Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE

General Certificate of Secondary Education

CYD-BWYLLGOR ADDYSG CYMRU

Tystysgrif Gyffredinol Addysg Uwchradd

142/04

DESIGN AND TECHNOLOGY

PAPER 2

FOCUS AREA: SYSTEMS AND CONTROL TECHNOLOGY

(Higher Tier – Grades D to A*)

P.M. TUESDAY, 6 June 2006

(1½ hours)

	Leave Blank
Question 1	
Question 2	
Question 3	
Question 4	
Question 5	
TOTAL MARK	

ADDITIONAL MATERIALS

You will need basic drawing equipment, a calculator and coloured pencils for this examination.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. Where the space is not sufficient for your answer, continue the answer at the back of the book, taking care to number the continuation correctly.

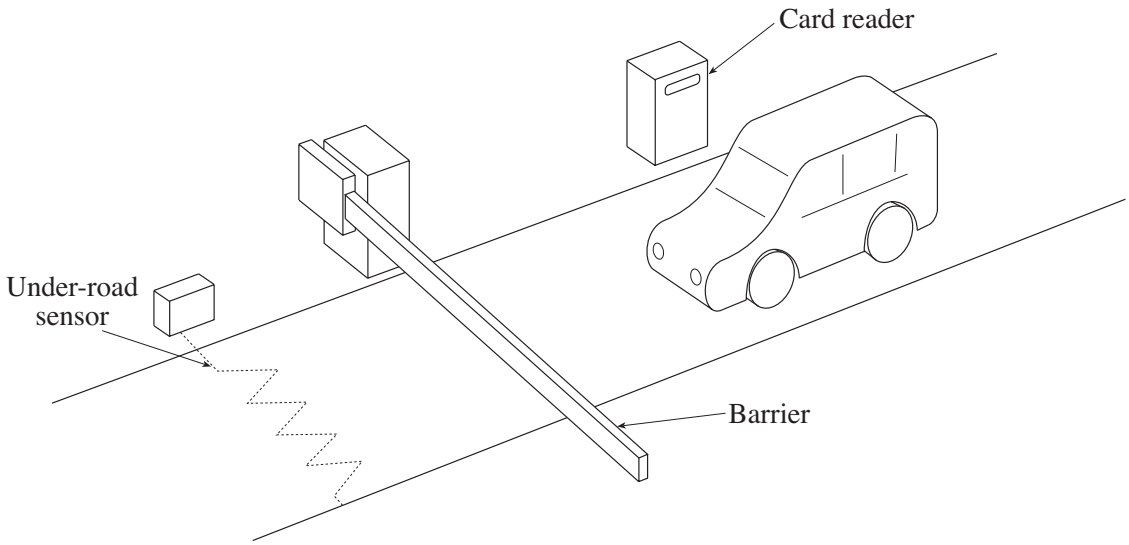
INFORMATION FOR CANDIDATES

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

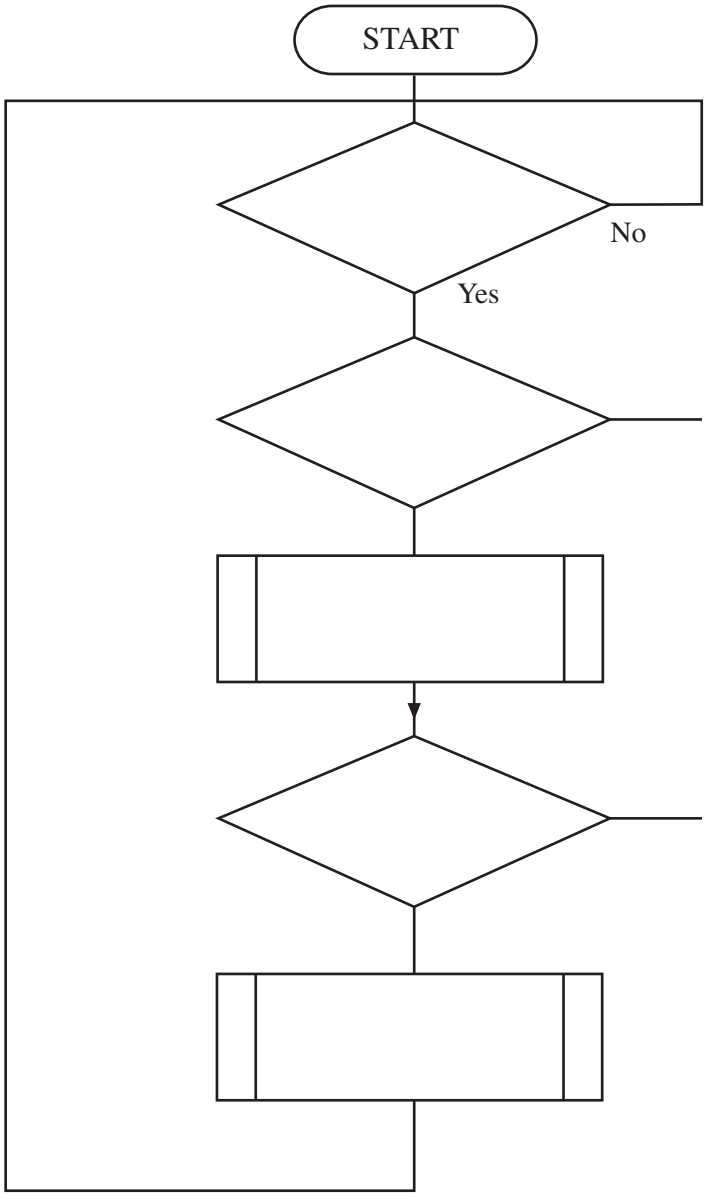
No certificate will be awarded to a candidate detected in any unfair practice during the examination.

Answer **all** *questions in the spaces provided.*

1. The diagram below gives some details of a barrier system.



(a) Complete the flowchart started below to show how the system operates. Use all the statements listed on the right. [7]



CARD CORRECT?

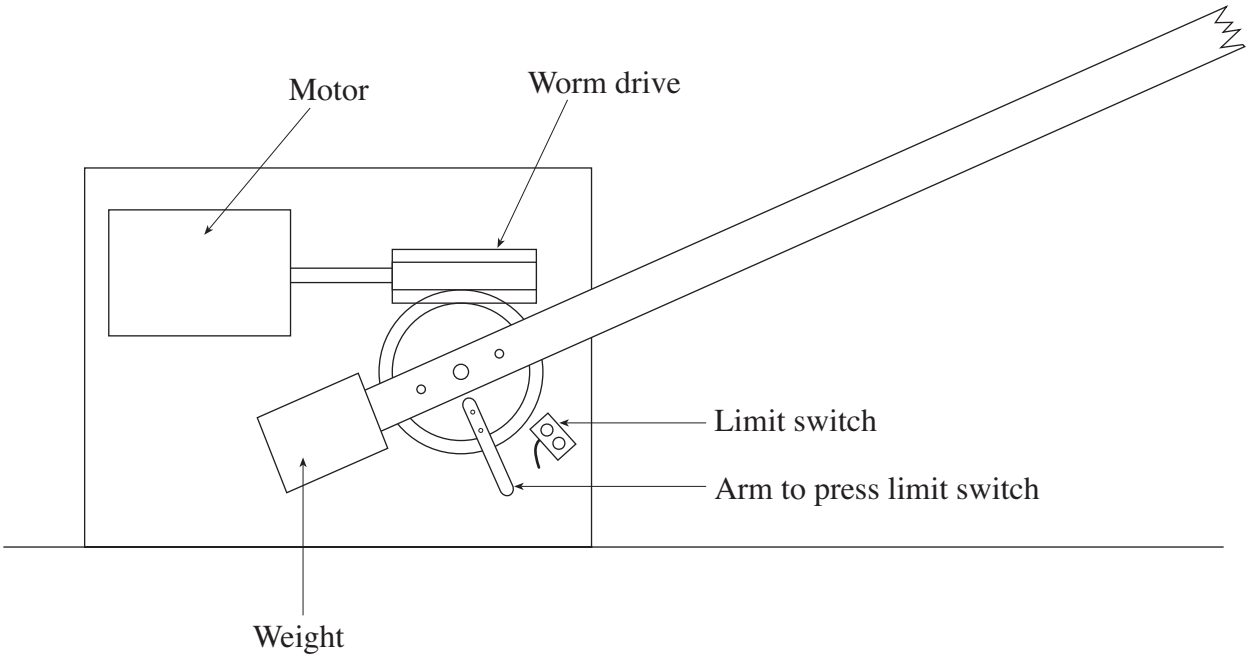
BARRIER DOWN

CARD INSERTED?

