



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

\* 4 8 1 6 5 6 2 7 2 6 \*

**DESIGN AND TECHNOLOGY**

**0445/04**

Paper 4 Systems and Control

**May/June 2009**

**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 and 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	
<b>Total</b>	

This document consists of **16** printed pages.

**Section A**

Answer **all** questions in this section.

1 Frameworks are one type of structure.

(a) (i) Give **one** example of a man-made framework.

..... [1]

(ii) Give **one** example of a natural framework.

..... [1]

(b) State the name of the other type of structure.

..... [1]

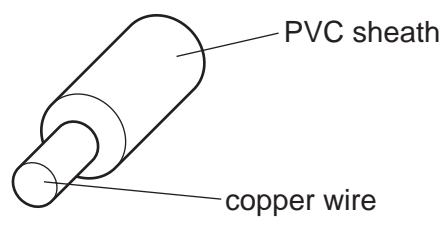
2 (a) Complete the statement below.

A strain gauge senses changes in ..... [1]

(b) Give **one** specific example of a use for a strain gauge.

..... [1]

3 Fig. 1 shows a cross sectional diagram of electrical cable.



**Fig. 1**

State the electrical property of each material.

PVC ..... [1]

Copper ..... [1]

3

4 Fig. 2 shows a cranked handle.

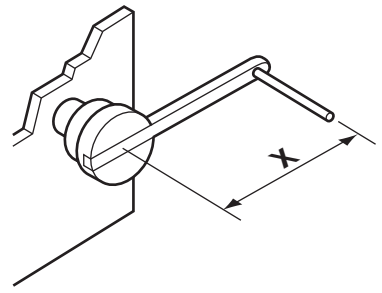


Fig. 2

Explain the term Mechanical Advantage (MA) for the cranked handle shown in Fig. 2.

.....

.....

.....

..... [2]

5 Sketch and label the circuit symbol for a light emitting diode.

[3]

6 A bevel gear system is a commonly used transmission system.

(a) Give **one** example of the use of a bevel gear system.

..... [1]

(b) Describe the motion conversion that takes place when a bevel gear system operates.

.....

.....

.....

..... [2]

7 Give **one** example of the use of logic gates in control systems.

.....

8 'I' section beams are commonly used in building construction.

(a) Sketch an 'I' section beam.

[2]

(b) Explain briefly why the beam is shaped in this way.

.....  
.....  
.....  
.....

[2]

9 Fig. 3 shows a device used to accurately measure deflection in structures.

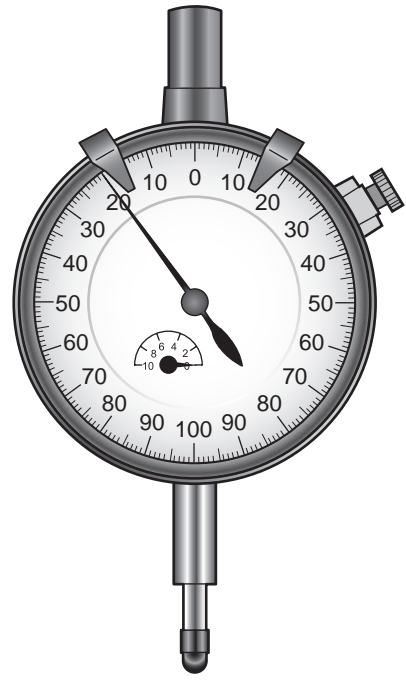


Fig. 3

Name the device shown in Fig. 3.

..... [1]

10 Electricity is measured in both voltage and current.

Explain these terms.

Voltage .....

.....

.....

..... [2]

Current .....

.....

.....

..... [2]

Section B

Answer **one** question from this section.

