UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6856101169

DESIGN AND TECHNOLOGY **0445/04**

Paper 4 Systems and Control **October/November 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	
Total	

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

Section A

Answer **all** questions in this section.

1 **(a)** Complete the statement below.

A thermistor senses changes in ..... [1]

(b) Give **one** example of a use for a thermistor.

..... [1]

2 Name **three** types of motion.

1 .....

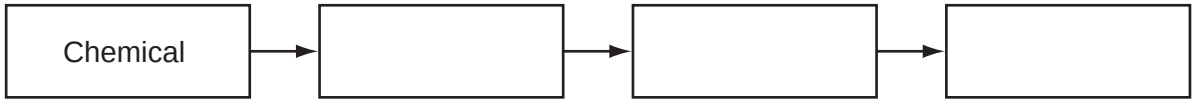
2 .....

3 ..... [3]

3 Sketch and label **one** example of a third-order lever.

[3]

4 Complete the block diagram below to show the energy conversions that take place when a battery-powered torch is used.



[3]

5 A rack and pinion is a type of gear system.

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

..... [1]

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

.....

.....

..... [3]

6 **(a)** Give **one** example of the use of a reed switch.

..... [1]

(b) Sketch and label a reed switch.

[3]

7 Explain the term 'bread-boarding' in electronics.

.....

.....

..... [2]

8 Complete the statement below.

A moment of force is defined as Force × ..... [1]

9 **(a)** Name the type of force that twists a member.

.....

(b) Give **one** example of where a twisting force can be found.

..... [1]

10 Complete the statement below.

Flat, toothed, round and vee are all types of ..... [1]

Section B

Answer **one** question from this section.

11 Fig. 1 shows a design for an automated pumping device.

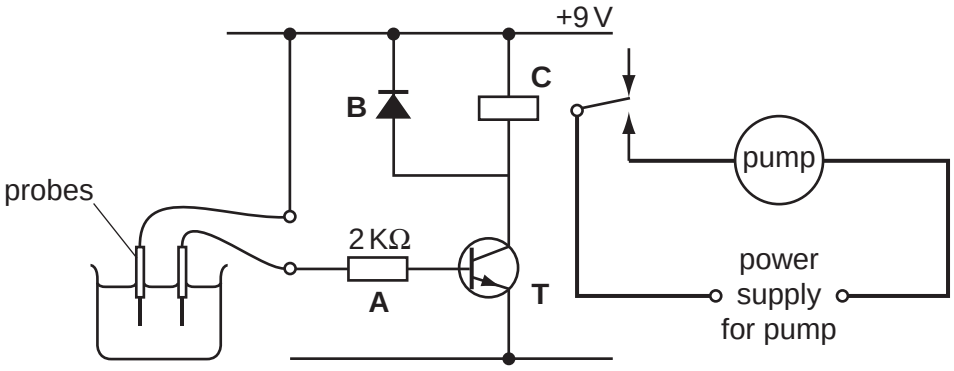


Fig. 1

(a) Describe how this circuit works when water reaches the probes.

.....

.....

.....

.....

.....

..... [3]

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

.....

.....

..... [3]

(c) Explain the purpose of component **B**.

.....

.....

..... [2]

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

.....

.....

..... [3]

(e) The circuit is found to be lacking in sensitivity.

Explain how the circuit could be made more sensitive.

.....

.....

..... [2]

(f) Fig. 2 shows a potential divider used to control a transistor.

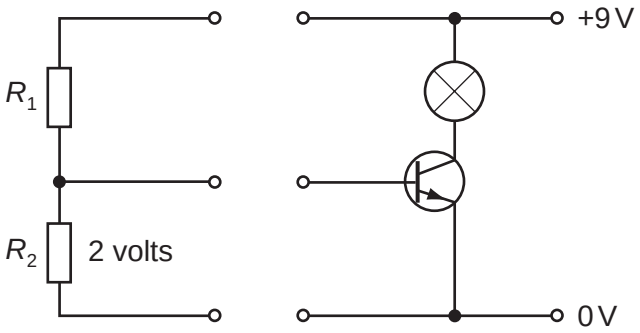


Fig. 2

Given that the voltage across R_2 needs to be 2 V for the transistor to work, and that the current flowing is 1 mA, calculate the value of R_1.

[3]

(g) (i) State how the value is shown on a resistor.

.....

(ii) Resistors have a tolerance value.

Explain what is meant by tolerance value.

.....

.....

..... [2]

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

A NOT gate is used with an LDR to control a security light that comes on when daylight falls below a set level.

(i) Complete the truth table for a NOT gate.

Input	Output

[3]

(ii) Draw the circuit symbol for a NOT gate.

