

Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE  
General Certificate of Secondary Education



CYD-BWYLLGOR ADDYSG CYMRU  
Tystysgrif Gyffredinol Addysg Uwchradd

142/02

**DESIGN AND TECHNOLOGY**

**PAPER 2**

**FOCUS AREA: SYSTEMS AND CONTROL TECHNOLOGY**

(Foundation Tier – Grades G to C)

P.M. TUESDAY, 5 June 2007

(1½ hours)

	<b>Leave Blank</b>
<b>Question 1</b>	
<b>Question 2</b>	
<b>Question 3</b>	
<b>Question 4</b>	
<b>Question 5</b>	
<b>TOTAL MARK</b>	

**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.

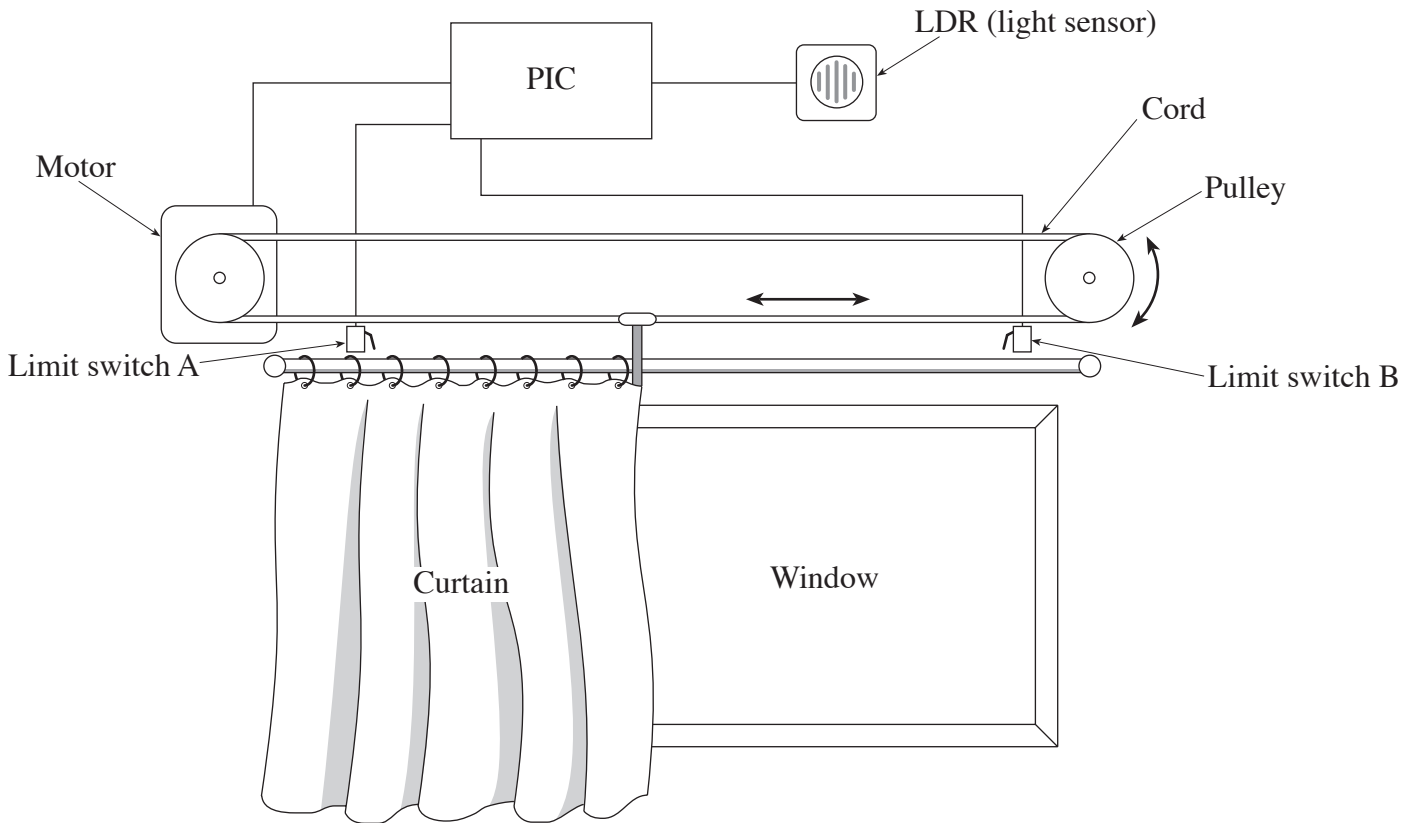
**INFORMATION FOR CANDIDATES**

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. (a) Details of a system that will automatically open a curtain when it gets light and close it when it gets dark are shown below.



