1)

Fig. 3.1 shows a circuit containing a battery of e.m.f. 12V, two resistors, a light-dependent resistor (LDR), an ammeter and a switch **S**. The battery has negligible internal resistance.

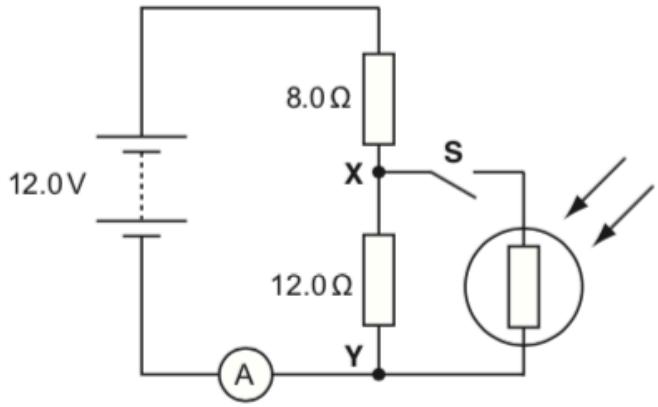

Fig. 3.1

(a) When the switch **S** is open, show that the potential difference between the points **X** and **Y** is 7.2 V.

[2]

(b) The switch **S** is now closed. Describe and explain the change to each of the following when the intensity of light falling on the LDR is increased:

(i) the ammeter reading

.....

.....

..... **[2]**

(ii) the potential difference across **XY**.

.....

.....

..... **[2]**

[Total: 6]

2)

Fig. 3.1 shows a thermistor and fixed resistor of 200 Ω connected through a switch **S** to a 24 V d.c. supply of negligible internal resistance. The voltmeter across the fixed resistor has a very high resistance.

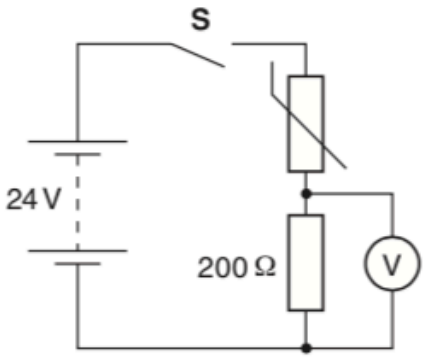

Fig. 3.1

(a) When the switch **S** is closed the voltmeter initially measures 8.0 V.

Calculate

(i) the current I in the circuit

I = ... A **[2]**

(ii) the potential difference V_T across the thermistor

V_T = ... V **[1]**

(iii) the resistance R_T of the thermistor

R_T = ... Ω **[2]**

(iv) the power P_T dissipated in the thermistor.

P_T = ... W **[2]**

(b) A few minutes after closing the switch **S** the voltmeter reading has risen to a steady value of 12V. The value of the fixed resistor remains at 200Ω.

Explain why

(i) the potential difference across the fixed resistor has increased

.....

.....

.....

..... **[3]**

(ii) the resistance of the thermistor must now be 200Ω.

.....

..... **[1]**

(c) Sketch, on the labelled axes of Fig. 3.2 below, a possible *I*-*V* characteristic for:

(i) the fixed resistor. Label it **R**. **[2]**

(ii) the thermistor. Label it **T**. **[2]**

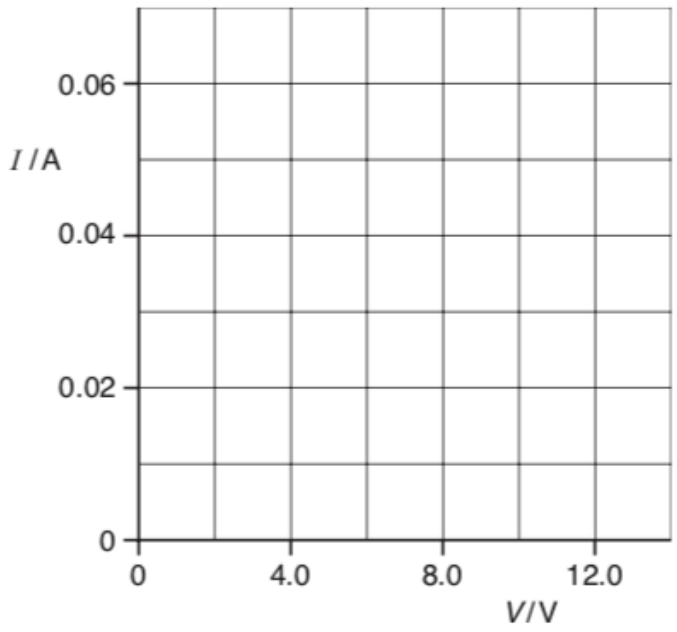

Fig. 3.2

[Total: 15]

3)

Fig. 4.1 shows how the resistance of a light-dependent resistor (LDR) varies with the intensity of the light incident on it.

