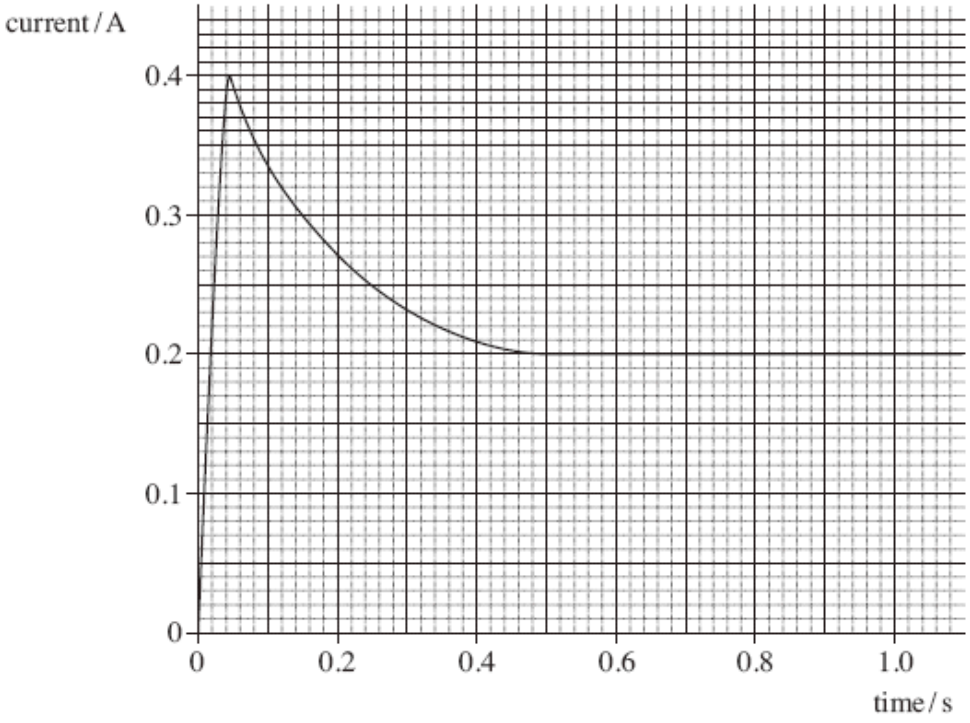
Q1. When a filament lamp is switched on it takes 0.50 seconds for the filament to reach its normal operating temperature. The way in which the current changes during the first second after switching on is shown on the graph below.



(a) Use the graph to determine the maximum current through the lamp.

answer = ... A

(1)

(b) Assuming that the lamp is connected to a 12V dc supply of a negligible internal resistance,

(i) Calculate the resistance of the lamp when it has reached its normal operating temperature,

answer = ... Ω

(1)

(ii) Calculate the power of the lamp when it has reached its normal operating temperature.

answer = ... W

(1)

(c) Explain why the current through the lamp decreases between 0.05 s and 0.50 s.

.....

.....

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.....

.....

(2)

(d) State and explain the change, if any, to the final current through the lamp if it is connected to the same supply with another similar lamp

(i) in series,

.....

.....

.....

.....

(2)

(ii) in parallel.

.....

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.....

.....

(2)

(e) State and explain why a filament lamp is most likely to fail as it is switched on.

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.....

.....

(2)
(Total 11 marks)

Q2. (a) A semiconducting diode is an example of a *non-ohmic* component. State what is meant by a non-ohmic component.

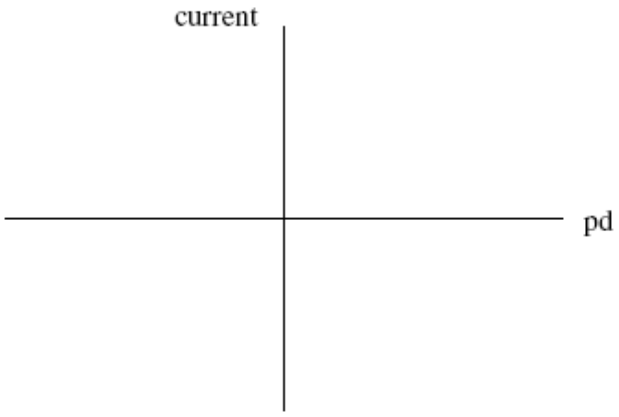
.....

.....

(1)

(b) A filament lamp is also an example of a non-ohmic component.

