



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 2008**

**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 an **14** printed pages and **2** blank pages.



Section A

Answer **all** questions in this section.

1 State the force acting on a tie in a framed structure.

..... [1]

2 (a) Name the transducer used to sense a change in light.

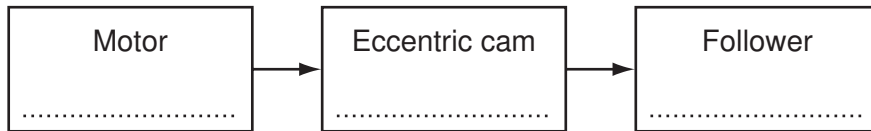
..... [1]

(b) Give **one** example of the use of a light sensor.

..... [1]

3 An eccentric cam driven by an electric motor is used to control the motion of a follower.

Complete the block diagram below to show the motion conversions that take place.



[3]

4 Sketch and label the circuit symbol for a transistor.

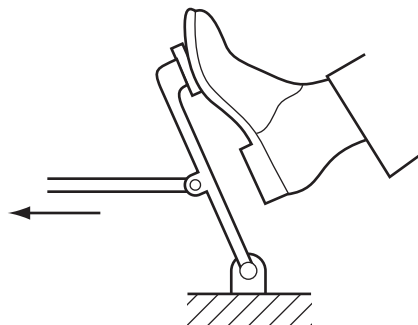
[3]

5 (a) Name the order of the lever shown below.

..... [1]

(b) Add labels to the diagram below to show:

- effort;
- load;
- fulcrum.

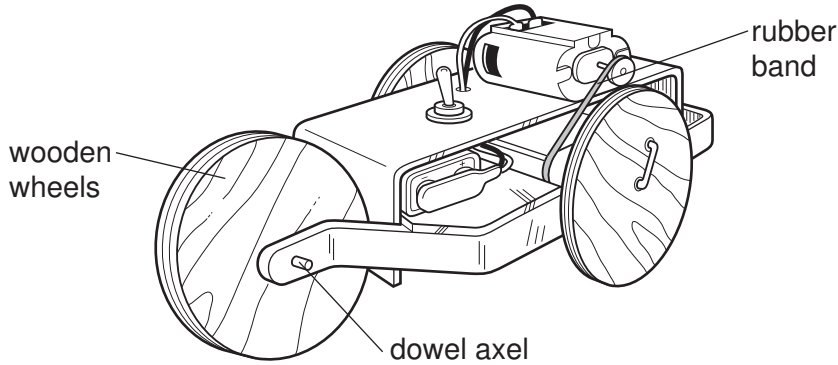


[3]

6 Complete the statement below.

Movement energy is called ..... energy.

7 When a simple battery-powered vehicle, as shown below, is operated, energy is converted into different forms. Some forms of energy are considered energy losses.



(a) Give **two** energy losses for the vehicle.

1 ..... [1]

2 ..... [1]

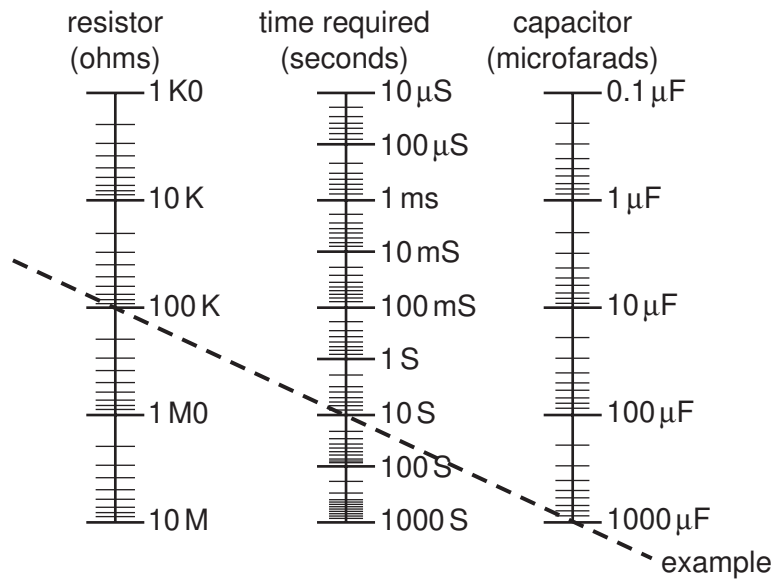
(b) (i) Give **two** ways of improving the energy efficiency of the vehicle.