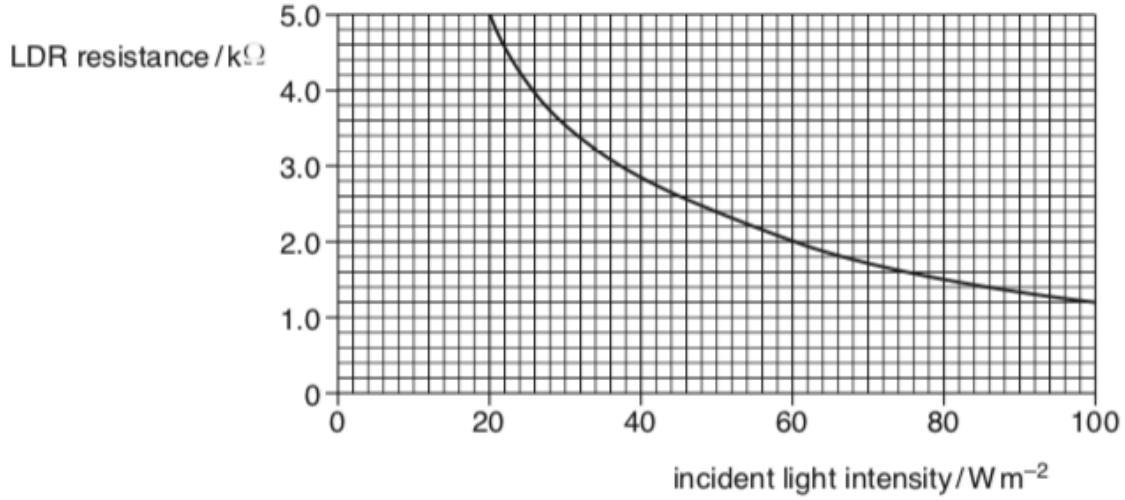

Fig. 4.1

(a) State how the resistance of the LDR changes with light intensity.

..... **[1]**

(b) Fig. 4.2 shows a light-sensing potential divider circuit where the LDR is connected in parallel to a voltmeter and data-logger.

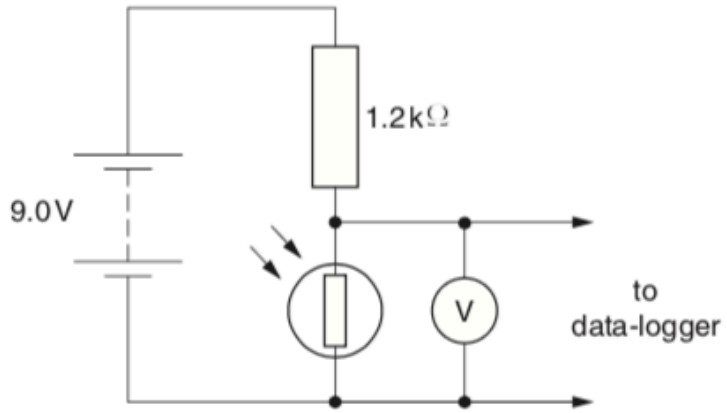

Fig. 4.2

The battery has an e.m.f. of 9.0 V and negligible internal resistance. The 1.2 kΩ resistor is made of carbon. The potential difference across the LDR is 6.0 V.

(i) State the potential difference across the 1.2 kΩ resistor.

potential difference = ... V **[1]**

(ii) Calculate the resistance R of the LDR.

R = ... kΩ **[3]**

(iii) Use Fig. 4.1 to determine the light intensity when the p.d. across the LDR is 6.0V.

light intensity = ... $W m^{-2}$ **[1]**

(c) (i) Fig. 4.1 shows that the change in resistance when the light intensity rises from $60 W m^{-2}$ to $80 W m^{-2}$ is 0.5kΩ. State the change in resistance when the light intensity rises from $20 W m^{-2}$ to $40 W m^{-2}$.

change in resistance = ... kΩ **[1]**

(ii) Larger changes in data-logger voltage are observed for changes at low light intensity rather than at high light intensity. Explain this.

.....

.....

.....

..... **[2]**

(d) When the circuit of Fig. 4.2 is operated for a long time, the carbon resistor becomes hot. The resistivity of carbon falls as the temperature rises. State and explain the effect on the potential difference across the LDR.

.....

.....

.....

.....

.....

..... **[3]**

(e) Describe briefly **two** advantages of using a data-logger to monitor the variation of light intensity falling on the LDR.

.....

.....

.....

.....

..... **[2]**

[Total: 14]

4)

Fig. 3.1 shows how the resistance of a thermistor varies with temperature.

