



Oxford Cambridge and RSA

**Tuesday 11 January 2022 – Morning**

**Level 1/2 Cambridge National in Principles in  
Engineering and Engineering Business**

**R101/01** Engineering principles

**Time allowed: 1 hour**



**You must have:**

- a scientific or graphical calculator
- a ruler (cm/mm)



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

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Last name

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**INSTRUCTIONS**

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.

**INFORMATION**

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [ ].
- Quality of written communication will be assessed in questions marked with an asterisk (\*).
- This document has **16** pages.

**ADVICE**

- Read each question carefully before you start your answer.

Answer **all** the questions.

1 Fig. 1 shows a lighting circuit with two lamps connected.

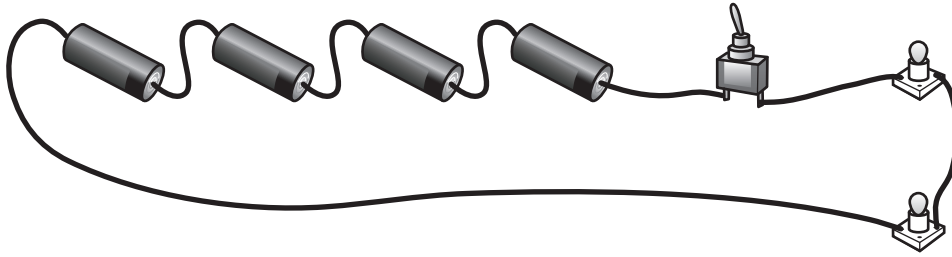


Fig. 1

(i) Complete the circuit diagram in Fig. 2 using the circuit symbols shown. [2]

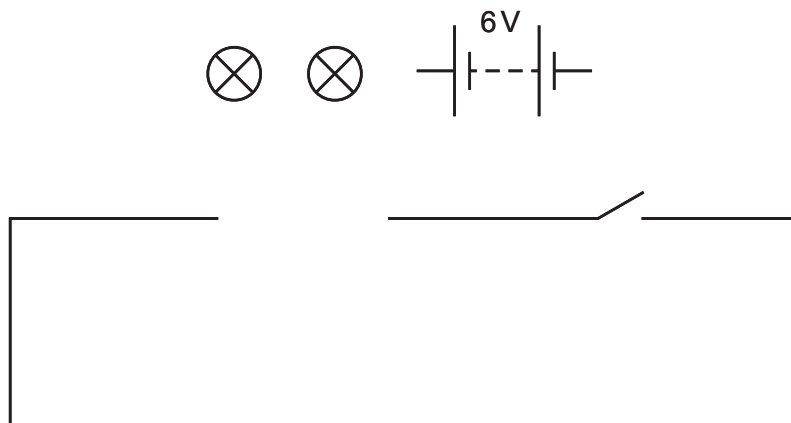


Fig. 2

(ii) Draw on Fig. 2 the symbol for a voltmeter, in the correct position to measure voltage across **one** of the lamps. [2]

(iii) State the reading that would be shown with the voltmeter across **one** of the lamps.  
 ..... [1]

(iv) The combined cell voltage is 6 V and each lamp is rated at 1.2 W.  
 Calculate the total current flow of the **two** lamps in your drawn circuit.  
 .....  
 .....  
 ..... [2]

(v) State **two** effects on the circuit if the two lamps were replaced with lamps rated at 3W.

1 .....

2 .....

[2]

(vi) Give **one** disadvantage of using this arrangement of circuit.

.....

..... [1]

- 2 (a) (i) Give **one** form of energy associated with the following engineering processes. Use each of the given terms once, more than once or not at all.

**Electrical**  
**Heat**  
**Light**  
**Mechanical**

MIG Welding .....

Using a hand-powered drill .....

Photo-etching delicate components .....

Grinding .....

[4]

- (ii) Give **one** other application of light as an energy form.

..... [1]

- (b) Fig. 3 shows a gear train arrangement. Gear B and gear C are locked together on the same shaft.

