



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
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**DESIGN AND TECHNOLOGY**

**0445/41**

Paper 4 Systems and Control

**October/November 2010**

**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	
<b>Section A</b>	
<b>Section B</b>	
<b>Total</b>	

This document consists of an **14** printed pages and **2** blank pages.



**Section A**

*For  
Examiner's  
Use*

Answer **all** questions in this section.

**1** Name **four** types of motion.

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

**2** Sketch and label a lever and clearly show the:

- load;
- effort;
- fulcrum.

[4]

**3** Give **one** example of a device that uses a screw mechanism.

..... [1]

**4** Explain the difference between static and dynamic forces.

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

5 Give **one** example of a compressive force acting on a structure.

..... [1]

6 Fig. 1 shows a beam bending under load.

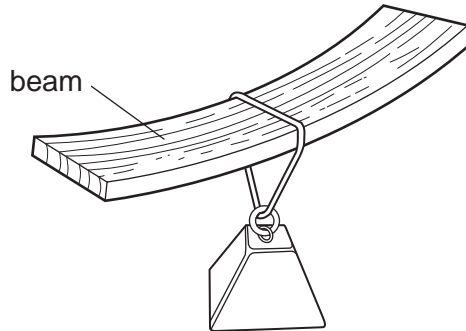


Fig. 1

Use notes and sketches to show how the beam could be made to support the same load with less bending.

[2]

7 Name **one** method of reinforcing a structure and give an example of its use.

Name ..... [1]

Example ..... [1]

8 Output devices that give off light include bulbs and LEDs.  
Give **two** benefits of using LEDs.

- 1 .....
- 2 ..... [2]

9 Fig. 2 shows a timer circuit.

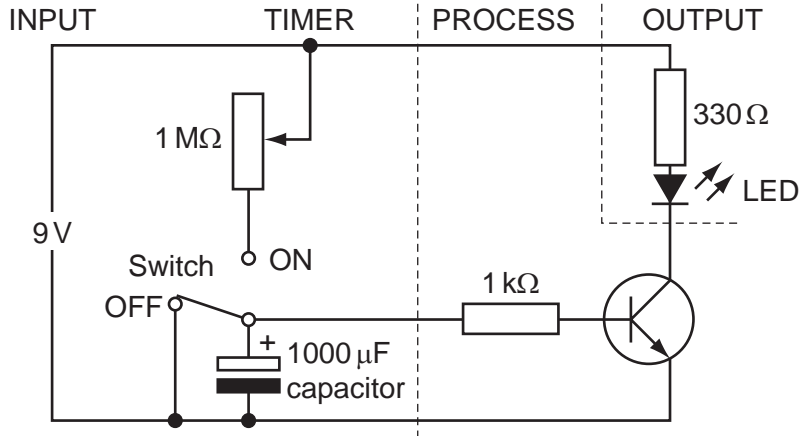


Fig. 2

(a) Explain how this circuit works.

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

(b) Explain the purpose of the variable resistor.

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

(c) Name the type of capacitor shown in Fig. 2.

- ..... [1]

Section B

Answer **one** question from this section.

10 Fig. 3 shows a circuit plan for a timer.

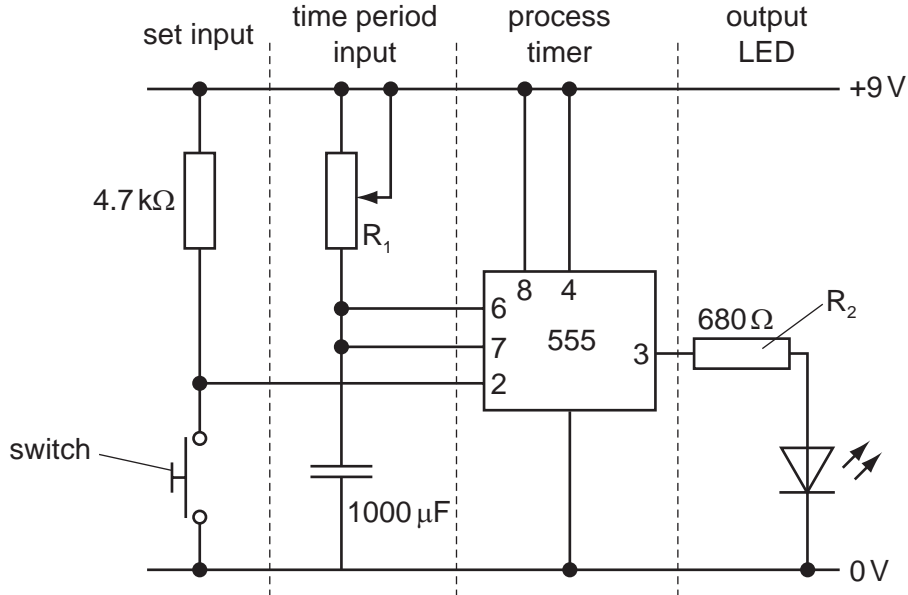


Fig. 3

(a) If the value of  $R_1$  is  $1\text{ k}\Omega$ , calculate the time period.

