Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
June 2006

DESIGN AND TECHNOLOGY **3546/F**
(SYSTEMS AND CONTROL TECHNOLOGY)
Written Paper
Foundation Tier

F

Wednesday 14 June 2006 1.30 pm to 3.30 pm

For this paper you must have:
- a pen, pencil, ruler, eraser and pencil sharpener

Time allowed: 2 hours

Instructions

- Use blue or black ink or ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **either Section A** – Mechanisms Focus Technology
  or Section B – Pneumatics Focus Technology.
- Answer **all** questions in your chosen section.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

Information

- The maximum mark for this paper is 125.
- The marks for questions are shown in brackets.
- A list of formulae and other information, which you may wish to use in your answers, is provided on page 2.
- All dimensions are given in millimetres unless otherwise stated.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
SECTION A MECHANISMS FOCUS	
Question	Mark
A1	
A2	
A3	
A4	
A5	
A6	
A7	
A8	
A9	
TOTAL	
SECTION B PNEUMATICS FOCUS	
Question	Mark
B1	
B2	
B3	
B4	
B5	
B6	
B7	
B8	
B9	
TOTAL	
Examiner's Initials	

You may use the following information when answering the questions.

Pneumatics

$$\text{Force} = \text{Pressure} \times \text{Area}$$

Ratio of Simple Gears

$$\text{Gear Ratio} = \frac{\text{Number of teeth on driven gear}}{\text{Number of teeth on driver gear}}$$

Velocity Ratio

$$\text{Velocity Ratio} = \frac{\text{Diameter of driven pulley}}{\text{Diameter of driver pulley}}$$

$$\text{Output speed} = \frac{\text{Input speed}}{\text{Gear/Velocity ratio}}$$

Forces

$$\text{Moments} = \text{Force} \times \text{Distance}$$

Sum of clockwise moments = sum of anti-clockwise moments

Series Resistance

$$R_T = R_1 + R_2 + R_3$$

Parallel Resistance

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \quad \text{OR} \quad R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

Potential Difference

$$V = I \times R$$

Transistors

$$\text{Current Gain} = \frac{\text{Collector Current}}{\text{Base Current}}$$

Amplifier Gain

$$\text{Av} = \frac{\text{Change in output voltage}}{\text{Change in input voltage}}$$

Area of circle = πr^2 $\pi = 3.142$

Resistor Colour Code

Colour	Number	Number of Zeros
Black	0	
Brown	1	0
Red	2	00
Orange	3	000
Yellow	4	0,000
Green	5	00,000
Blue	6	000,000
Violet	7	0,000,000
Grey	8	00,000,000
White	9	000,000,000

E12 Resistor preferred values

10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades thereafter.

EITHER

Turn over for Section A – Mechanisms Focus

OR

Turn to page 26 for Section B – Pneumatics Focus

SECTION A – MECHANISMS FOCUS

Answer **all** questions in this section.

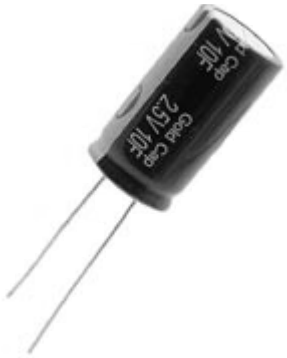
Do **not** answer these questions if you have answered the questions in **Section B – Pneumatics Focus** (pp. 26 – 45).

A1 This question is about recognising components.

(a) Each of the illustrations below shows an electronic component that can be used in circuits.

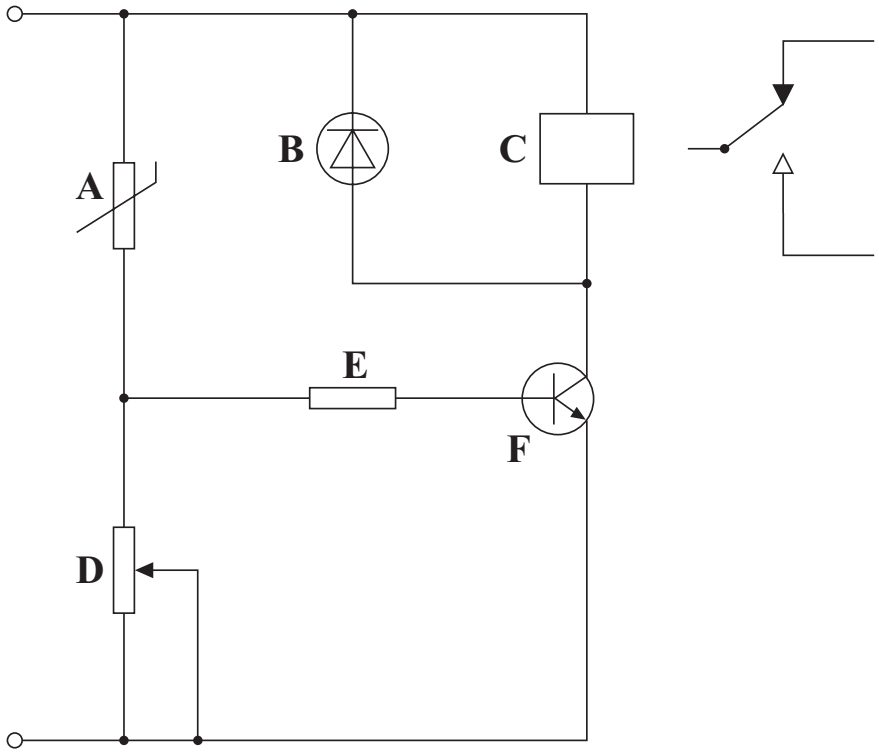
For each illustration, name the component and draw the electronic circuit symbol that represents it in a circuit diagram.

One example has been completed for you.

	Component	**Symbol**
	Capacitor	
		
		

(4 marks)

(b) The diagram below shows an electronic circuit. Some of the components have been labelled with a letter.



Place the correct letter in the spaces below. The first one has been done for you.

	Component	Letter
	Relay	C
(i)	Transistor	
(ii)	Diode	
(iii)	Thermistor	
(iv)	Variable resistor	

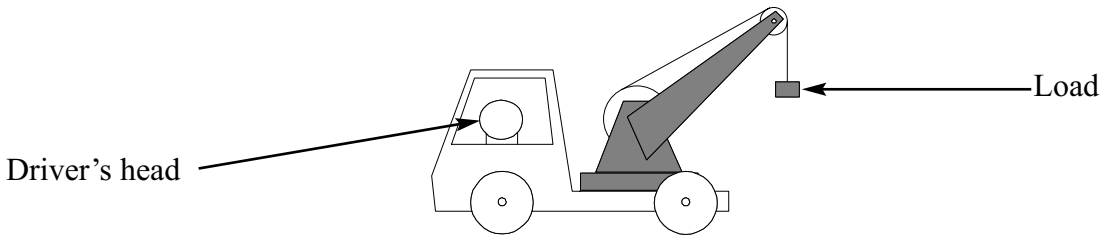
(4 marks)

8

A2 This question is about using mechanisms.

Figure 1, below, shows a push-along child's toy that has a crane on it.

Figure 1



(a) The figures below show part of the crane mechanism. The rope is attached to the load to be lowered.

Label the types of motion indicated by the direction arrows.

Figure 2

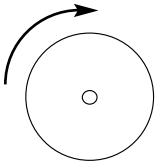
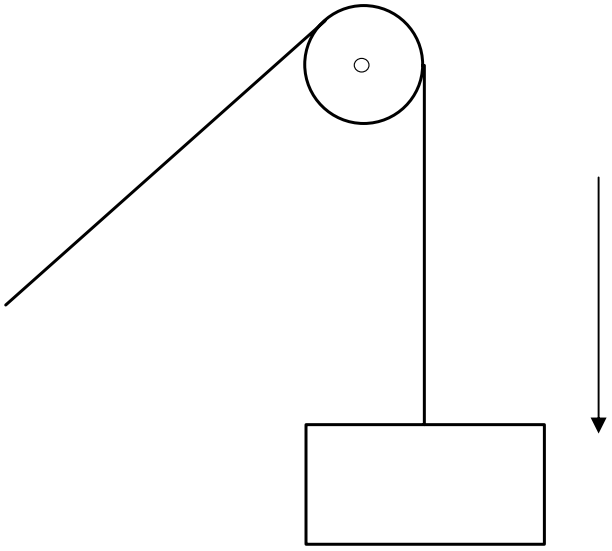


Figure 3



(i) Type of motion .....

(ii) Type of motion .....

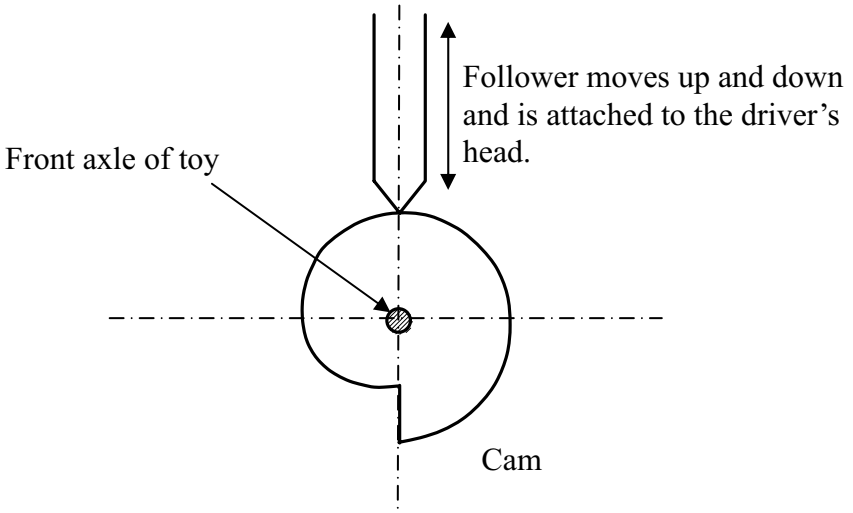
(2 marks)

(b) When the toy in **Figure 1** is pulled in a forward direction the driver's head goes up and down.

The mechanism below is used to produce this movement.

(i) On the drawing below show the direction the cam will turn.

Figure 4



(1 mark)

(ii) Describe what happens to the driver's head during one complete rotation of the cam shown above.

.....

.....

(2 marks)

(iii) Explain why the cam in **Figure 4** would **not** allow the toy to be pushed backwards.

.....

.....