11 Fig. 4 shows a circuit diagram for an audible alarm device.

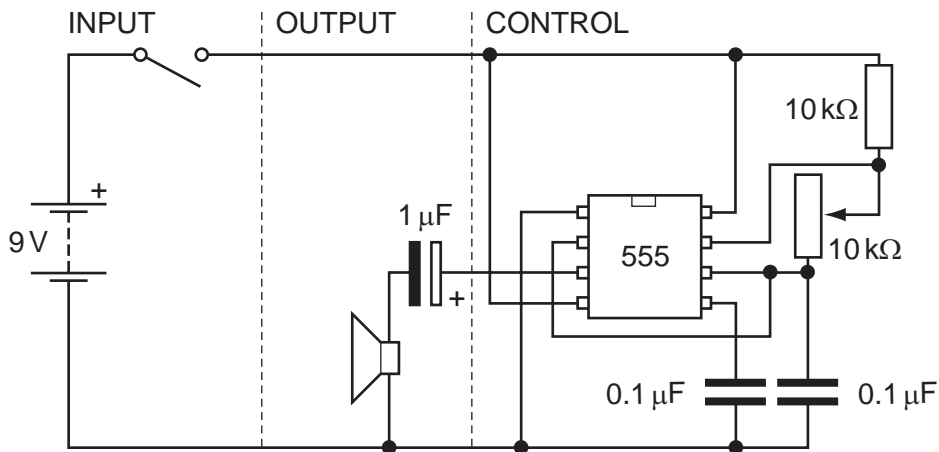


Fig. 4

(a) Explain how the circuit works.

.....

.....

.....

.....

.....

.....

..... [4]

(b) Label the 555 I.C. circuit symbol in Fig. 4 to show the pin numbers.

[2]

(c) There are **two** types of capacitor shown in the circuit diagram.

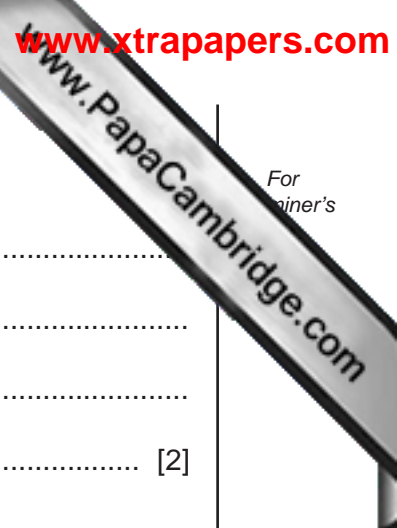
Explain the difference between the two types of capacitor.

.....

.....

.....

..... [3]



(d) Explain the function of the 10 kΩ variable resistor.

.....  
.....  
.....  
..... [2]

(e) The circuit diagram shows a 9 V battery.  
State how many cells make up a 9 V battery.

..... [1]

(f) The circuit is powered by a 9 V battery.  
Describe how a battery works in terms of energy conversion.

.....  
.....  
.....  
..... [2]

(g) A slide switch is used in the input part of the circuit.

(i) Sketch and label a slide switch.

[3]

(ii) Sketch the symbol for a toggle switch.

[2]

(iii) Explain how, by changing the type of input switch, the circuit could be used to detect someone entering a room.

.....

.....

.....

..... [3]

(h) Logic gates could be used to control the audible alarm.

Sketch and label a simple logic circuit that would activate the alarm when the input switch is 'on' and a light dependent resistor is 'off'.

[3]



12 Fig. 5 shows a black box diagram of a mechanism designed to convert one form of motion into another.

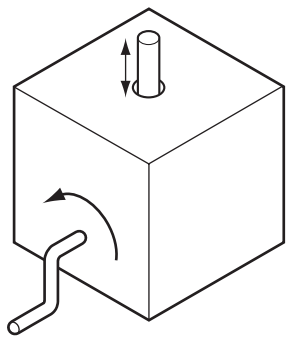


Fig. 5

(a) Name the **two** forms of motion indicated on Fig. 5.

..... [1]

..... [1]

(b) Sketch and label a cam and follower that could be used to perform this conversion.

(c) Fig. 6 shows a diagram of a snail cam and follower.

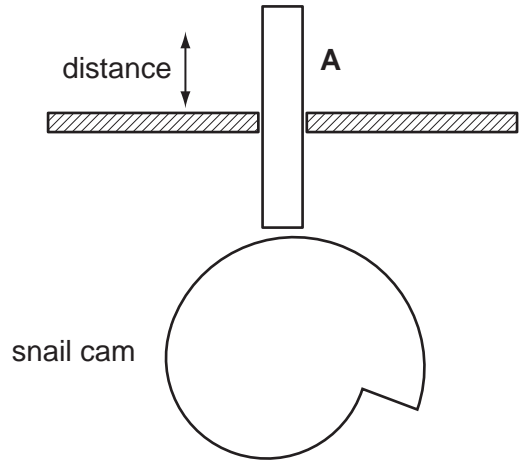


Fig. 6

(i) Describe the motion of the follower A for one revolution of the snail cam.

