is lost from the wire	B1
(c)	Turn ratio : 1:40	B1
(d)(i)	P = IV I = 500 000 / 250 I = 2000 A	B1

(d)(ii)	Ip/Is = Vs/Vp Ip / 2000 = 250/10000 Ip = 50 A	M1 A1
(e)(i)	P = I^2R = 50^2 x 20 = 50 000 W = 50 kW	M1 A1
(e) (ii)	Power drawn from power station = 500 kW + 50 kW = 550 kW	B1

<u>14 OR</u>

(a)	The switch is wrongly connected to the neutral wire. The switch should be connected to the LIVE wire	B1
(bi)	0 A	B1
(bii)	P = IV 50 = I x 240 I = 0.208 A	M1 A1
(biii)	3 x 0.208 = 0.625 A	B1
(c)	A fuse is used to **prevent excessive current from flowing in the circuit**. When there is excessive current flowing in the circuit, the low resistance wire in the fuse will **get heated up and blow**. Thus breaking the circuit	B1 B1
(d)	If the switch and fuse are on the neutral wire, when the fuse blows or the switch is turned off, <u>the appliance is still 'live' or not electrically isolated from the live wire</u>	B1
(e)	E = I^2Rt = 2 x 2 x 15 x 15 x 60 = 54000 J	M1 A1