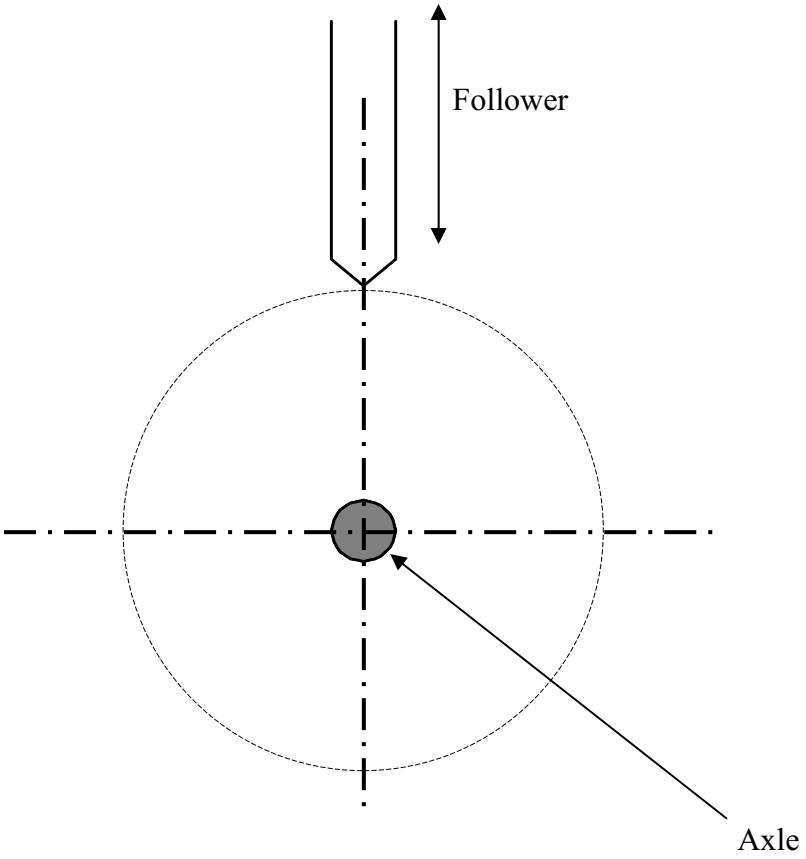
(1 mark)

Question A2 continues on the next page

(c) On the axle in **Figure 5** draw a cam that would allow the toy to be pushed forwards and backwards and move the driver's head up and down.

Draw your cam inside the dotted circle.

Figure 5



(3 marks)

(d) Rotating shafts often use the component shown below.

(i) What is the name of this component? .....
(1 mark)

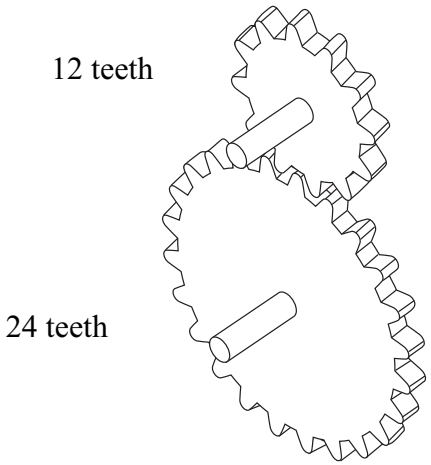
(ii) Why is it used? .....
(1 mark)

11

Turn over for the next question

A3 This question is about using gear systems.

The drawing below shows a gear system designed to **reduce** speed.



(a) Label the input shaft. *(1 mark)*

(b) Name the type of gear train shown in the drawing.

.....

(1 mark)

(c) Calculate the gear ratio for the system.

Formula .....

Calculation .....

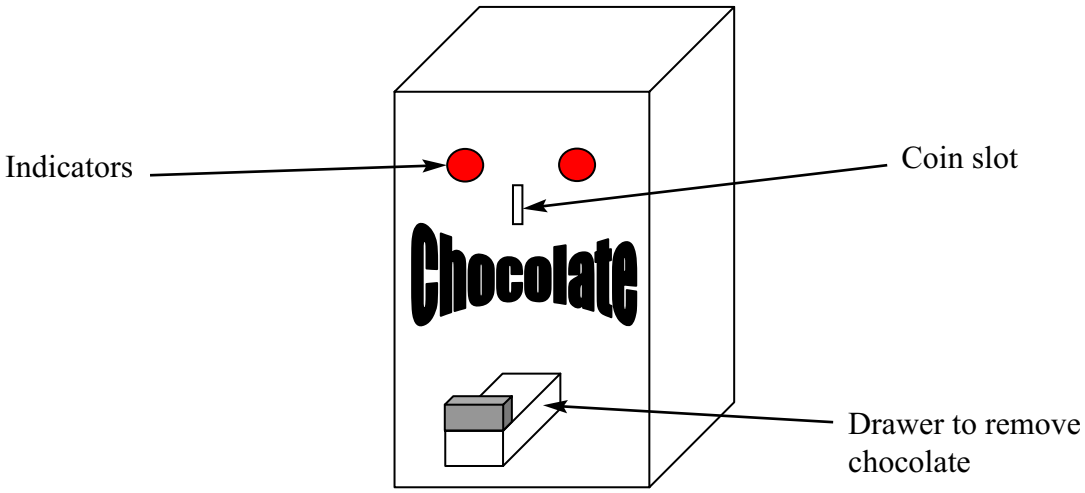
Answer .....

(3 marks)

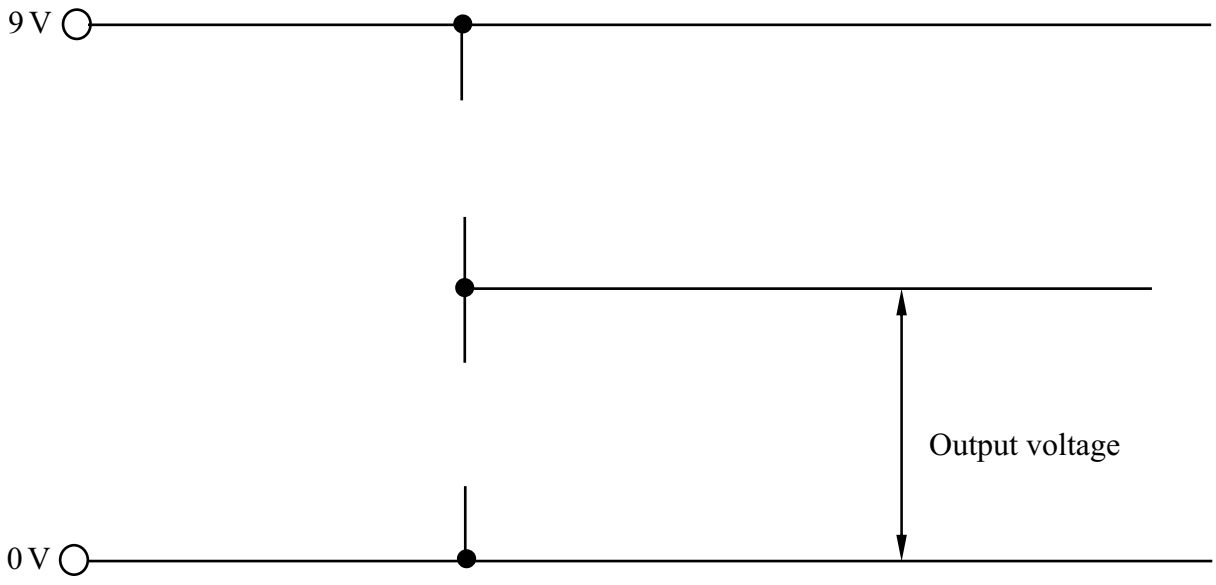
5

A4 This question is about sensing.

The designer of a chocolate bar dispenser has chosen to use a light sensing circuit to indicate when it is low on chocolate bars and when it needs refilling.



(a) Complete the circuit diagram below by adding a Light Dependent Resistor (LDR) and a variable resistor to give an output voltage when light is sensed.



(3 marks)

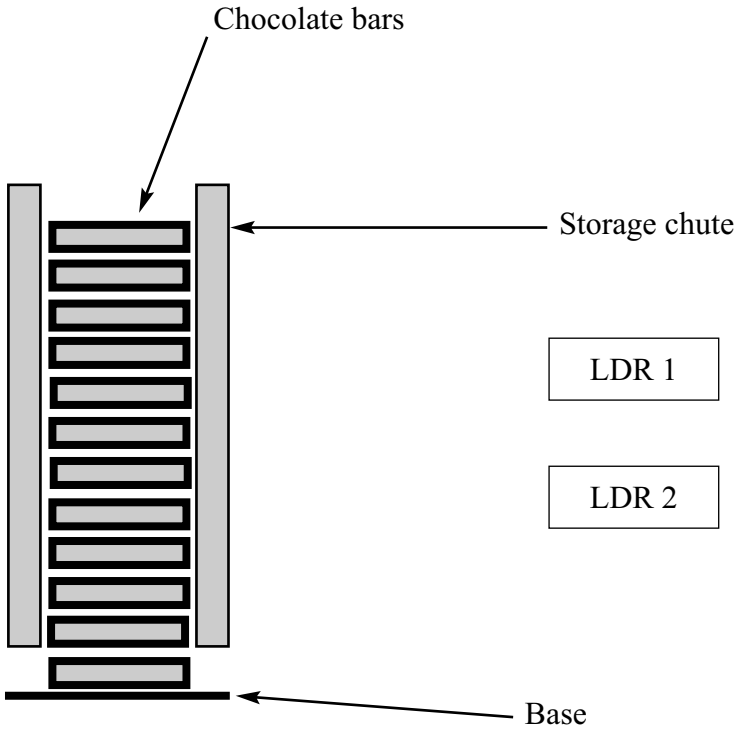
Question A4 continues on the next page

(b) The designer wants to use LDRs as sensors in **two** positions in the dispensing machine.

LDR 1 = LOW This will sense when there are only four products left in the dispensing machine.

LDR 2 = EMPTY This will sense when the container is completely empty.

Show with arrows where LDR 1 and LDR 2 would be positioned.



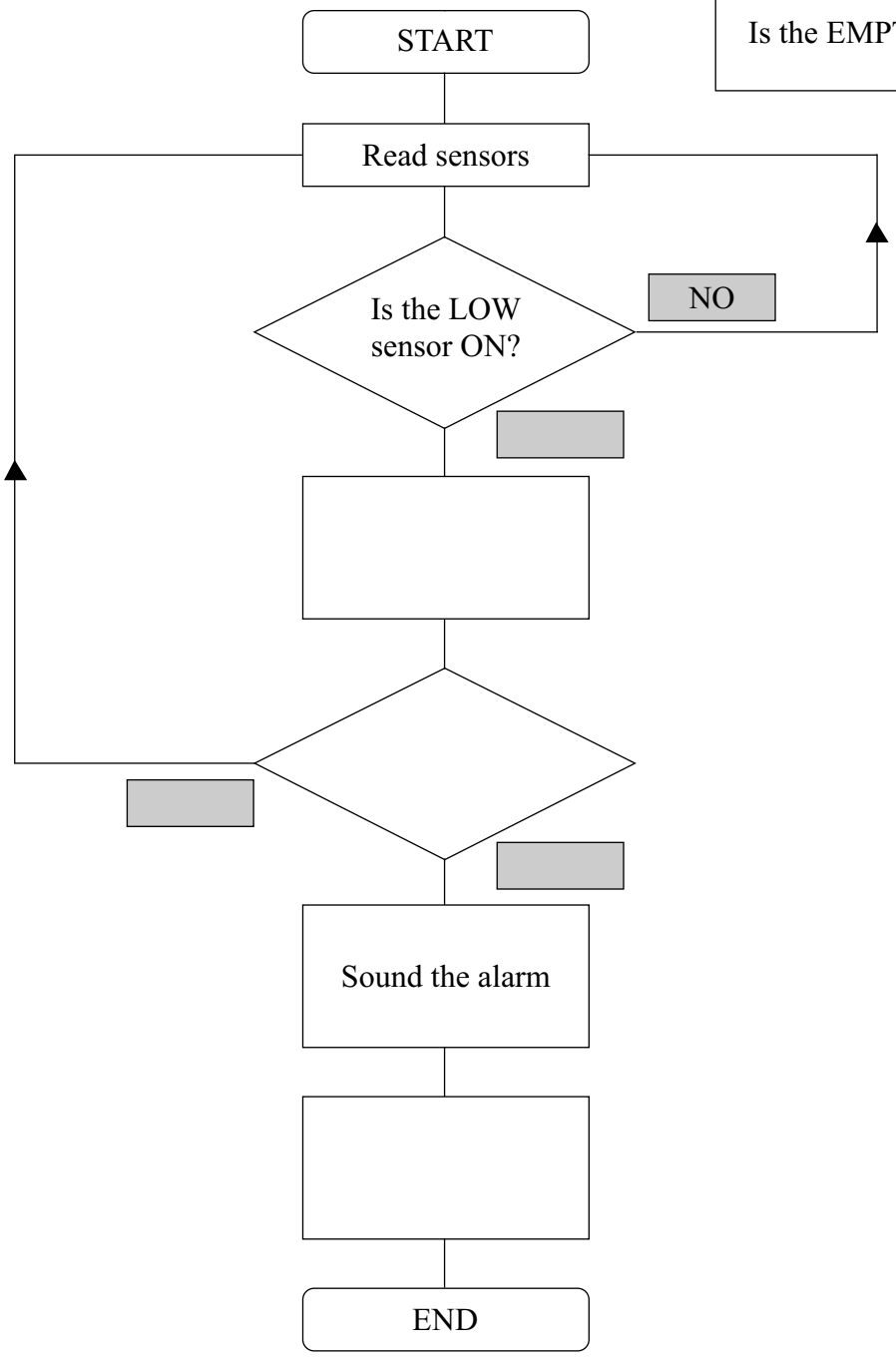
(2 marks)

(c) When the LOW sensor (LDR 1) is ON, a **WARNING** light comes on to show the shop staff that the dispensing machine needs refilling.