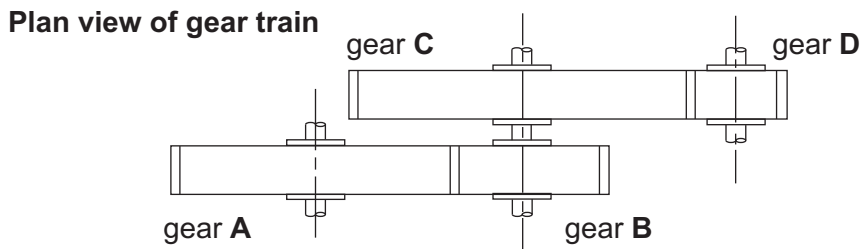
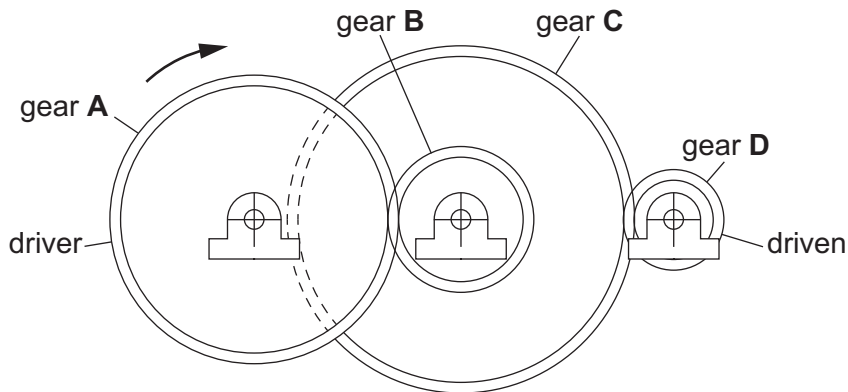


Fig. 3

- (i) Draw on Fig. 3 to indicate the direction of rotation of Gear D. [1]

- (ii) State the type of gear arrangement shown in Fig. 3.

..... [1]

- (iii) Gear **A** has 280 teeth and Gear **B** has 140 teeth.  
Calculate the velocity ratio.  
Give your answer as a ratio.

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

- (iv) State the purpose of Gear **C** in the gear train.

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

3 Fig. 4 shows a relay.

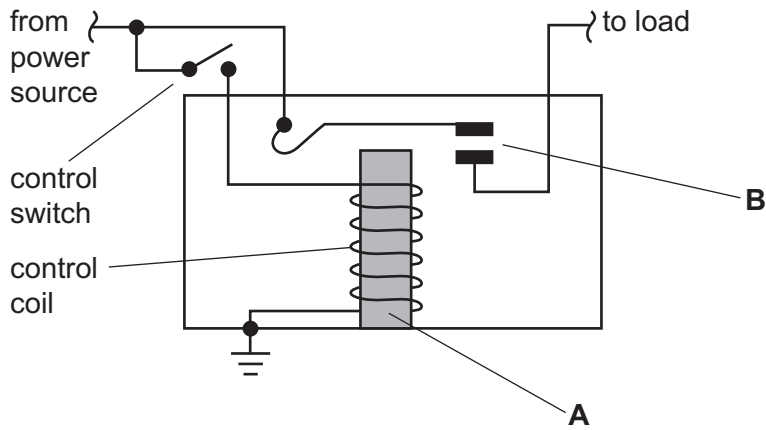


Fig. 4

(i) Name parts **A** and **B** of the relay.

Part **A** .....

Part **B** ..... [2]

(ii) Explain what happens when the control switch is closed.

.....

.....

.....

.....

..... [3]

(iii) Give **one** application of a relay and state a reason for using the relay.

Application .....

Reason for use .....

..... [2]

(iv) Relays can use either 'normally open' or 'normally closed' contacts. Describe the difference in operation between the two types.

.....

.....

.....

.....

..... [3]

