

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE
A515/01
DESIGN AND TECHNOLOGY:
ELECTRONICS AND CONTROL SYSTEMS
Sustainability and technical aspects of
designing and making – Electronics

TUESDAY 19 MAY 2015: Morning
DURATION: 1 hour 30 minutes
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname								
Centre number						Candidate number				

Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

A calculator may be used for this paper.

Pencil

Ruler (cm/mm)

A CALCULATOR MAY BE USED FOR THIS PAPER
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READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

Use black ink. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions in Section A AND Section B.

Read each question carefully and make sure that you know what you have to do before starting your answer.

Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) should be clearly shown.

Show all working out for calculations.

INFORMATION FOR CANDIDATES

The number of marks for each question is given in brackets [] at the end of the question or part question.

The total number of marks for this paper is 80.

Your quality of written communication is assessed in questions marked with an asterisk (*).

Dimensions are in millimetres unless stated otherwise.

Any blank pages are indicated.

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SECTION A

Answer ALL the questions

You are advised to spend 40 minutes on this section.

ON QUESTIONS 1–5 CIRCLE YOUR ANSWER.

1 Using a rechargeable battery can reduce your carbon footprint if you:

(a) Charge it from a mains socket

(b) Recycle it when it's flat

(c) Charge it from a solar electric panel

(d) Fit it backwards into your product

[1]

2 Some smart materials:

(a) Know what you are thinking

(b) Respond to tree growth

(c) Change their properties when heated

(d) Generate carbon credits automatically

[1]

3 Solar panels harvest energy from:

(a) Any fossil fuel

(b) Sustainable forest timber

(c) The movement of the planets

(d) The sun

[1]

4 Coal-fired power stations can contribute to:

(a) Volcanic ash clouds

(b) Acid rain

(c) Potholes in roads

(d) Improved tree growth

[1]

- 5 Reducing the use of chemicals dangerous to the environment can:
- (a) Increase charity shop profits
 - (b) Save you money
 - (c) Help keep your garden fence green
 - (d) Contribute to preserving the world's eco-systems [1]
- 6 Complete the following to give the meaning of the abbreviation RoHS.
- Restriction of H_____ S_____ [1]
- 7 State ONE source of renewable energy.
- _____ [1]
- 8 Give ONE reason why excessive carbon dioxide emissions may be harmful to the environment.
- _____
- _____ [1]
- 9 State the meaning of the term 'biodegradable'.
- _____ [1]
- 10 Which of the 6Rs describes the disassembly and reprocessing of materials for use in new products?
- _____ [1]

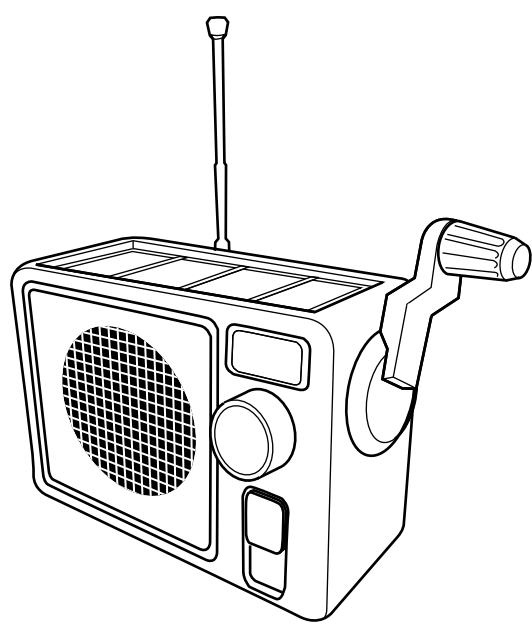
Decide whether the statements below are TRUE or FALSE.

Tick [✓] the box to show your answer.

	TRUE	FALSE	
11 Globalised companies only sell their products in the United Kingdom	<input type="checkbox"/>	<input type="checkbox"/>	[1]
12 All redundant products should be sent to landfill	<input type="checkbox"/>	<input type="checkbox"/>	[1]
13 All designers of mobile phones include built-in obsolescence	<input type="checkbox"/>	<input type="checkbox"/>	[1]
14 Leaving televisions on standby wastes energy	<input type="checkbox"/>	<input type="checkbox"/>	[1]
15 WEEE regulations help with safe disposal of faulty electronic products	<input type="checkbox"/>	<input type="checkbox"/>	[1]

16 Fig. 1 shows a wind-up rechargeable radio.

Fig. 1



(a) Identify **THREE** design features of the wind-up radio shown in Fig. 1.

