PreDP revision questions for Section B of the exam

Unit 5 and 6: Electricity and Electronics

The circuit shown in Fig. 10.1 uses a 12V battery.

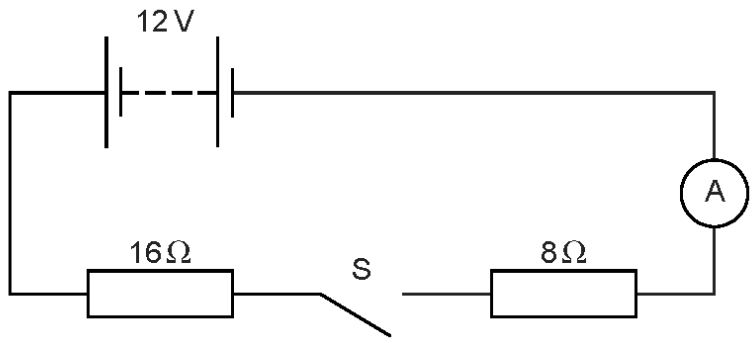

Fig. 10.1

(a) Switch S is open, as shown in Fig. 10.1.

State the value of

(i) the reading on the ammeter,

reading = ... [1]

(ii) the potential difference (p.d.) across S.

p.d. = ... [1]

(b) Switch S is now closed.

(i) Calculate the current in the ammeter.

current = ... [2]

(ii) Calculate the p.d. across the 8 Ω resistor.

p.d. = ... [2]

(c) The two resistors are now connected in parallel.

Calculate the new reading on the ammeter when S is closed, stating clearly any equations that you use.

reading = ... [4]

Fig. 11.1 is a schematic diagram of an electronic circuit controlling a lamp.

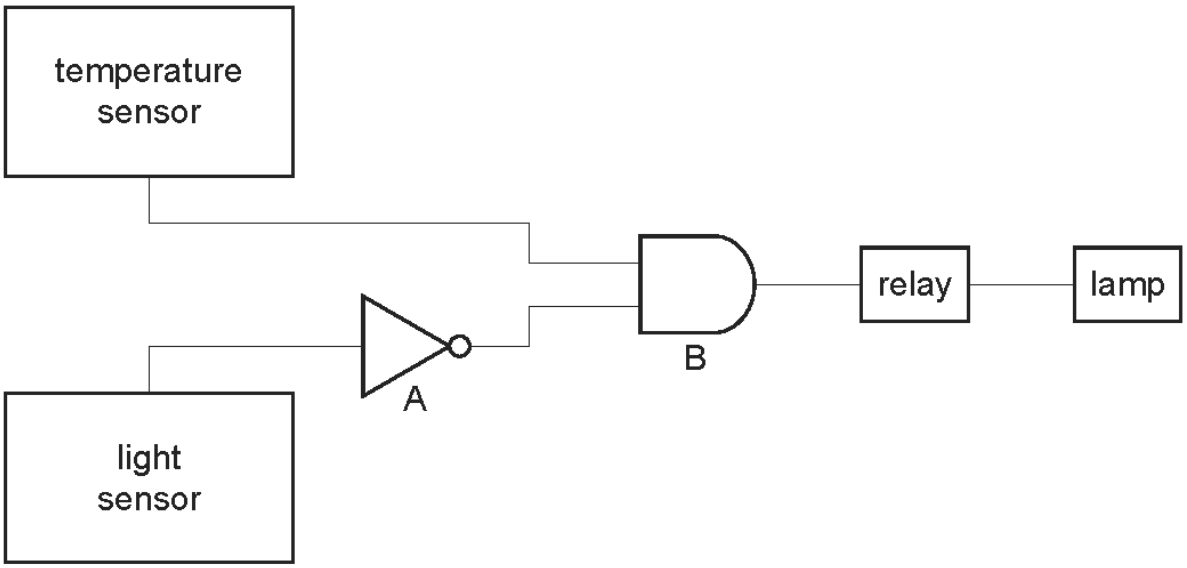

Fig. 11.1

(a) State the names of the logic gates A and B.

A ..... B ..... [2]

(b) The output of the temperature sensor is high (logic 1) when it detects raised temperature. The output of the light sensor is high (logic 1) when it detects raised light levels.

State the outputs of A and B when the surroundings are

(i) dark and cold, output of A = ...

output of B = ... [1]

(ii) dark and warm, output of A = ...

output of B = ... [1]

(iii) bright and warm. output of A = ...

what is a relay???

output of B = ... [1]

(c) **(i)** Suggest why B is connected to a relay, rather than directly to the lamp.

B cannot provide enough power current for lamp

..... [1]

(ii) The relay switches on when its input is high. In which of the three combinations in **(b)** will the lamp light up?

