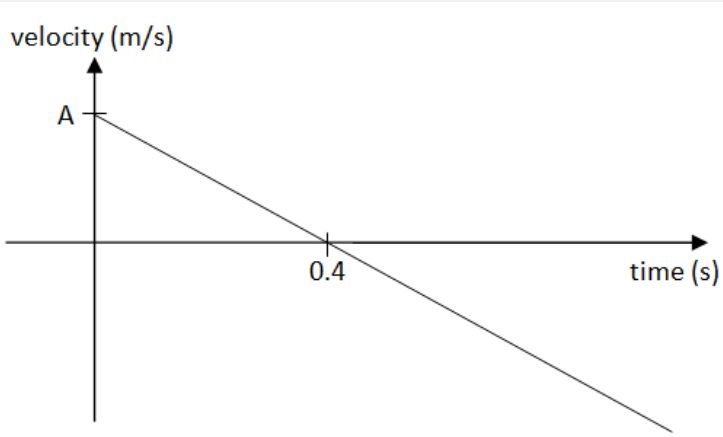
Section A (50 M)

A1a)

	Magnitude of acceleration	Direction of acceleration
As the ball moves upwards	**10 m/s^2**	**Downwards**
At the highest point of the motion	**10 m/s^2**	**Downwards**

1m for each row

b)



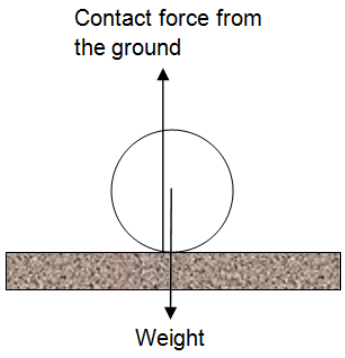
1m for straight line
1m for passing through t=0.4 on the x axis.

c) i) The gradient of the displacement-time graph is not constant in the first 1.0s which shows that the speed was never constant, and hence terminal velocity is not reached. 1

ii) The ball's velocity increases until it reaches terminal velocity at which its velocity becomes constant. 1

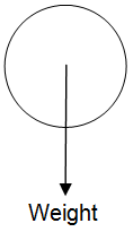
The acceleration at terminal velocity is zero. 1

A2a) 1



Boy on the floor

1



Boy in the air

b) i) $a = \frac{v-u}{t} = \frac{1.5-0}{0.5} = 3m/s^2$ 1

$F = ma = (60)(3) = 180N$ 1

ii) $P = \frac{F}{A} = \frac{(50)(10)}{\left(\frac{500}{10000}\right)}$ 1

$= 10000Pa$ 1

iii) The man exerts an additional downward force on top of his weight on the ground in the first 0.50s of the jump in order to give him a upward resultant force to jump off the ground. As a result, the force acting on the ground by the man during the first 0.50s is higher resulting in a larger pressure. 1

A3a) Work is the product of a force and the distance 1
moved in the direction of the force. 1

b) i) $Mass\ of\ water = Volume \times Density$

$= 200 \times 1000 = 200000\ kg$

$Work\ done = F \times d$ 1

$= 200000(10) \times 4$

$= 8\ 000\ 000\ J$

ii) $P = \frac{W}{t} = \frac{8\ 000\ 000}{5} = 1\ 600\ 000W\ or\ 1600kW$ 1

c) Not all the input power will be converted into useful output power, some of the energy is lost to the surroundings due to friction in the form of heat or sound. 1