- 1 _____
 - 2 _____
 - 3 _____
- [3]

(b) The wind-up radio includes a small rechargeable battery.

Give **ONE** benefit of including a rechargeable battery in the wind-up radio.

- _____
- _____ [1]

(c) The wind-up radio can be dismantled into its component parts using only a small cross-point screwdriver.

Give **TWO** benefits of this to the environment.

- 1 _____
 - _____
 - 2 _____
 - _____
- [2]

(d) The wind-up radio contains components made of different materials.

Choose from the following recycling processes to complete the table below, matching a recycling process to each material.

- Tertiary recycled
- Removed, tested and re-used
- Melted down and refined
- Sorted then melted down and re-used
- Ground up and used as filler

MATERIAL	RECYCLING PROCESS
Metal	Melted down and refined
Different thermoplastics	
Thermosetting plastics	
Electronic components	

[3]

(e) Give TWO ways that the wind-up radio could be disposed of by primary recycling.

- 1 _____
- 2 _____

[2]

(f) Use sketches and notes to illustrate to the user how to operate the wind-up radio.

[3]

[illegible]

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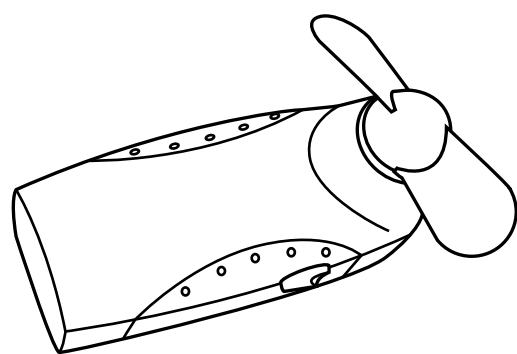
SECTION B

Answer ALL the questions

You are advised to spend 50 minutes on this section.

17 Fig. 2 shows a small battery powered hand-held fan and a table showing three circuit symbols for components from the fan.