If the EMPTY sensor (LDR 2) is turned ON, an alarm sounds and the **EMPTY** light comes on.

- Complete the flow chart by filling in the missing stages using the statements given in the box below.
- Write YES or NO in the three shaded boxes.

Turn ON **EMPTY** light
Turn ON **WARNING** light
Is the EMPTY sensor ON?



(6 marks)

11

Turn over ►

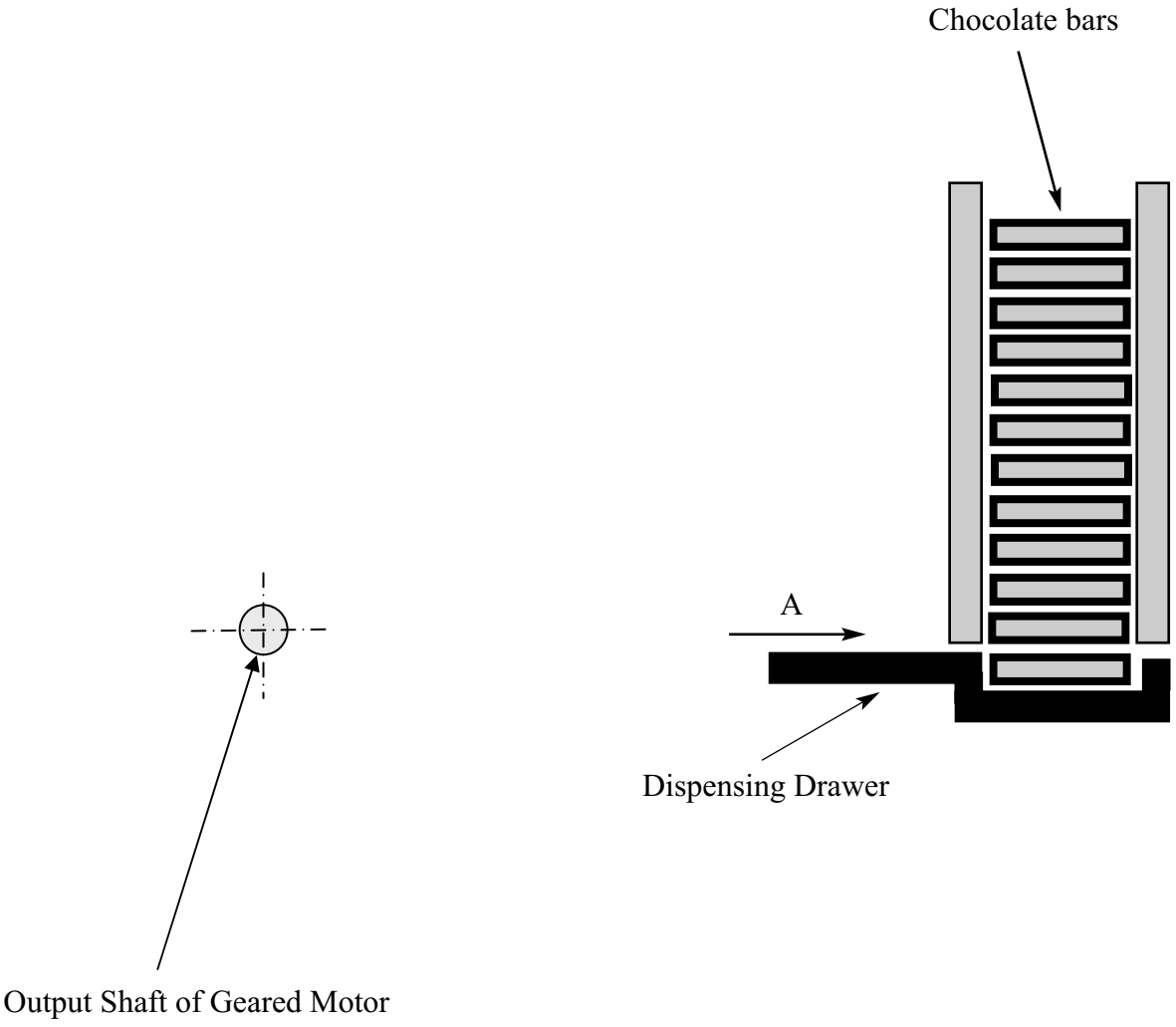
A5 This question is about designing powered mechanisms.

In this system a chocolate bar dispensing drawer moves in the direction of arrow A and returns to the start position.

The dispensing drawer mechanism is driven by a geared motor. Its output shaft is shown below.

(a) Using notes and sketches, design a mechanism that achieves this movement.

Marks will be awarded for	Appropriate mechanism	*(4 marks)*
	Quality of communication	*(2 marks)*



(b) (i) For a dispensing machine, give an example of another product that the machine could deliver.

.....

(1 mark)

(ii) Give an advantage to the user.

.....

(1 mark)

(c) When designing a powered mechanism several safety aspects need to be considered.

Complete the following sentences by filling in the missing words.

Choose from the list given below.

gear	stop	sensor	user	start
friction	slip	machine	ratio	electronic

The safety of the ..... should always be considered when designing a powered mechanism.

Guards should ensure that you cannot ..... the mechanism until they are in position.

Most guards use a ..... to detect whether they are in position.

A belt drive can be safer for powering a mechanism because it will ..... if something jams.

A ..... driven system will continue to exert force if there is a jam and this can result in a breakage.

(5 marks)

13

Turn over for the next question

A6 This question is about pulley systems.

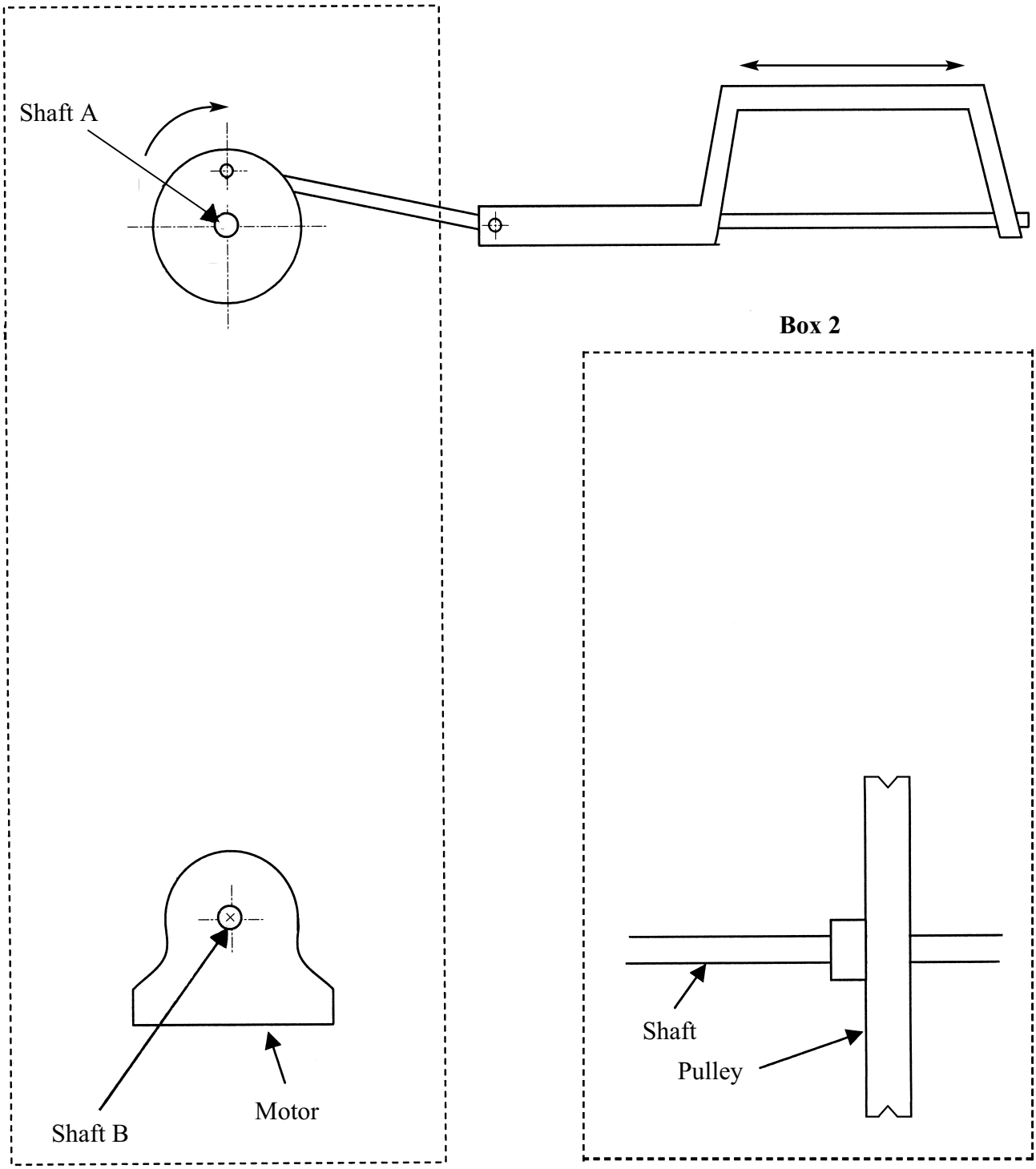
A powered hacksaw needs to move continuously backwards and forwards.
In the diagram below, some of the details of the hacksaw have been omitted for clarity.