[3]

12 The camera tripod shown in Fig. 3 uses a number of mechanisms.

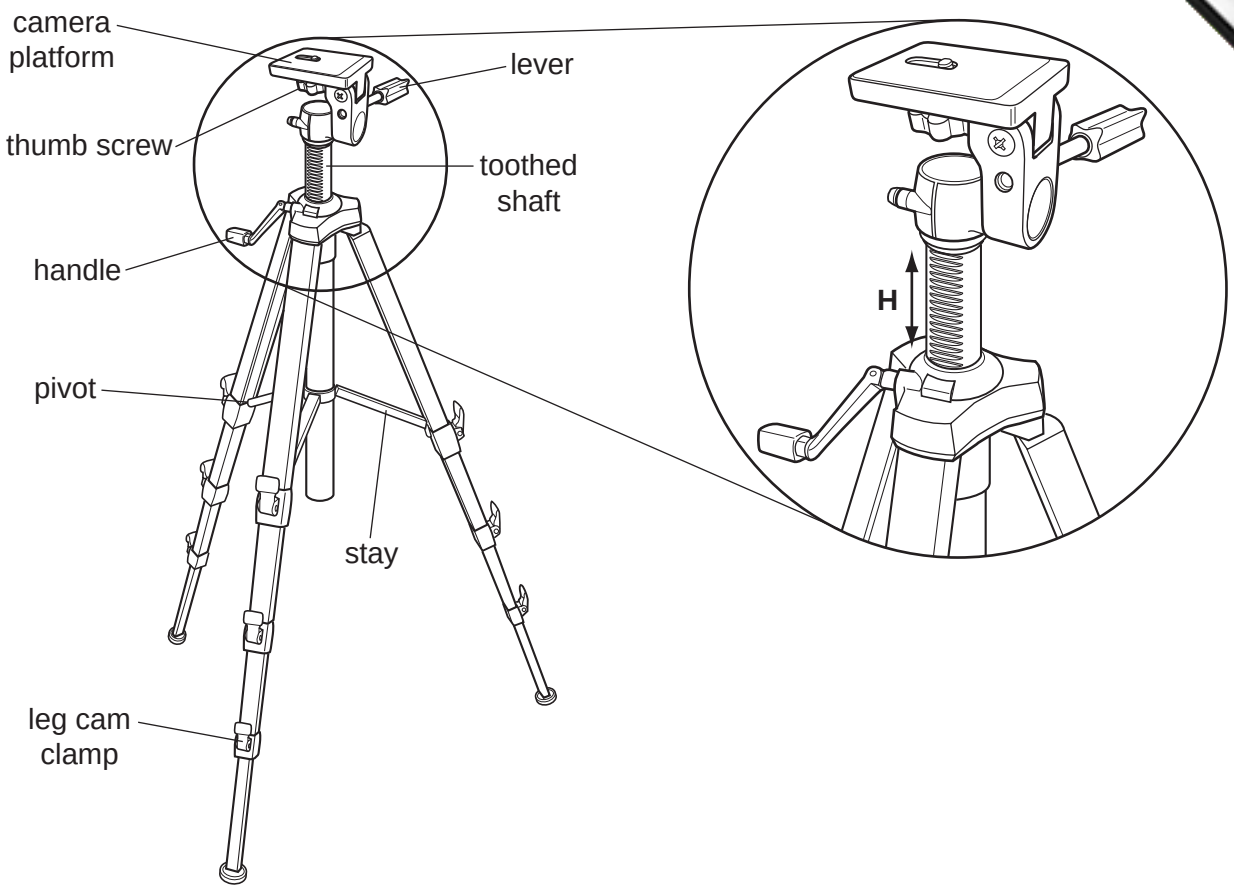


Fig. 3

(a) Explain the shape of the handle in terms of mechanical advantage (MA).

.....

.....

..... [2]

(b) The leg clamp uses an eccentric cam.

Use sketches and notes to show how an eccentric cam is used as a clamping device.

[3]

(c) Explain the purpose of the stay.

.....

.....

..... [2]

(d) The thumb screw is used to secure the camera in position.

Describe the motion conversions that take place when the thumb screw is used.

.....

.....

..... [2]

(e) Use sketches and notes to show how turning the handle adjusts the height **H**.

[3]

(f) The pivot is subjected to shear force.

Use sketches and notes to show what is meant by shear force.

[2]

(g) (i) Explain how the lever makes it easier for the camera to be positioned.

.....

.....

..... [2]

(ii) Fig. 4 shows a lever system.

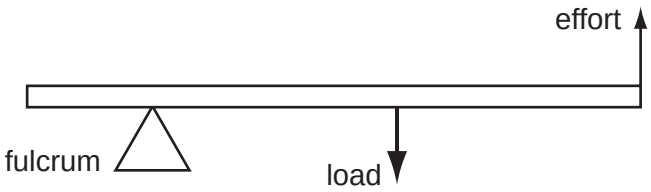


Fig. 4

Identify the order of lever shown in Fig. 4.

..... [1]

(iii) Use sketches and notes to show how a lever can be used to magnify a small movement.

[3]

(h) (i) Describe **one** example of a construction kit used in the modelling of a mec system.

.....

.....

..... [2]

(ii) Give **one** other way of modelling a mechanical system.

..... [1]

(iii) Explain the purpose of modelling a mechanical system prior to making it from resistant materials.

.....

.....

