



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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**DESIGN AND TECHNOLOGY**

**0445/42**

Paper 4 Systems and Control

**October/November 2011**

**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 **15** printed pages and **1** blank page.



Section A

Answer **all** questions in this section.

- 1 Identify the method of structural reinforcement shown in Fig. 1.

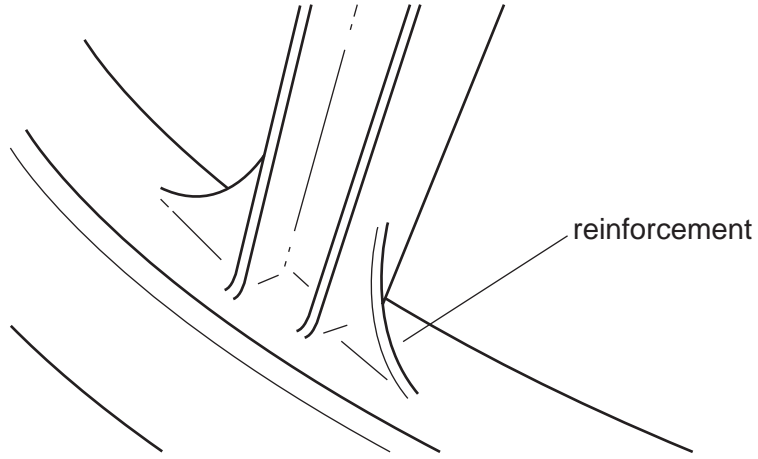


Fig. 1

..... [1]

- 2 Fig. 2 shows a structure. Label a strut and a tie on Fig. 2.

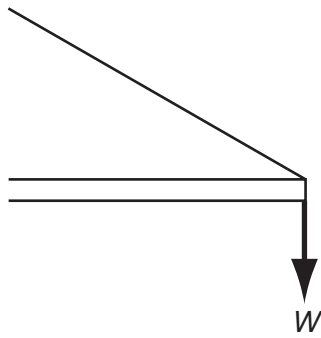


Fig. 2

[2]

- 3 Use sketches and notes to show how tensile and compressive forces are distributed in a simply loaded beam.

[3]

- 4 Use sketches and notes to show how a concrete beam is reinforced to make it more resistant to tensile forces.

[2]

- 5 LEDs are commonly used as lighting devices.  
Give **two** reasons why they are sometimes preferred to filament bulbs.

1 ..... [1]

2 ..... [1]

- 6 Fig. 3 shows a circuit diagram for an audible alarm device.

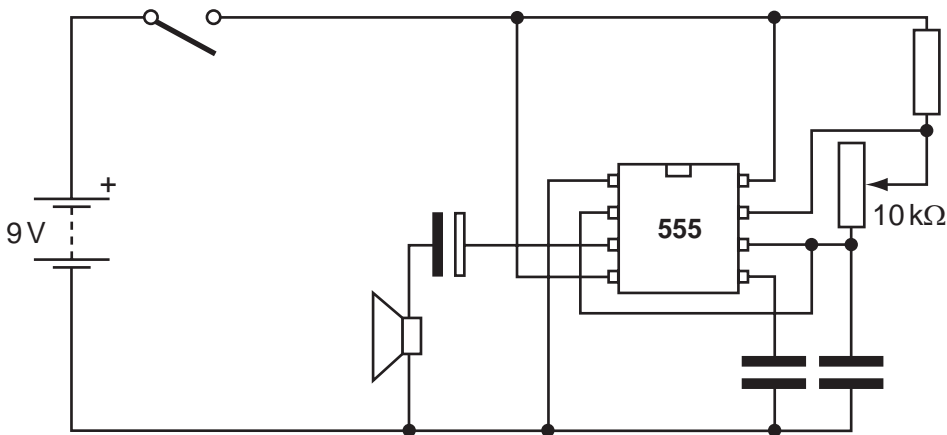


Fig. 3

- (a) Name the **two** types of capacitor shown in the circuit diagram.  
Explain the difference between the two types of capacitor.

.....

.....