(a) (i) In **Box 1**, add a pulley system that connects Shaft A and Shaft B and will enable the hacksaw operator to choose between two different speeds of operation. *(4 marks)*

(ii) In **Box 2**, using notes and sketches, show how the pulley could be attached to the Shaft. *(4 marks)*

Marks will *also* be awarded for Quality of drawing *(2 marks)*
Notes explaining system *(2 marks)*

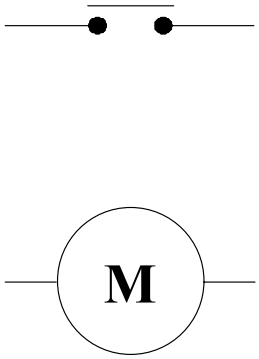
Box 1



Box 2

(b) As a safety feature it has been decided that the operator needs to press two push-to-make (PTM) switches to operate the hacksaw.

- Complete the circuit below by adding a second PTM switch and show how they connect to the hacksaw motor (M).
- Show connections to a suitable power supply.



(3 marks)

(c) Why would the switches be placed at least 500 mm apart on the machine?

.....

.....

(1 mark)

16

Turn over for the next question

A7 This question is about using workshop equipment.

When making products in the workshop health and safety is very important.

(a) State **two** safety rules that should be followed for **each** of the following common items of workshop equipment.

Give **six** *different* rules.

Etching Tank

Rule 1 .....

.....

Rule 2 .....

.....

(2 marks)

Pillar Drill

Rule 1 .....

.....

Rule 2 .....

.....

(2 marks)

Soldering Iron

Rule 1 .....

.....

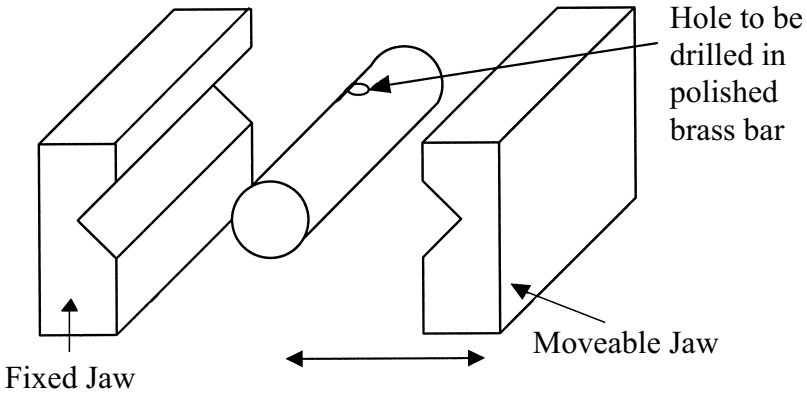
Rule 2 .....

.....

(2 marks)

(b) As part of a production process a hole is to be drilled in a polished brass bar using a drilling machine.

The bar is to be held by two jaws. The diagram below shows the bar and where the hole needs to be drilled.



(i) In the space below design a mechanism that would be suitable for closing the moveable jaw.

Marks will be awarded as follows	Suitability of mechanism	*(2 marks)*
	Appropriate for gripping	*(2 marks)*
	Quality of drawing	*(2 marks)*

(ii) Give **two** reasons for your choice of mechanism.

.....

.....

(2 marks)

(iii) Name a specific material for the jaws to be made of. .....

(1 mark)

(iv) Why is this material suitable?

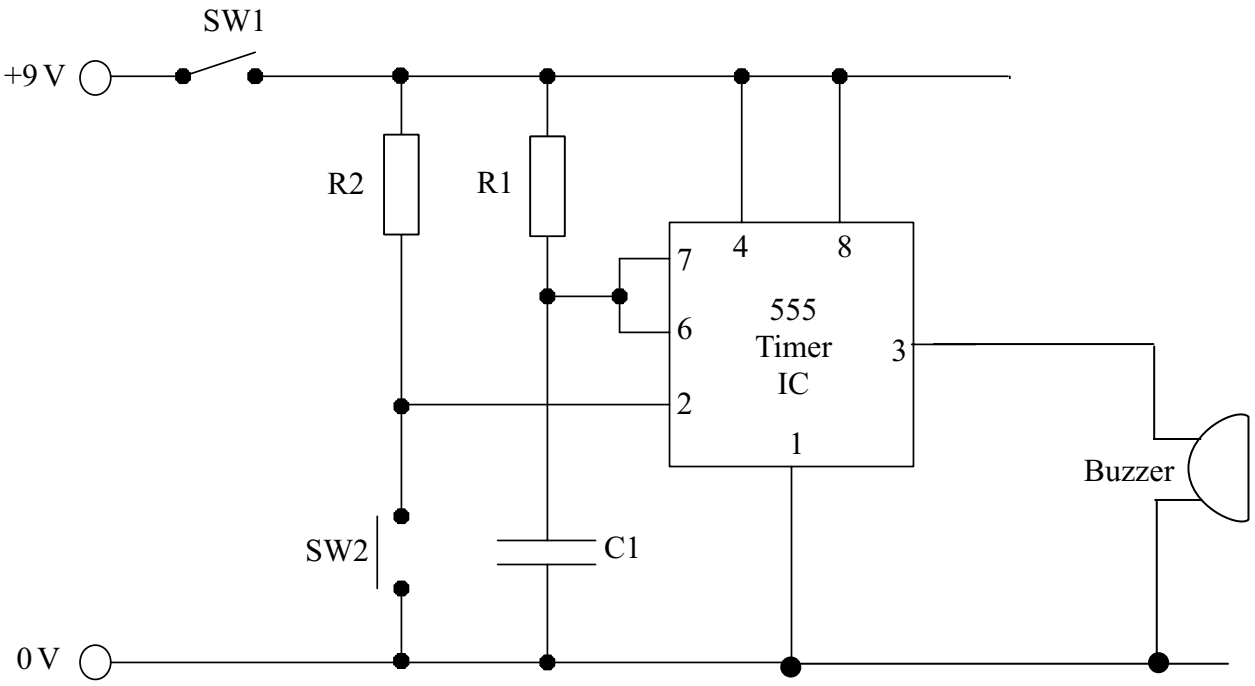
.....

(1 mark)

16

A8 This question is about timer circuits.

The timer circuit below controls a buzzer.



(a) Is this circuit a monostable or an astable?

.....

(1 mark)

(b) Which **two** components in this circuit control the time interval other than the Timer IC?

.... *(2 marks)*

(c) Which of the switches, SW1 or SW2, operates as the trigger for the circuit?

..... *(1 mark)*

(d) To improve the system the buzzer was replaced with a warning light.

The designer had to find out about the various types of lamp (bulb) that were available.

State **two** different research methods that the designer could have used to find out this information.

For each of your methods state **one** advantage of using it.

Research
Method 1 .....

Advantage .....
(2 marks)

Research
Method 2 .....

Advantage .....
(2 marks)

(e) Three different types of lamp are shown below.

A

9 volt Lamp

B

230 volt Lamp

C

230 volt Fluorescent Tubes

(i) Which of these three lamps would be suitable for the timer circuit?

.....
(1 mark)

(ii) Give **two** reasons for your choice.

.....

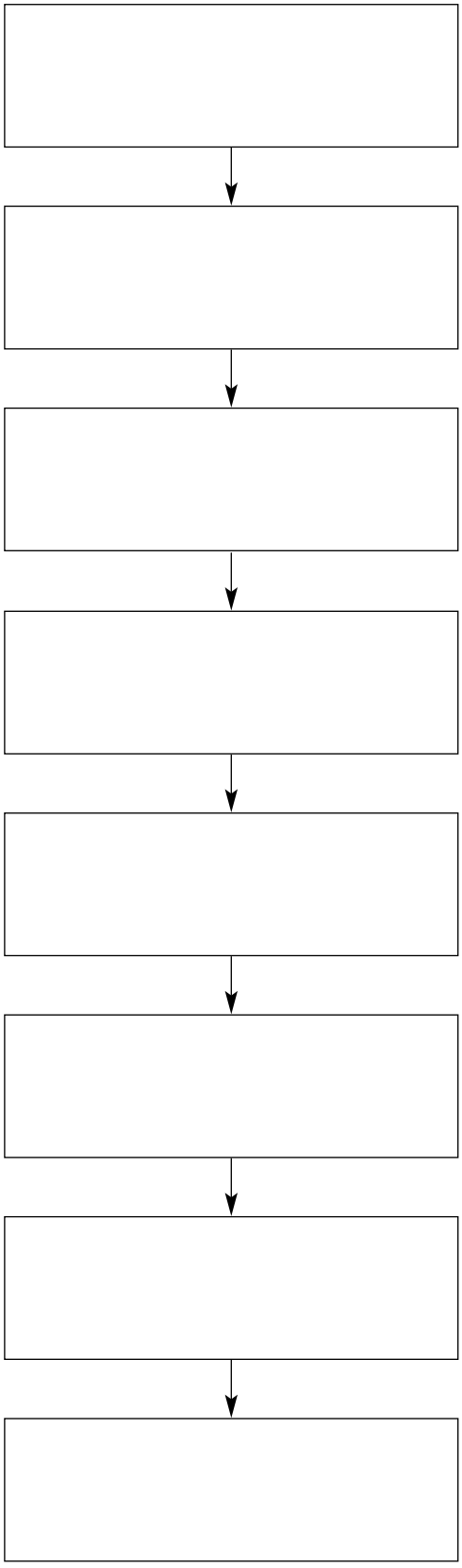
.....
(2 marks)

Question A8 continues on the next page

Turn over ►

(f) It was decided to vacuum form a cover for the timer circuit.

Complete the chart below to list the main stages of the vacuum forming process.



(8 marks)

19

A9 This question is about automated systems.

Computers are used in modern manufacturing for both designing and making.

(a) Complete the table below by stating whether the activity described is Computer Aided Design (CAD) or Computer Aided Manufacture (CAM).

One example has been completed for you.

Activity	**CAD or CAM?**
Robotic soldering	CAM
Using computer software to create a circuit layout	
Using a milling machine to produce a Printed Circuit Board (PCB)	
Using software to test a circuit on a computer	

(3 marks)

(b) An OR gate is used as part of a control circuit for a robot.

Complete the truth table for an OR gate.

INPUTS		**OUTPUT**
A	**B**	**X**
0	0	
0	1	
1	0	
1	1	

(4 marks)

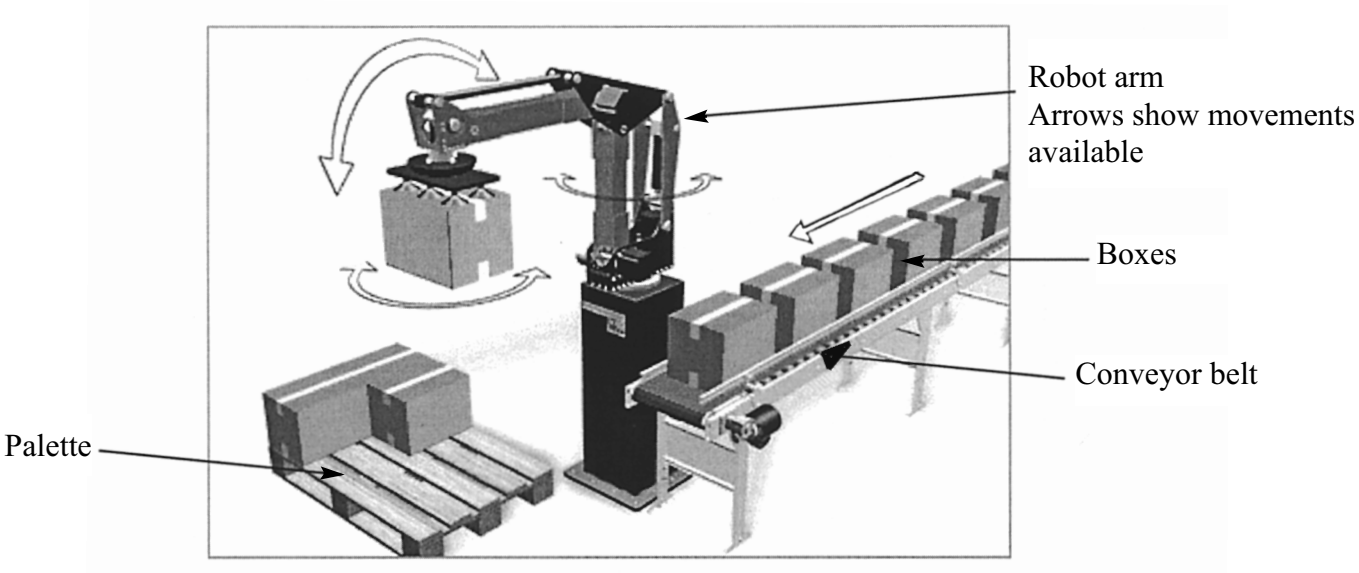
(c) Draw the symbol for an OR gate in the box below and label the inputs and output.