BARRIER UP

CAR OVER SENSOR?

(b) The barrier is moved by the motor and gear system shown below.



(i) The system makes use of **one** limit switch only. Describe the implications of having only one limit switch. [2]

.....

.....

(ii) Give **two** reasons why a worm drive is a good choice for this system. 2 × [2]

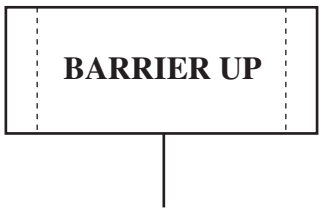
Reason 1 .....

.....

Reason 2 .....

.....

(iii) The upward movement of the barrier is controlled by the procedure or macro called BARRIER UP. Complete the flowchart for this procedure. [4]



(iv) A programmable interface controller (PIC) could be used to control the barrier, but a PIC cannot drive the motor *directly*.

Describe, using notes and sketches, what must be added if the motor is to be controlled by a PIC. [3]

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.....

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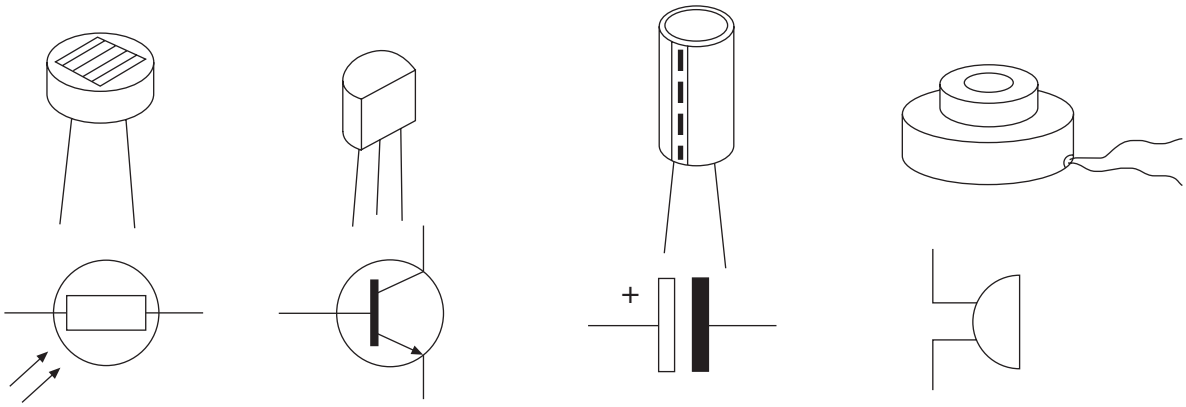
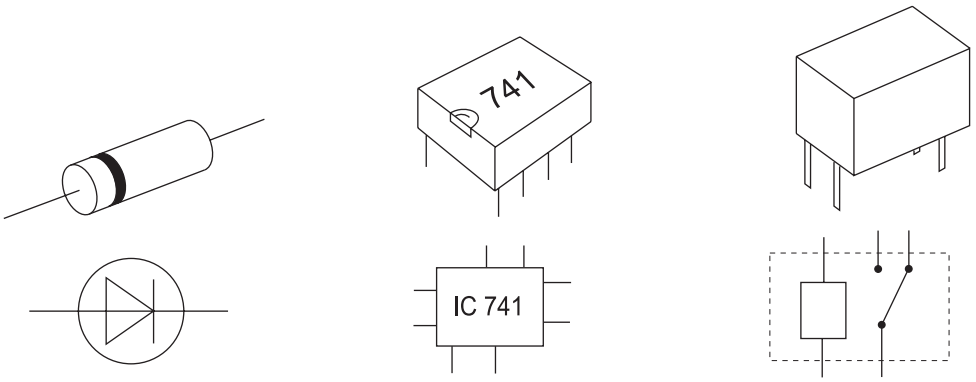
2. A drawing and circuit symbol for some electronic components are shown below.



LDR TRANSISTOR CAPACITOR BUZZER



DIODE IC 741 RELAY

(a) (i) Name **one** component that changes its resistance as the light level changes. [1]

.....

