CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

**DESIGN AND TECHNOLOGY** **0445/04**

Paper 4 Systems and Control **October/November 2007**

**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 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.

**Section A**

Answer **all** questions.

**Section B**

Answer **one** question.

You may use a calculator.

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

**[Turn over**

## Section A

Answer **all** questions in this section.

**1** Complete the statement below:

A tie is a structural member experiencing ............................................... force.  [1]
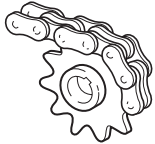
**2** Identify the electrical component shown below.



symbol
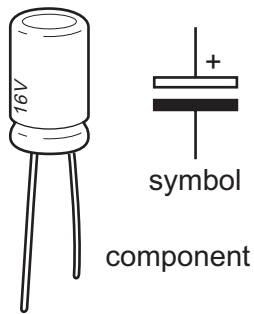
component

The component shown is ...........................................................................  [2]

Give one use of this component. ..............................................................  [1]

**3** Complete the table below.

| Name | Diagram | Use |
|---|---|---|
| Pear cam and flat follower | | Valve operation |
| |  | Bicycle transmission |

[3]

**4** Identify the class (order) of lever shown below:



effort          load          fulcrum
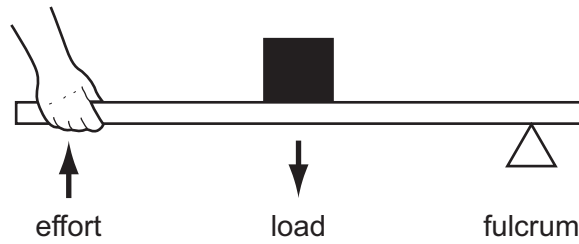
The lever shown is ............................................................................................................ [1]

Give an example of the use of this class of lever.

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

**5** The diagram below shows a linkage.

input motion



fixed pivot
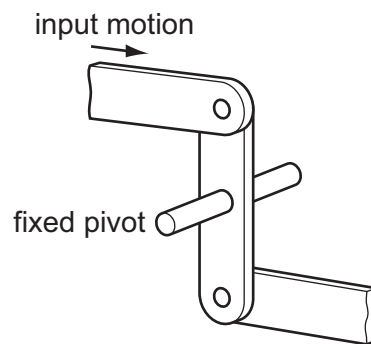
   **(a)** Add labels to show the direction of the output motion. [2]
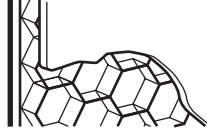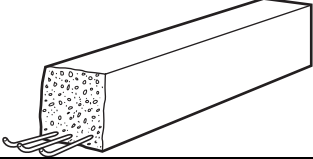
   **(b)** Name the type of motion shown in the diagram of the linkage above.

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

   **(c)** Explain the function of this linkage.

   .....................................................................................................................................

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

**6** Complete the table below.

| Name | Diagram | Use |
|---|---|---|
| Honeycomb cells | | [1] |
| [1] | [1] | |
| 'I' Section beam | [2] | Steel framed buildings |

**7** Identify the logic gate shown in the diagram below.
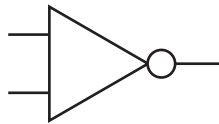
..................................................................................................... [1]

**8 (a)** State the purpose of an LDR transducer.

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

**(b)** Give **one** example of the use of an LDR.

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

**9** Give **one** example of the use of a strain gauge.

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

**10** Name **two** methods of reinforcing a square framed structure.

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

## Section B

Answer **one** question from this section.