..... [1]

(iii) Suggest a practical use for this circuit.

Fig. 11.1 is an electronic circuit controlling an electric heater.

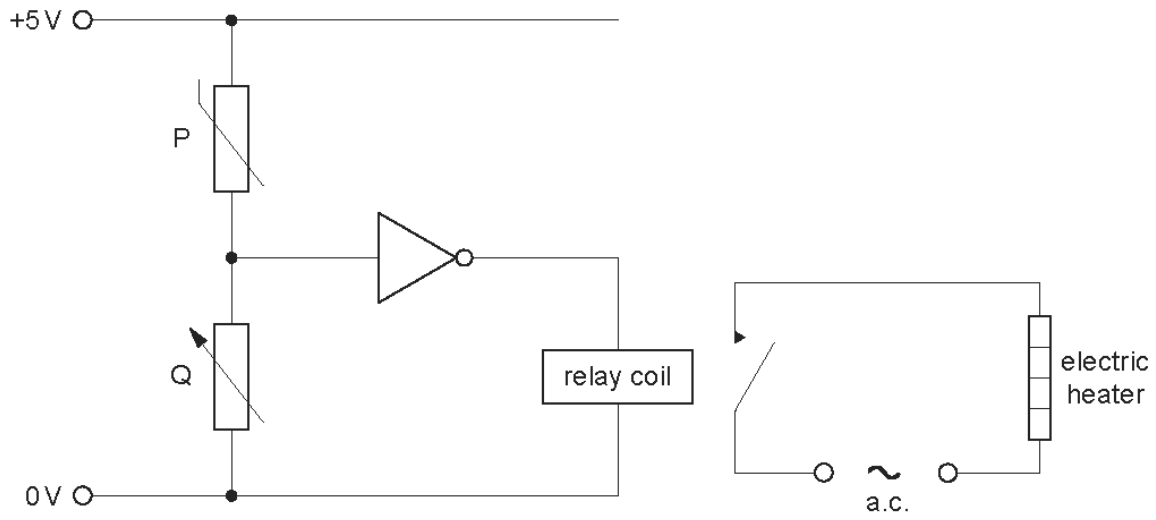

Fig. 11.1

The relay contacts close when there is a current in the relay coil.

(a) State the name of the logic gate in the circuit.

..... [1]

(b) **(i)** State the name of component P.

..... [1]

(ii) State what happens to P when its temperature falls.

..... [1]

(c) For the relay to operate, the output of the gate must be high (logic 1).

(i) What must be the input of the gate for the relay to operate?

..... [1]

(ii) State what the resistance of P must be, compared with the resistance of Q, in order to give this input to the gate.

..... [1]

(iii) Under what conditions will P have this resistance?

..... [1]

(d) Suggest why component Q is a variable resistor, rather than one with a fixed value.

..... [1]

(e) Suggest a practical use for this circuit.

The circuit in Fig. 9.1 contains a 4.0V battery, whose resistance can be ignored.

There are also three resistors, a 3-position switch, S, and another component, P.

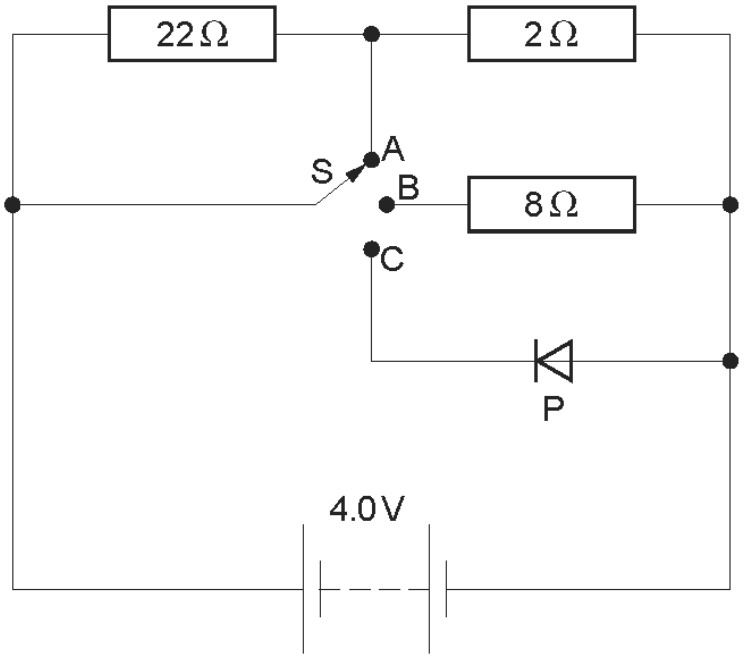

Fig. 9.1

(a) State the name of component P.

what is the difference between LED and diode?