(i) Sketch on the axes below the current-voltage characteristic for a filament lamp.



(2)

(ii) State, with reference to the current-voltage characteristic you have drawn, how the resistance of the lamp changes as the pd across its terminals changes.

.....

.....

(1)

(c) A filament lamp has a power rating of 36 W when there is a pd across its terminals of 12V.

(i) Calculate the resistance of the filament when the pd across its terminals is 12V.

answer = ... Ω

(2)

(ii) A student predicts that if the pd across the bulb is reduced to 6.0 V the power rating of the bulb would be 9.0 W. State and explain how in practice the power rating will be slightly different from this value.

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.....

.....

(3)
(Total 9 marks)

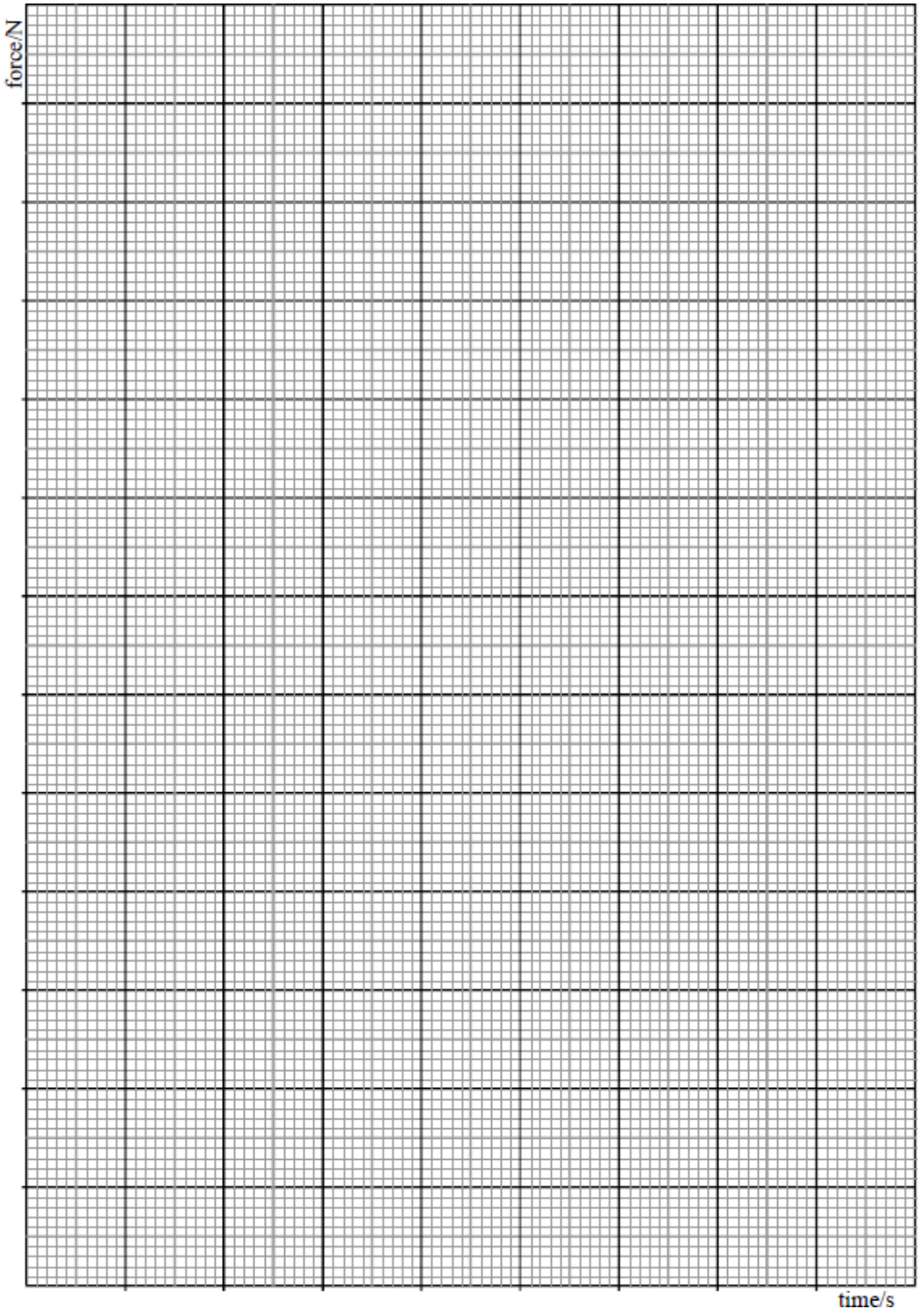
Q3. In an attempt to investigate how the resistance of a filament lamp varies with current through the lamp, a student obtains the results shown in the table.

voltage/V	0.50	1.50	3.00	4.50	6.00	12.00
current/A	0.51	1.25	2.00	2.55	2.95	4.00
resistance/Ω						

(a) Complete the table by calculating the corresponding values of resistance.