**11** Fig.1 shows a hand drill.



cranked handle

driver gear

driven gears

drill chuck
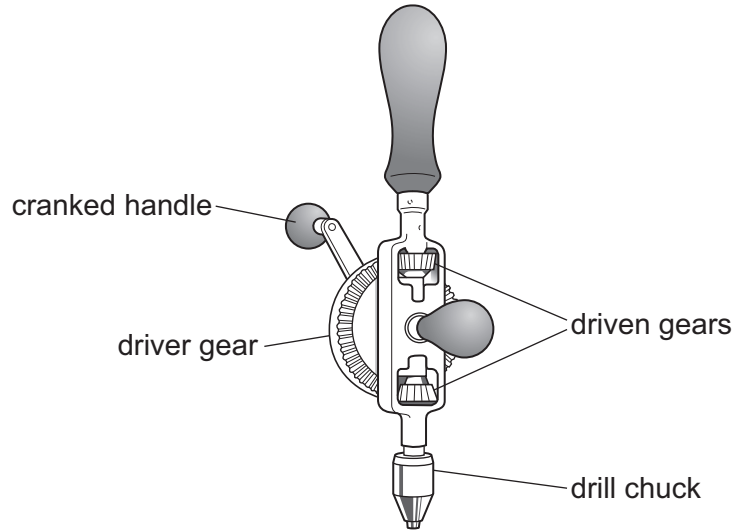
**Fig. 1**

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

[2]

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

[1]

**(ii)** Explain why the driver gear wheel is very much larger than the driven gear wheels.

[2]

(iii) Give **one** reason for the top driven gear wheel nearest the handle.

......................................................................................................................................

......................................................................................................................................

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

(c) Explain why the handle is cranked.

......................................................................................................................................

......................................................................................................................................

......................................................................................................................................

......................................................................................................................................

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

(d) The driver wheel has 60 teeth and the driven wheels have 12 teeth each.

(i) Calculate the gear ratio for this mechanism.

[3]

(ii) If the driver wheel is turned at 60 rpm, calculate the speed of the drill chuck.

[3]

**(e)** Fig. 2 shows a toothed belt drive arrangement.



pulley B

pulley A

drive belt
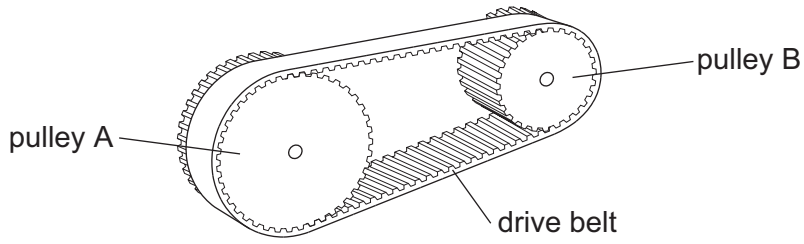
**Fig. 2**

(i) Give **one** benefit of using this type of belt drive.

.................................................................................................................................

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

(ii) Explain **one** drawback of using this type of belt drive.

.................................................................................................................................

.................................................................................................................................

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

(iii) Give **one** example of the use of this type of belt drive.

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

(iv) Explain how you would calculate the Velocity Ratio of this belt drive.

.................................................................................................................................

.................................................................................................................................

.................................................................................................................................

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

**(f)** Give **one** other type of pulley drive belt and give **one** use.

.................................................................................................................................

.................................................................................................................................