..... [1]

(b) Deduce the resistance of the circuit when switch S is connected to

(i) point A,

resistance = ... [1]

(ii) point B.

(c) State the current in component P when S is in position C, and explain your answer.

current = ...

explanation .....

.....

.....

..... [2]

(d) The 22 Ω resistor is removed as shown in Fig. 9.2.

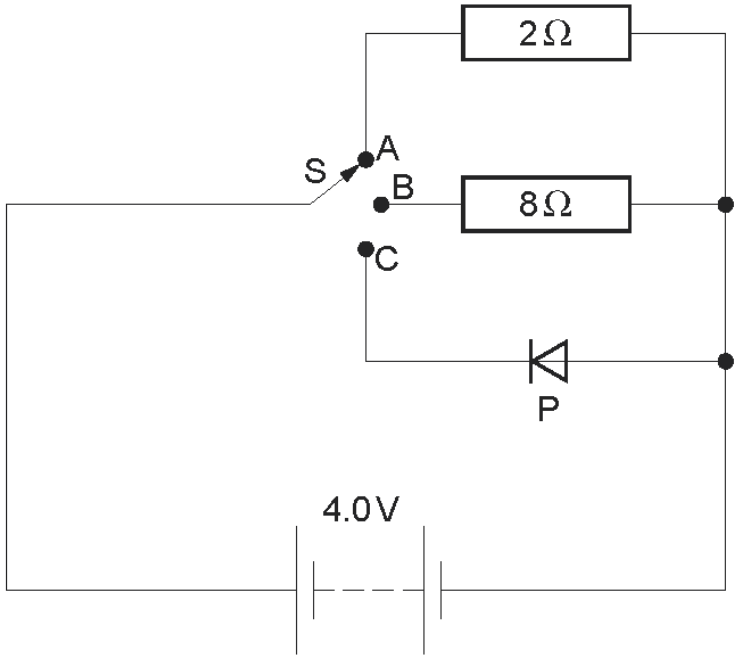

Fig. 9.2

Showing your working, decide which switch position will result in energy release from the circuit at the rate of 2.0W.

(a) Explain what is meant by the terms *analogue* and *digital*, as applied to electronic circuits.

analogue Idea of continuous variation of value of quantity

.....

digital idea of 2 states only, with no intermediate values

..... [2]

(b) Describe, if necessary using a diagram, the function of an AND gate in digital electronics.

.....

.....

.....

..... [2]

When he leaves work at 6.30 p.m. (18:30) one evening, a caretaker forgets to switch off the 100W lamp in his office. He doesn't discover this until he returns at 7.30 a.m. (07:30) the next morning.

The mains electricity supply is 250V.

(a) Calculate how much energy the caretaker has wasted.

energy wasted = ... [2]

(b) Calculate the charge that passed through the lamp during this time.

charge = ... [3]

(c) What happened to the energy wasted by the lamp?

.....

..... [1]

Fig. 7.1 shows how the resistance of the filament of a lamp changes as the current through the lamp changes.