..... [3]

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

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

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

..... [1]

7 Fig. 4 shows a mechanism.

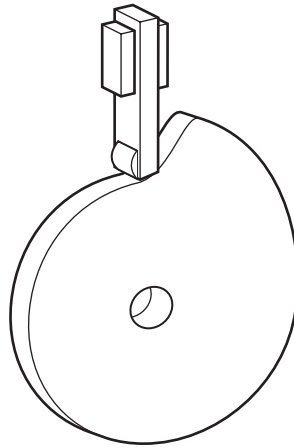


Fig. 4

(a) Name the mechanism shown.

..... [1]

(b) State the motion conversion that takes place during the operation of the mechanism.

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

8 Fig. 5 shows a mechanism for a windscreen wiper.

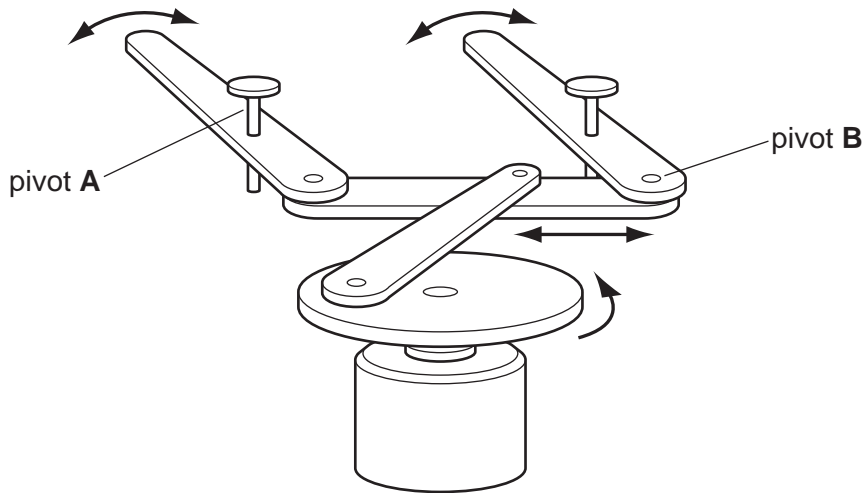


Fig. 5

Name the two types of pivot shown.

pivot A .....

pivot B ..... [2]

9 Designers use models when designing mechanisms.

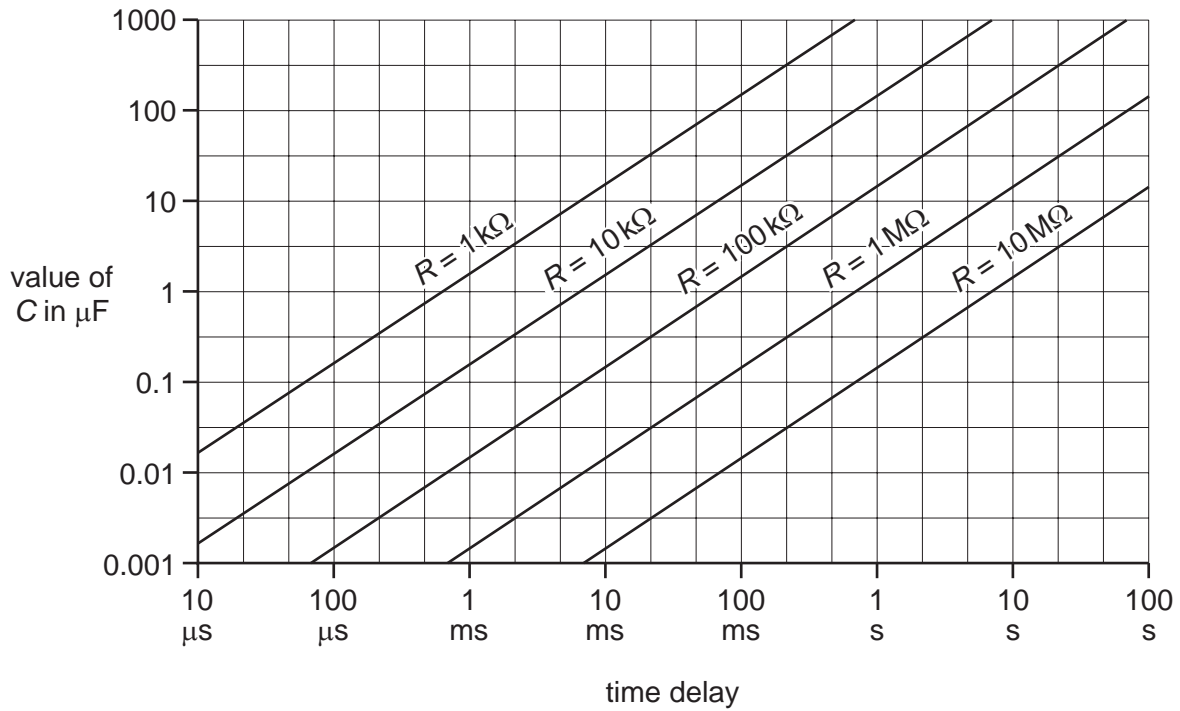
(a) Give **one** form of modelling.