(2 marks)

Question A9 continues on the next page

(d) Pick and place robots can be used at the end of a production process to place boxes on a palette.

The drawing below shows a robot doing this.



The boxes travel to the end of the conveyor belt. They are detected by a sensor, which stops the conveyor belt drive motor before they fall off the end.

The sequence below shows the main stages in the program controlling the robot arm.

Some of the statements are missing.

Draw arrows from the **Missing Statements** to the correct gap in the **Correct Sequence** on the right.

The first one has been done for you.

Missing Statements

- Robot arm raises and lifts box off the conveyor
- Sensor detects a box at the end of conveyor
- Robot arm releases grip on box
- Robot arm lowers the box onto the palette
- Robot arm moves into position above the box

Correct Sequence

1. Robot arm is in rest position
2. Sensor detects a box at the end of conveyor
3. *(blank)*
4. Robot arm lowers and grips the box
5. *(blank)*
6. Robot arm moves into position above the palette
7. *(blank)*
8. *(blank)*
9. Robot arm moves into position above the box
10. Robot arm returns to the rest position

(4 marks)

(e) State **two** reasons why robots would be suitable for loading heavy boxes onto palettes.

Reason 1 .....

Reason 2 .....

(2 marks)

(f) Give **two** other examples where robots could be used instead of production workers and give a reason why these are suitable tasks for robots.

1 A robot could be used to .....

This would be a suitable task because .....

.....

(2 marks)

2 A robot could be used to .....

This would be a suitable task because .....

.....

(2 marks)

(g) In large scale industrial production, robotics forms an important part of the production process.

(i) Give **two** advantages for workers of the use of robotics.

Advantage 1 .....

Advantage 2 .....

(2 marks)

(ii) Give **two** advantages for consumers of the use of robotics.

Advantage 1 .....

Advantage 2 .....

(2 marks)

(iii) Give **one** disadvantage of the use of robotics.

.....

(1 mark)

(h) PICs (Peripheral Interface Controllers) are often used to control automated systems and can be used to replace logic gates.

State **two** advantages of using PICs in this way.

Advantage 1 .....

(1 mark)

Advantage 2 .....

(1 mark)

END OF SECTION A QUESTIONS

SECTION B – PNEUMATICS FOCUS

Answer **all** questions in this section.

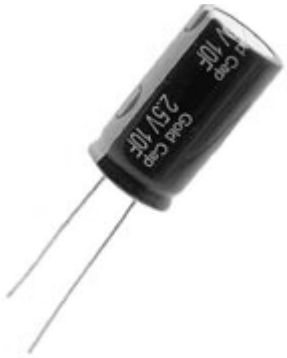
Do **not** answer these questions if you have answered the questions in **Section A – Mechanisms Focus** (pp. 4 – 25).

B1 This question is about recognising components.

(a) Each of the illustrations below shows an electronic component that can be used in circuits.

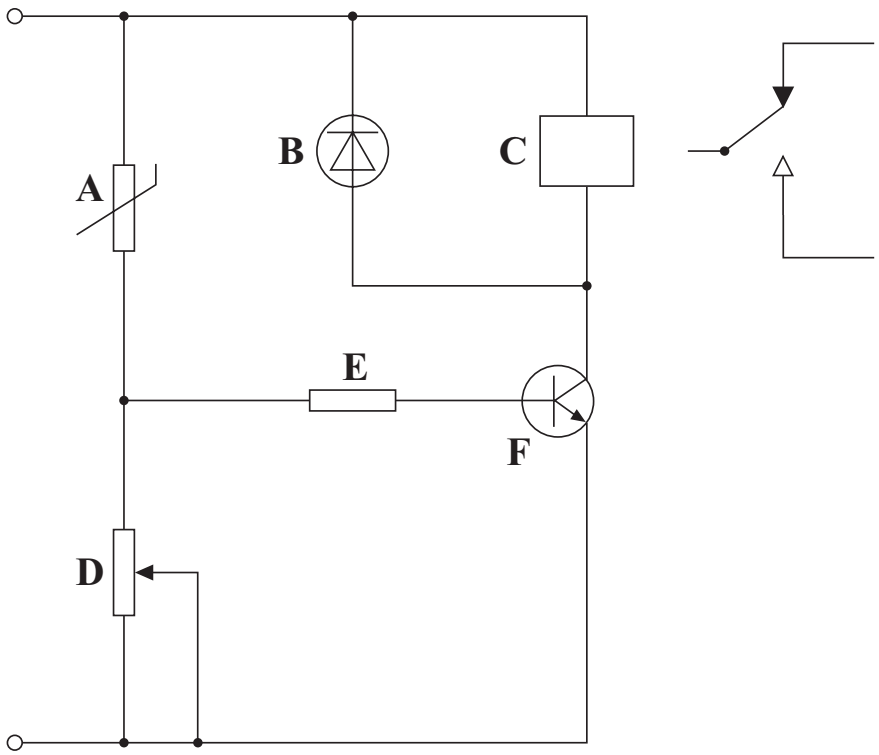
For each illustration, name the component and draw the electronic circuit symbol that represents it in a circuit diagram.

One example has been completed for you.

	Component	**Symbol**
	Capacitor	
		
		

(4 marks)

(b) The diagram below shows an electronic circuit. Some of the components have been labelled with a letter.



Place the correct letter in the spaces below. The first one has been done for you.

	Component	Letter
	Relay	C
(i)	Transistor	
(ii)	Diode	
(iii)	Thermistor	
(iv)	Variable resistor	

(4 marks)

8

B2 This question is about pneumatic components.

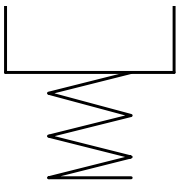
(a) Name the **two** pneumatic symbols drawn below.

Figure 6

Name of symbol

.....

Figure 7



Name of symbol

.....

(2 marks)

(b) Complete these sentences by stating what each component is used for.

The component in **Figure 6** is used to

.....

.....

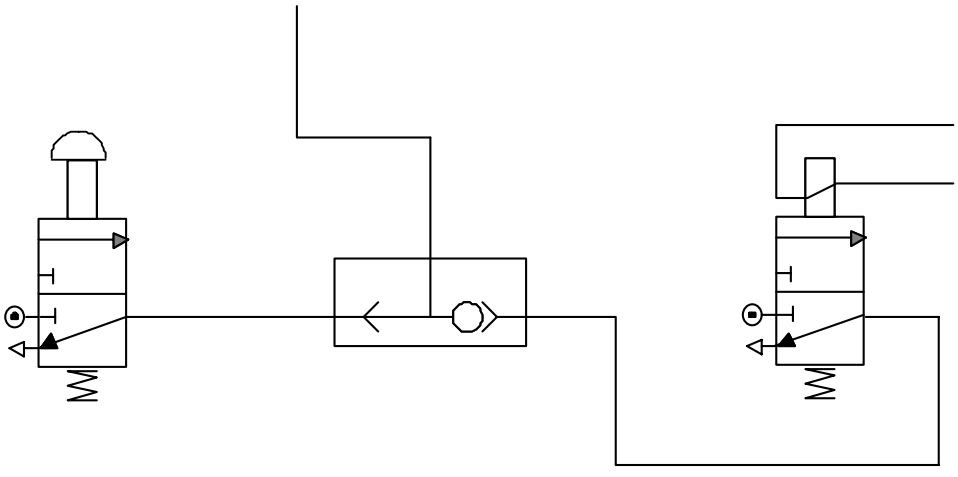
The component in **Figure 7** is used to

.....

.....

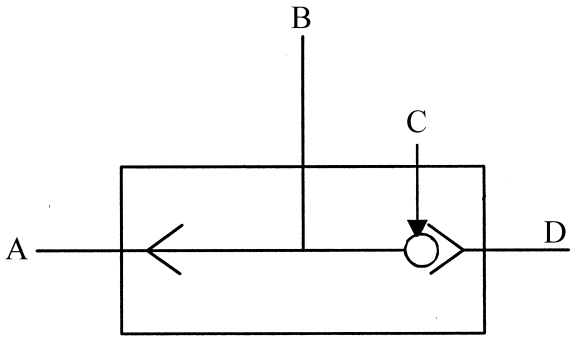
(2 marks)

(c) Complete the circuit diagram below by adding the pneumatic symbol for a Single Acting Cylinder as an output to the system.



(3 marks)

(d) The pneumatic symbol shown below is a shuttle valve.



Explain what a shuttle valve does.

Use the labels/letters given to help explain your answer.

.....

.....

.....

.....

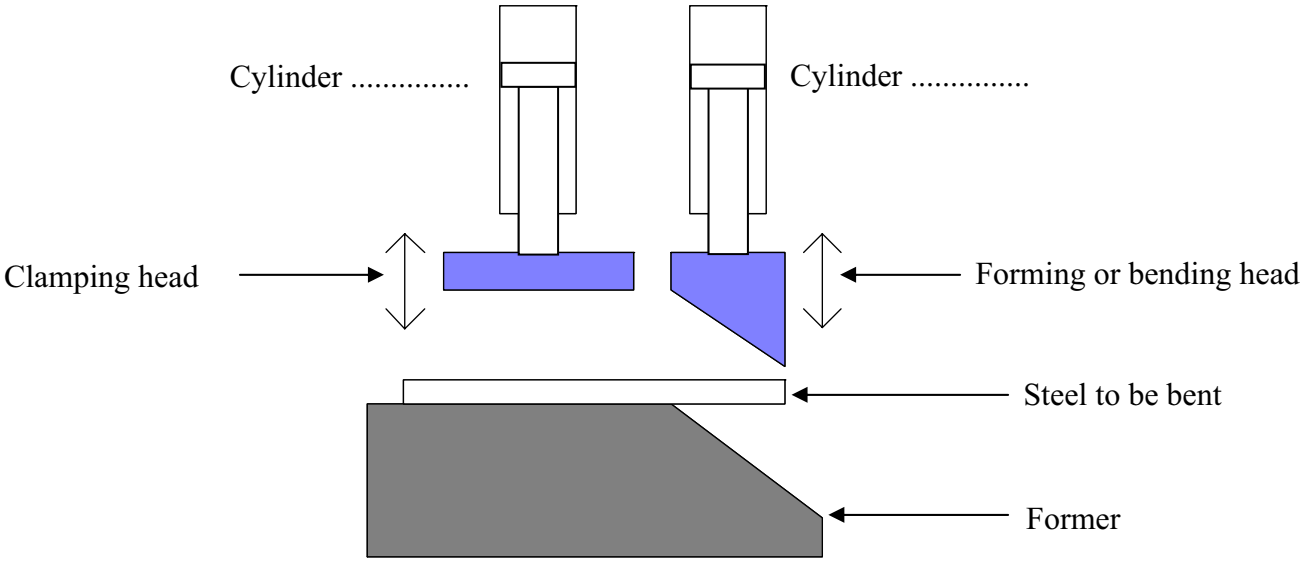
.....