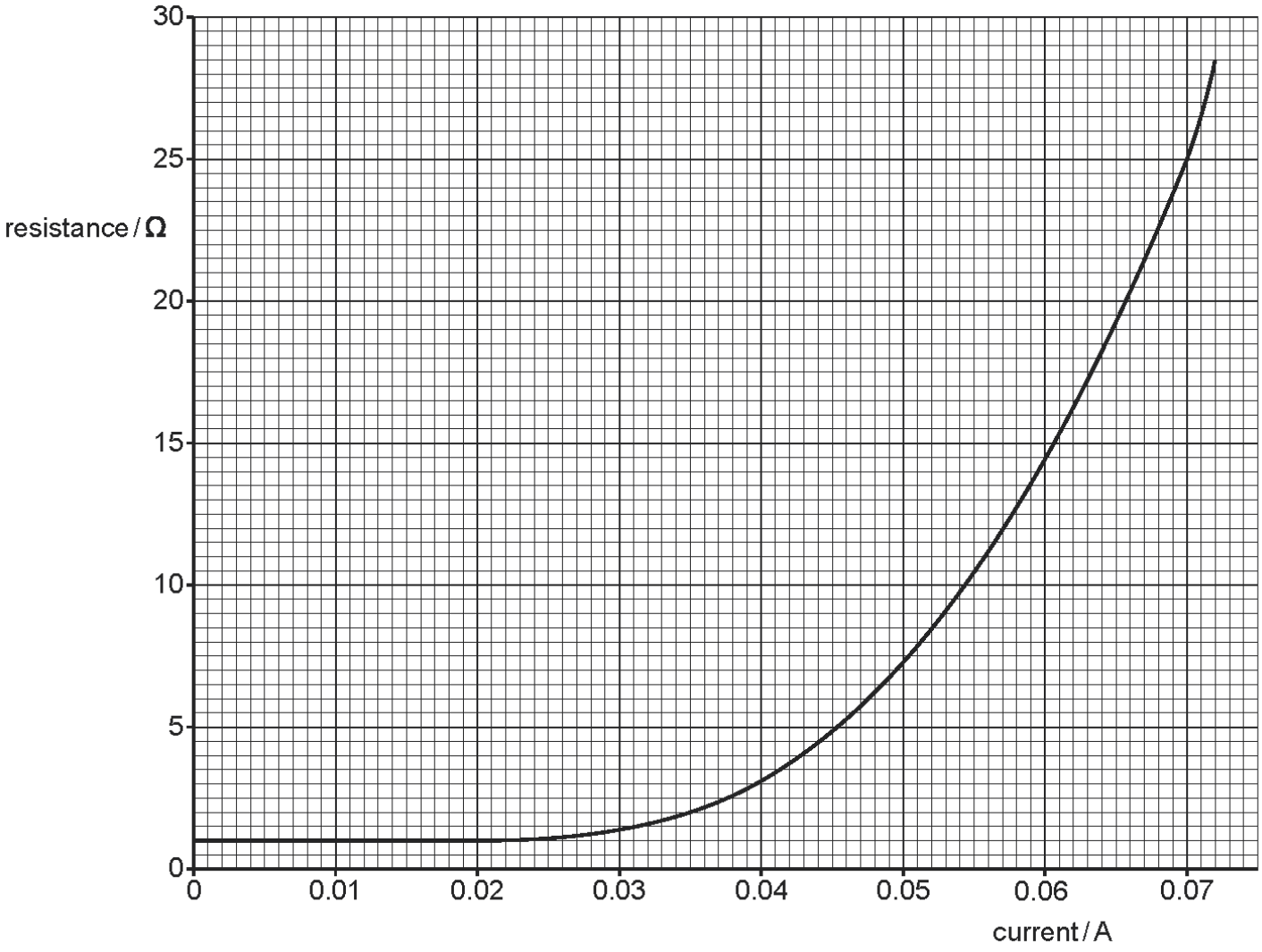

Fig. 7.1

(a) Describe how the resistance of the lamp changes.

.....

.....

..... [2]

(b) For a current of 0.070 A, find

(i) the resistance of the lamp,

resistance = ... [1]

(ii) the potential difference across the lamp,

potential difference = ... [2]

(iii) the power being dissipated by the lamp.

power = ... [2]

(c) Two of these lamps are connected in parallel to a cell. The current in each lamp is 0.070 A.

(i) State the value of the e.m.f. of the cell.

e.m.f. = ... [1]

(ii) Calculate the resistance of the circuit, assuming the cell has no resistance.

resistance = ... [2]

(a) What is meant by the *electromotive force* (e.m.f.) of an electric power supply?

Emf is the total voltage in the battery while the potential difference is the work done in moving a charge against the electric field between two specific points in the circuit.

.....[2]

(b) When connected to a 240V supply, a desk lamp has a power rating of 60W.

Calculate

(i) the current in the lamp,

current = ...[2]

(ii) the resistance of the lamp's filament.

resistance = ...[2]

(c) A torch lamp is normally connected to a 3.0V battery and carries a current of 0.25A. The resistance of its filament is 12Ω.

The desk lamp in **(b)** and the torch lamp are connected in series.

Students X and Y plan to connect the lamp combination to a 240V supply.

Student X says that the filament of the torch lamp will melt and the circuit will no longer work.
Student Y says that both lamps will light up and stay on.

Show, with a suitable calculation, whether student X or student Y is correct.

.....

(a) In the space below, draw the symbol for an OR gate.

[1]

(b) Describe the action of an OR gate in terms of its inputs and outputs.

.....

.....

.....

.....

.....[2]

(c) A car manufacturer wishes to install an alarm system in a 2-door car to inform the driver if either door is not properly closed. An OR gate is to be used in the construction of this system. Describe suitable input and output arrangements for the gate.

.....

.....

.....

.....

.....

.....[3]

Fig. 7.1 shows a circuit containing a 12V power supply, some resistors and an ammeter whose resistance is so small that it may be ignored.