Fig. 2



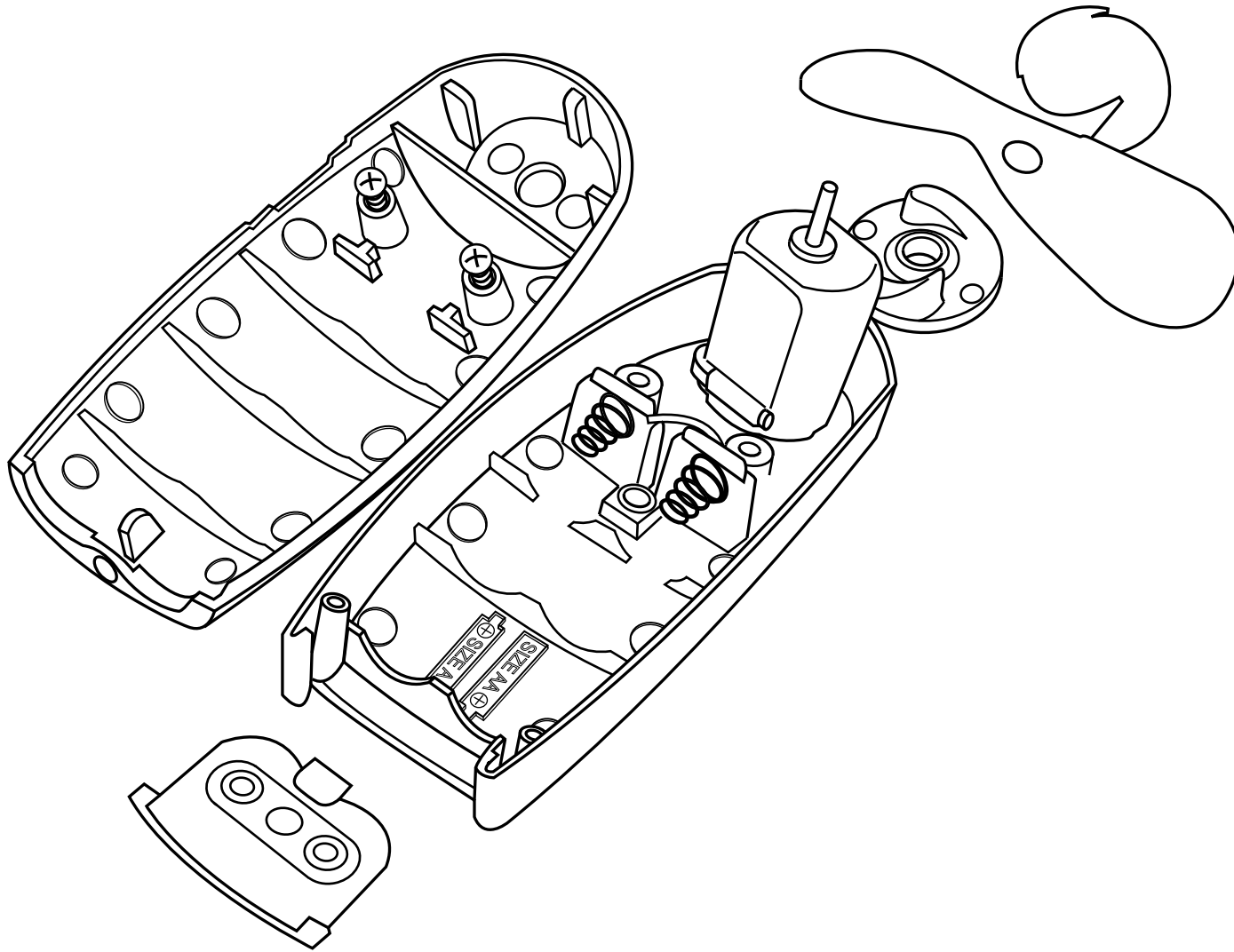
symbol	component

(a) (i) Complete the table by adding the name of each component next to its symbol.

[3]

(ii) Fig. 3 shows a view of the fan casing and components.

Fig. 3



Describe TWO features of the casing that show it has been injection moulded.

1 _____

2 _____

[2]

(iii) The battery symbol can be seen on the inside of the casing but it cannot be seen by the user when the casing is assembled.

Circle the area of design that should have been considered to avoid this.

function

aesthetics

ergonomics

anthropometrics

cost

[1]

(iv) Two 'AA' size 1.5V batteries are connected together to provide 3V for driving the fan motor.

State the name for this method of connecting the batteries.

_____ [1]

(b) Larger electric motors will often use a driver circuit that includes a relay.

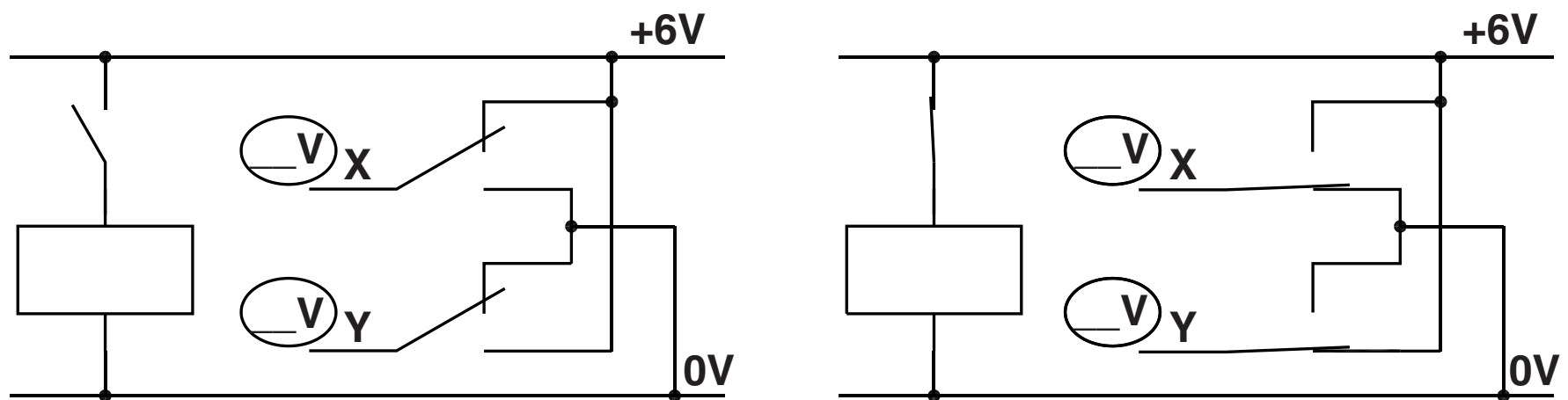
(i) Give ONE reason for using a relay to switch a motor on and off.

