UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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DESIGN AND TECHNOLOGY **0445/04**

Paper 4 Systems and Control **May/June 2007**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

To be taken together with Paper 1 in one session of 2 hours 15 minutes.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

You may use a calculator.
Section A
Answer **all** questions.
Section B
Answer **one** question.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **18** printed pages and **2** blank pages.

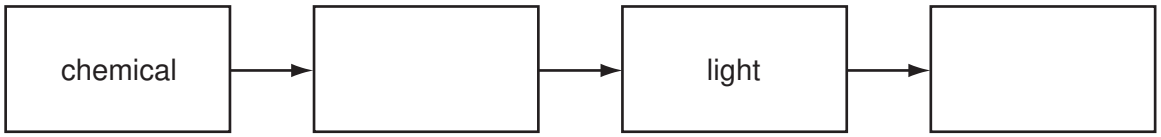
Section A

Answer **all** questions in this section.

1 Complete the statement below:

Moment = Force × ..... [1]

2 Complete the block diagram below to show the energy conversions that take place when a battery powered torch is switched on.



[2]

3 **(a)** Give **one** example of a man-made shell structure.

..... [1]

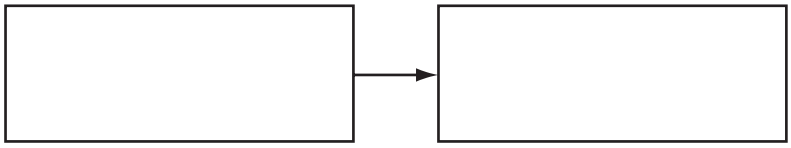
(b) Give **one** example of a natural frame structure.

..... [1]

4 Give **one** example of a third order lever.

..... [1]

5 **(a)** Complete the block diagram below to show the motion conversion that takes place when a rack and pinion gear system is operated.



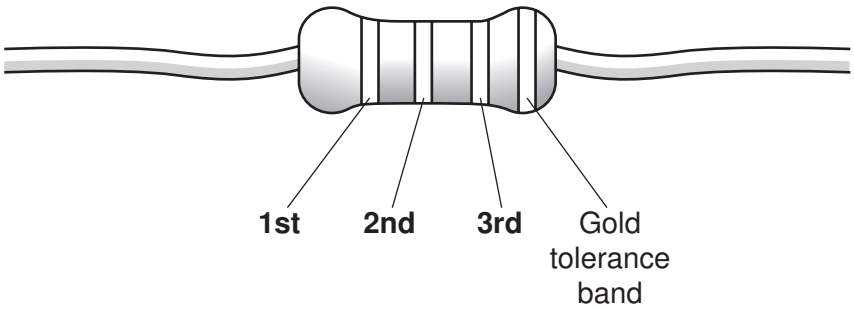
[2]

(b) Give **one** example of the use of a rack and pinion gear system.

..... [1]

6 The table and diagram below show the colour code system for resistors.

Colour	1st band	2nd band	3rd band	4th band
Black	0	0	-	Tolerance band
Brown	1	1	0	
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	0000000	
Grey	8	8	00000000	
White	9	9	000000000	



(a) State the colours of the bands for a 330 Ω resistor.

1st band ..... [1]

2nd band ..... [1]

3rd band ..... [1]

(b) Explain the use of the tolerance band.

..... [2]

7 Sketch and label the circuit symbol for an electrolytic capacitor.

[3]

8 Explain the structural term 'strut'.

.....

.....

..... [2]

9 There are different forms of pulley belt.

(a) Sketch and label a toothed belt.

[2]

(b) Give **one** example of the use of a toothed belt.

..... [1]

(c) Explain **one** benefit of using a toothed belt.

..... [2]

10 Name the transducer used to sense a change in temperature.

..... [1]

Section B

Answer **one** question from this section.