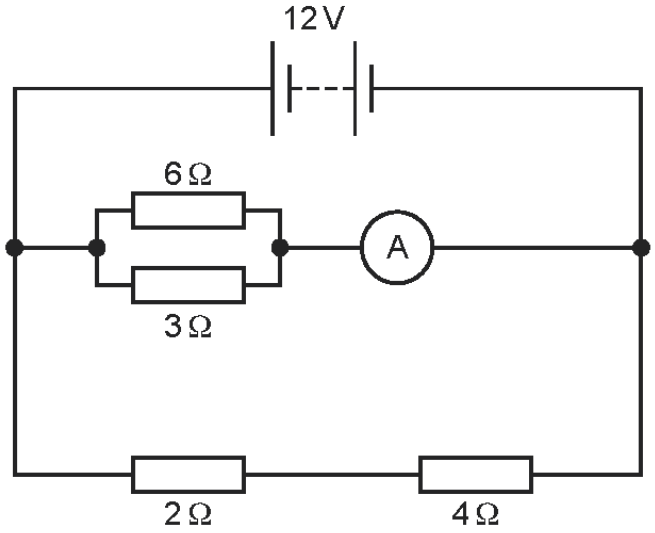

Fig. 7.1

(a) (i) Determine the potential difference across the 2Ω resistor.

potential difference = ...[1]

(ii) State the potential difference across the 3Ω resistor. ..... [1]

(b) Calculate the effective resistance of

(i) the 2Ω and 4Ω resistors connected in series,

resistance = ...[1]

(ii) the 3Ω and 6Ω resistors connected in parallel.

resistance = ...[2]

(c) Calculate the reading on the ammeter.

ammeter reading = ...[2]

(d) Without further calculation, state what happens, if anything, to the ammeter reading if

(i) the 2Ω resistor is shorted out with a thick piece of wire,

.....

(ii) the thick piece of wire from **(d)(i)** and the 3Ω resistor are both removed.

.....
[2]

The graphs in Fig. 9.1 show the relation between the current I and the potential difference V for a resistor and a lamp.

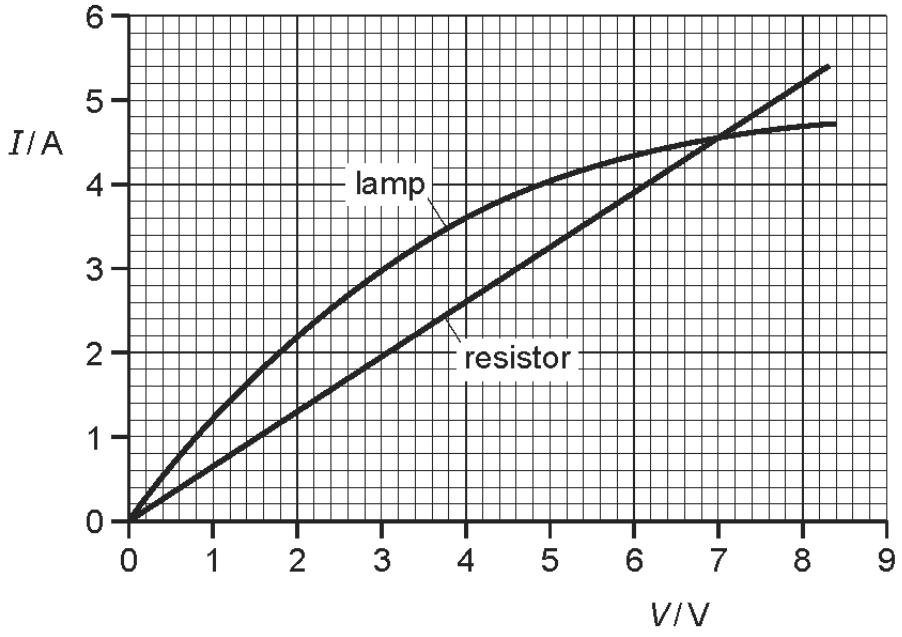

Fig. 9.1

(a) (i) Describe how, if at all, the resistance varies as the current increases in

1. the resistor, ...

2. the lamp. .....[2]

(ii) State the value of the potential difference when the resistor and the lamp have the same resistance.

potential difference = ...[1]

(b) The two components are connected **in parallel** to a supply of e.m.f. 4.0V. Calculate the total resistance of the circuit.

total resistance = ...[4]

The circuit shown in Fig. 10.1 was designed by an electronics student to provide a warning, by sounding the buzzer, that there is light in a photographic darkroom at times when it is in use.