..... [1]

(b) Give **one** benefit of modelling when designing mechanisms.

..... [1]

10 The chart below shows the relationship between  $C$  and  $R$  to be used in the design delay circuits.



Select a suitable value of  $C$  and  $R$  to give a time interval of 10 seconds.

$C$  ..... [1]

$R$  ..... [1]

Section B

Answer **one** question from this section.

- 11 Fig. 6 shows a circuit for a light-operated switch that will set off a buzzer when light falls on the sensor.

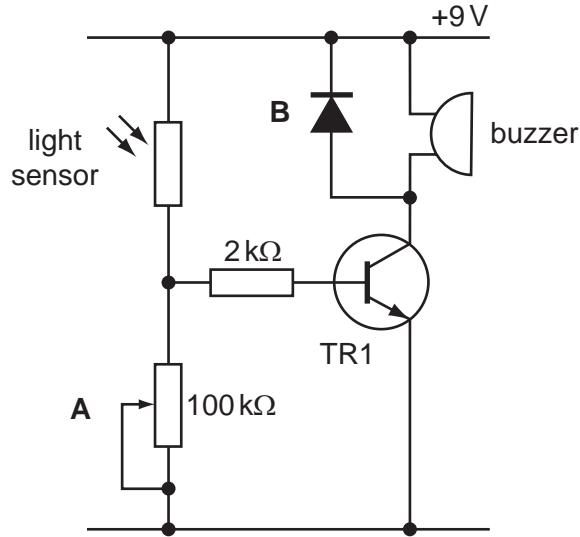


Fig. 6

- (a) (i) Name the device used as a light sensor.

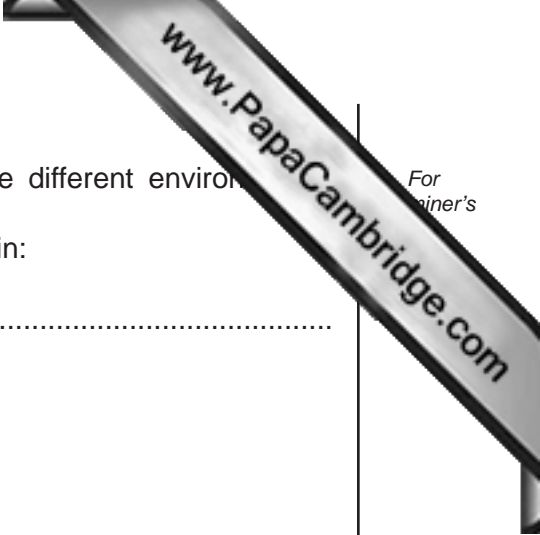
..... [1]

- (ii) Explain the purpose of the component A.

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

- (iii) Explain the purpose of the component B.

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



**(b) (i)** The circuit shown in Fig. 6 could be adapted to sense different environmental changes by using different sensors.

Name and sketch the sensors needed to sense changes in:

temperature .....

moisture .....

[6]

**(ii)** A membrane switch could be used with the circuit to sense a person stepping into a doorway.

Use sketches and labels to explain how a membrane switch is constructed.

[4]

**(iii)** When the light source is removed, the circuit will stop working.

Name and sketch the circuit symbol for a component that would latch the circuit on once triggered by the light source.

[3]



- (c) The circuit shown in Fig. 6 could be modified to make it more sensitive to smaller changes in light. Use sketches and notes to show how the circuit could be modified to make it more sensitive.

[2]

- (d) The circuit could be triggered by either a membrane switch or a light operated switch.

- (i) Use sketches and notes to show how two switches could be used to model a logic OR circuit.