.....

.....

.....

..... [2]

(ii) Draw on Fig. 6 to show the direction of rotation of the snail cam.

[1]

(d) Mechanical transmission systems can be operated by the following methods.

- Chains and sprockets
- Pulleys and belts
- Gears

Complete the table below to show these methods giving benefits, drawbacks and **one** example of the use of each method.

Method	Benefit	Drawback	Example of use
Chains and sprockets			
Pulleys and belts			
Gears			

[9]

(e) In some situations it is important to stop a gear from moving backwards. In these situations a ratchet and pawl mechanism can be used.

(i) Use sketches and notes to show a ratchet and pawl mechanism.

[4]

(ii) Give **one** specific example of the use of a ratchet and pawl mechanism.

..... [1]

(f) Fig. 7 shows a gear system from a lawn mower.

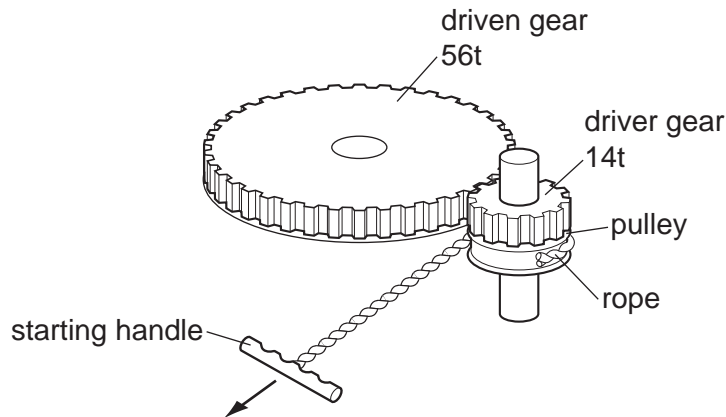


Fig. 7

Determine the velocity ratio (VR) for the system shown.

[3]

13 Fig. 8 shows an experiment to investigate the use of sheet materials to span a gap and support a load.

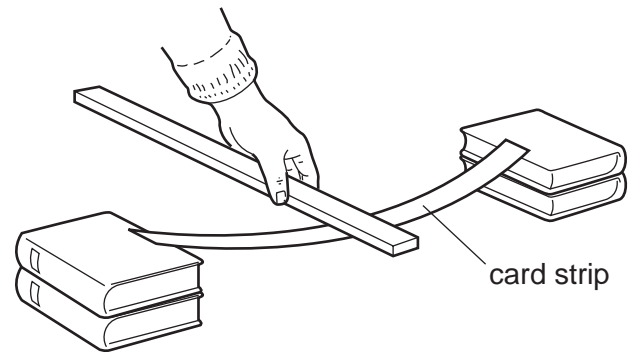


Fig. 8

(a) Explain how the card strip can be modified, without adding any more materials, to enable it to support the load more effectively.

.....

.....

..... [2]

(b) Fig. 9 shows a cutaway view of an internal door that has a cellular filling.

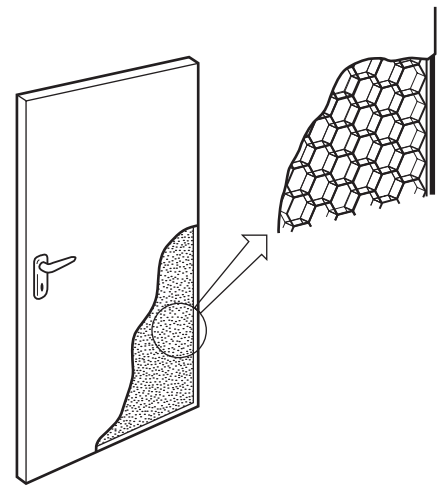


Fig. 9

(i) Give **three** benefits of this type of door construction.

1 ..... [1]

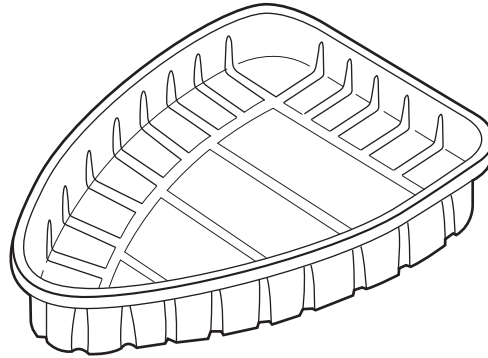
2 ..... [1]

3 ..... [1]

(ii) Name **one** other product that uses a similar type of construction.