11 Fig. 1 shows a pet cage.

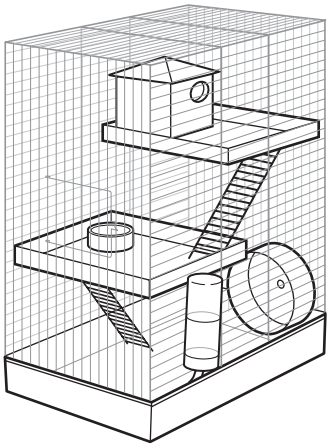
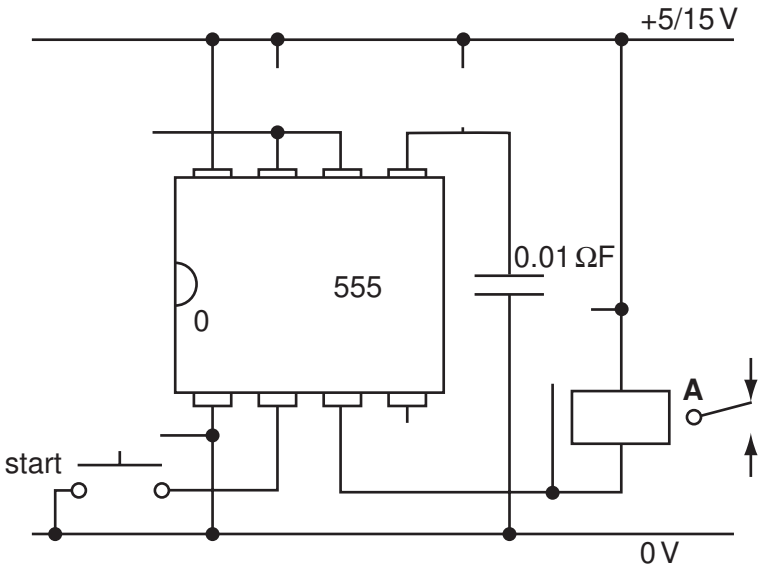


Fig. 1

A student decides to design an automated feeder that will dispense food at regular times over a week long period.

(a) Complete the circuit diagram below to show a timer circuit.



[4]

(b) Explain the purpose of the component **A**.

.....

.....

.....

..... [3]

(c) The circuit is used to control a solenoid.

Use notes and sketches to show the following parts of a solenoid:

- coil;
- moving rod;
- return spring.

[4]

(d) It is decided to use a sensor to monitor the water level in the pet's water dish.

Use notes and sketches to show a suitable sensor for this purpose.

[3]

(e) Fig. 2 shows a simple circuit that would sound a buzzer if the water level d
below a pre-set level.

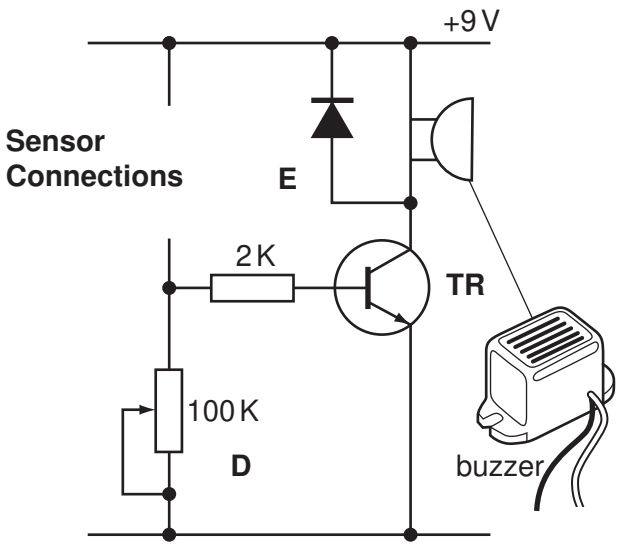


Fig. 2

(i) Explain the purpose of component **D**.

.....

.....

.....

..... [2]

(ii) Explain the purpose of component **E**.

.....

.....

.....

..... [2]

(f) The pet is to be trained to press buttons in a specific order to receive a food reward. Fig. 3 shows the arrangement of buttons to be pressed by the pet.