[1]

(ii) Fig. 4 shows a switching arrangement using a DPDT relay. The circuit is shown before and after the coil has been connected.

Fill in the voltage that will appear at points X and Y on both views.

Fig. 4



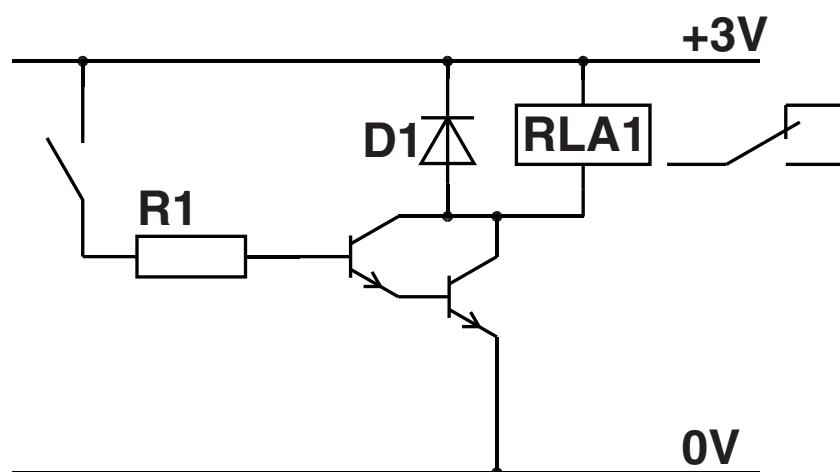
[1]

(iii) Explain how this circuit can be used to operate a small dc motor in reverse.

[2]

(c) Fig. 5 shows a driver circuit for relay RLA1.

Fig. 5



(i) State the purpose of components R1 and D1.

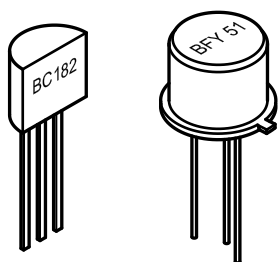
R1 _____
 _____ [1]

D1 _____
 _____ [1]

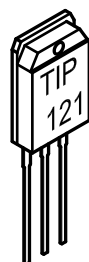
(ii) The Darlington pair transistor arrangement can be used in three ways as shown in Fig. 6. The cost of each transistor is shown in brackets.

Fig. 6

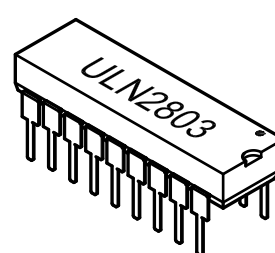
2 separate
transistors
BC182 BFY51
(£0.16)(£0.29)



single
Darlington
transistor
TIP121
(£0.41)



Array of 8 Darlington
transistors base resistors
included
ULN2803
(£0.61)



Give TWO reasons why a circuit designer may choose to use the Darlington array.

1 _____

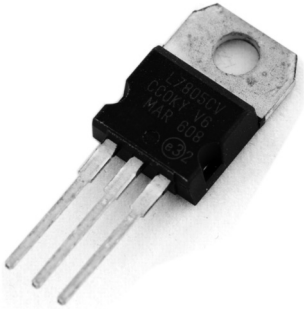
2 _____

[2]

18 (a) Many integrated circuits, including PIC devices, need a precise +5V supply voltage.
This can be provided by a 7805 voltage regulator.

Fig. 7 shows details of the regulator.

