



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
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**DESIGN AND TECHNOLOGY**

**0445/42**

Paper 4 Systems and Control

**May/June 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 |  |
|--------------------|--|
| Section A          |  |
| Section B          |  |
| <b>Total</b>       |  |

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



Section A

Answer **all** questions in this section.

1 Fig. 1 shows a black box diagram of a gearbox.

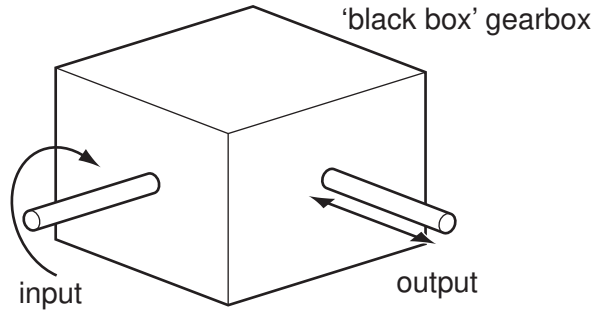


Fig. 1

Name the **two** types of motion indicated on Fig. 1.

..... [1]

..... [1]

2 Fig. 2 shows a diagram of a cam.

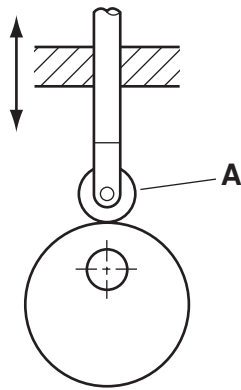


Fig. 2

(a) Name the type of cam shown in Fig. 2.

..... [1]

(b) Name the part labelled **A** in Fig. 2.

..... [1]

3 Complete the table below giving **one** example of the use of each gear.

| Method          | Example of use |
|-----------------|----------------|
| Spur gear       |                |
| Bevel gear      |                |
| Rack and pinion |                |

[3]

4 Mechanical systems often require lubrication.  
State **one** reason for needing lubrication in mechanical systems.

..... [1]

5 Fig. 3 shows a variety of structures.

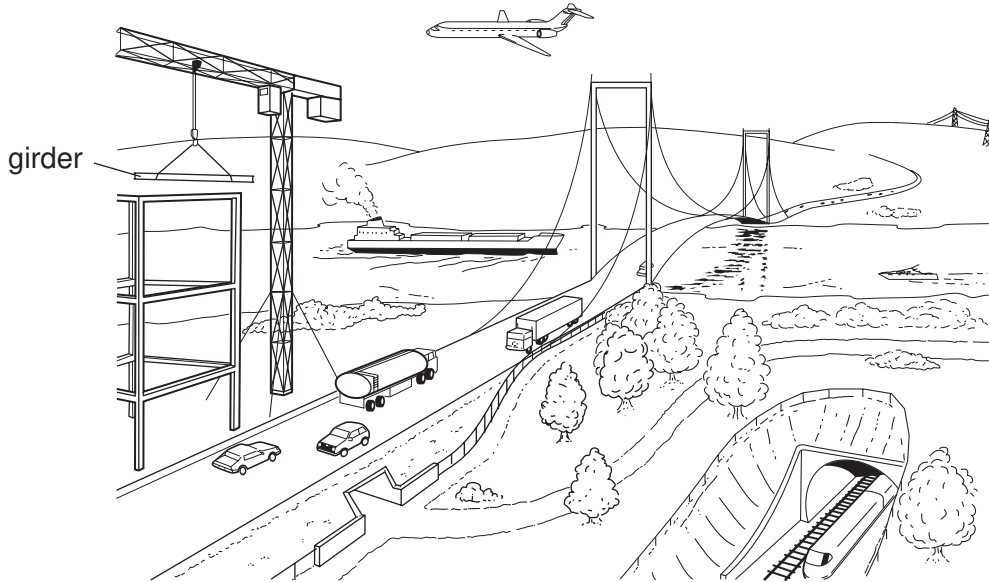


Fig. 3

(a) (i) Name **one** frame structure.

..... [1]

(ii) Name **one** shell structure.

..... [1]

(b) (i) Identify the type of force acting in the cables supporting the girder.

..... [1]

(ii) Structures are subjected to moments (turning forces).  
Define the term 'moment'.