(2)

(b) (i) On the grid below plot a graph of resistance against current for the filament lamp.



(ii) Use your graph to estimate the resistance of the filament lamp when no current flows through the lamp.

.....

(iii) Use your graph to determine the change in the resistance of the filament when the current increases

from 0 to 1.0 A, ...

.....

from 1.0 A to 2.0 A .....

.....

(iv) Calculate the power dissipated in the lamp filament when the current through the filament is 1.0 A and 2.0 A.

1.0 A .....

.....

2.0 A .....

.....

(8)

(c) Using information from part (b)(iv), explain why the change in resistance of the filament is less for a current change of 0 to 1.0 A than for a current change of 1.0 A to 2.0 A. Do **not** attempt any calculation.

.....

.....

.....

(2)
(Total 12 marks)

M1. (a) current = 0.40 A **(1)**

1

(b) (i) resistance = 12/0.2 = 60 Ω **(1)**

1

(ii) power = 12 × 0.2 = 2.4 W **(1)**

1

(c) resistance of filament increases **or** more collisions/scattering **(1)**

as temperature of filament increase **or** filament gets hot/heats (until reaches thermal equilibrium) **(1)**

2

(d) (i) voltage of supply now shared by lamps **or** resistance increased **(1)**

hence current reduced **(1)**

2

(ii) current through the **lamps** unchanged/stays the same **(1)**

as both connected directly to the supply **or** correct resistance argument **(1)**

2

(e) resistance of lamps will be lower when first switched on **(1)**

hence initial current will be larger **(1)**

sudden rapid change in temperature **(1)**

max 2

[11]

M2. (a) a non-ohmic conductor does not have a constant resistance **(1)**

1

(b) (i) curve of decreasing gradient with increasing V **(1)**

attempt to make graph symmetric in two opposite quadrants **(1)**

2

(ii) resistance **increases** as pd increases/current increases **(1)**

1

(c) (i) (use of $P = V^2/R$)

36 = 144/R **(1)**

R = 4.0 (Ω) **(1)**

2

(ii) reference to temperature change **(1)**

(resulting in) a lower resistance **(1)**

(hence) power rating would be greater **(1)**

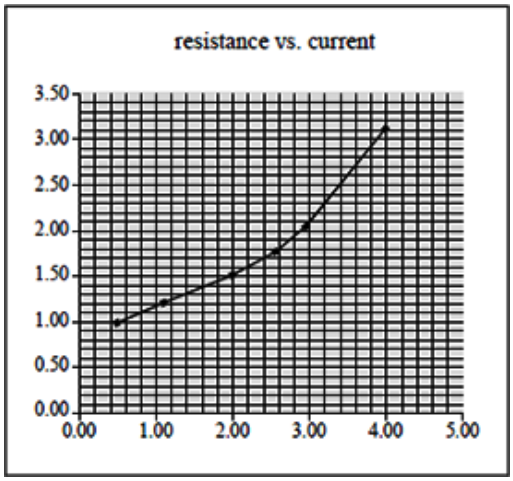
3

[9]

M3. (a) resistance / Ω 0.98 1.20 1.50 1.76 2.03 3.00 **(1) (1)**
[deduct one mark for each incorrect value]

2

(b) (i) sensible scales chosen **(1)**
points plotted correctly [deduct one mark for each mistake] **(1) (1)**
line of best fit **(1)**



(ii) 0.90 Ω **(1)**

(iii) 0.22 Ω **(1)**
0.38 Ω **(1)**

(iv) 1.12 W **(1)**
6.0 W **(1)**

max 8

(c) resistance increases with increasing temperature **(1)**
increase in heat dissipation for 1.0 A to 2.0 A is greater than for 0 to 1.0 A **(1)**
and so a greater corresponding rise in temperature **(1)**

max 2

[12]