(ii) Name **one** component that can store electrical energy. [1]

.....

(iii) Name **two** components that can amplify electrical current. [2]

(I) .....

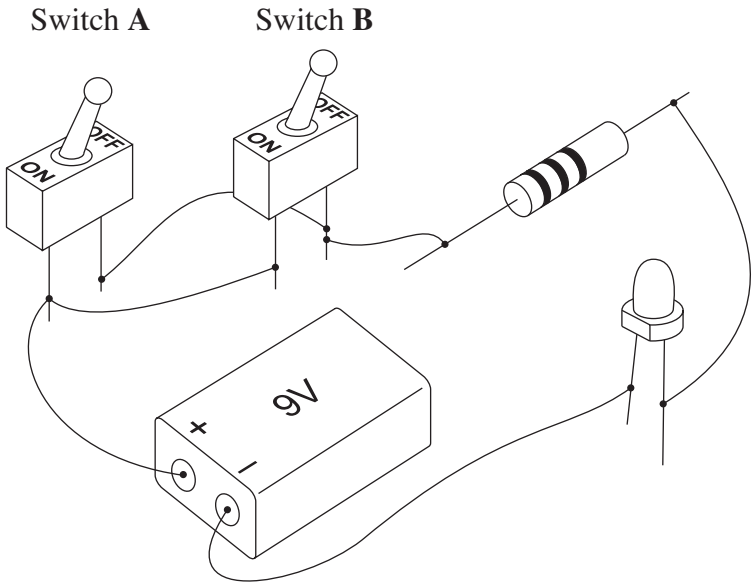
(II) .....

(iv) Describe **one** application where a diode is used. [2]

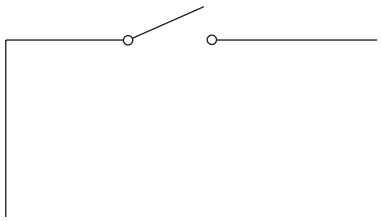
.....

.....

(b) A diagram of a simple circuit is shown below.



(i) Complete the circuit diagram of the system started below. Use the correct electronic symbols. [5]



(ii) State whether the switches are arranged in parallel or series. [1]

.....

(iii) Complete the table below describing how the switches control the LED. [1]

Switch A	Switch B	LED
Off	**Off**	**Off**
On	**Off**	
Off	**On**	
On	**On**	

(iv) The LED requires a 20mA current to operate properly. Calculate the size of resistor required in the circuit. (Use Ohm's law V =I × R, Ignore the resistance of the LED itself.) [3]

.....

.....

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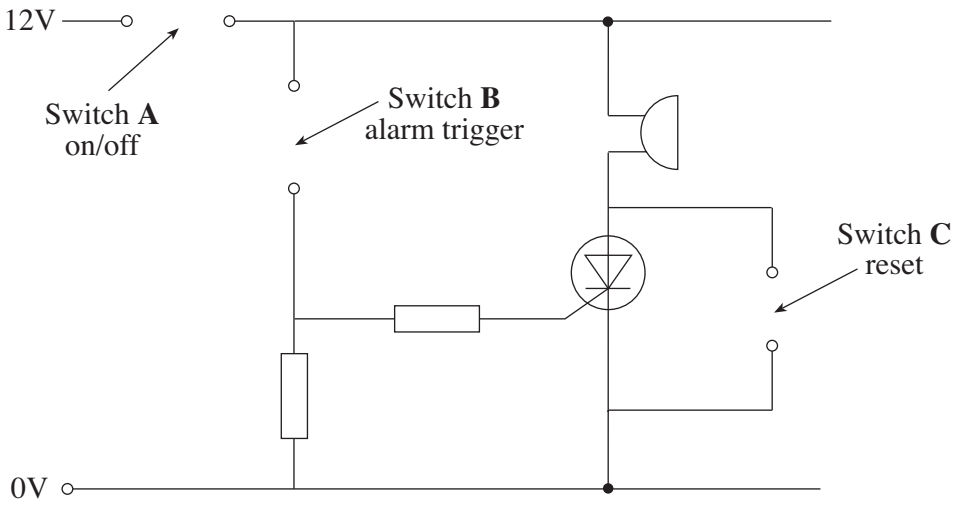
(c) The circuit below shows details of a basic alarm system to be used to warn that a door has been opened. The position of three switches is shown.