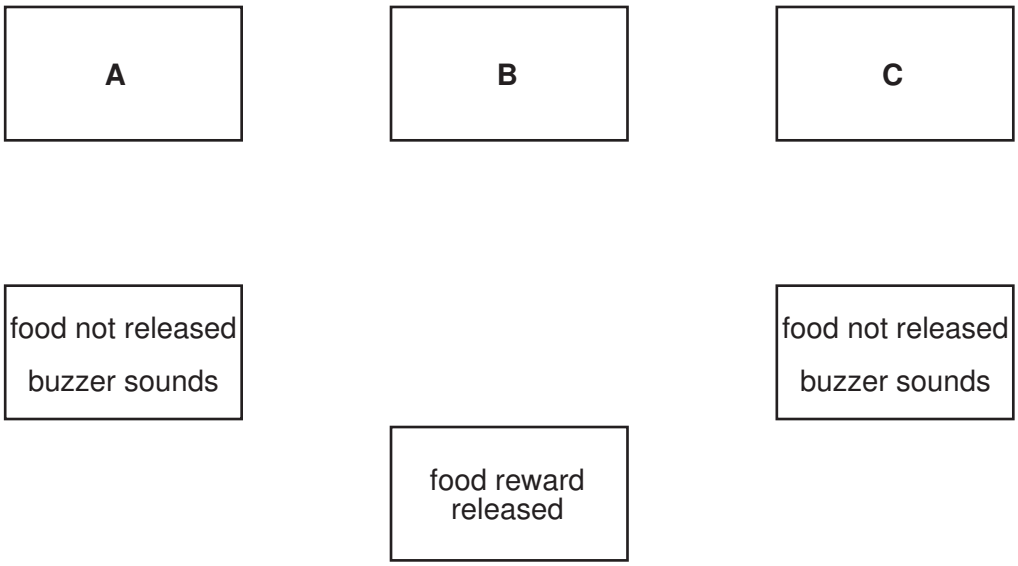


Fig. 3

Draw logic gates to show that the pet must press buttons **A** and **C** together to obtain food. If **B** is pressed in any combination a buzzer will sound and food will not be released.

[7]

12 Fig. 4 shows a design for a weather station for a school science project.

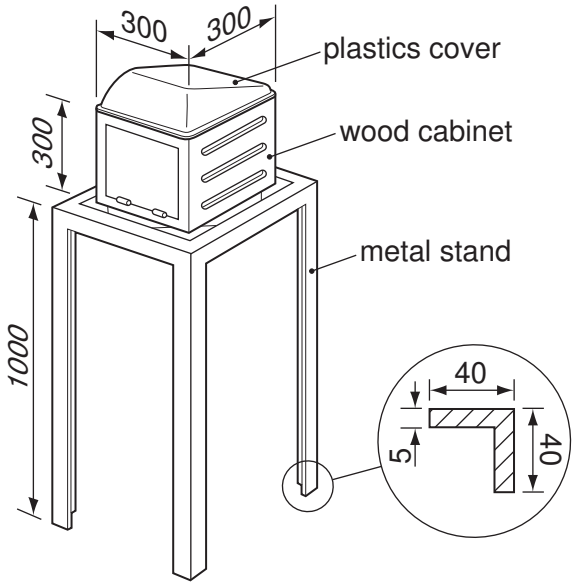


Fig. 4

(a) Explain, in structural terms, why the stand is made from 'L' section material.

.....

.....

.....

..... [3]

(b) Two types of structure are used in the design of the weather station.

Name **both** types and give an example of each from Fig. 4.

Name: .....

Example: ..... [2]

Name: .....

Example: ..... [2]

(c) Identify **one** fault in the design of the stand; use sketches and notes to show how the fault can be corrected.

[4]

(d) Screws are used to assemble the cabinet. When tightened one of the screws sheared off due to excessive force being applied.

Use sketches and notes to explain what is meant by 'shear'.

[3]

(e) Fig.5 shows detail of the plastics cover.

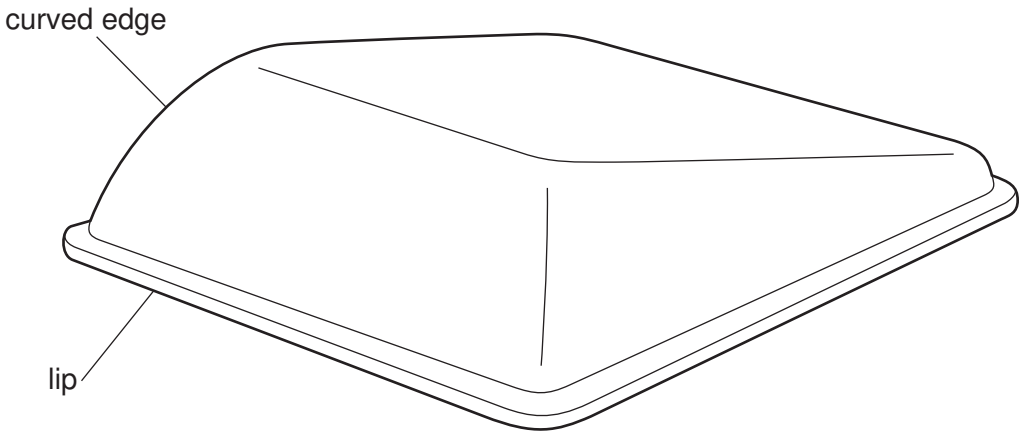


Fig. 5

(i) Explain the structural need for the 'lip'.

