UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER

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	
Total	

This document consists of **15** printed pages and **1** blank page.

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

Section A

Answer **all** questions in this section.

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

reinforcement

Fig. 1

.... [1]
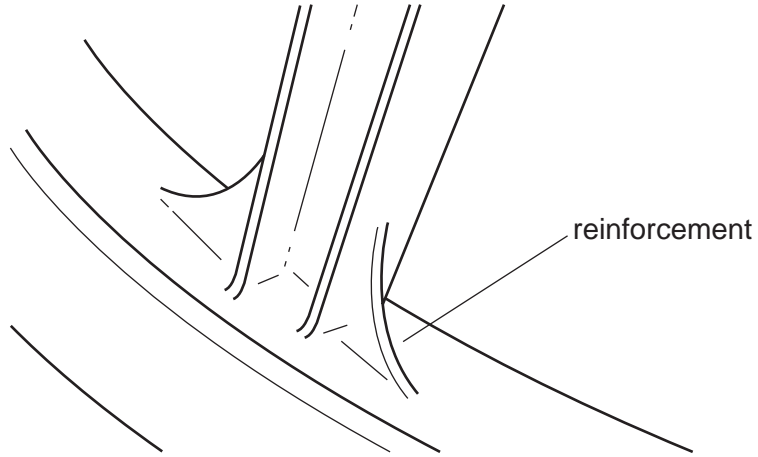
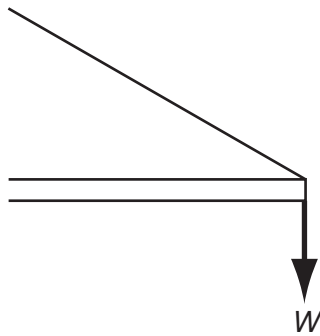2   Fig. 2 shows a structure. Label a strut and a tie on Fig. 2.

W

Fig. 2

[2]

3 Use sketches and notes to show how tensile and compressive forces are distributed on 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.
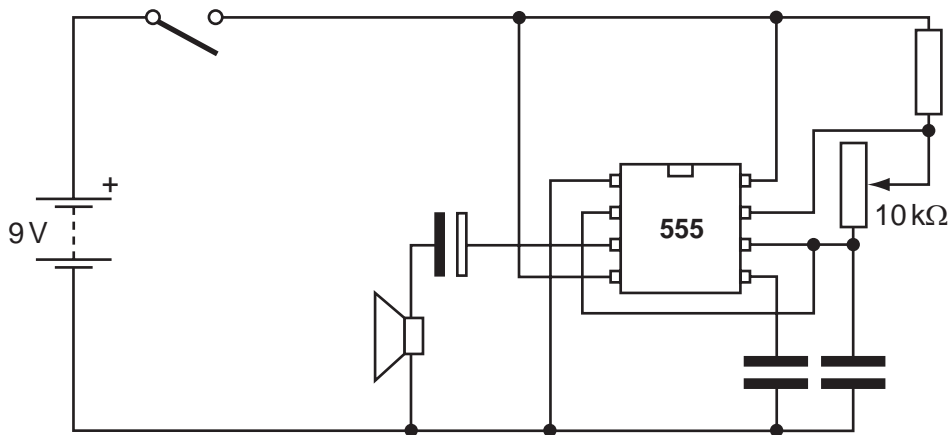
Fig. 3

(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.
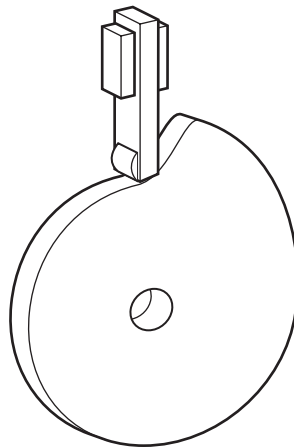
Fig. 4

(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.