- (i) **Name one** input device used in the system.

[1]

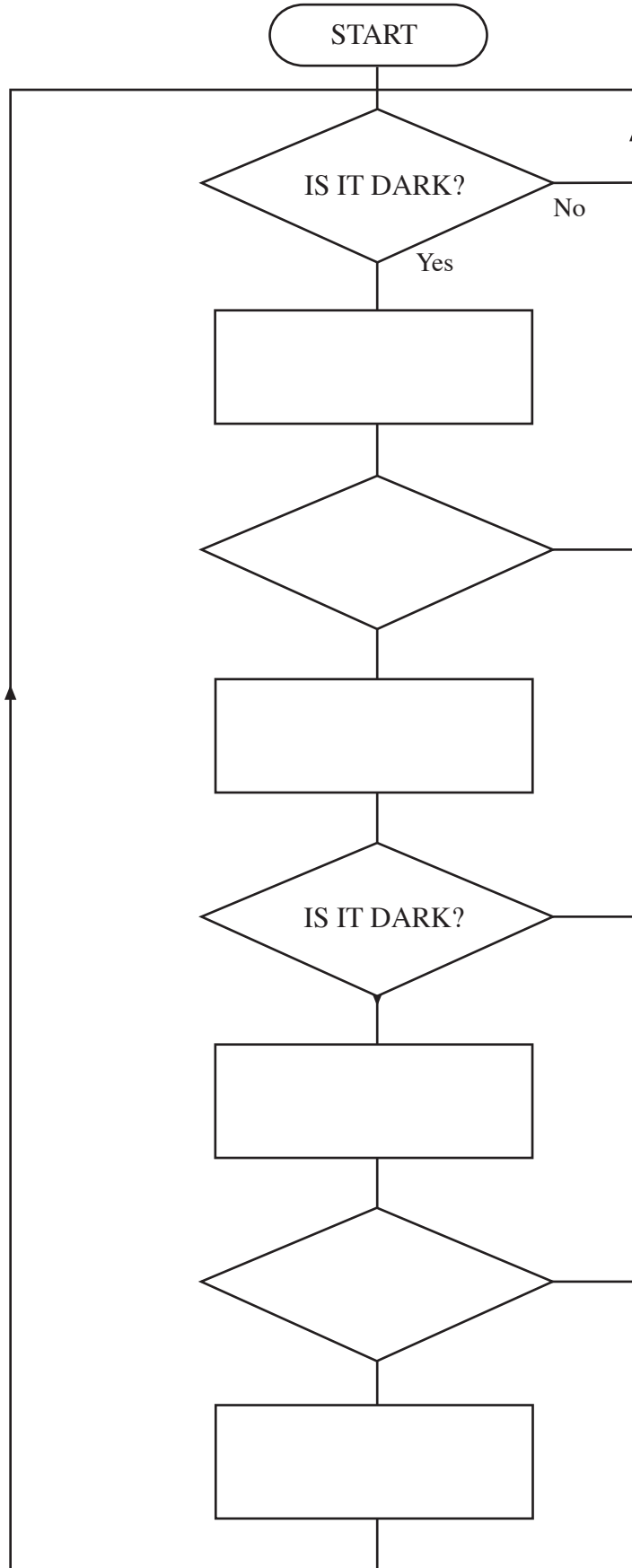
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- (ii) **Name one** output device used in the system.

[1]

.....

(b) **Using all** the commands listed on the right **complete** the flowchart that controls the system. Show all return loops.  
(Note: MOTOR FORWARD closes the curtain.) [9]



- MOTOR BACKWARD**
- MOTOR FORWARD**
- IS LIMIT SWITCH A  
PRESSED?**
- IS LIMIT SWITCH B  
PRESSED?**
- MOTOR STOP**
- MOTOR STOP**

(c) **Describe one** problem that might arise with this system when it is in use. [2]

.....