1 ..... [1]

2 ..... [1]

(ii) Use sketches and notes to show **one** method for improving the energy efficiency of the vehicle.

8 Using the table below, select the appropriate value of resistance,  $R$ , that gives a time of 1 second if the capacitance value is  $100\ \mu\text{F}$ .



$R = \dots\dots\dots$  [1]

9 Give **one** example where a logic system is used in everyday life.  
 .....  
 ..... [1]

10 Explain the need for a factor of safety when designing a structure.  
 .....  
 ..... [2]

Section B

Answer **one** question from this section.

11 Fig. 1 shows a 555 timer circuit to control the time period for an LED.

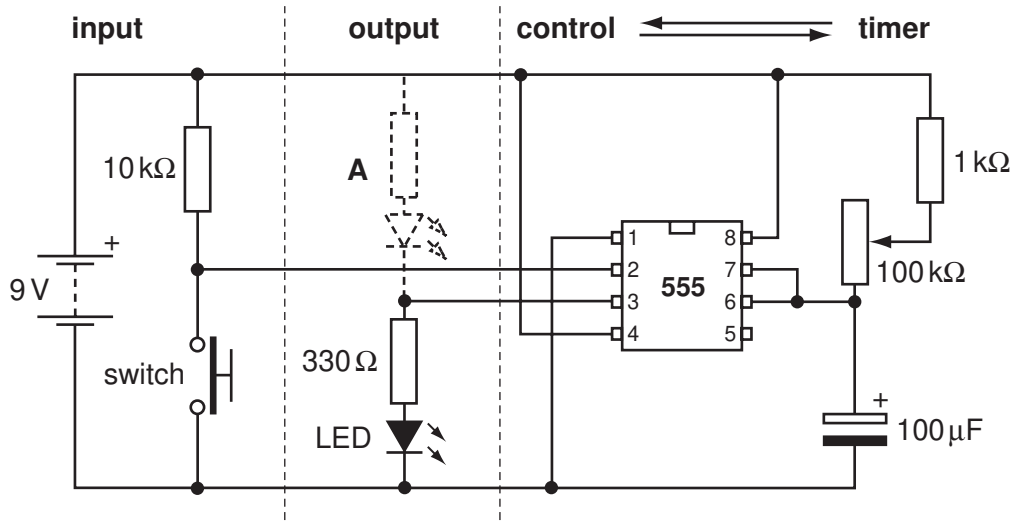


Fig. 1

(a) Explain, step by step, the operation of the circuit.

.....

.....

.....

..... [4]

(b) Explain the purpose of the 330Ω resistor.

.....

.....

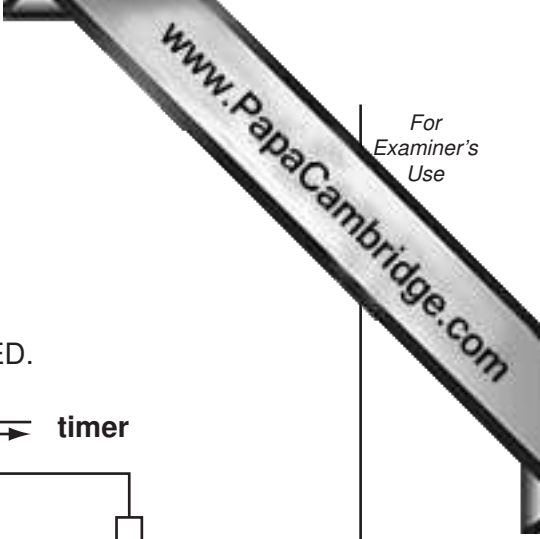
..... [2]