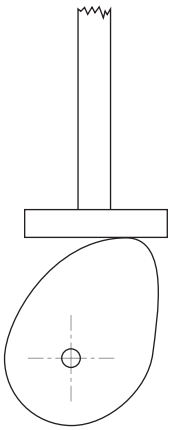


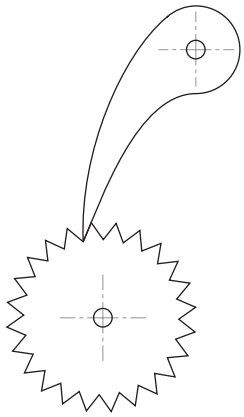
Complete the table below by naming the exact type of switch you would choose for **each** position, giving a clear reason for your choice. [6]

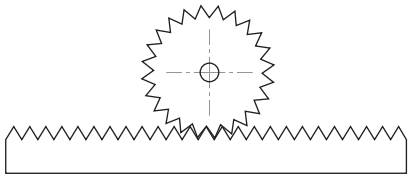
	Type of switch	**Reason for choice**
Switch A	.....	.....
Switch B	.....	.....
Switch C	.....	.....

3. *(a)* Three basic mechanical systems are shown below.

(i) Write the correct name for **each** system in the space provided. [3]







Name ..... Name ..... Name .....

(ii) Choose any **two** of the systems shown in (i) and describe an application where **each** is used. 2 × [2]

Name of system: .....

Application: .....

.....

.....

Name of system: .....

Application: .....

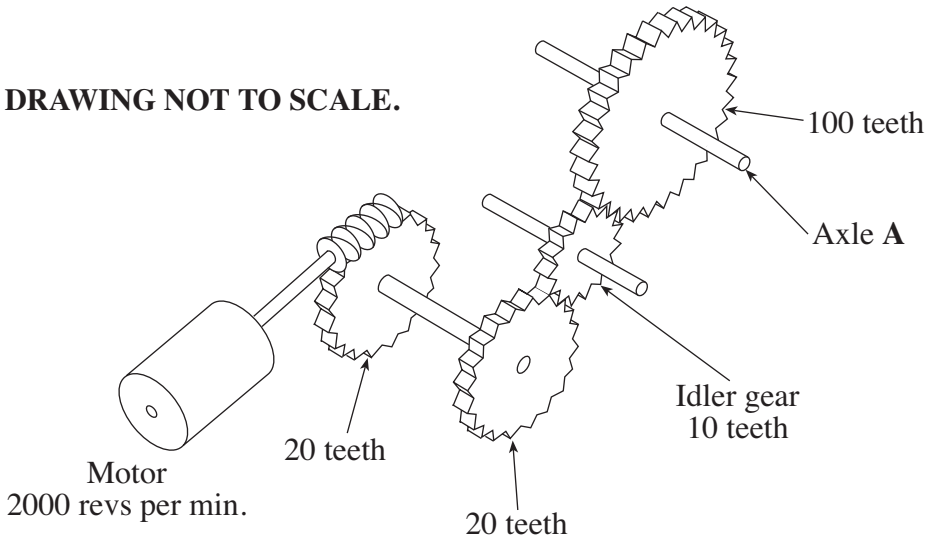
.....

.....

(b) (i) A gear system is shown below. The driving motor turns at 2000 revs per minute. Calculate the RV (rotational velocity) of axle **A**. [4]

Show all workings.

DRAWING NOT TO SCALE.



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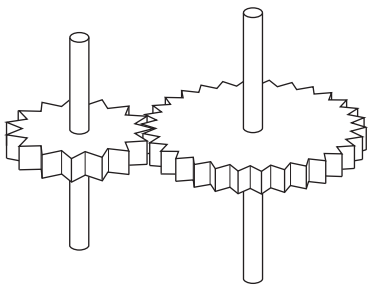
(ii) State the function of the idler gear. [1]

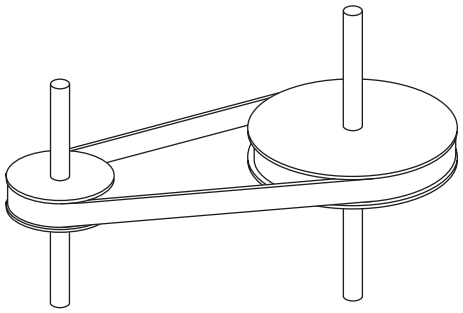
.....