.....

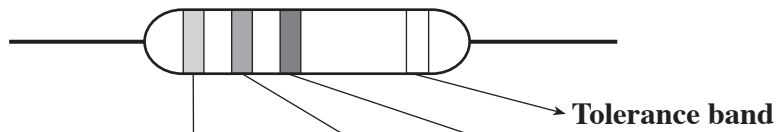
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(d) A PIC (Programmable Interface Controller) is used in many modern systems. **Describe one** other situation where a PIC would be used. [2]

.....

.....

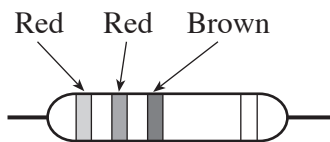
2. (a) Information about the resistor colour code is shown below.



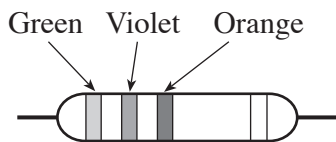
COLOUR	BAND 1	BAND 2	BAND 3
Black	0	0	x 1
Brown	1	1	x 10
Red	2	2	x 100
Orange	3	3	x 1000
Yellow	4	4	x 10,000
Green	5	5	x 100,000
Blue	6	6	x 1,000,000
Violet	7	7	
Grey	8	8	
White	9	9	

(i) Use the information to **calculate** the value of **each** of the resistors shown below.

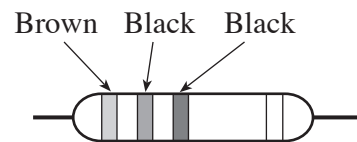
3 × [2]



Value: .....



Value: .....



Value: .....

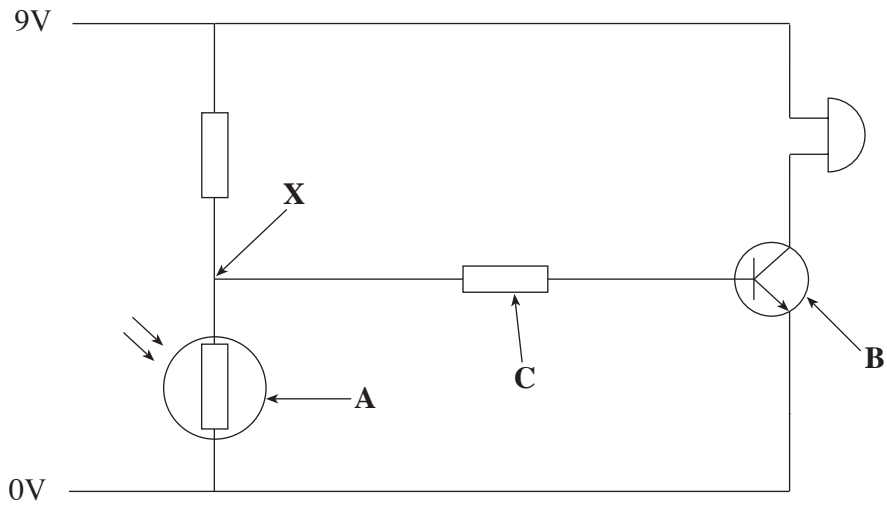
(ii) Resistors have a tolerance band. **Explain** the purpose of the tolerance band.

[2]

.....

.....

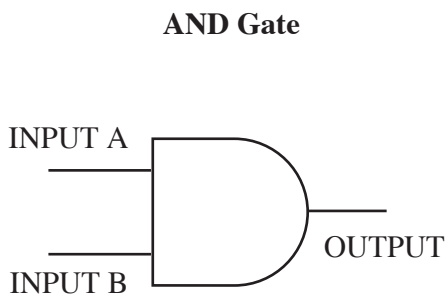
(b) A simple light sensing circuit is shown below.



- (i) Name component A. .... [1]
- (ii) Name component B. .... [1]
- (iii) Explain why resistor C is necessary. [2]  
.....  
.....
- (iv) Circle the correct words in the following statement. [4]

When it gets (**dark / light**) the voltage at X (**increases / decreases**). When the voltage at the (**base / emitter / collector**) reaches (**0.6 V / 1.2 V**) component B switches on and the buzzer sounds.