(4 marks)

11

Turn over for the next question

B3 The diagram below shows a pneumatic system for bending steel.



The operating procedure is:

Cylinder A clamps the material to be bent (goes +ve)
Cylinder B bends the material (goes +ve)
Cylinder B then retracts (goes –ve)
Cylinder A then retracts (goes –ve)

The process then repeats itself.

(a) Label cylinder B. *(1 mark)*

(b) Why does cylinder A operate first?

.....

(1 mark)

(c) What does 'goes +ve' mean?

.....

(1 mark)

(d) If the system shown were to be used in a real situation, state **two** methods which could be used to protect the user from the dangers posed by the moving pistons.

Method 1 .....

.....

(1 mark)

Method 1 .....

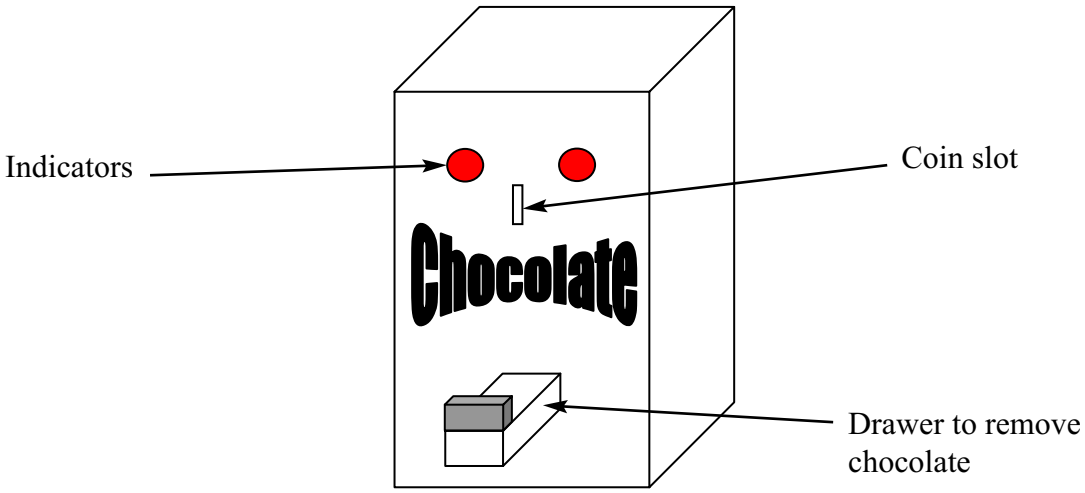
.....

(1 mark)

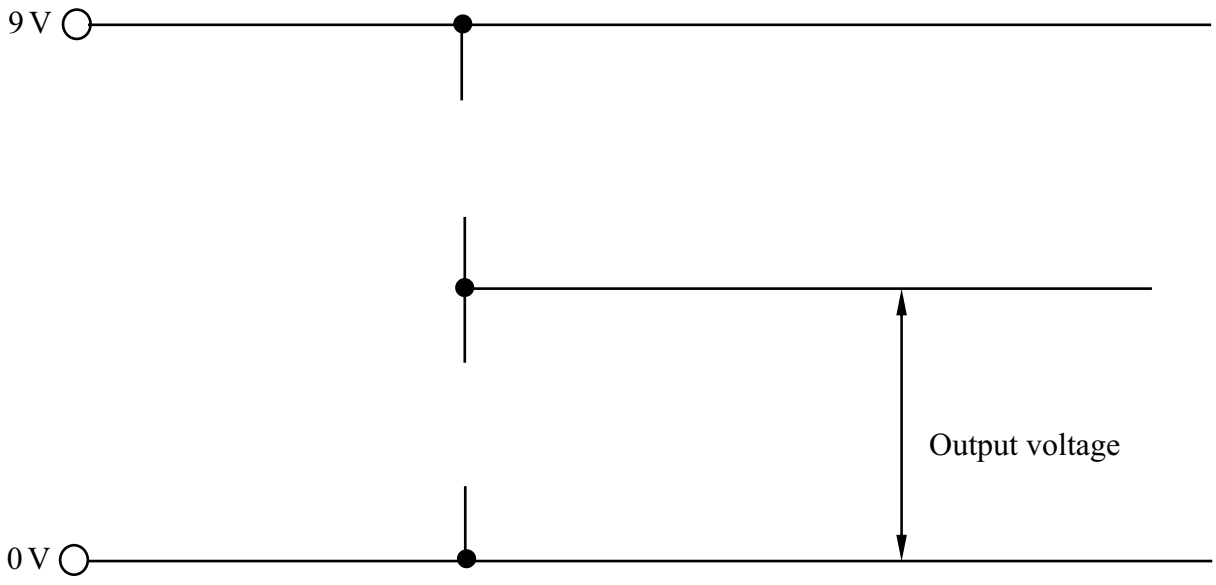
5

B4 This question is about sensing.

The designer of a chocolate bar dispenser has chosen to use a light sensing circuit to indicate when it is low on chocolate bars and when it needs refilling.



(a) Complete the circuit diagram below by adding a Light Dependent Resistor (LDR) and a variable resistor to give an output voltage when light is sensed.



(3 marks)

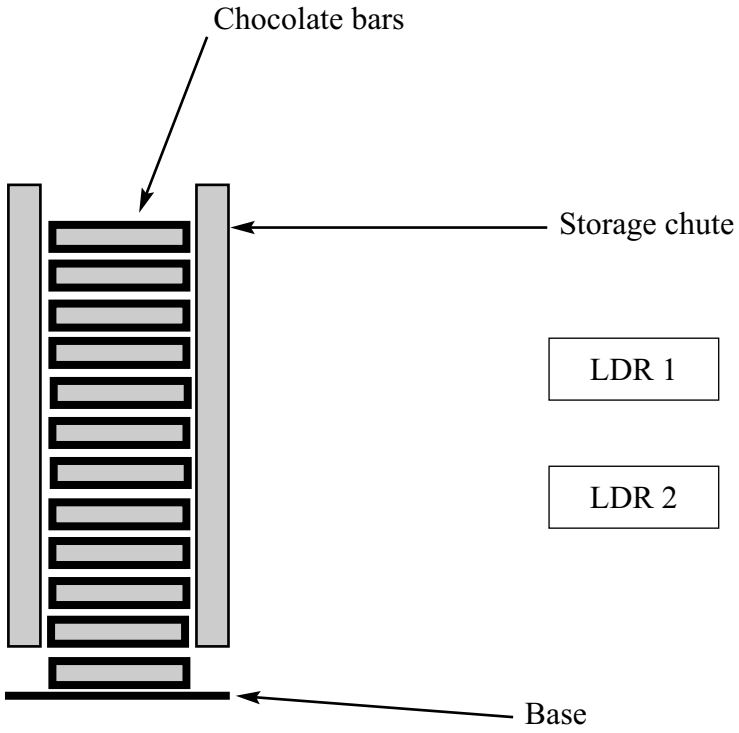
Question B4 continues on the next page

(b) The designer wants to use LDRs as sensors in **two** positions in the dispensing machine.

LDR 1 = LOW This will sense when there are only 4 products left in the dispensing machine.

LDR 2 = EMPTY This will sense when the container is completely empty.

Show with arrows where LDR 1 and LDR 2 would be positioned.



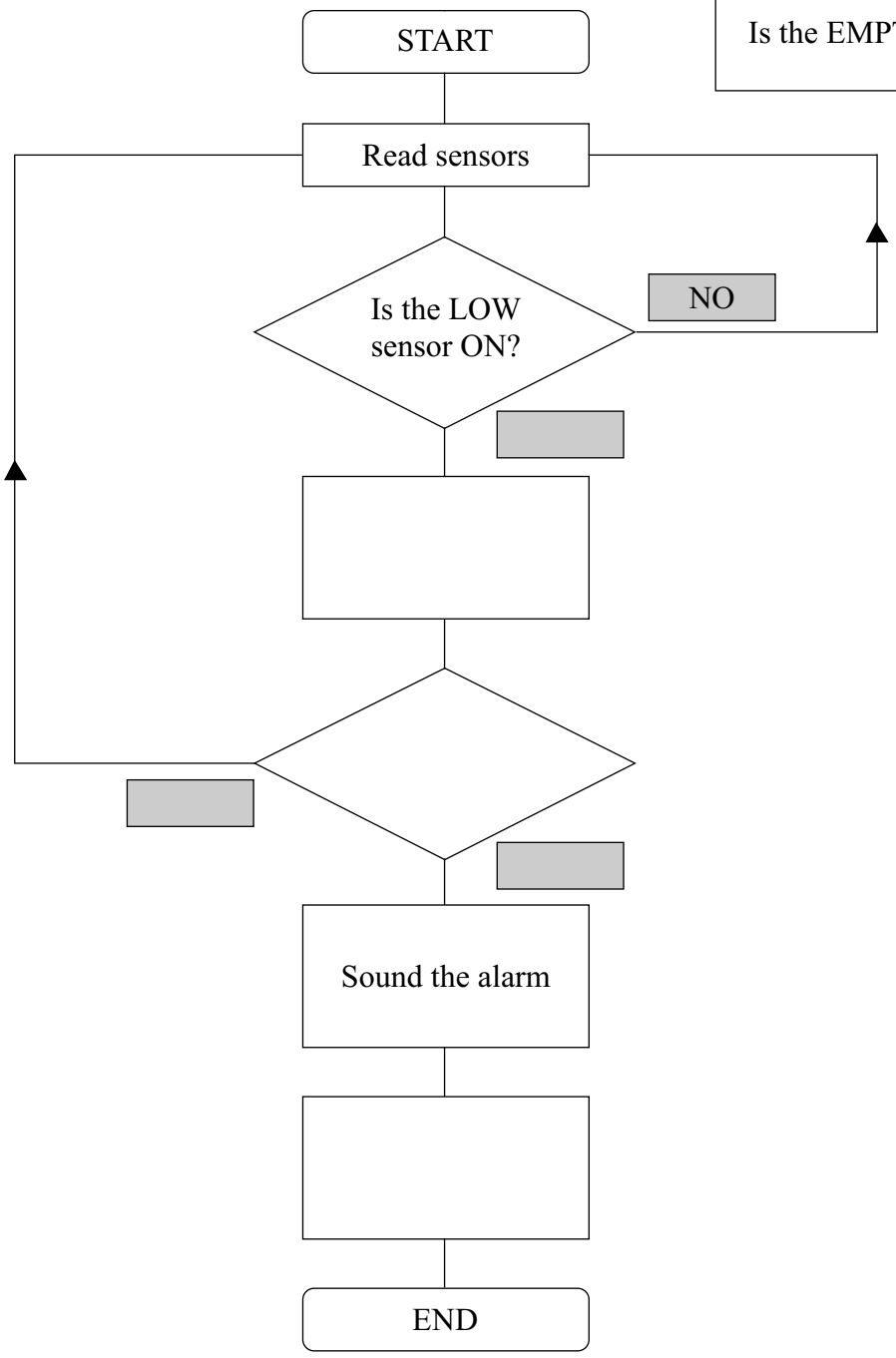
(2 marks)

(c) When the LOW sensor (LDR 1) is ON, a **WARNING** light comes on to show the shop staff that the dispensing machine needs refilling.