Fig. 7



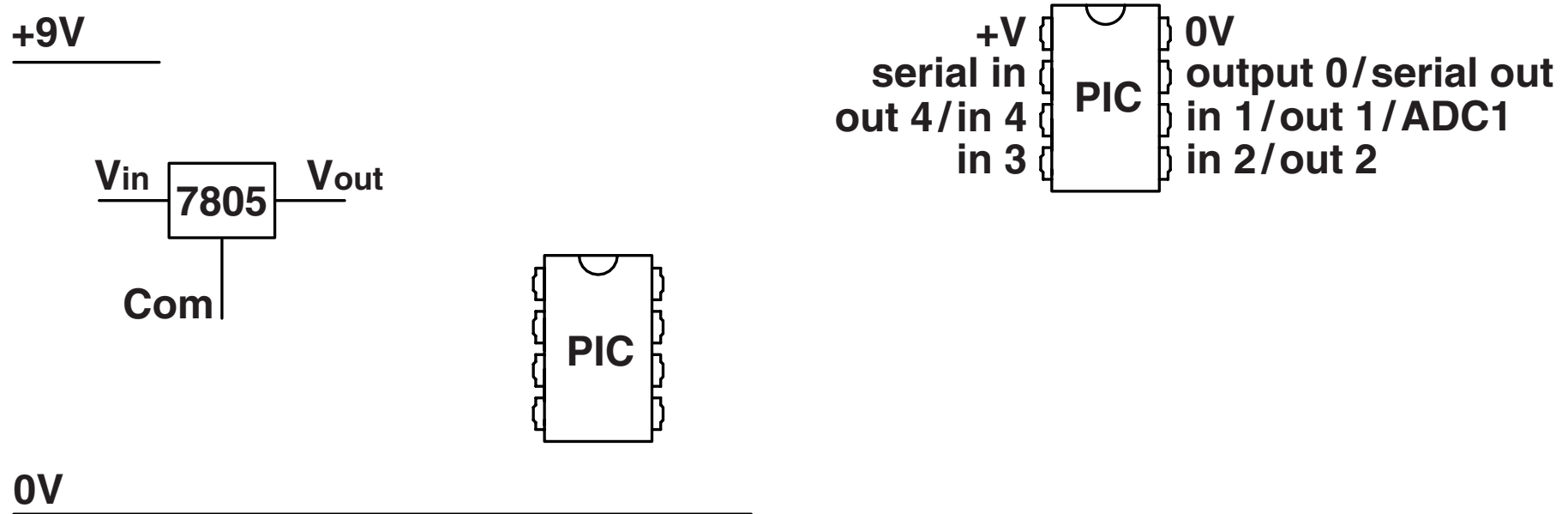
7805		
ELECTRICAL CHARACTERISTICS	MIN	MAX
Input voltage	7.5V	20V
Operating temperature range	0°C	+125°C
Output voltage	+5V	±4%
Maximum current	1 A	
Short circuit current	230 mA	

(i) The output voltage has a tolerance of $\pm 4\%$.
State the range of output voltage from the 7805 voltage regulator.

between _____ V and _____ V [1]

- (ii) Complete the circuit diagram in Fig. 8 by adding connections to the 7805 voltage regulator and power connections to the PIC IC.

Fig. 8



[4]

- (iii) The input voltage can be provided by a battery. A range of voltages that can be provided by batteries is shown below.