(c) The symbol for an AND gate is shown below. Complete the truth table for the gate. [4]



**TRUTH TABLE**

INPUT A	INPUT B	OUTPUT
0	0	
1	0	
0	1	
1	1	

(d) A photograph of a multimeter is shown below.



(i) **State two** jobs that this multimeter can be used for. [2]

Job 1 .....

Job 2 .....

(ii) **Explain** the purpose of the rotary switch in the centre of the multimeter. [2]

.....

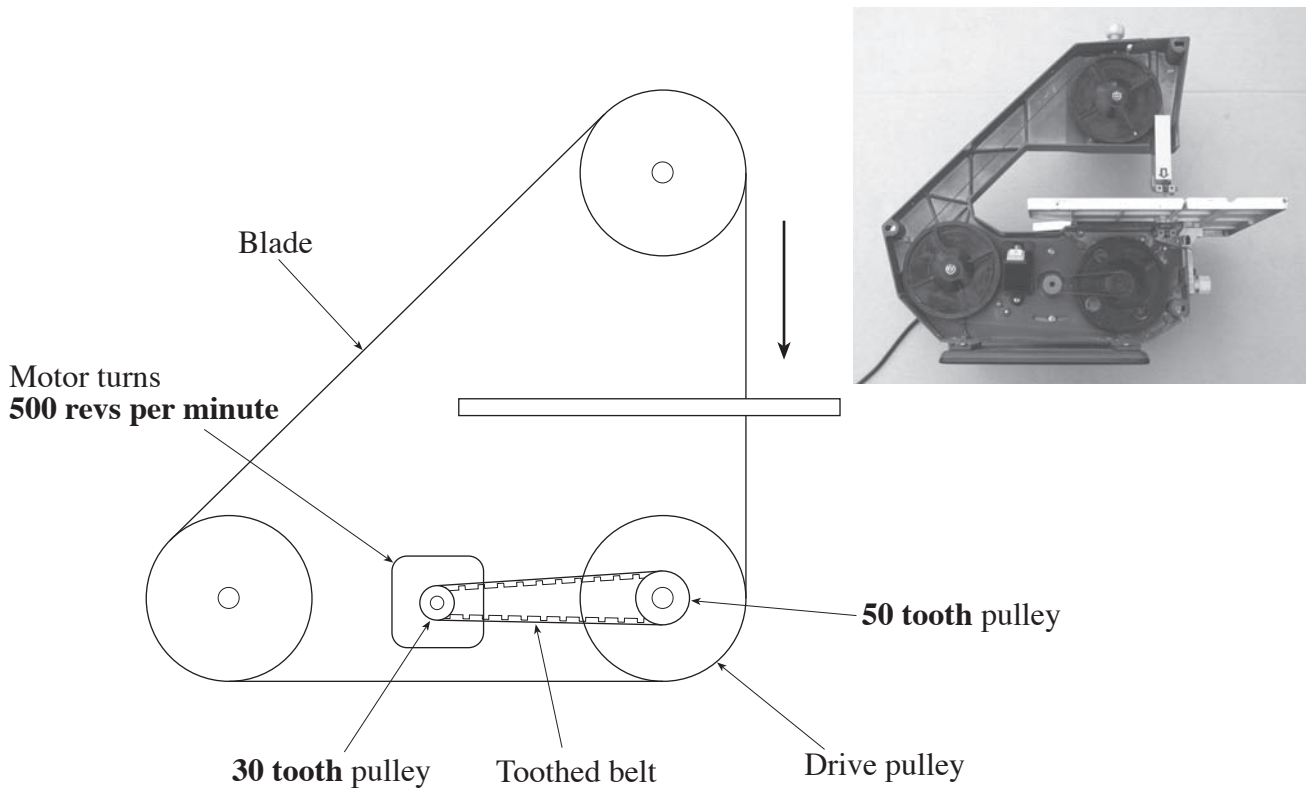
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(iii) **State** the exact reading shown on the multimeter in the photograph. [2]

**Give** both value and units.

Reading: .....

3. (a) Details of the drive system for a small band saw are shown below.



- (i) **State one** advantage of using a toothed belt in this system. [1]

.....

- (ii) **Calculate** the rotational velocity of the drive pulley. [3]  
(Show all workings.)

.....