.....

(c) Two methods of transferring motion between parallel shafts are shown below.



GEARS



BELT AND PULLEYS

Give **two** advantages that belt and pulley systems have over gear systems. 2 × [2]

Advantage 1 .....

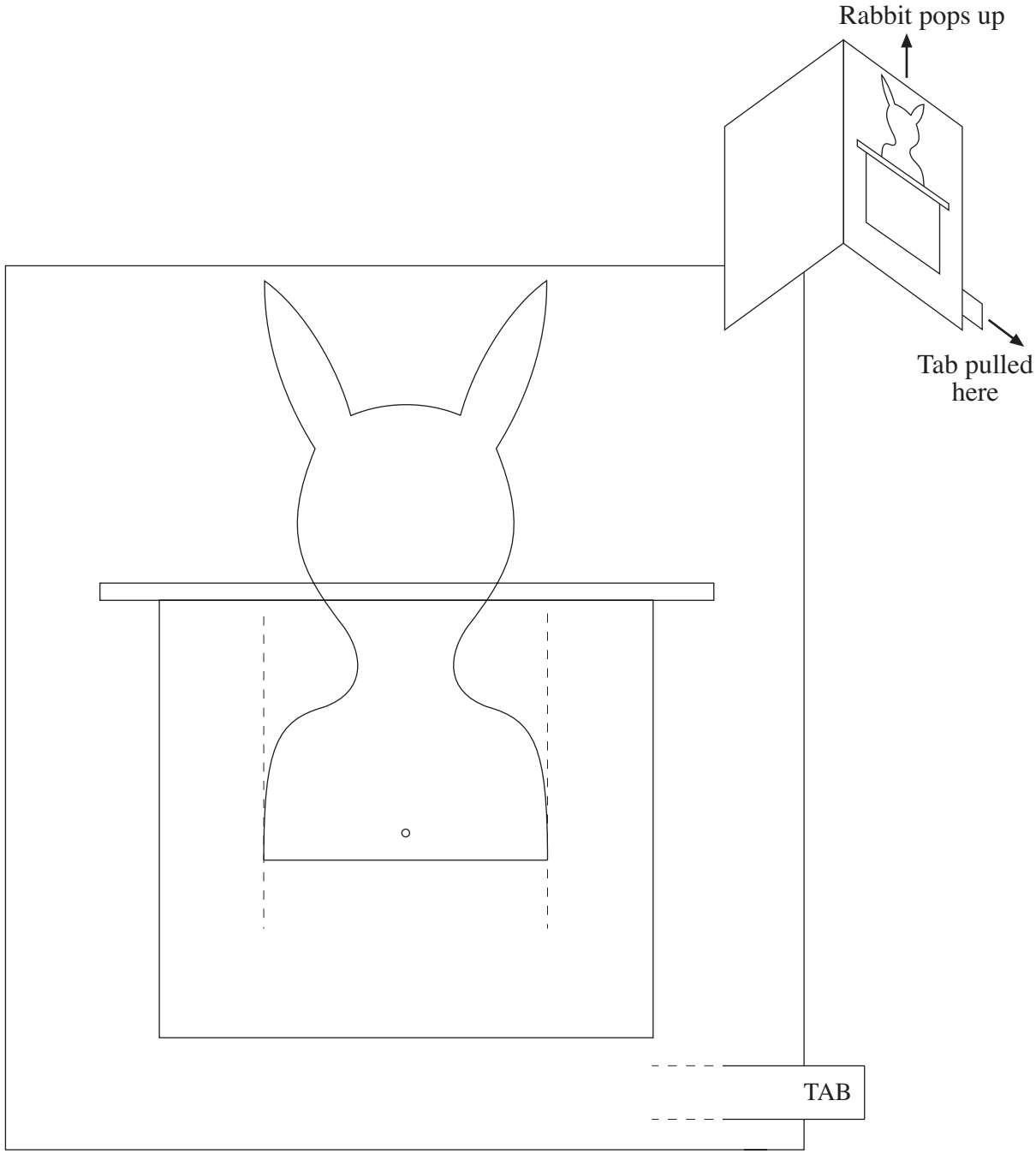
.....