pivot **A**

pivot **B**

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 of time delay circuits.
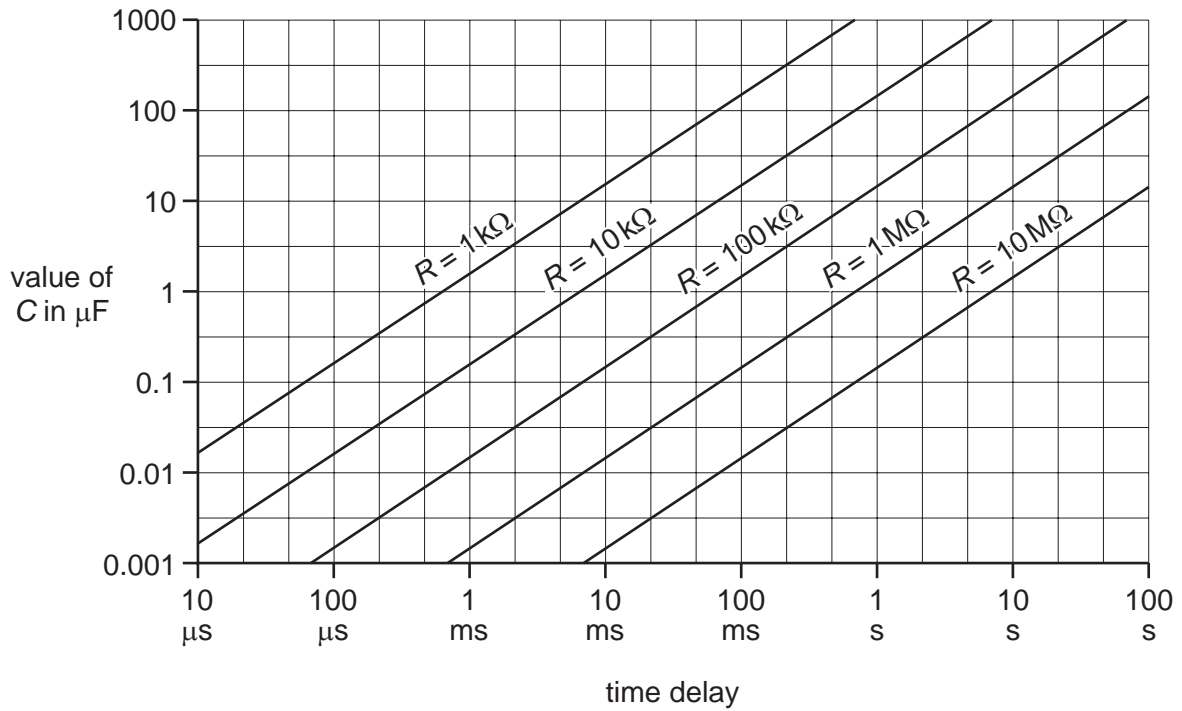
Select a suitable value of *C* and *R* to give a time interval of 10 seconds.

C .... [1]

R .... [1]

Section B

Answer **one** question from this section.

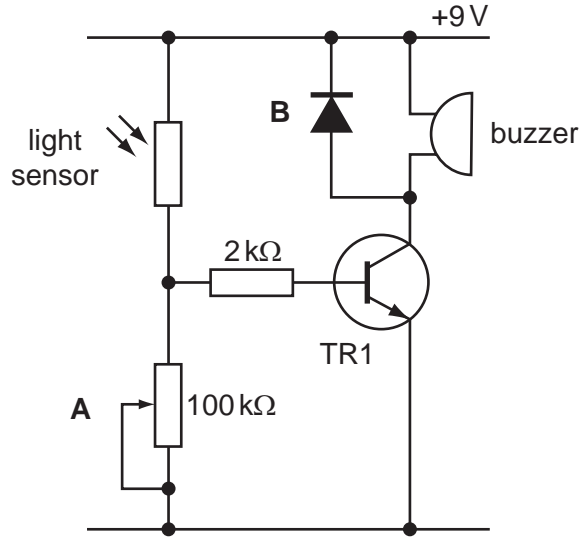**11** Fig. 6 shows a circuit for a light-operated switch that will set off a buzzer when light falls on the sensor.

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]

[Turn over

(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.