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

**12** Fig.3 shows a variety of both natural and man made structures.



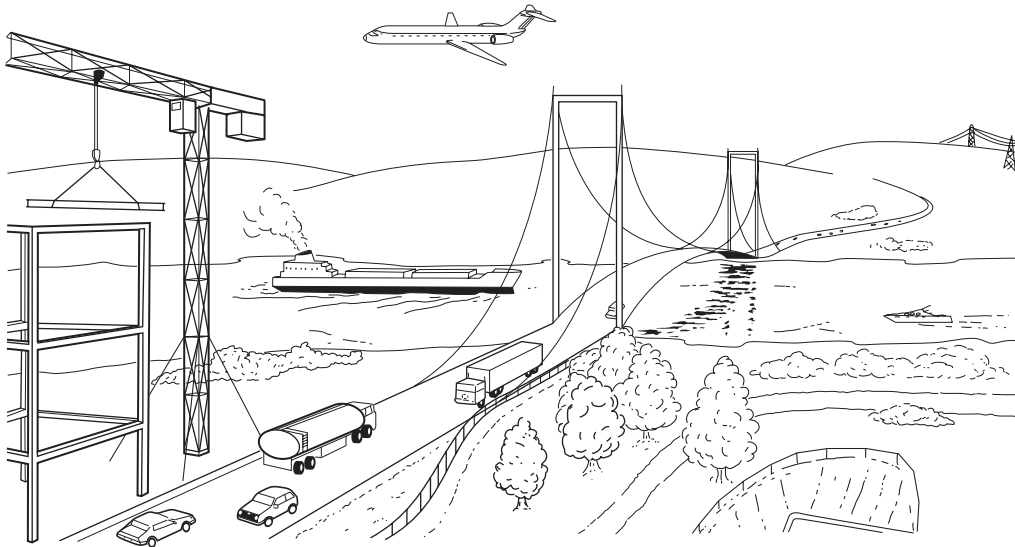**Fig. 3**

**(a) (i)** Name **one** frame structure in Fig.3.

[1]

**(ii)** Name **one** man made shell structure in Fig.3.

[1]

**(b)** Explain the difference in the way in which frame and shell structures work.

[2]

**(c)** Explain the following functions of a structure.

Support: ........................................................................................................................

..............................................................................................................................................

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

Span: ...........................................................................................................................

..............................................................................................................................................

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

Contain: ......................................................................................................................

..............................................................................................................................................

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

**(d)** Structures can be subjected to static and dynamic forces.

Explain, using examples, the difference between static and dynamic forces.

..............................................................................................................................................

..............................................................................................................................................

..............................................................................................................................................

..............................................................................................................................................

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

**(e)** Fig. 4 shows a structure for a roof truss.
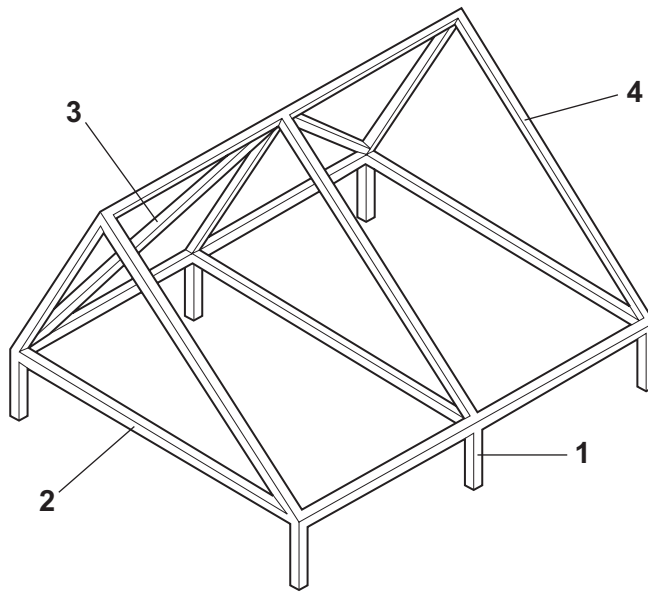


**Fig. 4**

(i) Name the parts numbered **1** to **3**.

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

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

3 ........................................................................................................................... [1]

(ii) Part **4** is a strut.

Use sketches and notes to explain the type of load experienced by a strut.

[2]

   **(iii)** Use sketches and notes to explain why the roof truss is made up of triangles.

[2]

   **(iv)** Draw **one** method of reinforcing the joints in the roof truss.

[2]

**(f)** Use notes and sketches to explain the term redundant member.

[3]