A4a) State change from gas to liquid. 1

b) When steam condenses, internal potential energy of the steam is given out to the copper tube and then transferred to the sea water. 1
The seawater absorbs the energy and its internal kinetic energy increases, causing the particles to slide faster within the liquid. 1
1

c) $Q = mc\Delta\theta$ 1

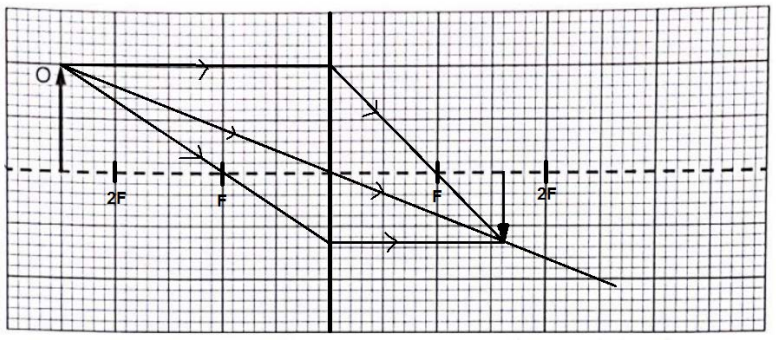
$220 \times 10^6 = m(3900)(49 - 28)$ 1

$m = 2686.2\ kg$

$= 2700\ kg\ (2sf)$ 1

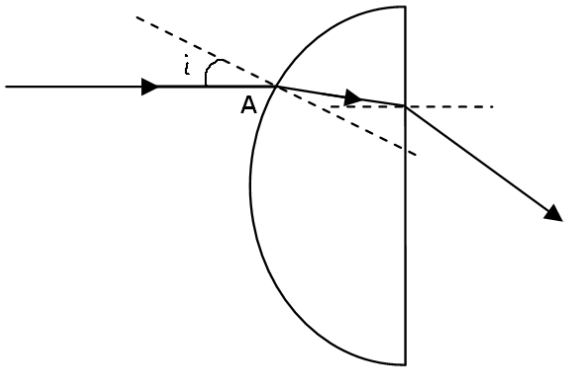
A5a) i) Distance between the optical centre and the focal point. 1

ii) 3



(the F and 2F indicated here are for the student's reference only. Actual answer your only supposed to label **ONE** F.)

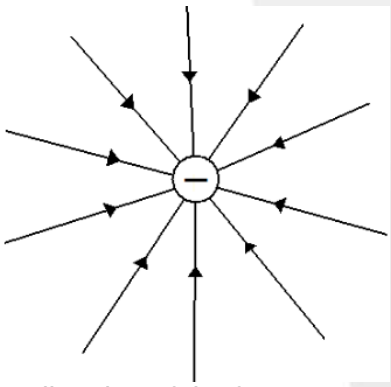
b) i)



1m for correct angle of incidence and normal at A
1m for correct ray diagram

ii) A larger refractive index for the blue light will result in a larger angle of refraction, 1
which will lead to a decrease in the focal length 1

A6a) i)



2

ii) The direction of the force on a small positive charge 1

b) i) Negative charges at the top of the metal strip
Positive charges at the bottom of the metal strip 1

ii) <u>The positive charges at the bottom of the strip are closer</u> to the negatively charged sphere than the negative charges at the top of the strip, hence the attraction is stronger than the repulsion 1

A7a)

$$V_{out} = \frac{R_{LDR}}{R_{FR} + R_{LDR}} V$$

$$= \frac{600}{8000 + 600}(12)$$ 1

$$= 0.8372V \approx 0.84V(2sf)$$ 1

b) i) 4.0V 1

ii) $V = IR$

$$I = \frac{V}{R} = \frac{4}{8000} = 0.0005A$$ 1

$$R_{LDR} = \frac{V_{LDR}}{I_{LDR}} = \frac{8}{0.0005} = 16000\Omega$$ 1

*All solutions/answers are provided by the teachers of AO Studies and MOE or UCLES bears no responsibility for these suggested solutions/answers.

c) Under bright light, potential difference across the LDR is 0.84V and potential difference across the fixed resistor will be 12V - 0.84V = 11.16V. Since V_{out} is in parallel with the fixed resistor now, the lamp will light up. 1

In dim light, potential difference across the LDR is 8.0V, and potential difference accross the fixed resistor, hence the lamp will be 4.0V. As a result, the lamp will not light up. 1