.....

.....

.....

..... [2]

(ii) Explain, in structural terms, why the edges of the plastics cover are curved.

.....

.....

.....

..... [2]

(iii) The material used for the plastics cover expands when warmed by the sun.

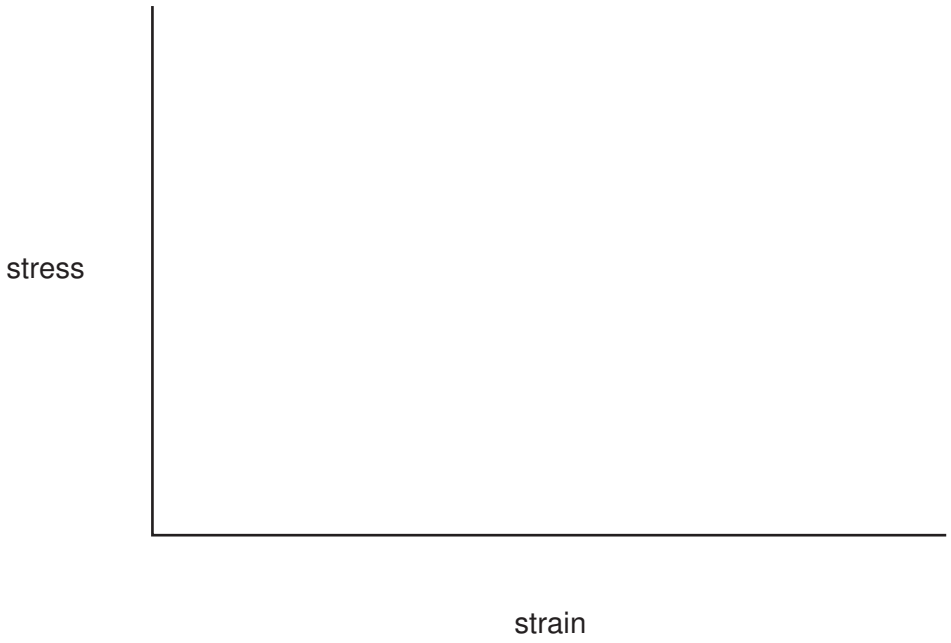
Name **one** device that could be used to measure accurately a small amount of expansion.

..... [1]

(f) The material used to make the stand is mild steel.

(i) Complete a stress strain graph, on the axes given below, for mild steel and lab clearly the following features:

- elastic region;
- plastic region;
- break point.



[3]

(ii) During installation of the weather station the legs of the stand are reduced in length by 0.01 mm.

Calculate the strain on the legs.

.....

.....

.....

..... [3]