[3]

- (ii) Complete the truth table for this logic function.

Input A	Input B	Output

[3]

12 Fig. 7 shows a hand drill.

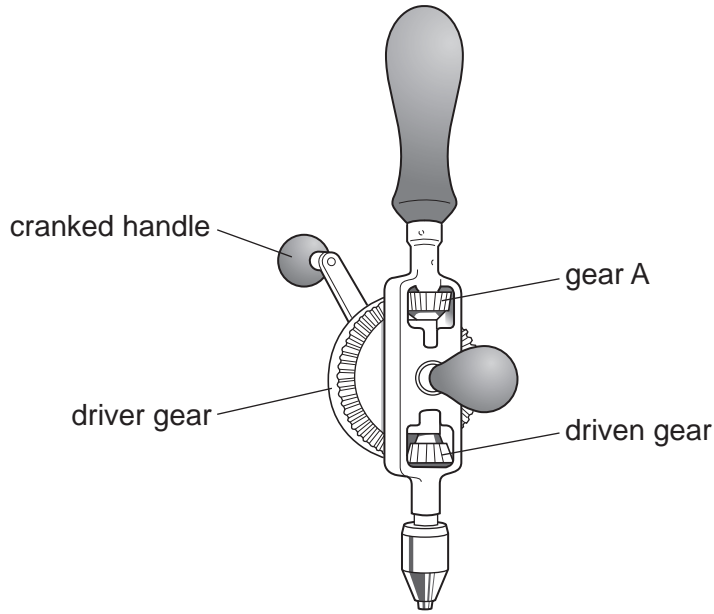


Fig. 7

(a) Explain the motion conversion that takes place when using a hand drill.

.....

.....

.....

..... [3]

(b) (i) Name the type of gear mechanism used in the hand drill.

..... [1]

(ii) Explain the purpose of gear A wheel in this mechanism.

.....

.....

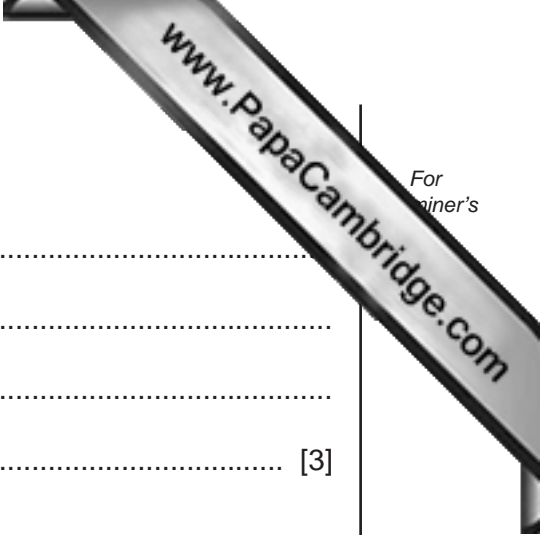
..... [2]

(iii) Explain why the driver gear is very much larger than the driven gear.

.....

.....

..... [2]



(c) Explain why the handle is cranked.

.....

.....

.....

..... [3]

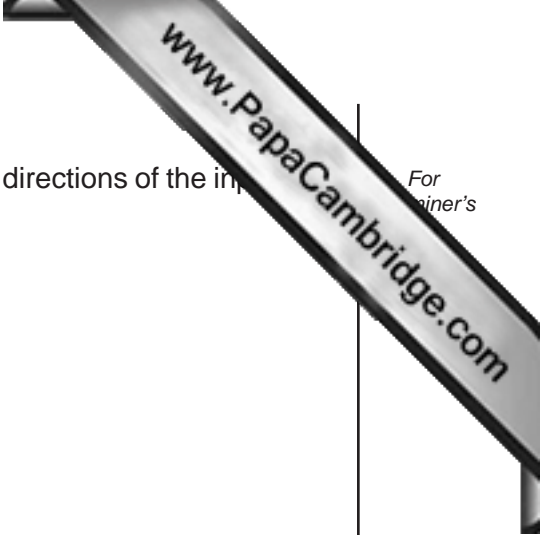
(d) The driver gear has 60 teeth and the driven gear has 12 teeth.

(i) Calculate the gear ratio for this mechanism.