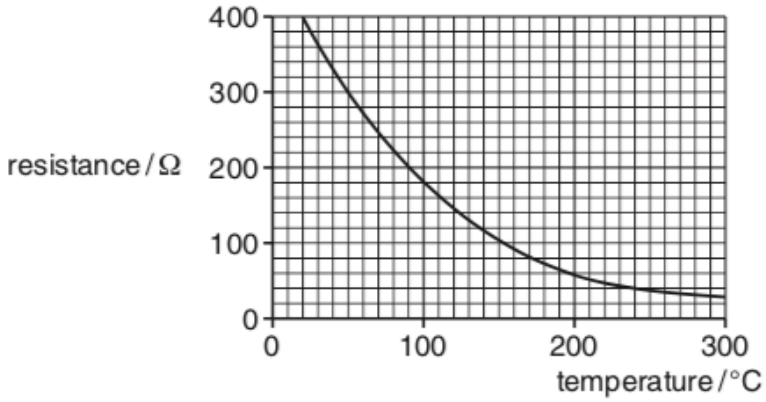

Fig. 3.1

The thermistor is used in the potential divider circuit of Fig. 3.2 to monitor the temperature of an oven. The 6.0 V d.c. supply has zero internal resistance and the voltmeter has infinite resistance.

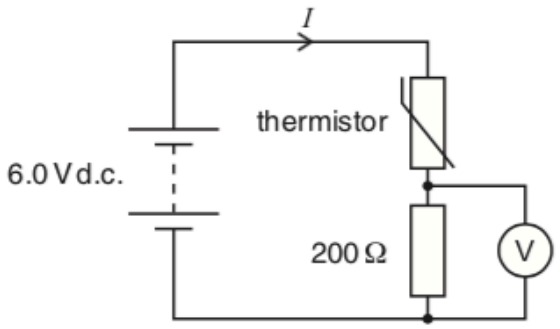

Fig. 3.2

(a) State and explain how the current I in the circuit changes as the thermistor is heated.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(b) Use Fig. 3.1 to calculate the voltmeter reading when the temperature of the oven is 240 °C.

voltmeter reading = ... V **[4]**

(c) A light-dependent resistor (LDR) is another component used in sensing circuits.

(i) Complete Fig. 3.3 with an LDR between **X** and **Y**.

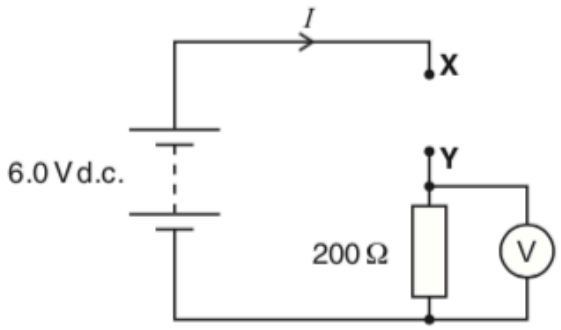

Fig. 3.3

[1]

(ii) State with a reason how the voltmeter reading varies as the intensity of the light incident on the LDR increases.

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.....

.....

.....

..... **[2]**

[Total: 10]

5)

Fig. 1.1 shows the *I-V* characteristic of a 6.0V 1.5W filament lamp.

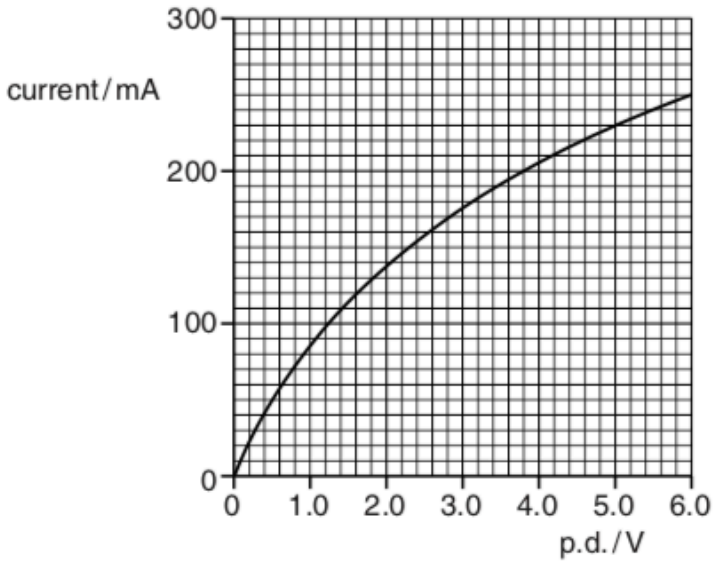

Fig. 1.1

(a) (i) State how Fig. 1.1 shows that the filament lamp does not obey Ohm's law.

.....

..... **[1]**

(ii) Explain how Fig. 1.1 shows that the resistance of the filament lamp is about 10Ω when the current is between zero and 50mA.