Advantage 2 .....

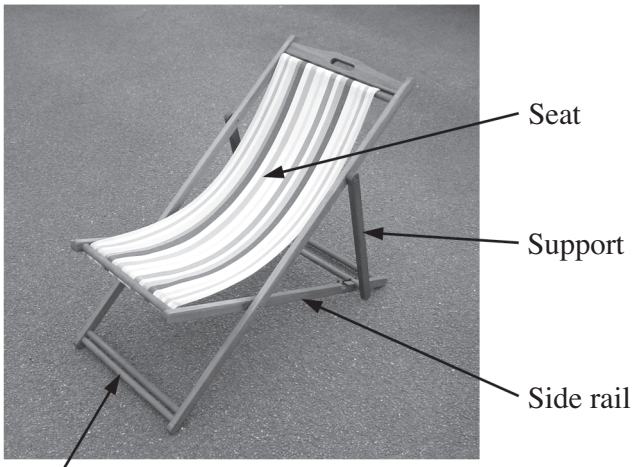
.....

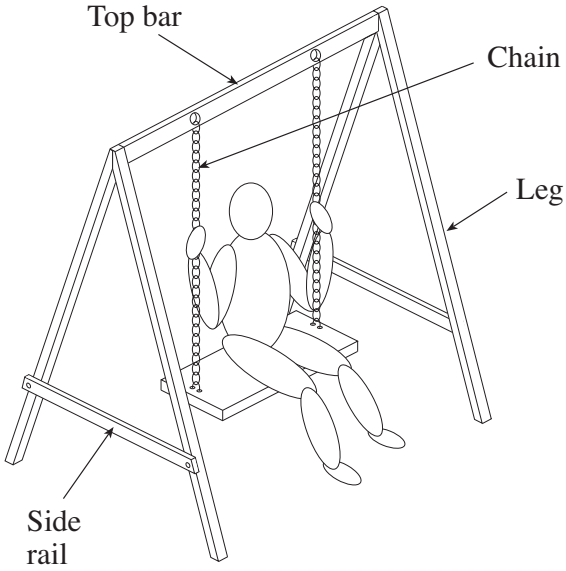
(d) A child's birthday card has a rabbit popping up from a hat when a tab is pulled to the right.

Complete the design for the card by **adding** a simple system of links to cause this to happen. Label clearly all fixed and moving pivots. [4]



4. A deckchair and a swing are shown below. Some parts of each product are labelled.



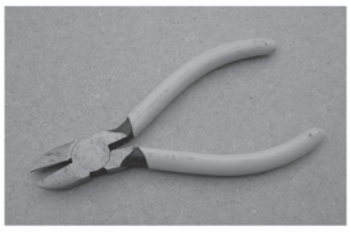


(a) Complete the table below by writing in the name of a part that is subject to the forces listed. *An example has been done for you*. [5]

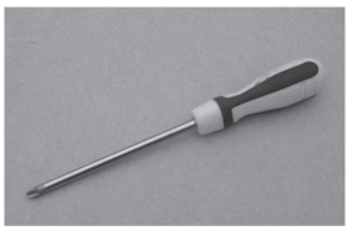
FORCE	DECKCHAIR	SWING
Tension		**Chain**
Compression		
Bending		

(b) Three common hand tools are shown below. **Name** the tool that experiences torsion when in use. [1]