+3V +9V +4.5V +12V +6V

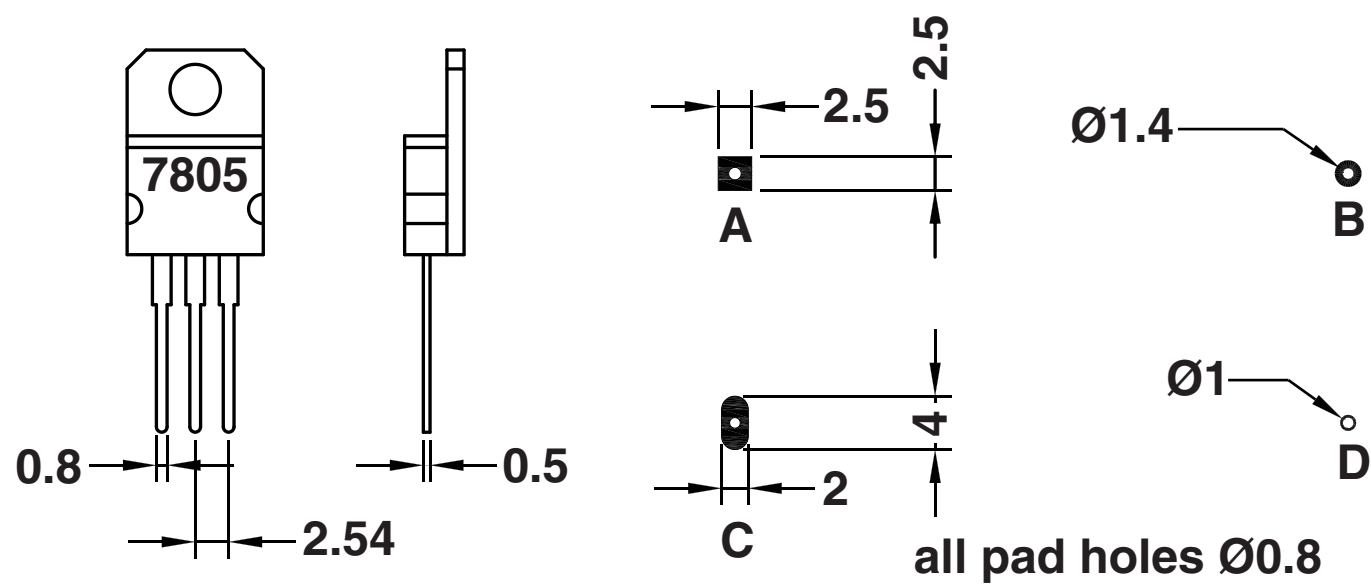
Using information from Fig. 7 circle the TWO battery voltages which are suitable for providing the 7805 input voltage.

[1]

(b) Pad shapes and sizes can be set precisely on PCB design software.

Fig. 9 shows a range of possible pads and the dimensions of the 7805 voltage regulator.

Fig. 9



Give ONE reason why type C is the most suitable for the 7805 voltage regulator.

[1]

- (c) The full circuit for the 7805 voltage regulator includes two capacitors.
A $0.33\ \mu\text{F}$ capacitor is placed between V_{in} and Com.
A $0.1\ \mu\text{F}$ capacitor is placed between V_{out} and Com.
Use sketches and notes to explain the purpose of the two capacitors.

[2]

Discuss the methods that can be used within a school workshop to reduce the risk of injury and long term effects resulting from being in the workshop environment.

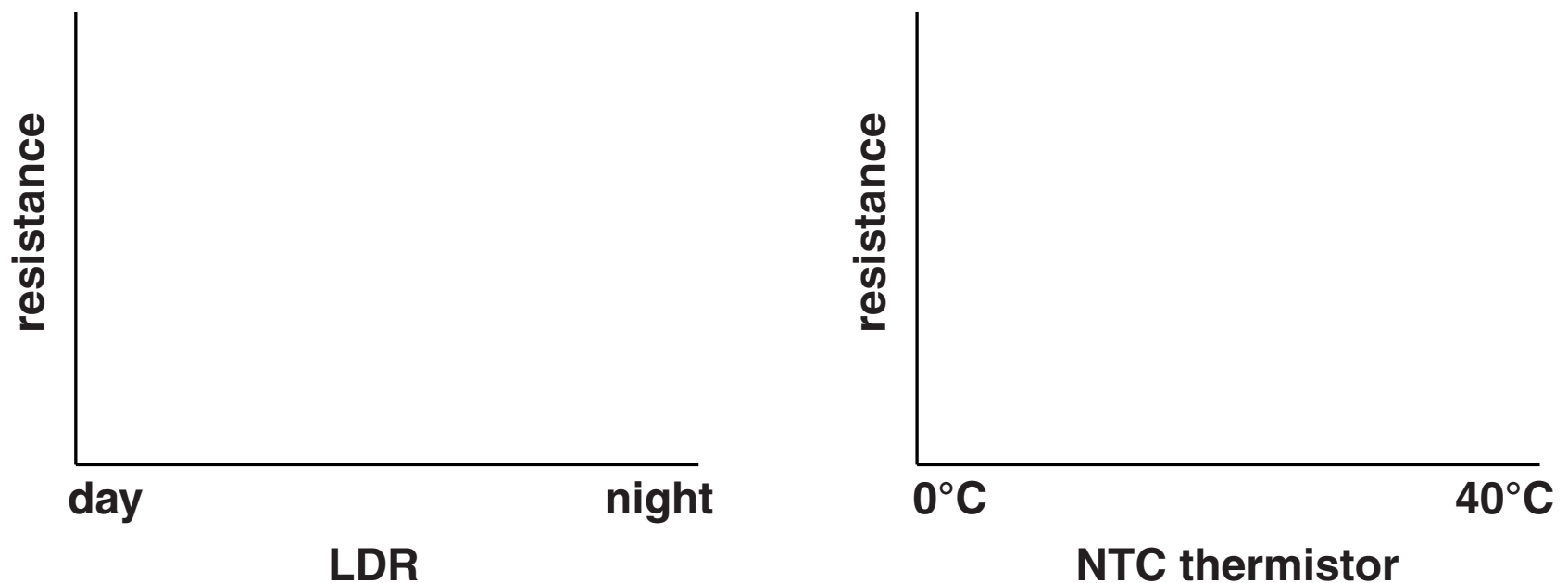
[illegible]