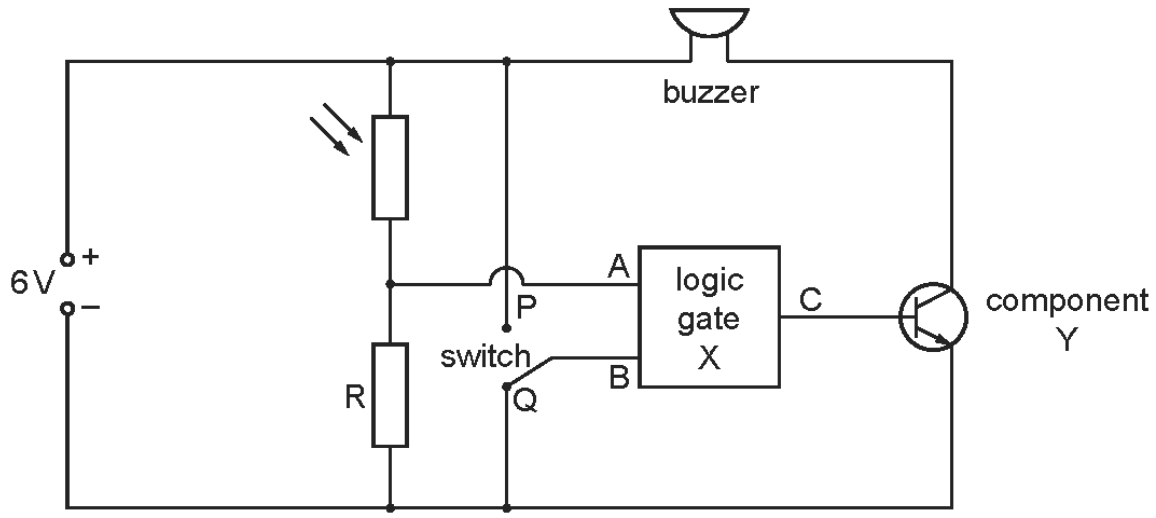

Fig. 10.1

When the darkroom is in use the switch is moved to position P. When it is not in use, the switch is in position Q.
Depending upon the light level, the resistance of the light dependent resistor varies between much higher and much lower than the resistance of resistor R.

(a) State what happens to the resistance of the light dependent resistor when the light level changes from dark to light.

.....

..... [1]

(b) Write down whether the voltage level is high (logic 1) or low (logic 0) at the various points in the circuit in the following situations:

(i) at A light in the darkroom, ...

dark in the darkroom, ...

(ii) at B switch in position P, ...

switch in position Q. ..... [2]

(c) The output C of logic gate X is only high (logic 1) when both inputs A and B are high (logic 1). State which type of gate is logic gate X.

..... [1]

(d) State the name of component Y.

..... [1]

(e) Explain whether or not the student's circuit achieves the aim of providing a warning that there is light in the darkroom when it is in use.

.....

.....

.....

..... [2]

This question refers to quantities and data shown on the circuit diagram of Fig. 9.1.

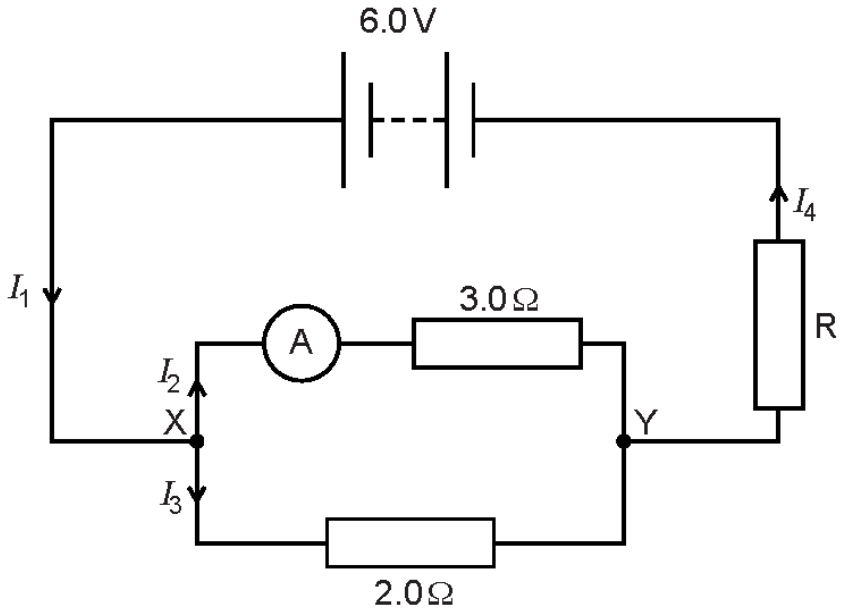

Fig. 9.1

(a) State the relationship between

(i) the currents I_1, I_2 and I_3, ...[1]

(ii) the currents I_1 and I_4. ..... [1]

(b) The ammeter reads 0.80 A. Assume it has zero resistance.

Calculate

(i) the potential difference between X and Y,

p.d. = ... [1]

(ii) the current I_3,

current = ... [2]

(iii) the resistance of R.