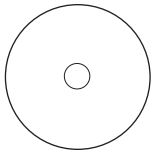
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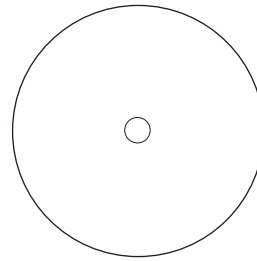
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- (iii) There are two other pulleys available to replace the 30 tooth pulley to allow the speed of the band saw to be altered. **Place a tick (✓) in the box next to the pulley that should be used to make the band saw turn twice as fast.** [1]

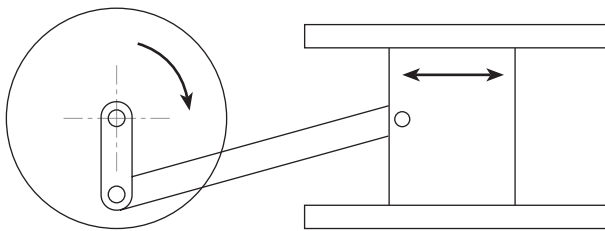


15 tooth pulley

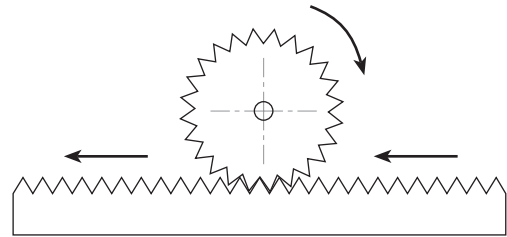


60 tooth pulley

- (b) Two simple mechanisms are shown below.



**CRANK AND SLIDER**



**RACK AND PINION**

Using the words from the list, **complete** the **two** sentences below. (You can use a word more than once.)

**ROTARY**

**LINEAR**

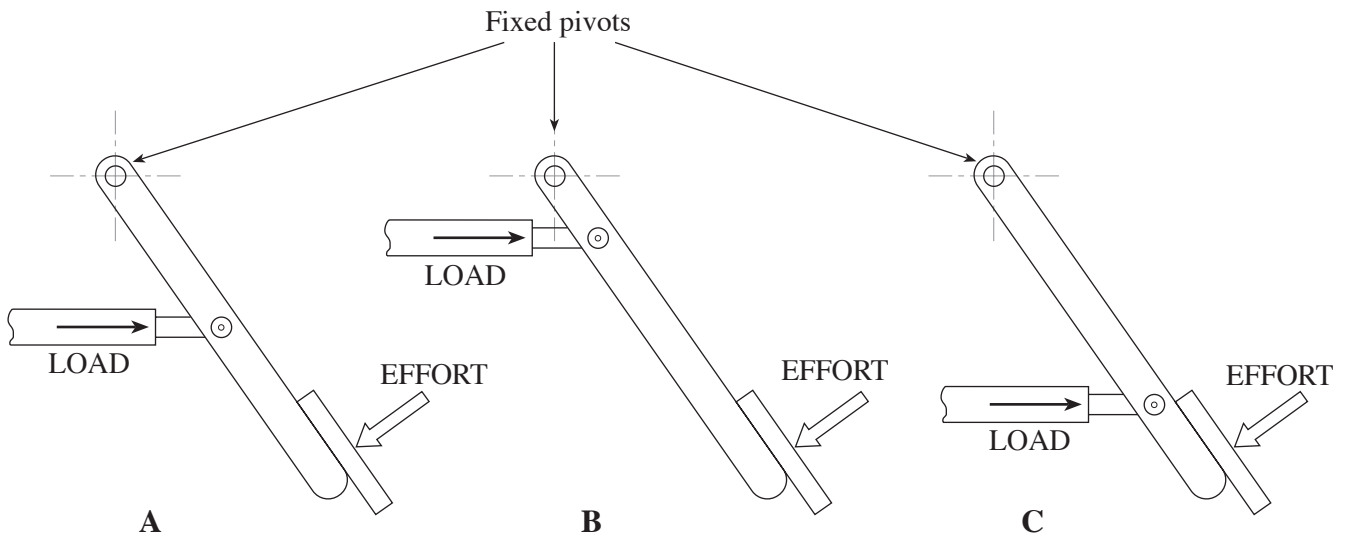
**RECIPROCATING**

**OSCILLATING**

- (i) The ..... motion of the crank causes ..... motion in the slider. [2]

- (ii) The ..... motion of the pinion causes ..... motion in the rack. [2]

(c) Three different designs for a car brake pedal are shown below.