cranked handle

gear A

driver gear

driven gear
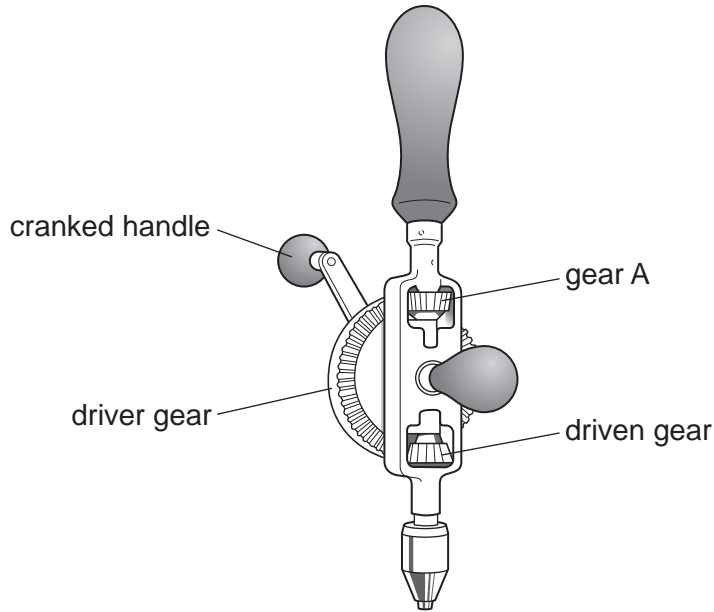
Fig. 7

(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.
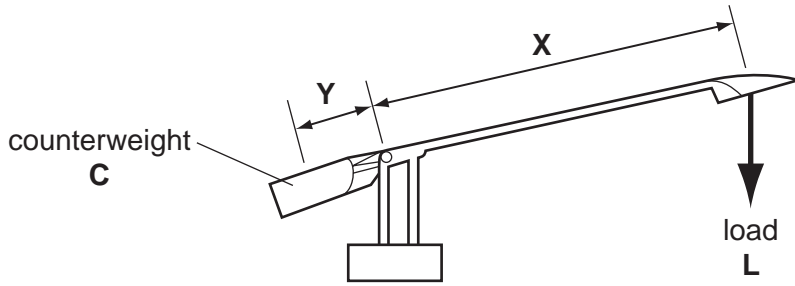
Fig. 8

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

....

....

....

....

.... [3]

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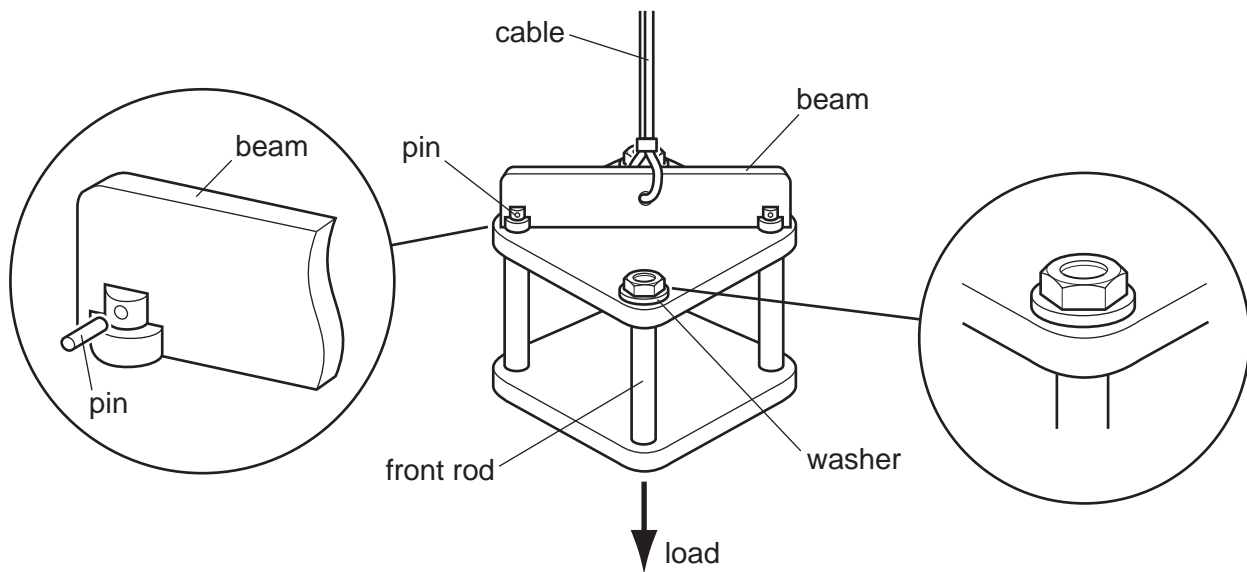
Fig. 9

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

.... [1]

(ii) The front and rear rods are secured by nuts screwed onto their tops and bottoms.
Name the type of force that the rods experience when the nuts are being tightened.

.... [1]

(iii) When the unit is loaded, the storage unit is found to be unstable.
Use sketches and notes to show how the beam could be modified to make the
storage unit more stable.

[3]

(iv) Explain why the hole for the cable must be drilled in the centre of the beam.

....

....

....

.... [3]

(v) When loaded, the cable is said to behave elastically.
Explain what this means in structural terms.

....

....

....

.... [3]

(vi) Name the type of force experienced by the pin when the unit is loaded.

.... [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]

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