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

6 Explain the need for triangulation in structures.

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

7 Name **one** way of accurately measuring deflection in structures.

..... [1]

8 When fault finding in electronic circuits a variety of meters is used. Complete the table below.

| Meter   | Units measured | Example of use                               |
|---------|----------------|--|
| Ammeter |                | Measure current flowing through a transistor |
|         | Volts          | Measure voltage across a potential divider   |
|         |                | Check the continuity of an electrical lead   |

[4]

9 Fig. 4 shows a simple alarm circuit.

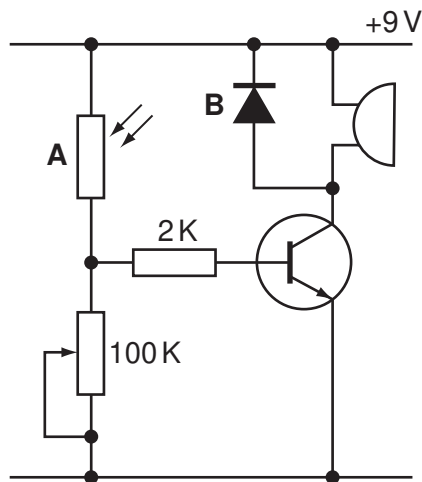


Fig. 4

(a) Name the component labelled **A**.

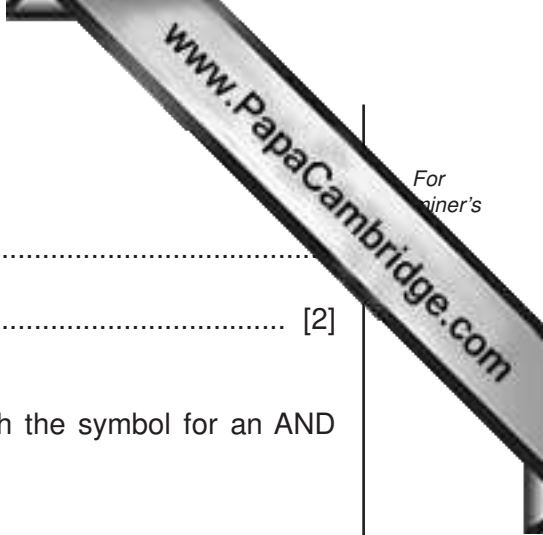
..... [1]

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

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

10 Logic gates are used to control many electronic devices. Sketch the symbol for an AND gate.

[2]



## Section B

Answer **one** question from this section.

- 11 (a) Complete Fig. 5 which shows a selection of switches.


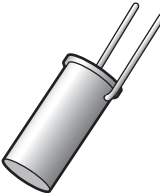
| Type           | Appearance  | Application   |
|----------------|---|---|
| [1]            |  | Non-contact operation by magnet for detecting the opening or closing of doors/windows |
| Tilt           |  | [2]   |
| Membrane panel | [3]   | Waterproof keypads  |

Fig. 5

- (b) A slide switch can be used to select different functions in a circuit. Draw and label a simple circuit diagram to show this operation.

(c) A transistor is used as a switch to control the flow of current in circuits.

(i) Explain how a transistor works as a switch.

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

(ii) Draw and label an npn transistor to show the:

- base;
- collector;
- emitter.

[4]

(d) Describe how you would solder a transistor into a circuit without damaging it.

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

(e) Logic gates are a form of switch. They are used to control electronic devices.  
Give **one** example of the use of logic gates to control an electronic device.

..... [1]

(f) Fig. 6 shows a diagram of a circuit used to model a logic gate.

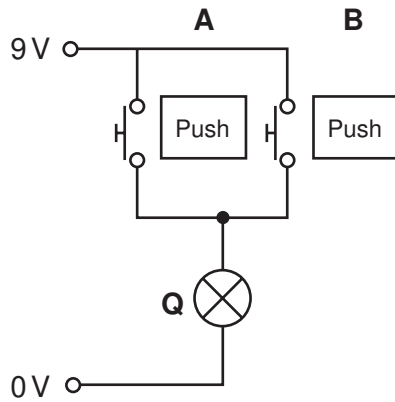


Fig. 6

(i) Name the type of gate that this circuit is modelling.

..... [1]

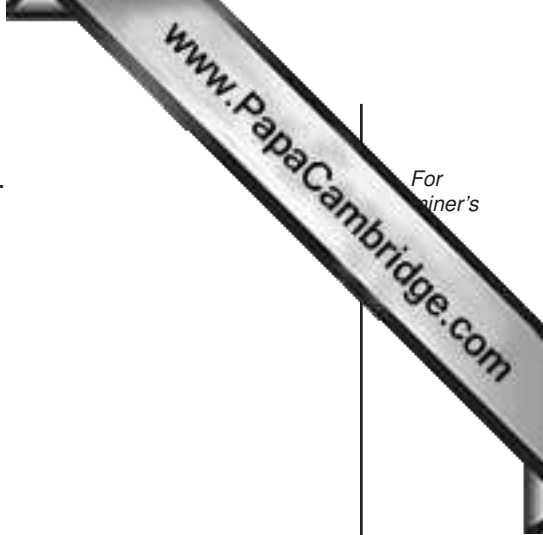
(ii) Complete the truth table for this gate.

| A | B | Q |
|---|---|---|
| 0 |   | 0 |
| 0 | 1 |   |
| 1 | 0 | 1 |
| 1 |   | 1 |

[3]

(iii) Sketch the logic symbol for the gate shown.