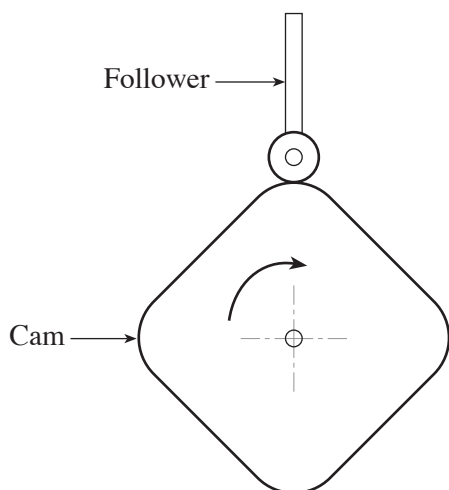
(i) **State** which class of lever is used in the brake systems. [1]

.....

(ii) **State** which system would require the **least** effort to slow the car. [1]

.....

(d) Three *cam and follower* systems are shown below. For **each** system **write** a brief description of the movement of the follower during **one complete** revolution of the cam. [3 × 2]



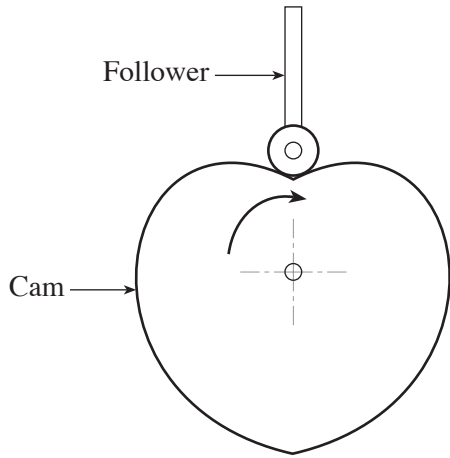
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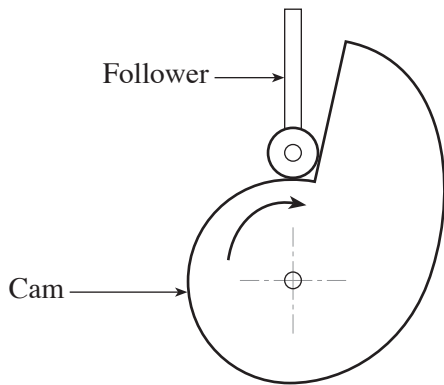
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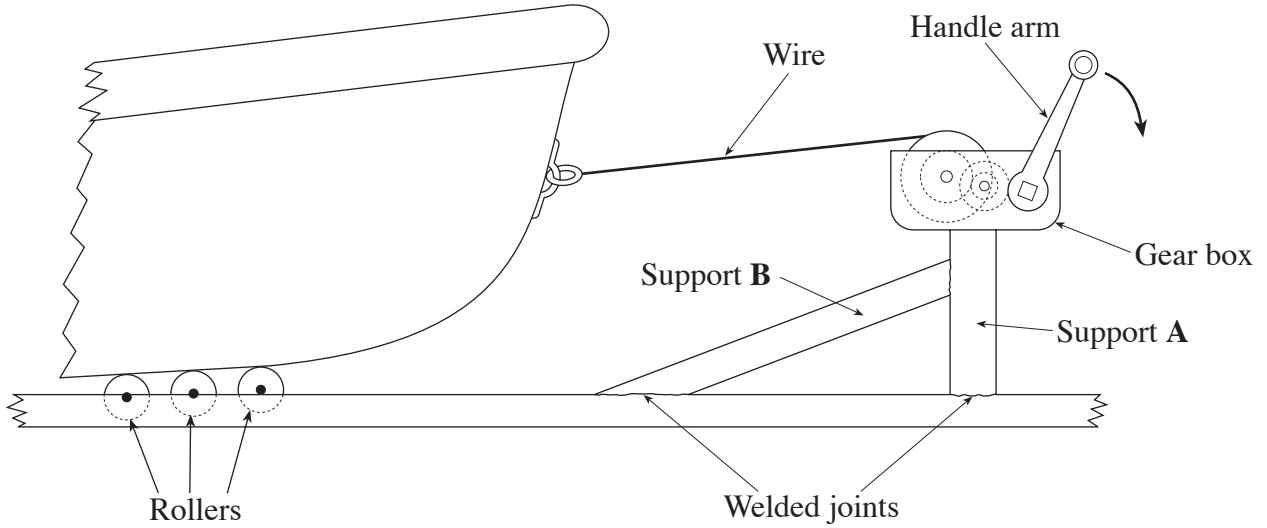
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4. (a) The drawing below shows a heavy boat being pulled onto its trailer using a winch.