.....

(c) Fig. 10 shows an example of plastics food packaging.

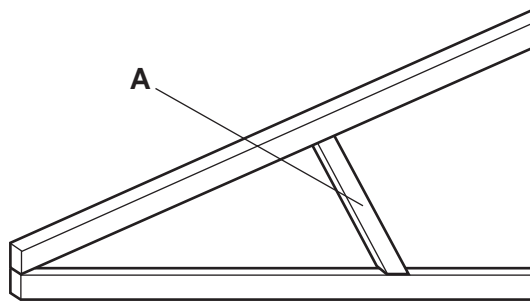


**Fig. 10**

Describe the structural features of this packaging.

.....  
.....  
..... [3]

(d) Fig. 11 shows members in a framework.



**Fig. 11**

(i) Name part **A** and explain its use in a framework.

.....  
.....  
.....  
..... [3]

(ii) Use sketches and notes to show how the joints could be reinforced using gussets.

[3]

(iii) Give **one** benefit of using gussets to reinforce roofing trusses.

.....  
..... [1]

(e) Fig. 12 shows a suspension bridge.

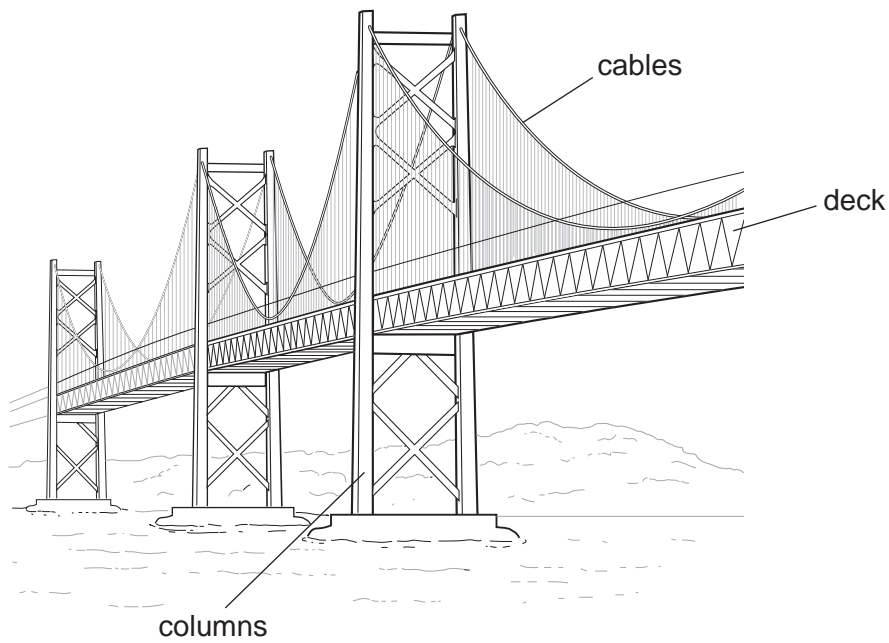


Fig. 12

(i) Complete the table below.

Member	Type of forces experienced	Failure
Cable	Tension	
Column		Buckling
Deck		

[4]

(ii) Name the type of loading that a bridge experiences.

..... [1]

(iii) Fig. 13 shows how the cables are joined to the columns with pins.

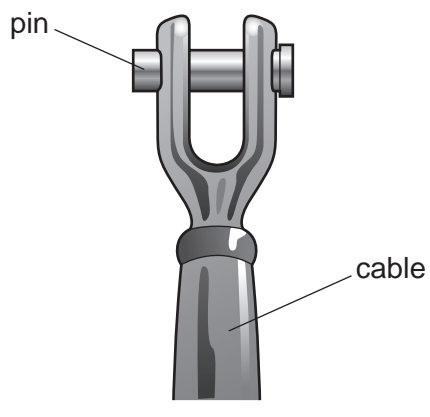


Fig. 13

Name the force acting on the pins.

..... [1]

(iv) The pins experience stress.

Explain how the effects of stress can be reduced on the pins.

.....  
.....  
..... [3]

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