[3]

(b) (i) Identify the switch shown in Fig. 3.

..... [1]

(ii) Explain why this switch has been selected.

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

(c) Explain the purpose of  $R_2$ .

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

(d) A battery is used as a power supply for this circuit.

(i) Sketch and label the circuit symbol for a 9 V battery.

[3]

(ii) Give **three** reasons why a battery would be used to power the circuit.

1 .....

2 .....

3 ..... [3]

(iii) Use sketches and notes to show the energy conversions that take place when the LED is illuminated.

[3]

- (e) Sketch and label a graph showing the charging of a capacitor.

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Use*

[4]

- (f) Sketch and label a 3D drawing of an LED. Clearly show how the positive and negative connections are indicated.

[4]

11 Fig. 4 shows two linkages.

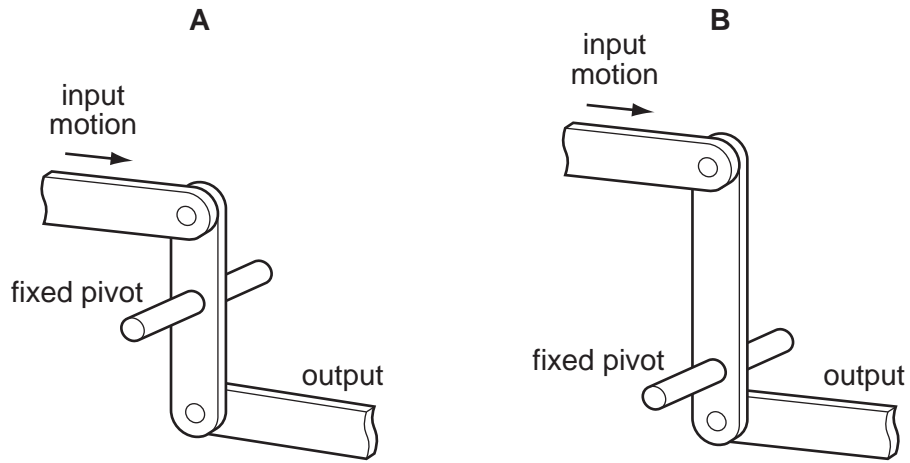


Fig. 4

(a) (i) Describe the output in terms of force and direction for linkage A.

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

(ii) Describe the output in terms of force and direction for linkage B.

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

(b) Fig. 5 shows a bell crank lever.

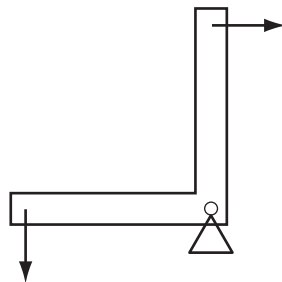


Fig. 5

(i) Explain the purpose of this type of lever.

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



(ii) Give **one** example of the use of a bell crank lever.

..... [1]

(c) Fig. 6 shows a weighing device.

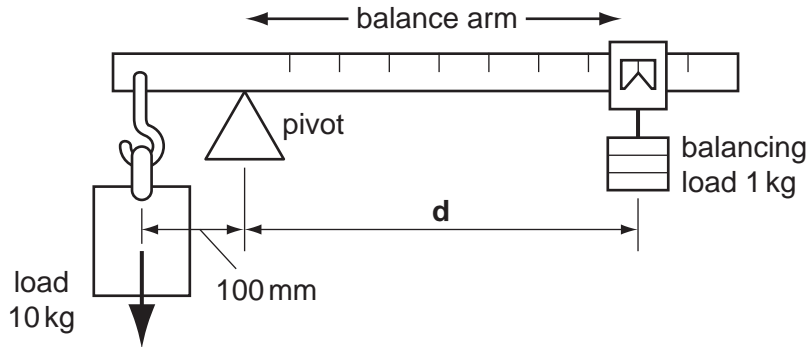


Fig. 6

Calculate the distance, **d**, that the balancing load must be from the pivot, to achieve equilibrium.

[3]

(d) The weighing device experiences moments of force.  
Explain what is meant by a 'moment of force'.

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

(e) Fig. 7 shows a pantograph linkage used to produce enlarged copies of drawings.