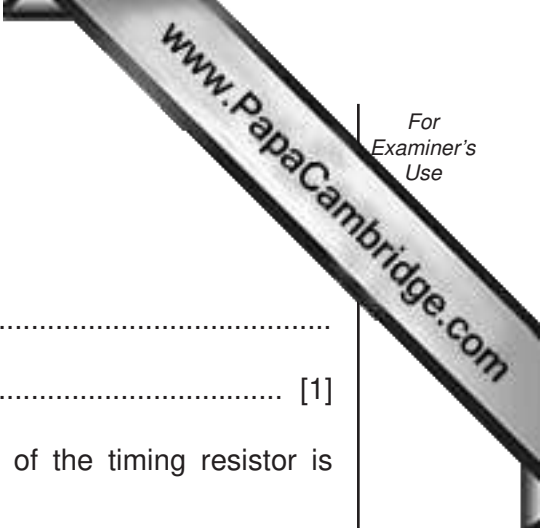
(c) Explain the effect of moving the LED to position **A** as outlined by the dotted lines.

.....

.....

..... [3]





(d) The 100  $\mu$ F capacitor is an electrolytic capacitor.

State why it should be connected according to its polarity.

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

(e) The value of the timing capacitor is 100  $\mu$ F and the value of the timing resistor is 100 k $\Omega$ .

Calculate the time delay in seconds.

[4]

(f) Identify the type of switch used in the circuit shown in Fig. 1.

..... [1]

(g) The circuit is powered by a 9 V battery.

Explain the difference between a battery and a cell.

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

(h) Logic gates can be used to control circuits and systems.

Fig. 2 shows a simple circuit using two switches to simulate inputs and a lamp to show the output.

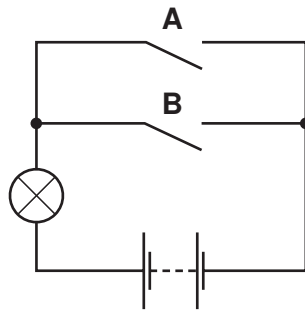


Fig. 2

(i) State the name of the logic gate that this circuit represents.

..... [1]

(ii) Sketch the symbol for this logic gate.

[3]

(iii) Identify the type of electrical arrangement of the switches in the circuit shown in Fig. 2.

..... [1]

(iv) Complete the truth table below for this logic circuit.

Input A	Input B	Output
0	0	
0	1	1
		1

[3]

12 Fig. 3 shows a design for a can-crushing press.

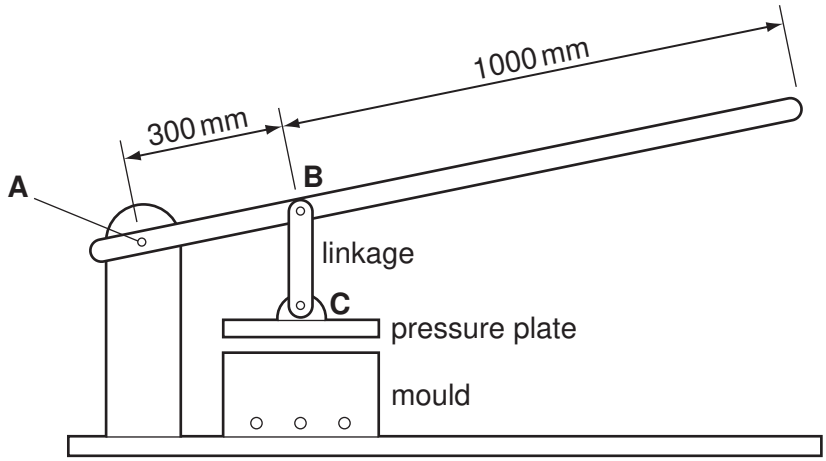


Fig. 3

(a) Using the example of the can-crushing press, explain what is meant by the term Mechanical Advantage.