[2]





12 Fig. 7 shows a variety of pulley systems.

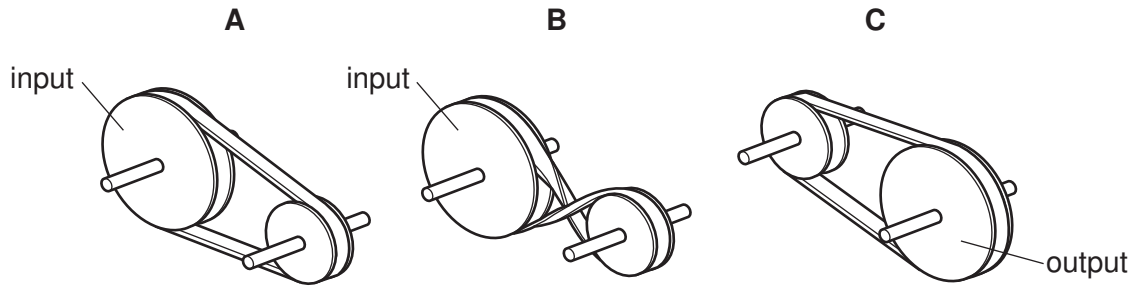


Fig. 7

(a) Complete the table below to describe the motion transmission for each pulley system shown in Fig. 7.

| Pulley system | Input     | Output direction | Output speed |
|---------------|-----------|------------------|--------------|
| <b>A</b>      | Clockwise |                  | Increased    |
| <b>B</b>      | Clockwise |                  |              |
| <b>C</b>      |           | Clockwise        |              |

[5]

(b) Fig. 8 shows a pulley system. Calculate the driven pulley speed.

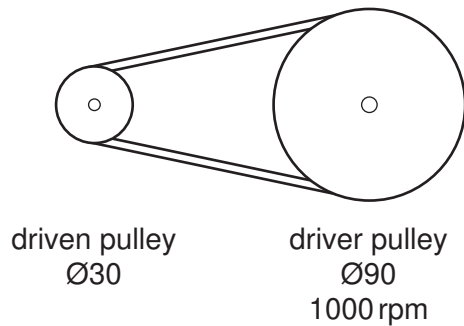


Fig. 8

[3]

(c) Fig. 9 shows a variety of pulley belts.

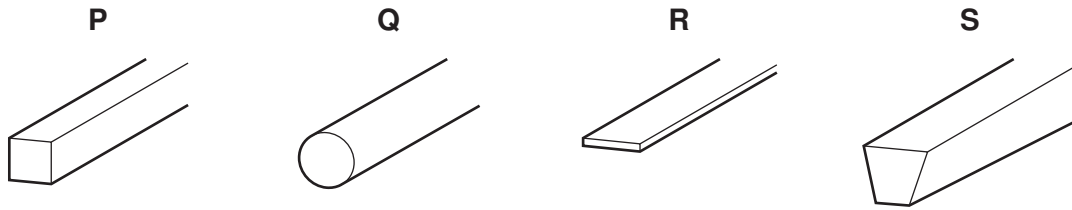


Fig. 9

(i) Belts **P**, **Q** and **R** are used in small pulley systems.  
Give **one** example of a system using one of these types of belt.

..... [1]

(ii) Explain why belt **S** would be used in larger machinery pulley systems.

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

(iii) Give **one** example of a machine that uses belt **S**.

..... [1]

(d) Fig. 10 shows a simple gear system.

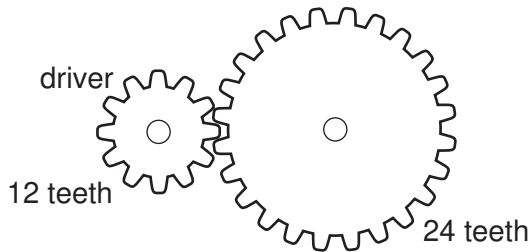


Fig. 10

(i) Calculate the Velocity Ratio for this system.

(ii) State the effect that the gear system shown in Fig. 10 has on output speed.

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

(iii) The driven gear will turn in the opposite direction to the driver gear.  
Explain, using notes and sketches, how the driven gear can be made to turn in the same direction as the driver gear.

[3]

(e) Some mechanical systems use a ratchet and pawl mechanism.

(i) Give **one** example of the use of a ratchet and pawl.

..... [1]

(ii) Explain the purpose of a ratchet and pawl mechanism.

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

(iii) Sketch and label a ratchet and pawl mechanism.