13 Fig. 6 shows a typical building site.

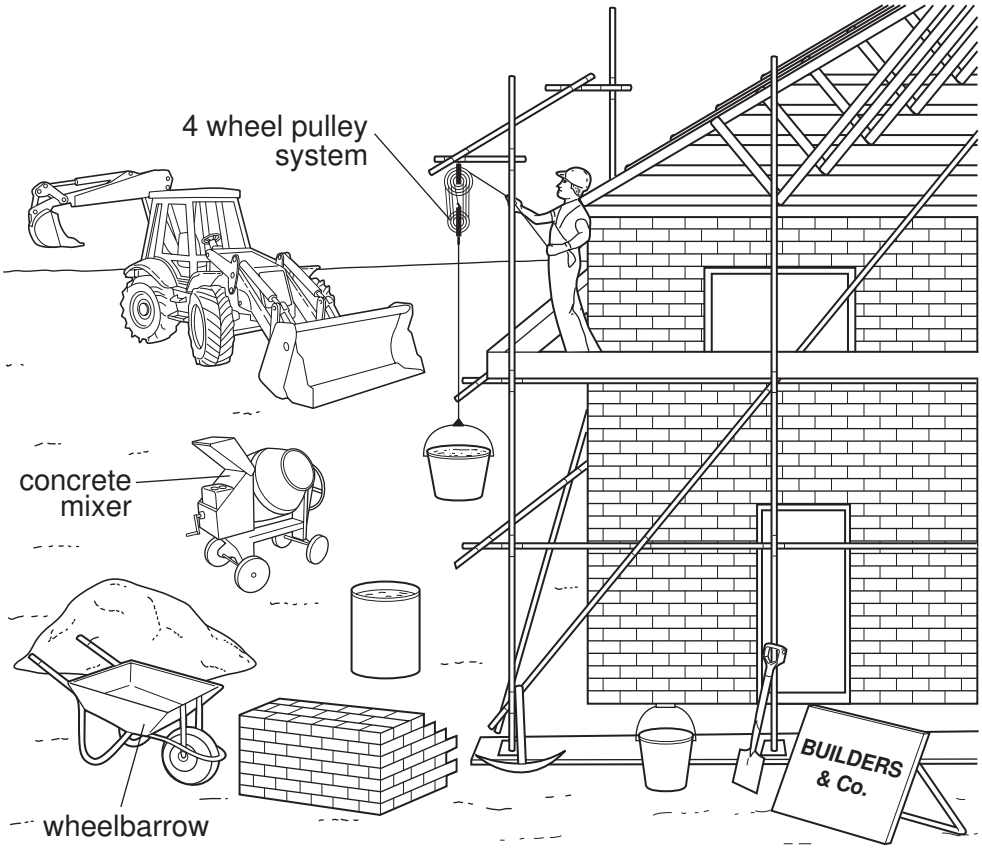


Fig. 6

(a) The wheelbarrow is an example of the use of leverage.

Name **two** other items from Fig. 6 that use levers.

1 ..... [1]

2 ..... [1]

(b) Fig. 7 shows a schematic diagram of the wheelbarrow as a lever.

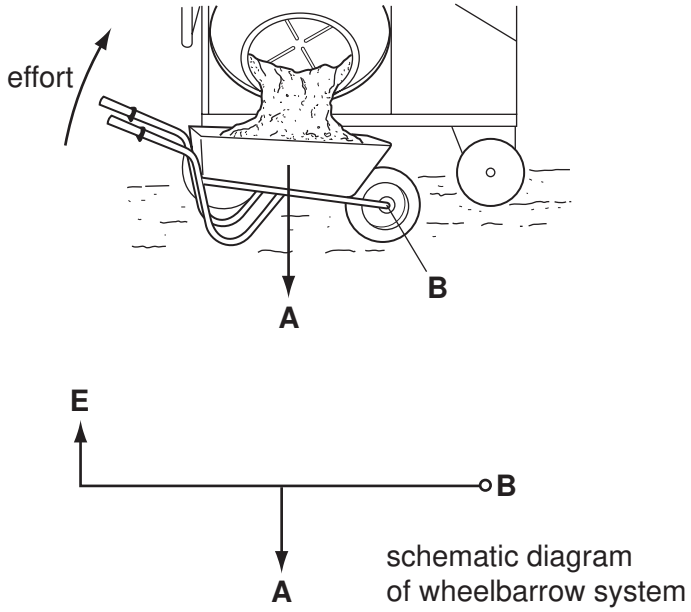


Fig. 7

(i) State the order of lever to which the wheelbarrow belongs.

..... [1]

(ii) Name of the force acting at **A**.

..... [1]

(iii) Name of point **B**.

..... [1]

(c) Fig. 8 shows a worker holding the wheelbarrow.

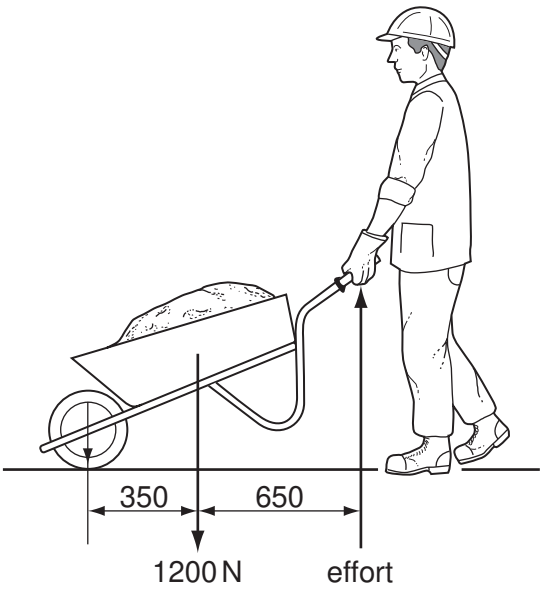
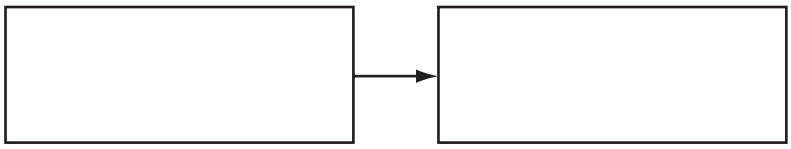


Fig. 8

(i) For the conditions shown, calculate the effort required to lift the wheelbarrow.