.....

.....

..... [2]

(b) A force of 100 N is applied at the end of the handle.

Calculate the force that is transmitted to the pressure plate.

[3]

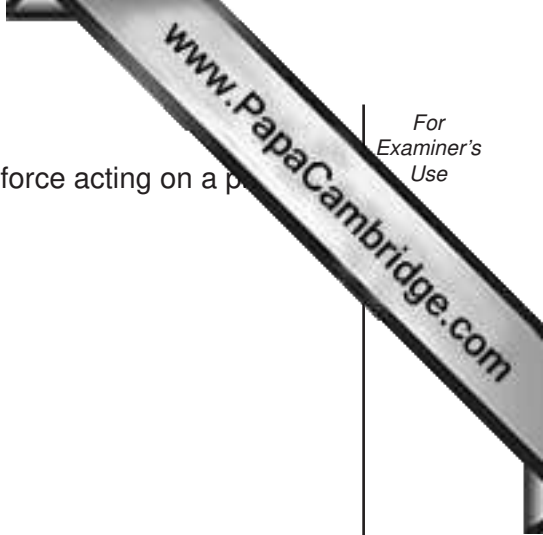
(c) (i) State the type of force acting on pin A.

..... [1]

(ii) Identify another component in the press that has this type of force acting on it.

..... [1]





(iii) Use sketches and notes to show the result of this type of force acting on a p

[3]

(d) Suggest **one** way in which operation of the press could be made easier.

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

(e) Identify the order of lever shown in Fig. 3.

..... [1]

(f) It is decided to add simple plain bearings at **A**, **B** and **C**.


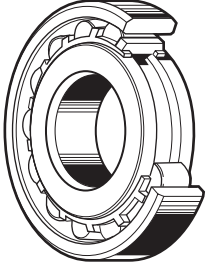
(i) Explain the need for bearings in mechanical systems.

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

(ii) Use sketches and notes to show a simple plain bearing.

[3]

(g) Complete the table below.

Bearing	Diagram	Example
[1]		Bicycle
Roller		[1]

(h) Lubrication is needed in mechanical systems.

(i) Give **two** reasons for lubricating mechanical systems.

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

(ii) State **two** types of lubricant and in each case give a specific example of use.

Type 1 .....  
 Use .....  
 ..... [2]

Type 2 .....  
 Use .....  
 ..... [2]

13 Stability in structures is very important.

(a) Look at Fig. 4 and for each structure add members to make them more stable.

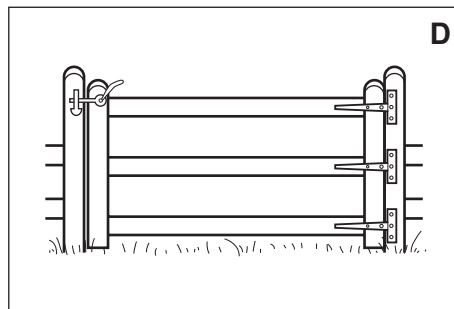
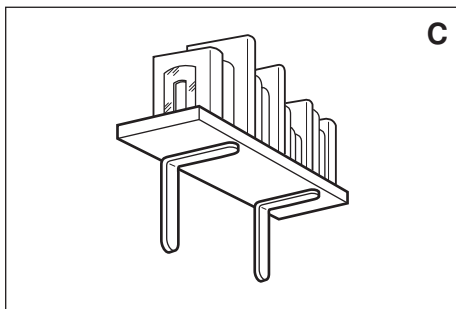
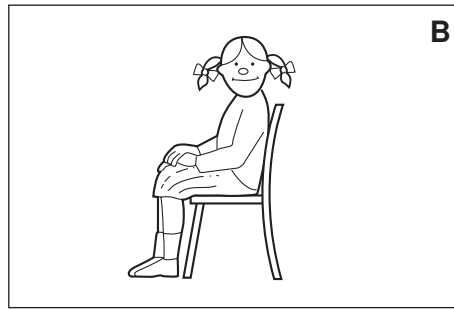
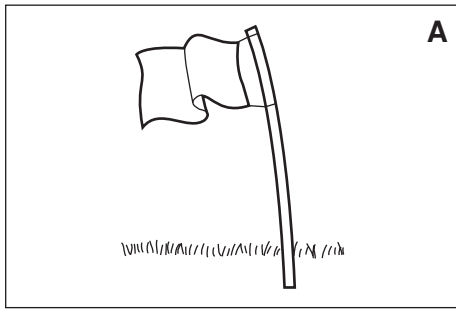