If the EMPTY sensor (LDR 2) is turned ON, an alarm sounds and the **EMPTY** light comes on.

- Complete the flow chart by filling in the missing stages using the statements given in the box below.
- Write YES or NO in the three shaded boxes.

Turn ON **EMPTY** light
Turn ON **WARNING** light
Is the EMPTY sensor ON?



(6 marks)

11

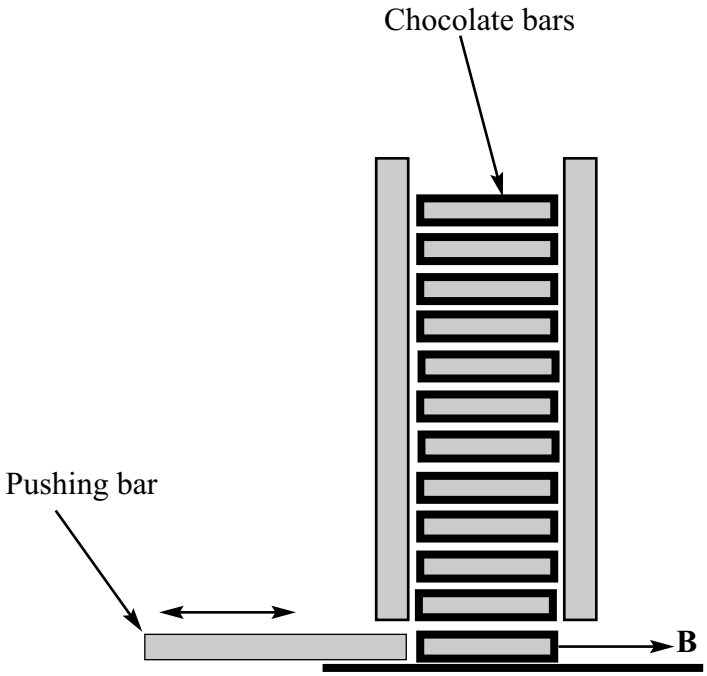
Turn over ►

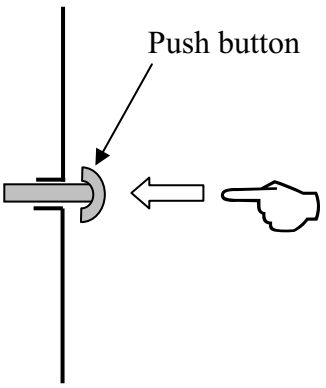
B5 This question is about controlling pneumatic systems.

(a) On a dispensing machine, an operator will push a button and a chocolate bar will be dispensed.

- Using notes and sketches, design a simple pneumatic system to push the bottom chocolate bar in the direction of arrow B when the push button is pressed.
- The push button has been drawn for you.
- The pushing bar is to be activated by a cylinder.
- The pushing bar is to return when the push button is released.

Marks will be awarded for Appropriate pneumatic system *(4 marks)*
Quality of communication *(2 marks)*





(b) (i) For a dispensing machine, give an example of another product that the machine could deliver.

.....

(1 mark)

(ii) Give an advantage to the user.

.....

.....

(1 mark)

(c) When designing a pneumatic system several safety aspects need to be considered.

Complete the following sentences by filling in the missing words.

Choose from the list given below.

high	piston	sensor	user	start
friction	stop	machine	low	electronic

The safety of the ..... should always be considered when designing a pneumatic system.

Guards should ensure that you cannot ..... the pneumatic system until they are in position.

Most guards use a ..... to detect whether they are in position.

A ..... pressure pneumatic system can be safer because it will stop if something jams.

A ..... pressure pneumatic system will continue to exert force if there is a jam and this can result in a breakage.

(5 marks)

13

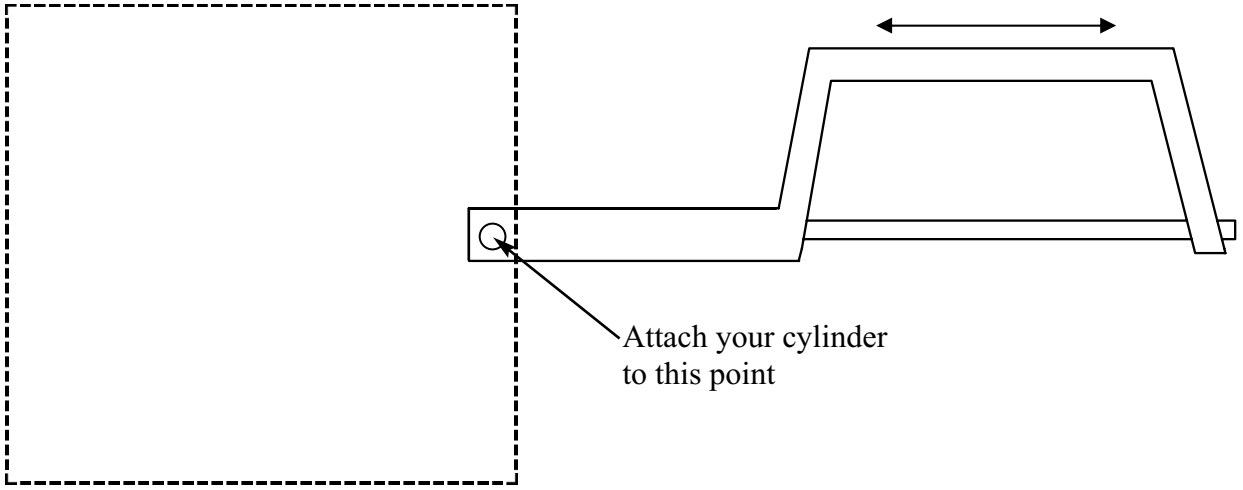
Turn over for the next question

B6 This question is about a pneumatically powered hacksaw.

The hacksaw needs to move continuously backwards and forwards.

(a) With the aid of a sketch, show how a cylinder could be attached to the left-hand end of the hacksaw frame.

Draw your answer in the box.

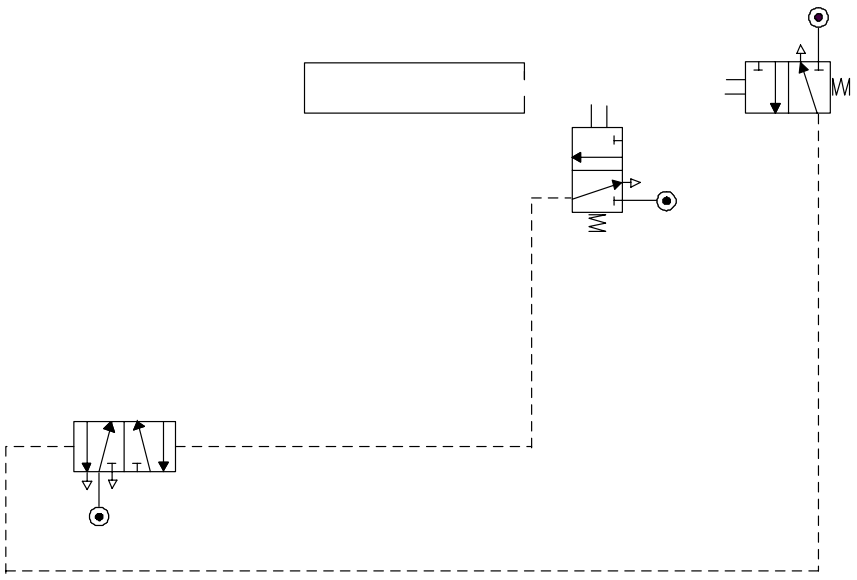


(2 marks)

(b) Complete the diagram below by adding suitable ends to both three-port valves. Complete the drawing of the double acting cylinder. Add **all** air lines to the circuit.

Marks will be awarded for:

Suitable ends for both three-port valves	*(3 marks)*
Correctly completed cylinder	*(4 marks)*
Correct connections between cylinder and valves	*(3 marks)*

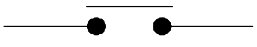


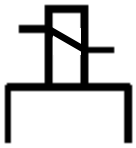
(c) It has been decided to operate the hacksaw with solenoid operated valves which control the airflow to the system.

As a safety feature, the operator needs to press two push-to-make (PTM) switches to control the hacksaw.

Complete the circuit below by adding a second PTM switch and show how they control the airflow to the system.

Show connections to a suitable power supply.





(3 marks)

(d) Why would the switches be placed at least 500 mm apart on the machine?

.....

.....

(1 mark)

16

Turn over for the next question

B7 This question is about using workshop equipment.

When making products in the workshop health and safety is very important.

(a) State **two** safety rules that should be followed for **each** of the following common items of workshop equipment.

Give **six** *different* rules.

Etching Tank

Rule 1 .....

.....

Rule 2 .....

.....

(2 marks)

Pillar Drill

Rule 1 .....

.....

Rule 2 .....

.....

(2 marks)

Soldering Iron

Rule 1 .....

.....

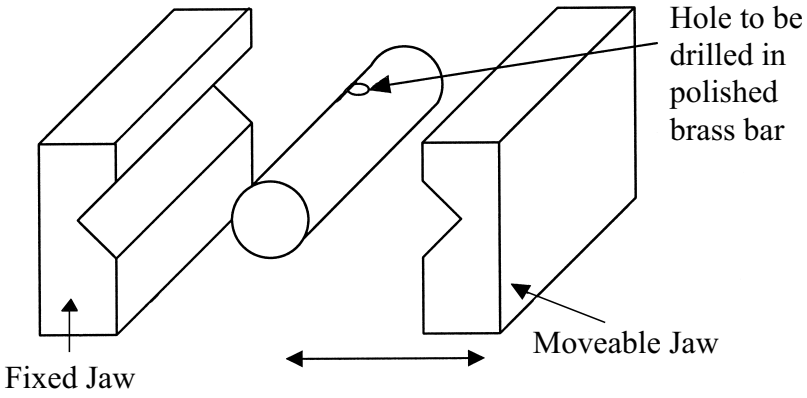
Rule 2 .....

.....

(2 marks)

(b) As part of a production process a hole is to be drilled in a polished brass bar using a drilling machine.

The bar is to be held by two jaws. The diagram below shows the bar and where the hole needs to be drilled.



(i) In the space below design a pneumatically operated system that would be suitable for closing the moveable jaw.

Marks will be awarded as follows

Suitability of pneumatic system	*(2 marks)*
Appropriate for gripping	*(2 marks)*
Quality of drawing	*(2 marks)*

(ii) Give **two** reasons for your choice of pneumatic system.

.....

.....

(2 marks)

(iii) Name a specific material for the jaws to be made of. .....

(1 mark)

(iv) Why is this material suitable?