A8a) Sum of clockwise moments = sum of anti-clockwise moments

$F \times 25 = 11 + 30$ 1

$F = 1.64N$ 1

b) When a current passes through the unmagnetised steel core, it is magnetised. This causes a downward attraction force on the iron arm 1

causing the iron arm to rotate anti-clockwise and thus breaking the contact. 1

c) The core is made of steel which is a hard magnetic material. After the steel core has been magnetised, 1

it retains its magnetism and it continues to attract the iron arm even after the circuit has been cut off. and hence the circuit breaker cannot be reset. 1

Section B (30M)

B9a) i) A sound wave of a high frequency. 1

ii) The sound produced by the buzzer does not beep when the car is 200cm away from the wall.

As the car moves to 140cm away from the wall, the buzzer beeps at 4 beeps per second constantly until the car reaches 80cm away from the wall. The buzzer will then beep at 10 beeps per second constantly until the car reaches 20cm away from the wall where it will give a continuous high pitch sound. 1

iii) Device B gives a gradual increase in the buzzer's beeping rate as the car moves towards the wall compared to the device A which gives sudden changes after it reaches certain distances away from the wall. 1

b) i) 0.25s 1

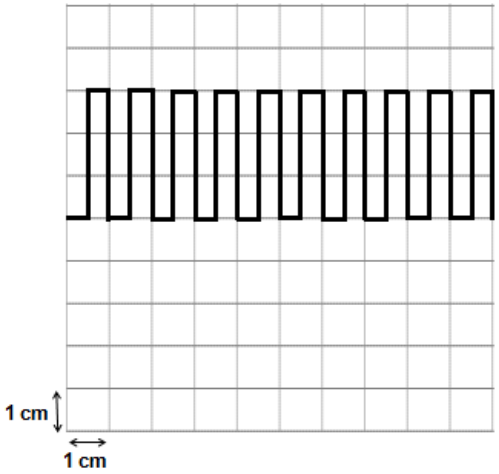
ii) $2d = v \times t$

$2d = (340)(4 \times 10^{-3})$ 1

$d = 0.68m$ 1

10 beeps per second

c)



1m for correct shape

1m for correct amplitude

1m for correct frequency

B10a) i) The gradient in the graph is not constant, showing that the resistance is not constant, and hence does not obey Ohm's Law. 1

ii) As the current increases, the temperature increases which causes the resistance to increase. 1

b) When voltage is 6.0V, current = 35mA 1

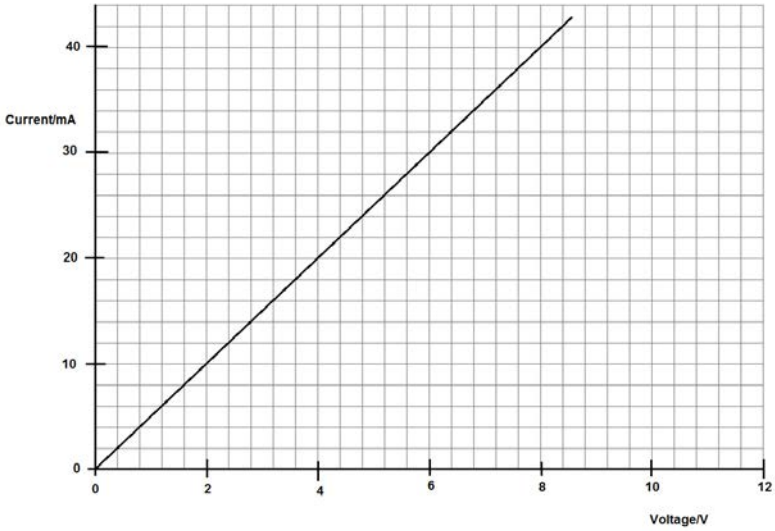
$V = IR$

$$R = \frac{V}{I} = \frac{6.0}{35 \times 10^{-3}}$$

$$= 171.43\Omega = 170\Omega(2sf)$$ 1

c) i) Work done by a electrical source in driving a unit charge around a complete circuit. 1

ii)