- (i) **Explain** why the rollers are useful. [2]

.....

.....

- (ii) **Name** a suitable material for the trailer frame. [1]

.....

- (iii) **Explain** why the gear box is used. [2]

.....

.....

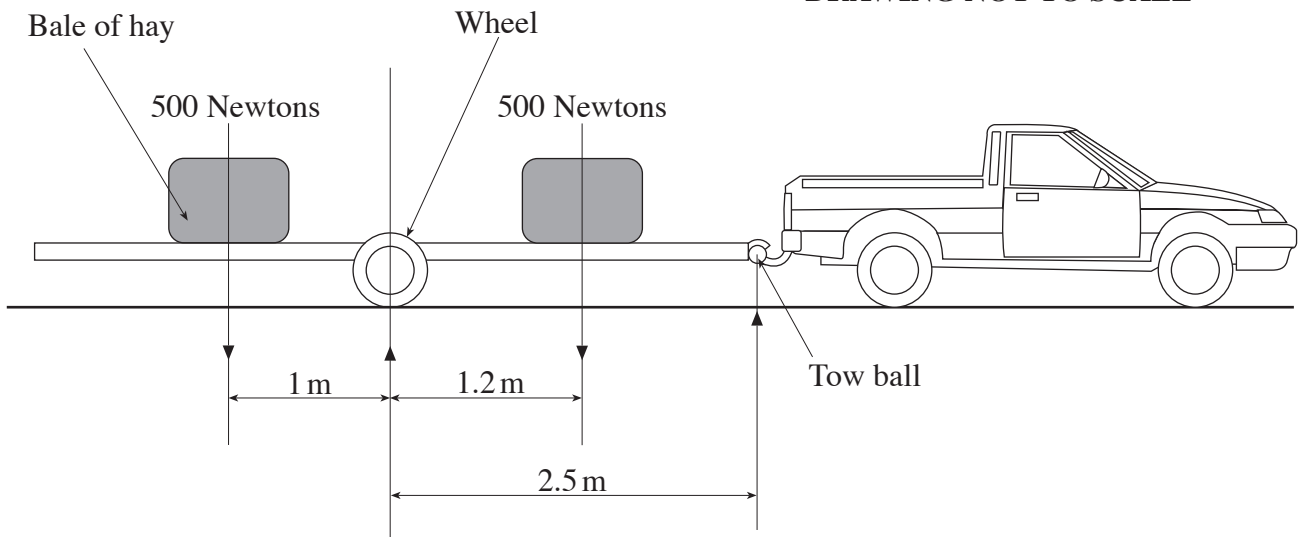
(iv) **Choosing** words from the list, **complete** the table below by writing the type of force that is present in **each** of the parts named. [4]

**SHEARING                  TENSION                  TORSION                  COMPRESSION                  BENDING**

PART	FORCE
Support A	.....
Support B	.....
Wire	.....
Handle arm	.....

(b) A farm trailer loaded with two bales of hay and hitched to a vehicle is shown below.

**DRAWING NOT TO SCALE**



(i) **Circle** the correct words in the following sentence. [1]

The loaded trailer is tending to LIFT UP / PRESS DOWN the back end of the vehicle.

(ii) Using the principle of moments, calculate the actual force acting on the tow ball of the vehicle. [4]

.....

.....

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.....

- (iii) **Explain** where you think the two bales should be positioned on the trailer in order to reduce the force on the tow ball and give a reason for your answer. [3]

Position for bales .....