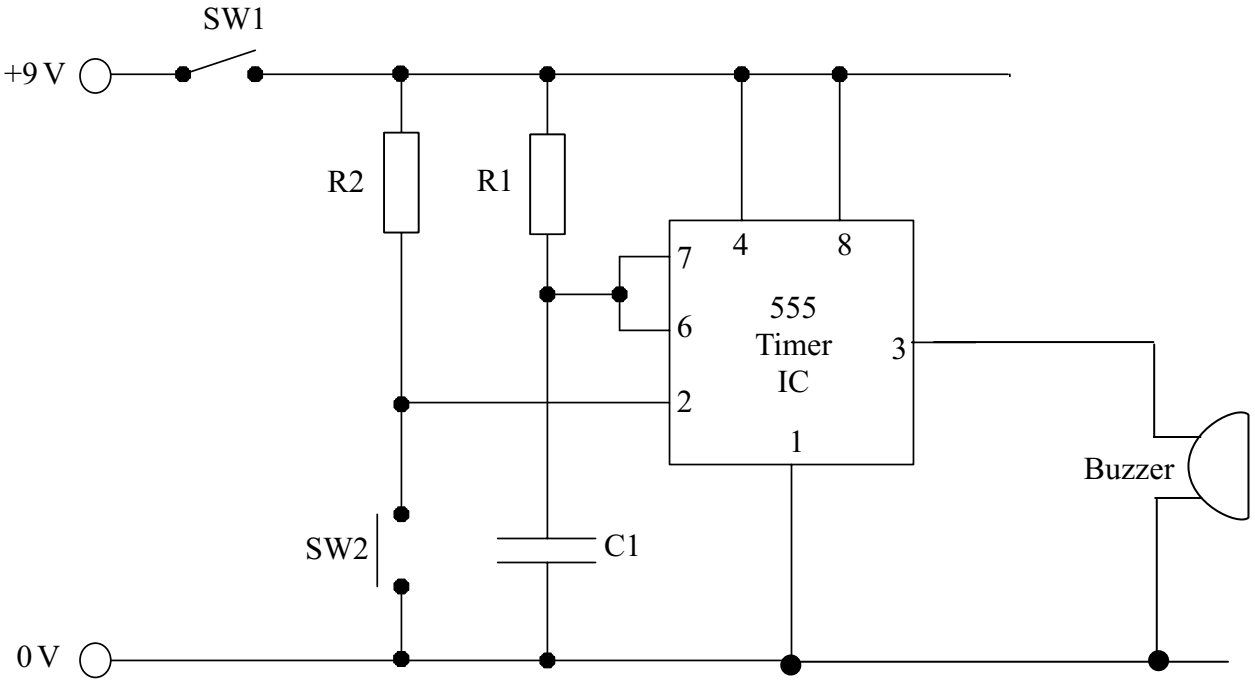
.....

(1 mark)

16

B8 This question is about timer circuits.

The timer circuit below controls a buzzer.



(a) Is this circuit a monostable or an astable?

.....

(1 mark)

(b) Which **two** components in this circuit control the time interval other than the Timer IC?

.... *(2 marks)*

(c) Which of the switches, SW1 or SW2, operates as the trigger for the circuit?

..... *(1 mark)*

(d) To improve the system the buzzer was replaced with a warning light.

The designer had to find out about the various types of lamp (bulb) that were available.

State **two** different research methods that the designer could have used to find out this information.

For each of your methods state **one** advantage of using it.

Research
Method 1 .....

Advantage .....
(2 marks)

Research
Method 2 .....

Advantage .....
(2 marks)

(e) Three different types of lamp are shown below.

A

9 volt Lamp

B

230 volt Lamp

C

230 volt Fluorescent Tubes

(i) Which of these three lamps would be suitable for the timer circuit?

.....
(1 mark)

(ii) Give **two** reasons for your choice.

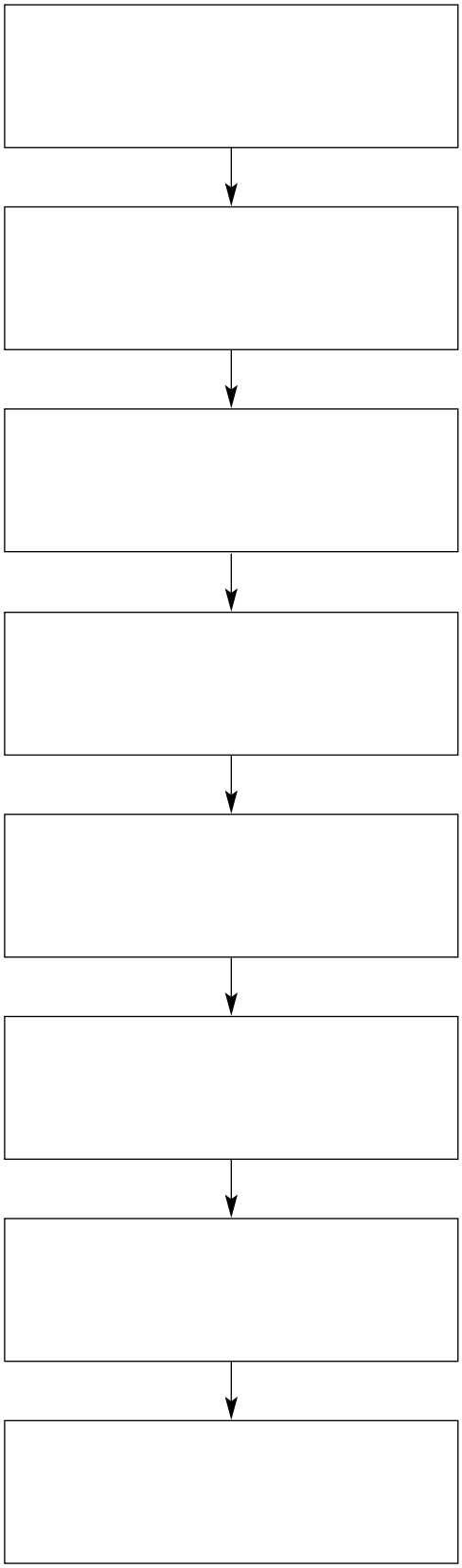
.....

.....
(2 marks)

Question B8 continues on the next page

(f) It was decided to vacuum form a cover for the timer circuit.

Complete the chart below to list the main stages of the vacuum forming process.



(8 marks)

19

B9 This question is about automated systems.

Computers are used in modern manufacturing for both designing and making.

(a) Complete the table below by stating whether the activity described is Computer Aided Design (CAD) or Computer Aided Manufacture (CAM).

One example has been completed for you.

Activity	**CAD or CAM?**
Robotic soldering	CAM
Using computer software to create a circuit layout	
Using a milling machine to produce a Printed Circuit Board (PCB)	
Using software to test a circuit on a computer	

(3 marks)

(b) An OR gate is used as part of a control circuit for a robot.

Complete the truth table for an OR gate.

INPUTS		**OUTPUT**
A	**B**	**X**
0	0	
0	1	
1	0	
1	1	

(4 marks)

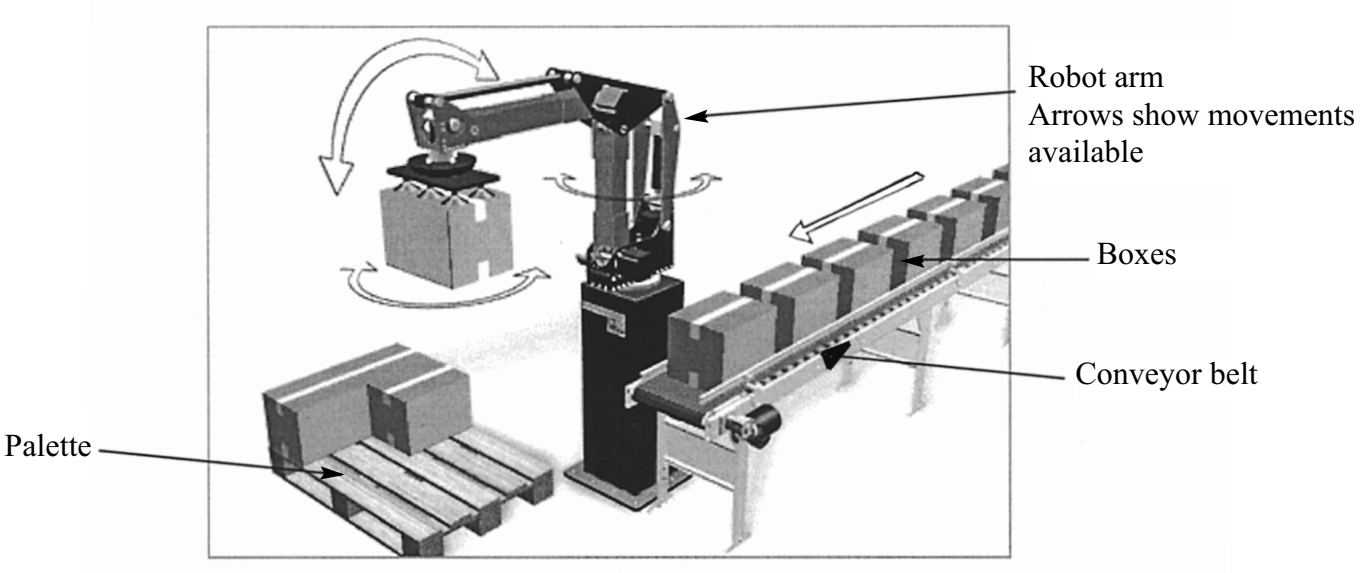
(c) Draw the symbol for an OR gate in the box below and label the inputs and output.

(2 marks)

Question B9 continues on the next page

(d) Pick and place robots can be used at the end of a production process to place boxes on a palette.

The drawing below shows a robot doing this.



The boxes travel to the end of the conveyor belt. They are detected by a sensor, which stops the conveyor belt drive motor before they fall off the end.

The sequence below shows the main stages in the program controlling the robot arm.

Some of the statements are missing.

Draw arrows from the **Missing Statements** to the correct gap in the **Correct Sequence** on the right.

The first one has been done for you.

Missing Statements

- Robot arm raises and lifts box off the conveyor
- Sensor detects a box at the end of conveyor
- Robot arm releases grip on box
- Robot arm lowers the box onto the palette
- Robot arm moves into position above the box

Correct Sequence

1. Robot arm is in rest position
2. Sensor detects a box at the end of conveyor
3.
4. Robot arm lowers and grips the box
5.
6. Robot arm moves into position above the palette
7.
8.
9. Robot arm moves into position above the box
10. Robot arm returns to the rest position

(4 marks)

(e) State **two** reasons why robots would be suitable for loading heavy boxes onto palettes.

Reason 1 .....

Reason 2 .....

(2 marks)

(f) Give **two** other examples where robots could be used instead of production workers and give a reason why these are suitable tasks for robots.

1 A robot could be used to .....

This would be a suitable task because .....

.....

(2 marks)

2 A robot could be used to .....

This would be a suitable task because .....

.....

(2 marks)

(g) In large scale industrial production, robotics forms an important part of the production process.

(i) Give **two** advantages for workers of the use of robotics.

Advantage 1 .....

Advantage 2 .....

(2 marks)

(ii) Give **two** advantages for consumers of the use of robotics.

Advantage 1 .....

Advantage 2 .....

(2 marks)

(iii) Give **one** disadvantage of the use of robotics.

.....

(1 mark)

(h) PICs (Peripheral Interface Controllers) are often used to control automated systems and can be used to replace logic gates.

State **two** advantages of using PICs in this way.

Advantage 1 .....

(1 mark)

Advantage 2 .....

(1 mark)

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END OF QUESTIONS

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