[2]

(iii) Explain why the resistance of the filament lamp is much larger (about 25Ω) at 6.0V.

.....

.....

.....

..... **[2]**

(b) A student designs a circuit for a night light using the filament lamp of part **(a)** and a light-dependent resistor (LDR). The circuit is shown in Fig. 1.2.

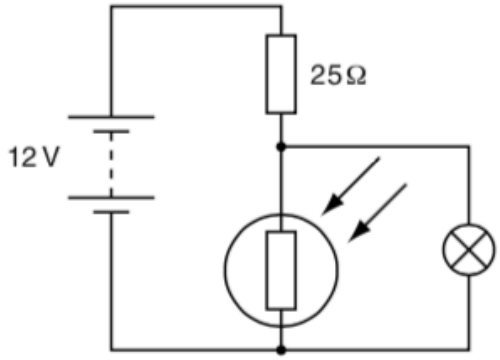

Fig. 1.2

This LDR has a resistance of about 1Ω in daylight and 1000Ω in the dark.

Show that the circuit will cause the lamp to be off in the day and on at night as long as the light from the lamp does not shine on the LDR.

In your answer you should explain clearly with or without calculation how the circuit functions to cause the lamp to be off in daylight and on in the dark.

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.....

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..... **[5]**

[Total: 10]

17 (a) **Fig. 17.1** shows a resistor and a diode connected in series to a cell.

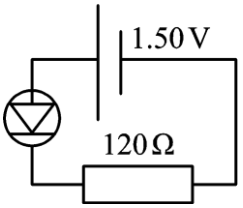

Fig. 17.1

The resistor has resistance 120 Ω. The cell has e.m.f. 1.50 V and negligible internal resistance. The potential difference across the diode is 0.62 V.

Calculate the total power dissipated in the circuit.

power = **…….** W **[3]**

(b) A student designs a circuit to vary the brightness of a filament lamp. The circuit is shown in **Fig. 17.2**.

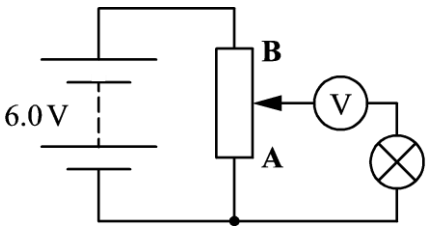

Fig. 17.2

The circuit is set up. Moving the slider from **A** to **B** changes the voltmeter reading from 0 V to 6.0 V but the lamp stays off. The lamp is not faulty.

Explain the observations above and refine the circuit design so that the brightness of the lamp can be varied as the slider is moved from **A** to **B**.

…….

…….

…….

…….

…… **[3]**

(c)* Fig. 17.3 shows how the resistance of a thermistor varies with temperature.

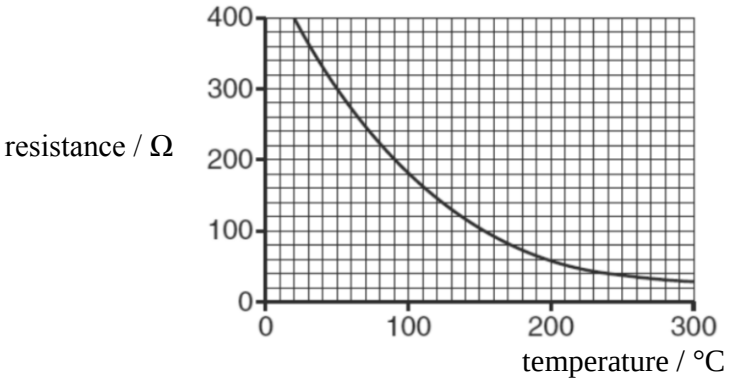

Fig. 17.3

Fig. 17.4 shows a potential divider circuit which uses this thermistor. The circuit is designed to monitor the changes in the temperature of an oven in the range 200 °C to 300 °C.

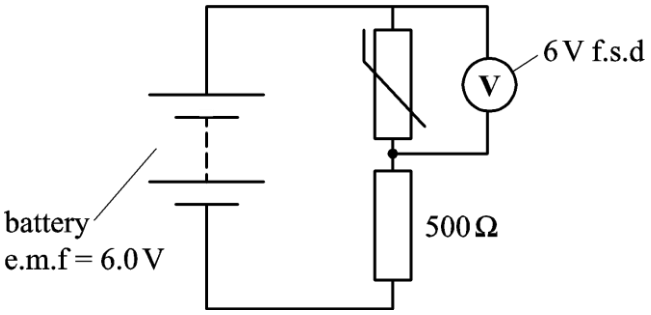

Fig. 17.4

The voltmeter has very high resistance and has a full scale deflection (f.s.d.) of 6.0 V.

Explain how the circuit works and use calculations to discuss a significant limitation of this design.

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…… **[6]**