A student is designing a digital electronics circuit and needs to use the logic gate X shown in Fig. 10.1.

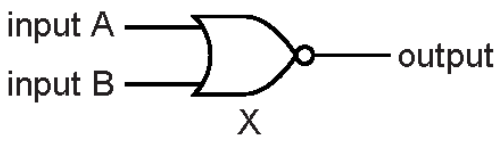

Fig. 10.1

(a) Name the logic gate X. ..... [1]

(b) Write down the values of the output when the inputs are

(i) input A low (logic 0), input B low (logic 0), output .....

(ii) input A low (logic 0), input B high (logic 1), output .....

(iii) input A high (logic 1), input B low (logic 0), output .....

(iv) input A high (logic 1), input B high (logic 1). output .....

[2]

(c) When the student starts to build the circuit, he finds that the store room has run out of this type of logic gate. There is a supply of AND, OR and NOT gates. The student's teacher explains that a combination of two of these gates may be used instead of logic gate X.

(i) State the two gates he should use to replace logic gate X.

..... and .....

(ii) Draw clearly in the space below these two logic gates, correctly connected, using standard symbols.

[3]

(d) Fig. 10.2 shows a block diagram, not using standard symbols, of a combination of gates.

Fig. 10.2

State the logic levels of points Y and Z when the logic levels of points U and W are both 1.

Fig. 11.1 shows part of a circuit designed to switch on a security lamp when it gets dark.

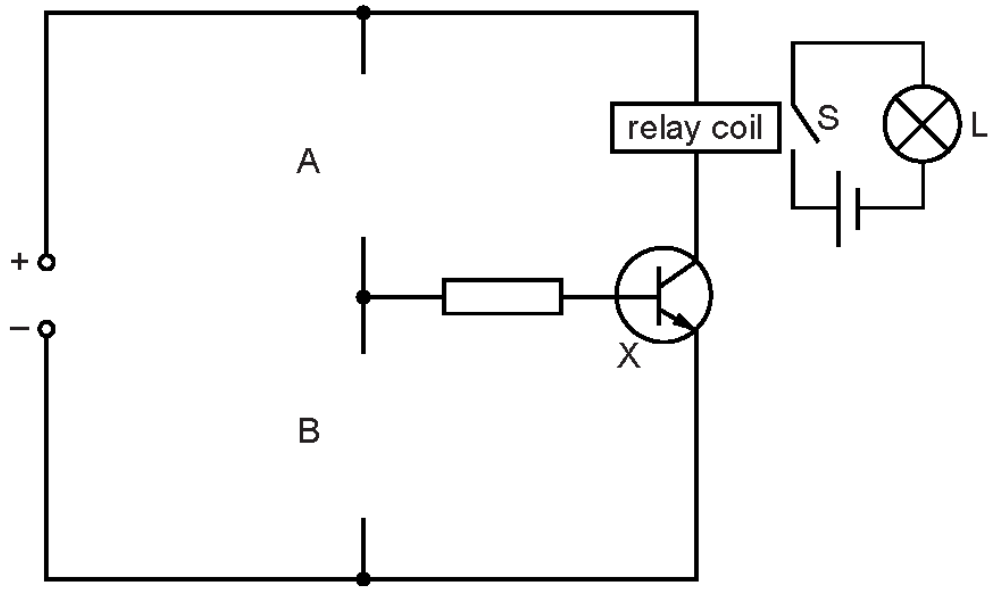

Fig. 11.1

When there is a current in the relay coil, switch S closes and the lamp L comes on.

(a) Write down the name of the component X. ..... [1]

(b) The circuit has gaps at A and at B.

State the components that need to be connected into these gaps for the circuit to perform its required function.

gap A .....

gap B .....

[3]

(c) The circuit in Fig. 11.1 is modified. The function of lamp L is now to give a warning when the temperature becomes too high.

State any necessary changes of components in the circuit.

.....

.....

..... [2]

Fig. 10.1 is the symbol for a NAND gate with inputs A and B.

Fig. 10.1

(a) Input A and input B can be set to 1 (high) or to 0 (low).

Complete the table below to give the outputs for this NAND gate.

input A	input B	output
0	0	
0	1	
1	0	
1	1	

[1]

(b) The two inputs of the NAND gate are joined together and connected to an input C, as shown in Fig. 10.2.

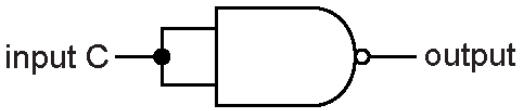

Fig. 10.2

(i) Determine the output of this NAND gate when

1. input C is set to 0,

output = ...