19 A garden centre needs a warning system to indicate when the temperature has fallen below a set level at night time after the centre has closed.

- (a) An LDR will detect low levels of light and an NTC thermistor will detect the falling temperature.

Complete the graph in Fig. 10 to show the changes in resistance in each of the sensors.

Fig. 10



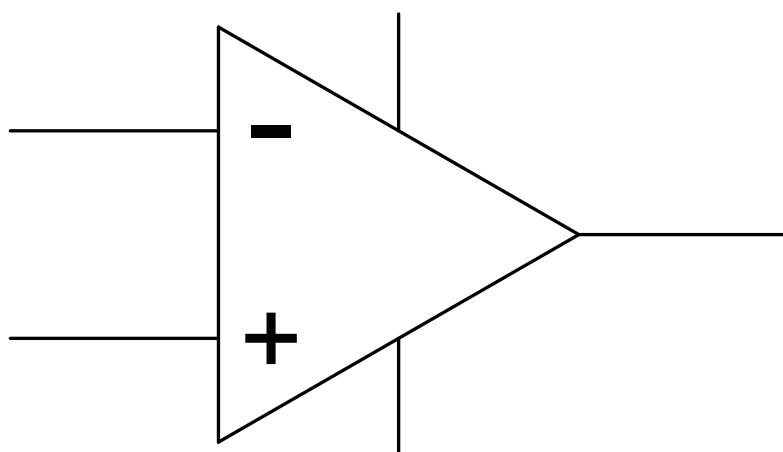
[2]

- (b) (i) Fig. 11 shows the circuit symbol for a comparator.
Add labels for the following connections to the comparator:

inverting input

non-inverting input

Fig. 11



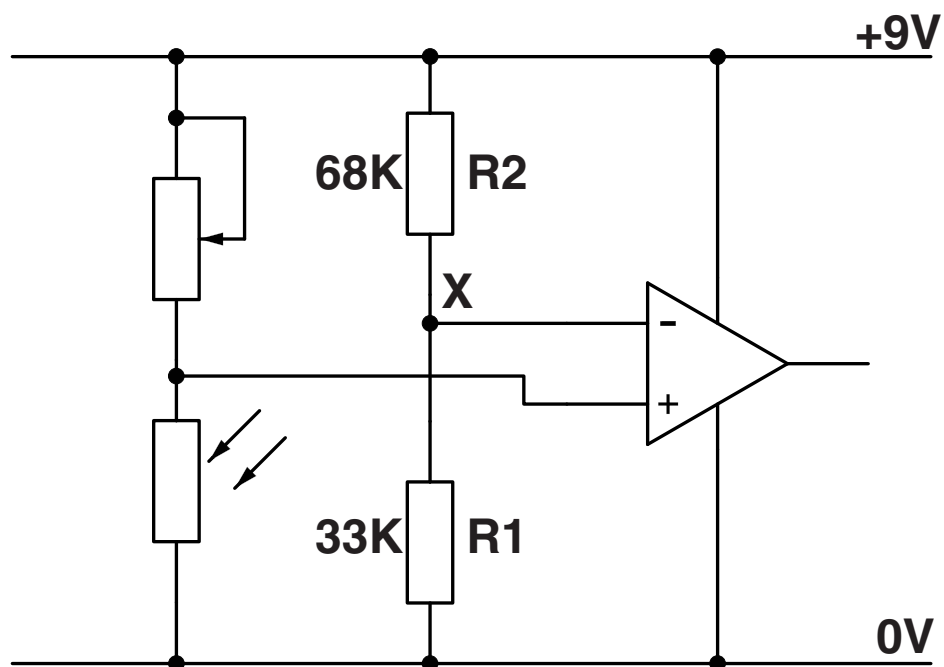
[2]

- (ii) Explain how the comparator output is decided.