       **[Turn over**

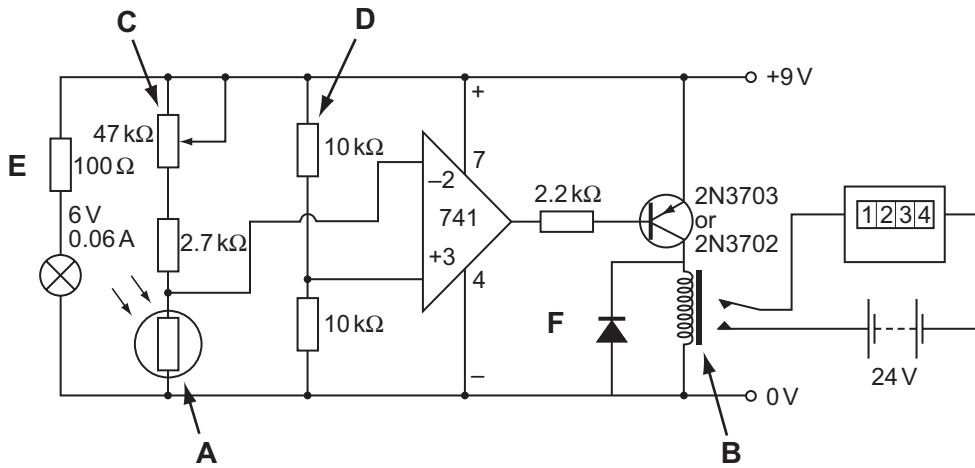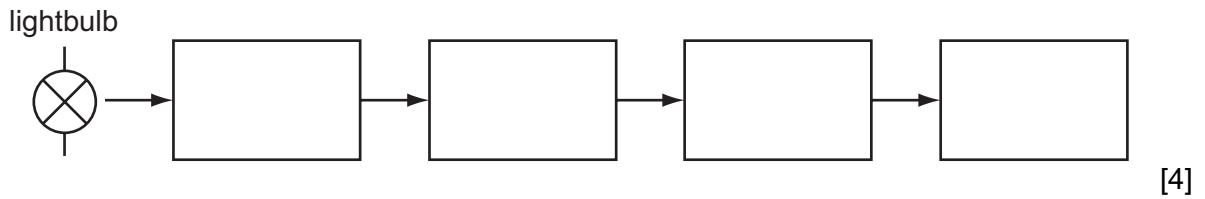**13** Fig. 5 shows a counting circuit triggered by a photoswitch.



**Fig. 5**

**(a)** Complete the block diagram to explain how this counting circuit works each time the light beam, shining on component **A**, is broken.



[4]

**(b) (i)** Name component **B**.

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

**(ii)** Explain the purpose of component **B** in this circuit.

............................................................................................................................................

............................................................................................................................................

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

**(iii)** Explain the need for component **F**.

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

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

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

..............................................................................................................................

..............................................................................................................................

..............................................................................................................................

..............................................................................................................................

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

**(v)** State the purpose of the resistor **E**.

..............................................................................................................................

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

**(c)** The pair of 10 kΩ resistors labelled **D** are known as a potential divider.

Explain the term potential divider.

..............................................................................................................................

..............................................................................................................................

..............................................................................................................................

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

**(d)** Explain how the circuit shown in Fig. 5 could be simply modified to count when the light beam is shining on component **A**.

..............................................................................................................................

..............................................................................................................................

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

**(e)** Logic gates could be used to control a counter. Fig. 6 shows a pressure pad circuit that is used to trigger a counter when a person steps on pad **P** and, at the same time, presses the push button **Q**.
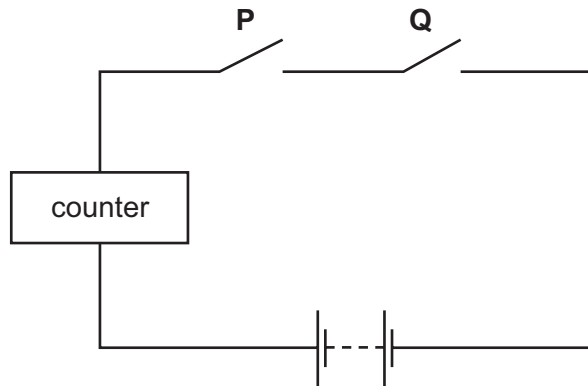


**Fig. 6**

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

| Pad P   On/Off | Pad Q   On/Off | Counter state   On/Off |
|---|---|---|
| Off | Off | Off |
| Off | On | |
| On | Off | |
| | | On |

[4]

    **(ii)** Identify the type of logic circuit shown.

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

**BLANK PAGE**

**BLANK PAGE**