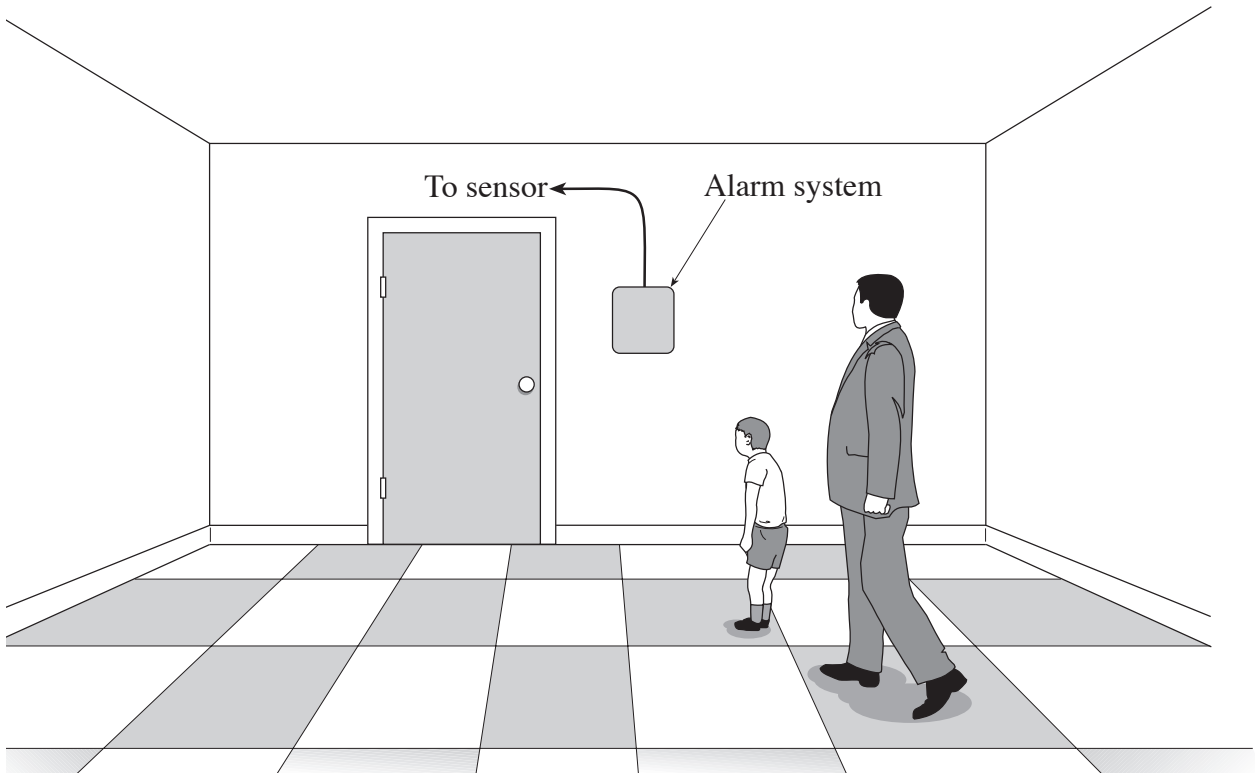
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Reason .....

.....

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5. The owner of a nursery group has asked you to **design** an alarm system that will warn the nursery teacher that the nursery room door has been opened by a child or other person.



### SPECIFICATION

#### The alarm must:

- warn the teacher that the door has been opened;
- be battery powered;
- be able to be armed and disarmed by the teacher but not by a child in the group;
- be securely cased and fixed in an appropriate position.

**Sketch** your design in the boxes on the following pages.

#### Marks will be awarded for:

- |       |  |     |
|-------|--|-----|
| (i)   | a clear block diagram based on INPUT, PROCESS and OUTPUT of the control system for the device; | [4] |
| (ii)  | fully labelled details of the electronic circuit used in the alarm;                            | [6] |
| (iii) | clear details of how the alarm is triggered by the door opening;                               | [4] |
| (iv)  | clear details of a case and how the circuit fits into it;                                      | [3] |
| (v)   | details of how the alarm cannot be armed or disarmed by a child;                               | [2] |
| (vi)  | quality of communication.  | [6] |



(i) Draw a block diagram of your system.

(ii) Draw a labelled circuit diagram of your system.

(iii) Draw details of how the alarm will be triggered when the door is opened.

(iv) Draw one design for a suitable case for the alarm showing how the circuit fits into it and showing how the alarm cannot be altered by a child.