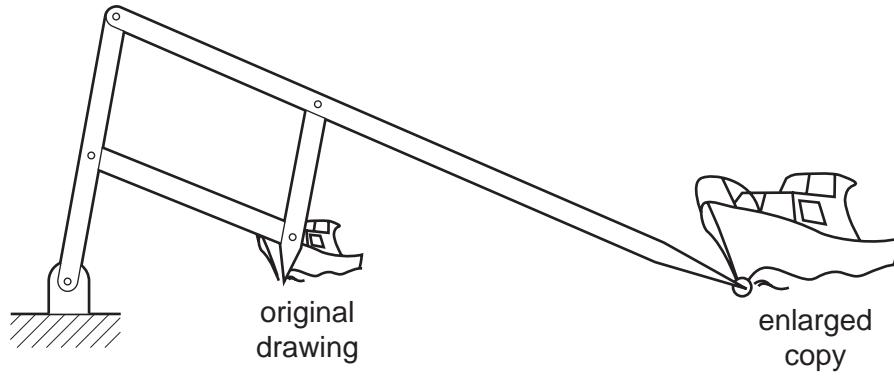


Fig. 7

Explain how the pantograph uses the principle of levers to enlarge the copy.

.....

.....

.....

..... [3]

(f) Fig. 8 shows a toggle clamp linkage.

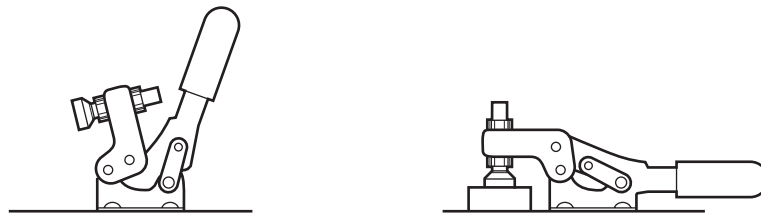


Fig. 8

(i) Give **one** example of the use of a toggle clamp.

..... [1]

(ii) Use notes and sketches to explain how the toggle clamp works.

[3]

(g) Fig. 9 shows a floor mop linkage.

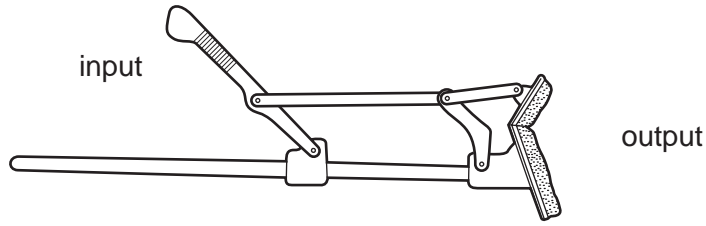


Fig. 9

(i) Add arrows to Fig. 9 to show the movement of the input and the output. [2]

(ii) Add labels to Fig. 9 to show **one** fixed pivot and **one** moving pivot. [2]

12 Fig. 10 shows a variety of structural components.

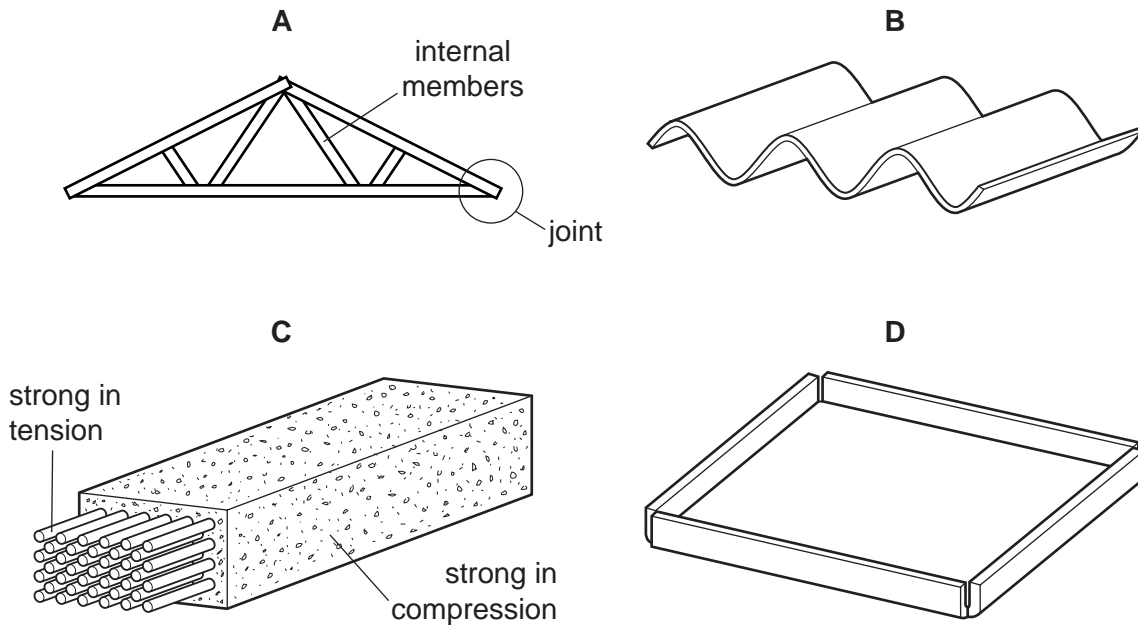


Fig. 10

(a) (i) Identify structure A.