Hammer



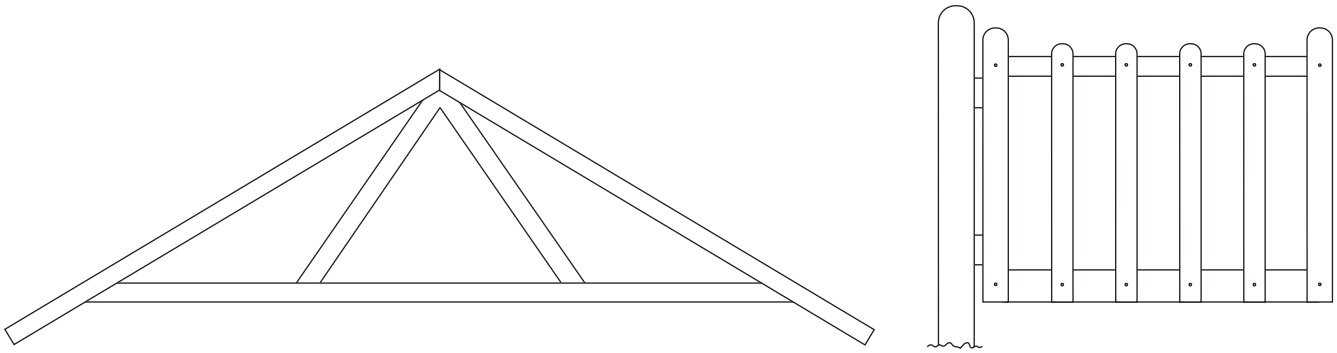
Wire Cutters



Screwdriver

Name of tool: .....

(c) Diagrams of a roof truss and a garden gate are shown below.



(i) The roof truss is more rigid than the gate. Explain why this is so. [2]

.....

.....

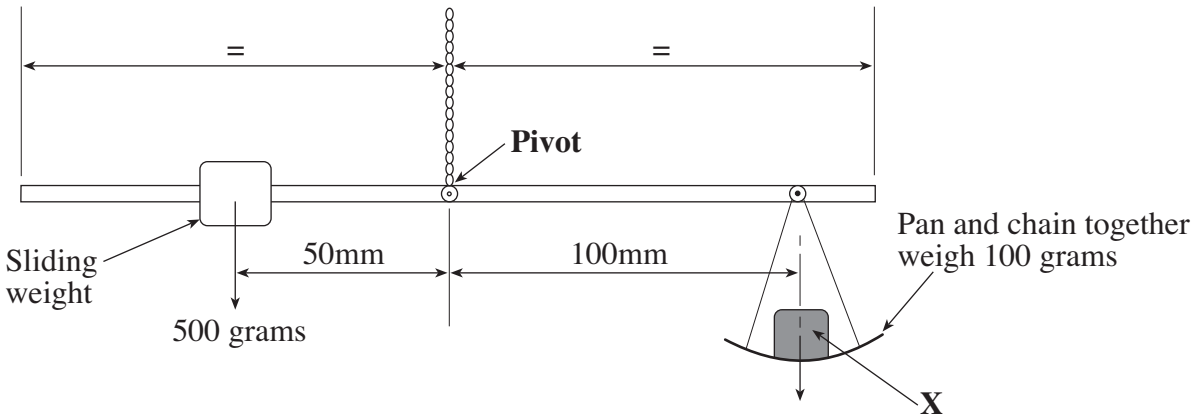
(ii) Explain what can be done to the gate to make it more rigid. [2]
You may draw on the diagram to help your answer.

.....

.....

(d) The diagram below shows a simple balance weighing scales. **Calculate** the weight of the object marked **X**. **Note:** the pivot is at the centre of the bar. [3]

Show all your workings.



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PLEASE TURN OVER FOR QUESTION 5.

5. Very young children are sometimes frightened if it is too dark in their bedrooms. Design an automatic night-light for a young child's bedroom.

SPECIFICATION

- The night-light must switch itself on when the room gets dark.
- The threshold (i.e. the light level at which it switches on/off) must be adjustable.
- The night-light must be of a form that a young child will find comforting or amusing.
- The night-light must be battery powered or make use of a small mains transformer/adapter.
- The night-light must fix to a wall, cot or ceiling.

Sketch your designs in the boxes that follow.

Marks will be awarded for:

(i) annotated sketches to show the general look of the night-light; [6]

(ii) a clear block diagram based on INPUT, PROCESS and OUTPUT of the control system for the night-light; [4]

(iii) fully labelled details of the electronic circuit used in the night-light; [6]

(iv) a clear sketch to illustrate how the night-light is fixed to the wall, ceiling or cot; [3]

(v) quality of communication. [6]

(i) Show the general look of your design.

(ii) Draw a clear BLOCK diagram showing the INPUT, PROCESS and OUTPUT of the control system.

(iii) Draw a fully labelled circuit diagram of your system.

(iv) Show details of how the night-light is fixed in position.

For continuation only.