Fig. 4

[4]

(b) Each of the above structures is subject to static and dynamic loading.

Explain the difference between static and dynamic loading.

.....

.....

..... [2]

(c) A typical numerical value for the factor of safety for a bridge is 4.

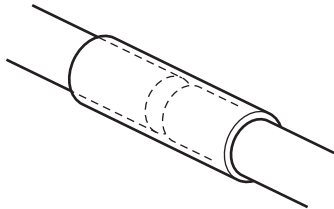
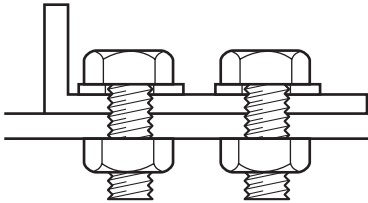
Explain why this is so.

.....

.....

..... [3]

(d) Complete the table below to show different joining methods in structures.

Joining method	Diagram	Use
Gusset plate	[2]	[1]
[1]		Joining tent poles
Nut and bolt		[1]

(e) Laminating is a structural construction method.

(i) Use sketches and notes to show the laminated structure of plywood.

[2]

(ii) Explain the way in which laminating improves the structural capabilities of plywood.

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

- (f) The selection of materials is important when designing structures.

Fig. 5 shows a lintel made from concrete.

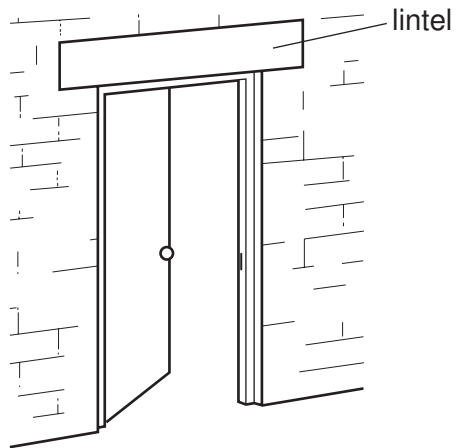


Fig. 5

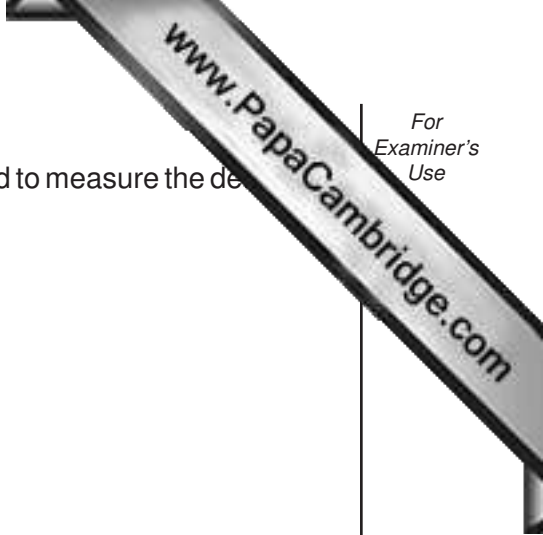
- (i) Use sketches and notes to show the forces acting within the lintel.

[2]

- (ii) Explain, using sketches and notes, how the concrete lintel would be reinforced to make it suitable for this use.

[2]

- (iii) Show, using sketches and notes, how a strain gauge is used to measure the deflection of the lintel.



[3]