[3]

(ii) Complete the block diagram below to show the motion conversions that take place when the wheelbarrow is moved forward.



[2]

(d) Fig. 9 shows detail of a pulley system.

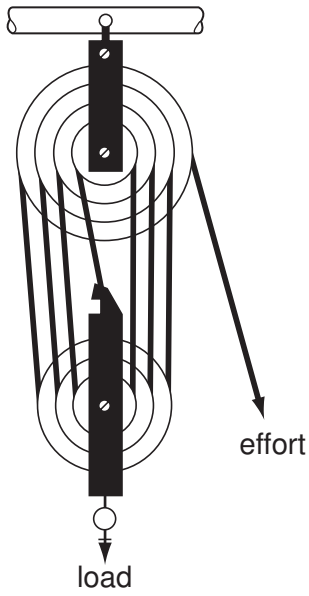


Fig. 9

(i) State the Mechanical Advantage (MA) of this system.

.....

[1]

(ii) For an effort of 850 N, calculate the load that could be lifted using this system.

[3]

(iii) Explain **one** drawback to using pulley systems.

.....

.....

.....

.....

[2]

(e) Fig. 10 shows part of the starting system for a cement mixer.

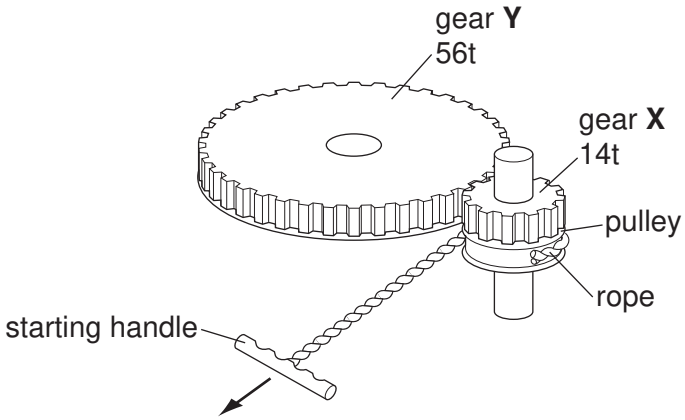


Fig. 10

(i) Add arrows to Fig. 10 to show the direction of the motion of the gears as the starting handle is pulled. [2]

(ii) Gear **X** turns gear **Y** to start the motor.

Name gear **X** and gear **Y**.
Choose, from the list below, words to complete the following sentences.

driven driver spur worm idler

Gear **X** is known as: ..... [1]

Gear **Y** is known as: ..... [1]

(iii) Calculate the Velocity Ratio (VR) for the gear system.

[3]

(f) Fig. 11 shows a cranked handle from a machine.

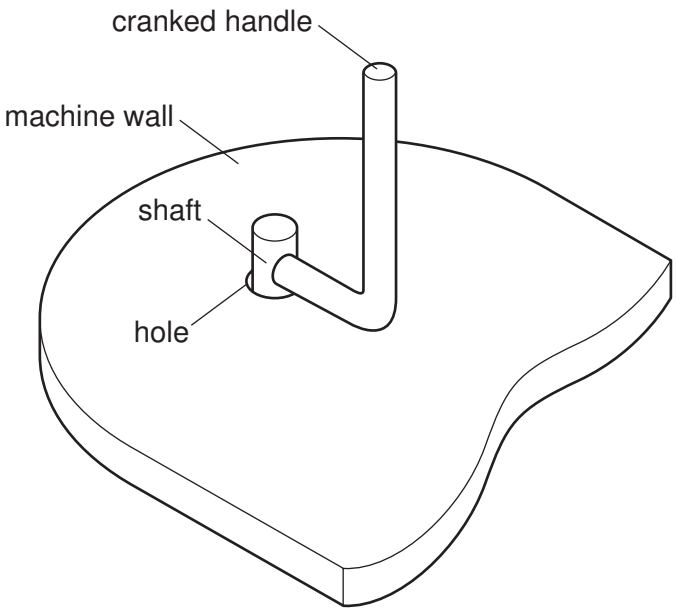


Fig. 11

Explain why the handle is cranked.

.....

.....

.....

..... [2]

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