[2]

- (iii) Fig. 12 shows the first circuit idea for the warning system which will provide a change in signal when it is night time.

Fig. 12



Calculate the voltage at point X.

Use the formula $V_{\text{out}} = \frac{R_1}{R_1 + R_2} \times V_{\text{in}}$

[3]

- (c) (i) Both sensors will be attached to the circuit by flexible connecting wires. Use sketches and notes to show a method of connecting the wires to a circuit board so that they can be removed easily. [2]**

- (ii) When the comparators register low temperature and darkness the output of both transistor switches is 0V or logic 0. A warning is needed if this state occurs.

A truth table for combining the outputs is shown in Fig. 13.

Fig. 13

LDR circuit		thermistor circuit
thermistor circuit		output
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

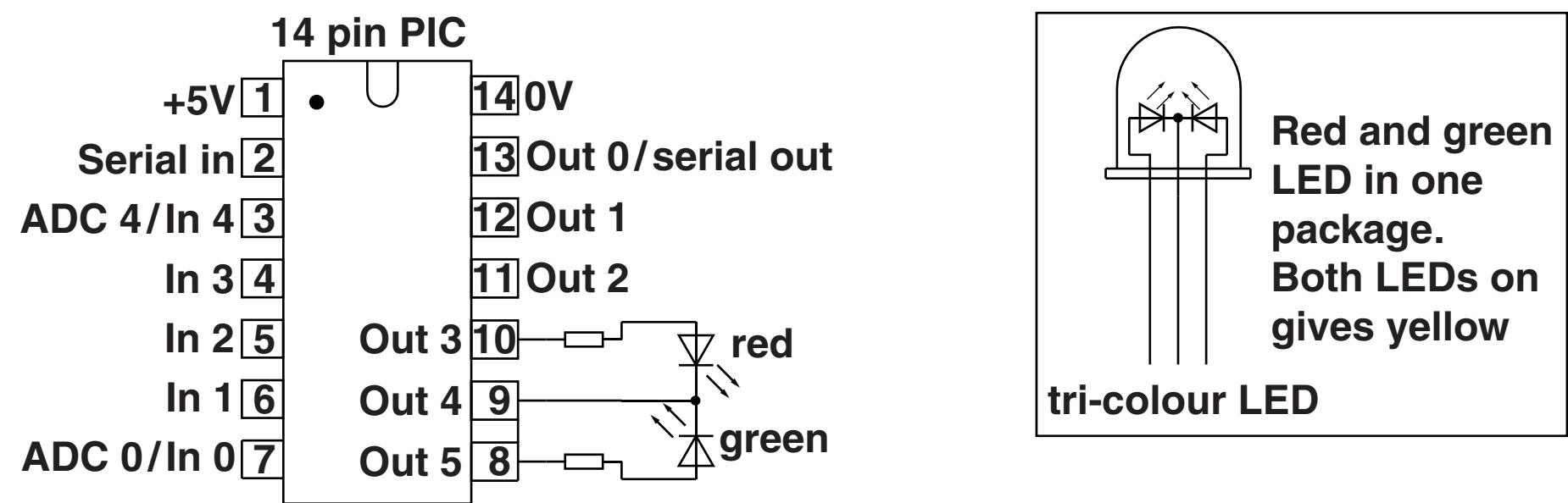
State the name of the logic gate that can be used in the circuit.

_____ [1]

(d) An alternative circuit could use a PIC chip instead of comparators.
 Fig. 14 shows a PIC IC with a tri-colour LED at the outputs.

Complete the table to show the output logic levels that will switch each colour on.

Fig. 14



Colour showing	Out 3	Out 4	Out 5
red on			
green on			
yellow on			

[3]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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