..... [1]

(ii) Explain the purpose of the internal members of structure A.

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

(iii) Use sketches and notes to show how the joint shown in structure **A** can be reinforced.

[3]

(b) Explain why the corrugated sheet, **B**, is structurally better than a flat sheet.

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

(c) (i) Identify component **C**.

..... [1]

(ii) Give **one** example of its use.

..... [1]

(d) Structure **D** is to be made from 1.5 mm mild steel sheet.

(i) Name **one** permanent method for joining the corners.

..... [1]

(ii) Name **one** temporary method for joining the corners.

..... [1]

(e) Fig. 11 shows a diagram of a simply supported beam.

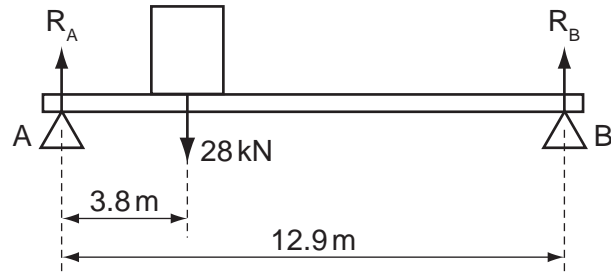


Fig. 11

Calculate the values of the reactions  $R_A$  and  $R_B$ .

[4]

(f) Fig. 12 shows a variety of different sections for beams.

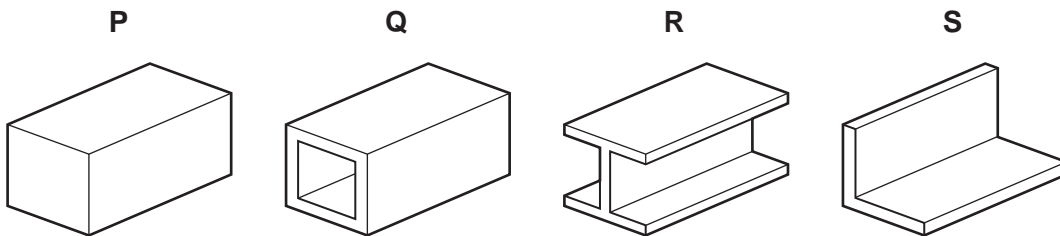


Fig. 12

(i) Explain why sections Q, R and S are preferred to section P.

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

(ii) Give one example of use for beam Q.

..... [1]

(iii) Explain why, in structural terms, beam R is shaped in this way.

.....

.....

.....

..... [3]

(g) The beams shown in Fig. 12 are to be made from mild steel.

Complete Fig. 13 to show a typical stress/strain graph for mild steel, labelling the:

- elastic region;
- plastic region;
- break point.

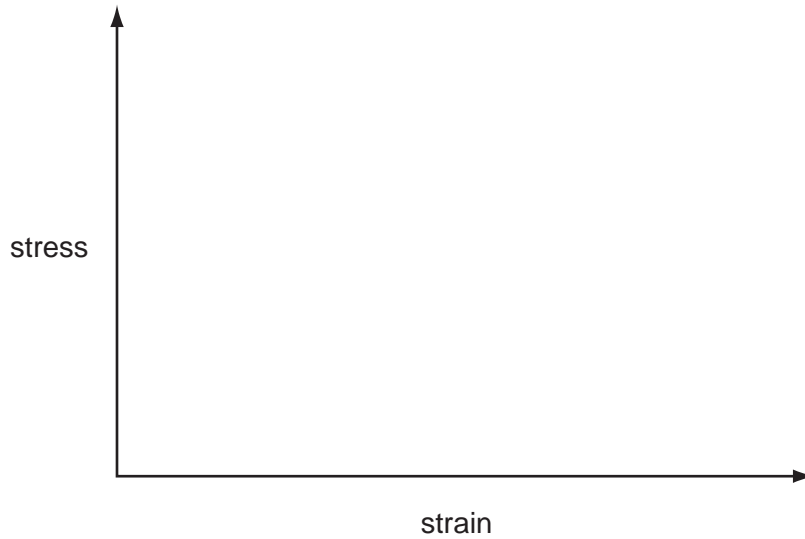


Fig. 13

[3]



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