2. input C is set to 1.

output = ...

[1]

(c) A circuit combines three NAND gates.

The inputs to the circuit are P and Q, as shown in Fig. 10.3.

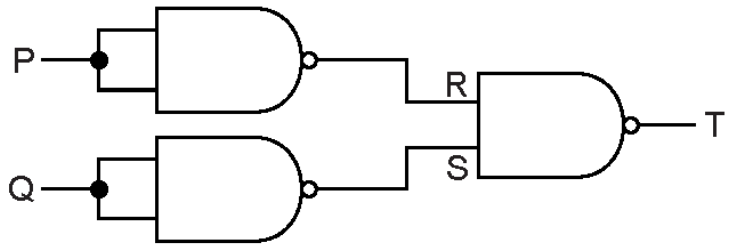

Fig. 10.3

Points R, S and T in the circuit are also labelled.

Input P is set to 0 and input Q is set to 1.

Determine the logic states (0 or 1) of points R, S and T.

point R = ...

point S = ...

point T = ...

[2]

(a) Describe the action of

(i) a NOT gate,

..... [1]

(ii) a thermistor.

..... [1]

(b) Fig. 11.1 shows a circuit that switches on a warning lamp when the temperature in an oven falls below a set value.

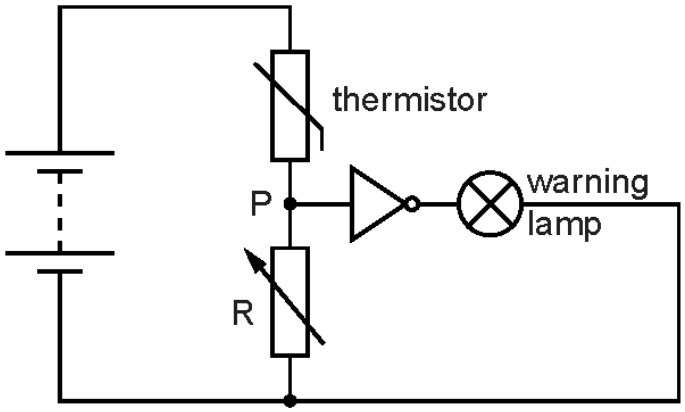

Fig. 11.1

Explain, with reference to the components in the circuit and point P,

(i) why the warning lamp is on when the temperature in the oven is below the set value,

.....

.....

.....

.....

.....

.....

..... [4]

(ii) the effect of changing the resistance of R.

.....

(a) Fig. 10.1 shows a digital logic circuit, not using the recognised symbols.

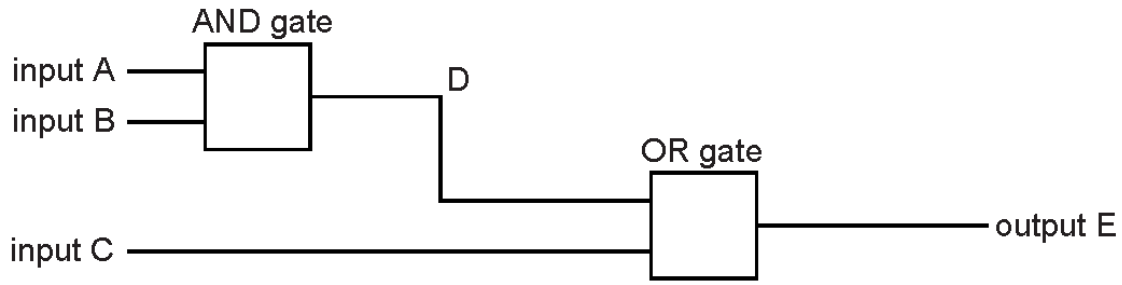

Fig. 10.1

Complete the table below to indicate the logic levels of points D and E in the circuit, when points A, B and C are at the logic levels indicated.
0 represents low or off. 1 represents high or on.

A	B	C	D	E
0	0	0		
0	0	1		
1	1	1		

[3]

(b) Draw the recognised symbol for an AND gate.

[1]

(c) A NAND gate can be replaced by an AND gate and a NOT gate.

Draw a diagram to show how the AND gate and the NOT gate should be connected. Label clearly the logic gates and any input or output.

[2]

(a) Data may be transmitted as an analogue signal or as a digital signal.

(i) Explain what is meant by

1. an *analogue* signal,

.....

.....

.....

2. a *digital* signal.

.....

.....

.....

[3]

(ii) State two advantages of the transmission of data in digital form.

1. can be regenerated/ noice can be eliminated

.....

2. correct transmitted signal

.....

[2]

easy to be regenerated
more info can be sent
easily processed by computers

+ PRACTICE Conversion between binary and decimal forms of numbers.