[3]

13 Fig. 11 shows a towel rail fixed to a wall.

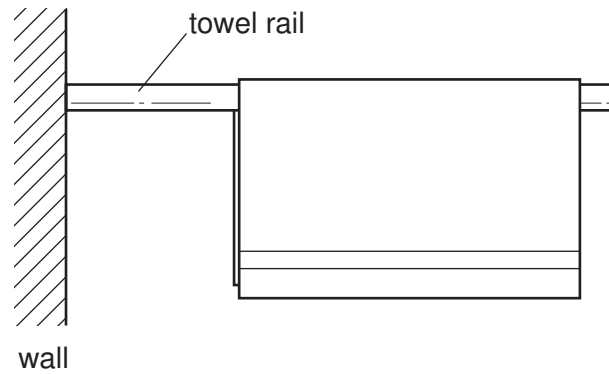


Fig. 11

(a) Name the type of structure shown.

..... [1]

(b) Redraw the towel rail and clearly label the:

- tension forces;
- compression forces;
- load.

[3]

(c) The towel rail is said to be in equilibrium.  
Use notes and sketches to explain the term 'equilibrium'.

[3]

- (d) The weight of the towel is 12 N acting 600 mm from the wall. Calculate the reaction at the wall.

[3]

- (e) The towel rail is made from stainless steel tubing. Explain in structural terms why tubing is the best choice for the towel rail.

.....

.....

..... [2]

- (f) Fig. 12 shows the wall mount for the towel rail.

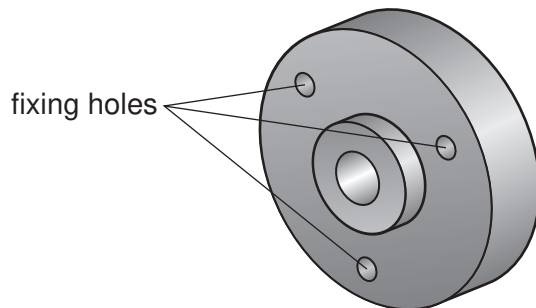


Fig. 12

- (i) Explain why there are three fixing holes on the mount.

.....

..... [2]

- (ii) Name the type of force applied by a screwdriver when fixing the mount to a wall.

..... [1]

- (iii) Explain what could happen to the screw if too much force is applied.

.....

.....

..... [2]

(g) Fig. 13 shows a metal stepladder.

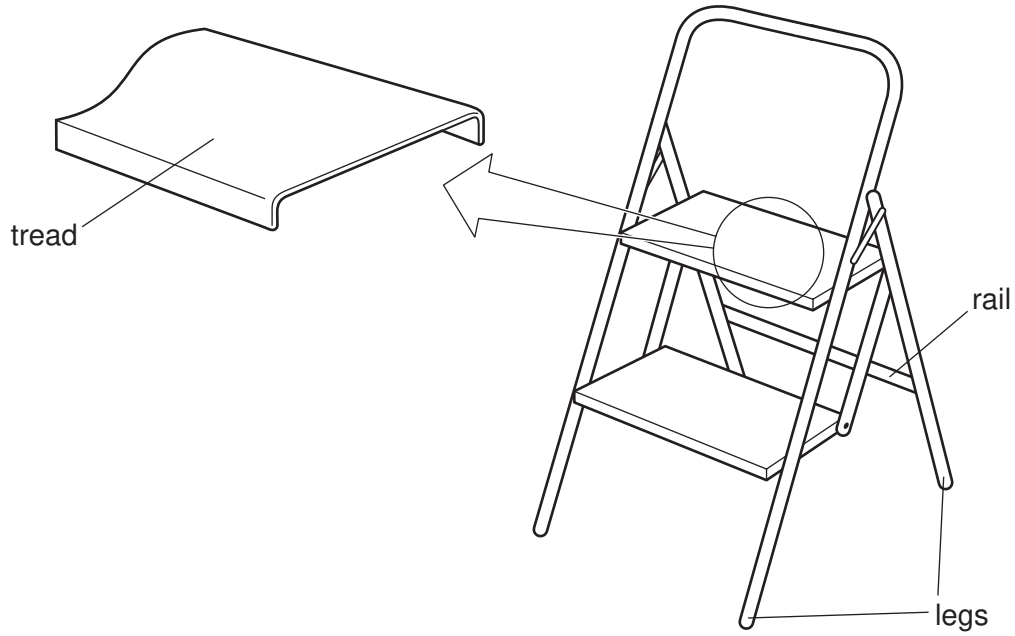


Fig. 13

(i) Explain why the legs of the stepladder form a triangular shape when opened.

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

(ii) Explain the purpose of the rail.

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

(iii) Explain why the tread has folded edges.

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

- (iv) Use notes and sketches to show the effect of loading on one of the step treads.

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[2]