1m for straight line

1m for correct gradient

iii) $V_L = I_L R_L$

$I_L = \frac{V_L}{R_L} = \frac{6}{170} = 0.03529A$ 1

$V_R = I_R R_R = (0.03529)(200)$

$= 7.0588V$

$E = 6 + 7.0588 = 13.0588V \approx 13V\ (2sf)$ 1

Either B11a) The mains circuit is of a very high potential and any electrical fault which can damage appliances or cause electric shocks to users. 1

The mains circuit is connected to everything else in the restaurant and if a fault happens in the mains circuit that causes the fuse to blow, all other circuits will also have its current cut off. 1

b) i) $P = VI$

$Current\ of\ each\ lamp\ in\ dining\ area = \frac{P}{V} = \frac{12}{230} = \frac{6}{115}A$

$Current\ of\ each\ lamp\ in\ kitchen = \frac{P}{V} = \frac{40}{230} = \frac{4}{23}A$ 1

$Current\ of\ each\ lamp\ in\ entrance = \frac{P}{V} = \frac{18}{230} = \frac{9}{115}A$

$Total\ Current = 26\left(\frac{6}{115}\right) + 5\left(\frac{4}{23}\right) + 4\left(\frac{9}{115}\right)$ 1

$= 2.539A \approx 2.5A$ 1

ii) 3A 1

c) i) $P = I^2R$

$5 = (65)^2R$ 1

$R = 0.00118\Omega \approx 0.0012\Omega(2sf)$ 1

ii) 1. directly proportional 1

2. inversely proportional

OR B11a) i) A voltage that reverses direction at a regular frequency 1

ii) Since the magnitude of the alternating voltage is always changing, it produces a changing magnetic field in the iron core which passes through the secondary coil. A voltage is induced in the secondary coil due to the changing magnetic flux linkage according to Faraday's Law 1

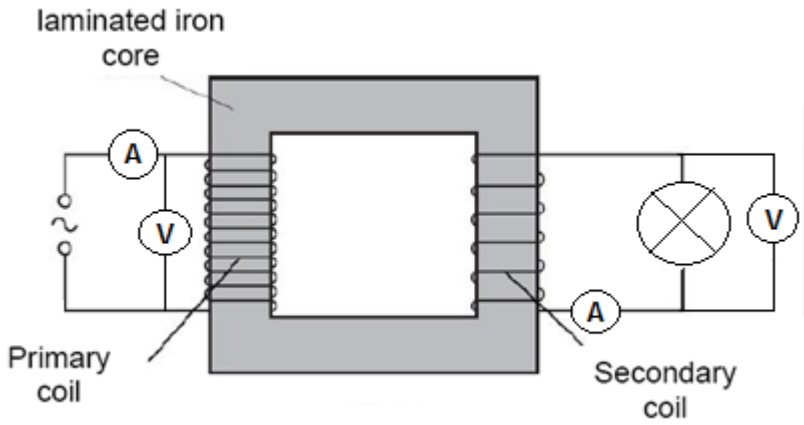
iii) The iron core allows the magnetic flux to efficiently transfer from the primary to the secondary coil and reduces the amount of energy lost to the surroundings in the process. 1

b) $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

$\frac{N_s}{480} = \frac{8.0}{230}$ 1

$N_s = 16.7 \approx 17\ turns$ 1

c) i) 2



ii) The percentage of useful power output out of the total power input. 1

iii) $P_p = V_p I_p = (230)(0.022) = 5.06W$ 1

$P_s = V_s I_s = (8.0)(0.5) = 4.0W$

$Efficiency = \frac{4.0}{5.06} \times 100\% = 79.05\% \approx 79\%(2sf)$ 1