..... [2]

13 Fig. 5 shows a simple experiment into loading of a beam.

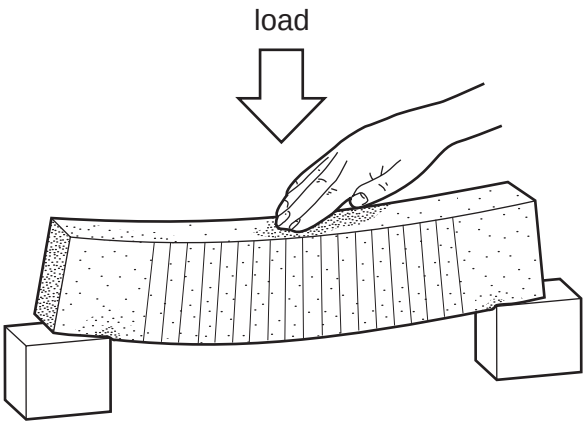


Fig. 5

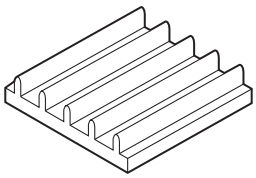
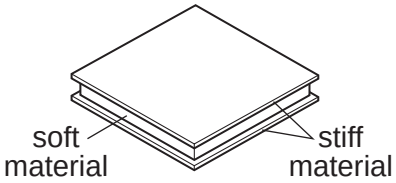
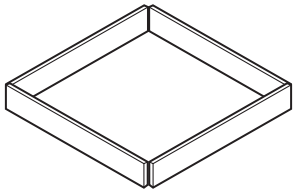
(a) Add labels to Fig. 5 to show the areas of tension and compression on the beam. [2]

(b) If the load on the beam is 100 N and the distance between the supports is 300 mm, determine the reactions at each support.

[2]

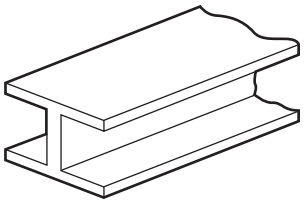
(c) Structural materials are reinforced to improve their capability to carry loads.

Complete the table below to show various reinforcement methods and their uses.

Name	Diagram	Use
Ribs		[1]
[1]		Display board
Triangulation	[1]	[1]
Folding		[1]

(d) The cross-sectional shape of materials is an important feature of structural design.

Look at the diagram below and explain why the beam is shaped in this way.



.....

.....

..... [3]

(e) Fig. 6 shows a graph of stress against strain for mild steel.

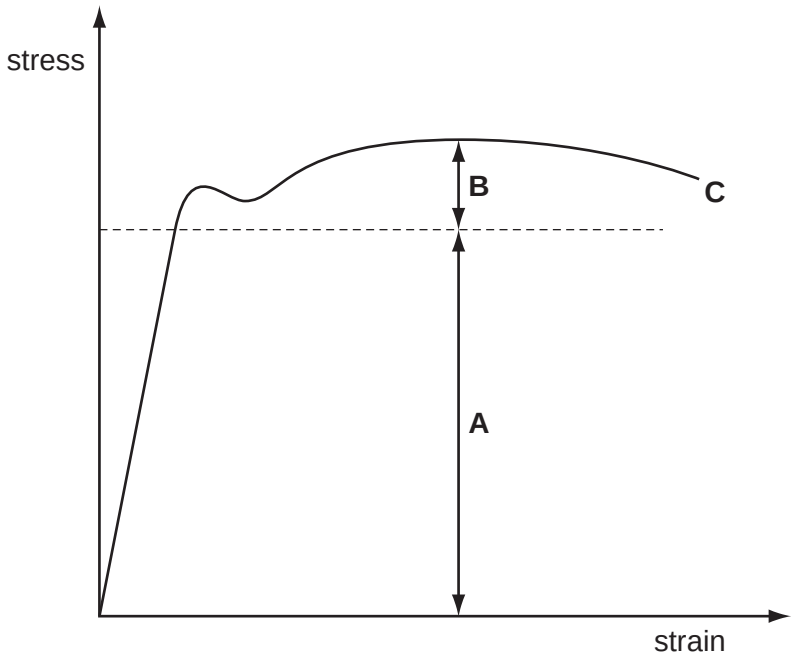


Fig. 6

(i) Explain how the material behaves in region **A**.

.....

.....

..... [2]

(ii) Explain how the material behaves in region **B**.

.....

.....

..... [2]

(iii) State what happens to the material at point **C**.

..... [1]

(f) Fig. 7 shows a test sample.

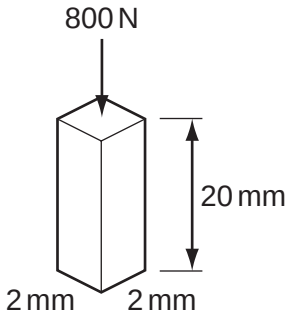


Fig. 7

(i) Calculate the stress on this sample.

[3]

(ii) Explain the effect on the stress if the sample was increased in area to 4 mm × 4 mm.

.....

..... [2]

(iii) If the sample was subjected to a compressive load and its length shortened by 0.04 mm, calculate the strain on the sample.

[3]

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