[3]

(ii) If the driver gear is turned at 60 r.p.m., calculate the speed of the driven gear.

[3]



(e) (i) Sketch a worm gear system. Label the parts and show the directions of the input and output motion.

[5]

(ii) Explain how a worm gear system obtains a large reduction in speed.

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

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

..... [1]

13 Fig. 8 shows a design for a desk lamp.

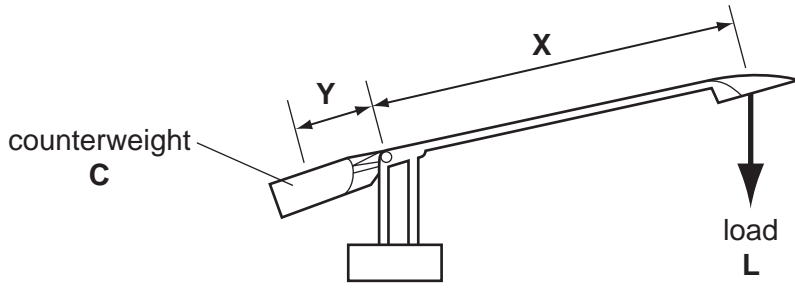


Fig. 8

(a) Show how the value of the counterweight would be calculated.

.....

.....

.....

.....

..... [3]

(b) Fig. 9 shows a design sketch of a hanging storage unit.

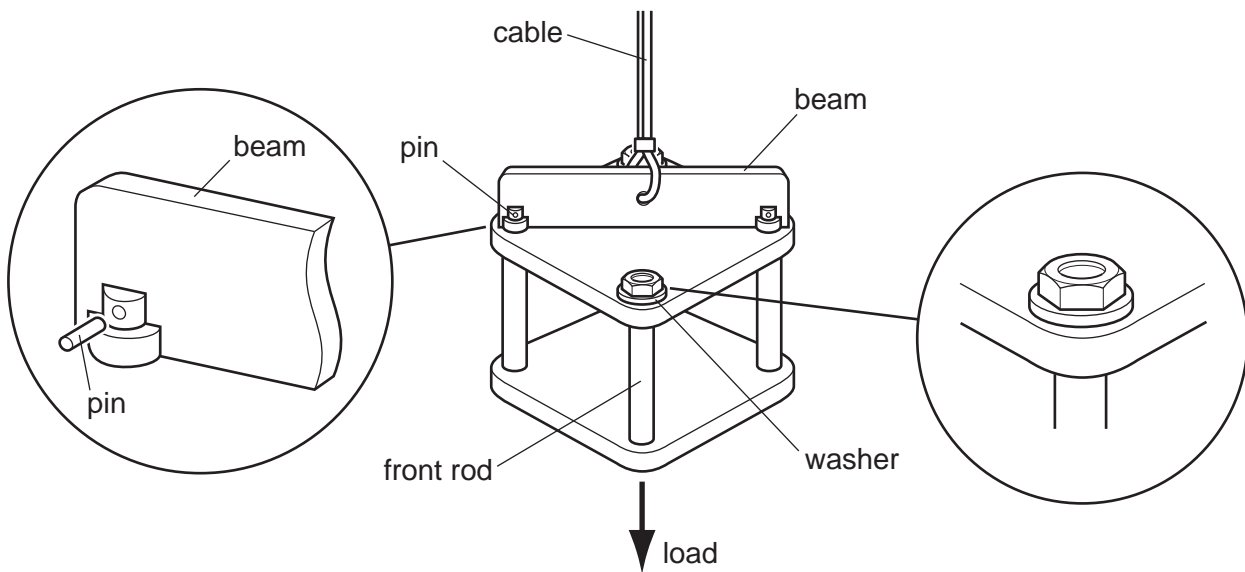


Fig. 9

(i) Name the type of force acting on the cable.

..... [1]



(c) A washer is used between the nut and the shelf.  
Explain why this is beneficial to the structure.

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

(d) It is found that the rods, being made from solid metal bars, make the weight of the unit too heavy.  
Use sketches and notes to show how this problem could be overcome.

[4]

(e) (i) The selection of material sections in structures is very important.  
Sketch and label an 'I' section beam and explain why the beam is shaped in this way.

[3]

(ii) Give **one** example of the use of an 'I' section beam.

..... [1]