4 Fig. 5 shows a pneumatic circuit to clamp and press a workpiece.

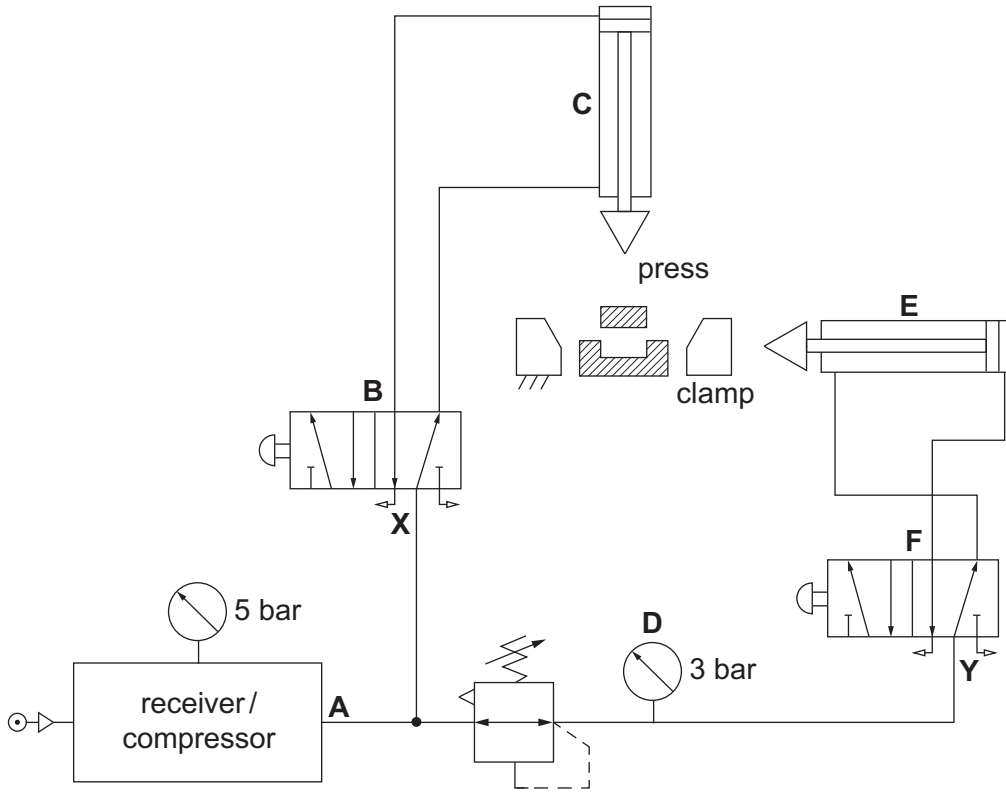


Fig. 5

(i) State **one** effect of a slight leak of compressed air at **A**, output line of the receiver.

..... [1]

(ii) Give the name for component **D**.

..... [1]

(iii) Describe why component **D** is used for the clamp circuit.

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

(iv) State the type of cylinder that would be used for the clamp and press.

..... [1]



- (v) The statements below describe the stages used to clamp and press the workpiece in Fig. 5.

Draw lines to show the correct sequence of these stages.

One has been completed for you.

Sequence	Stage
1	Cylinder E outstrokes, operating clamp to hold workpiece
2	Operator presses button on valve F
3	Operator presses button on valve B to operate press
4	Valve F changes state, outstroking the clamp cylinder E
5	Cylinder C is supplied with air through port X
6	Cylinder E exhausts through port Y

[4]

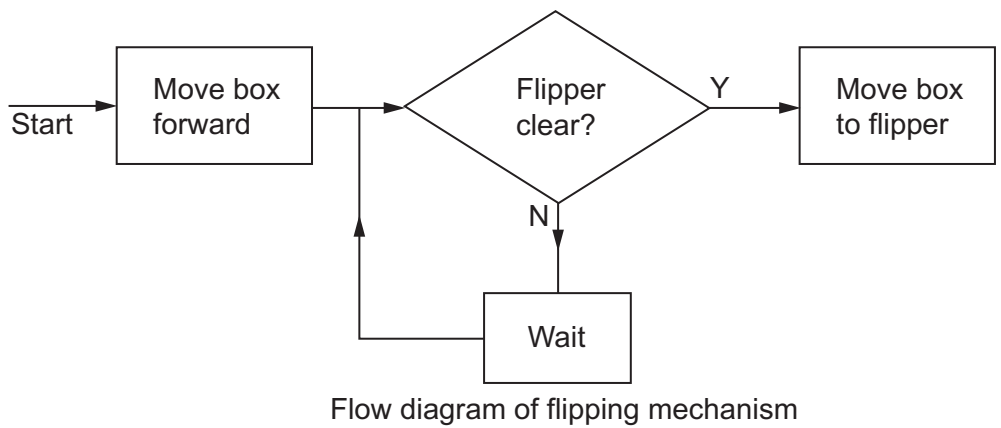
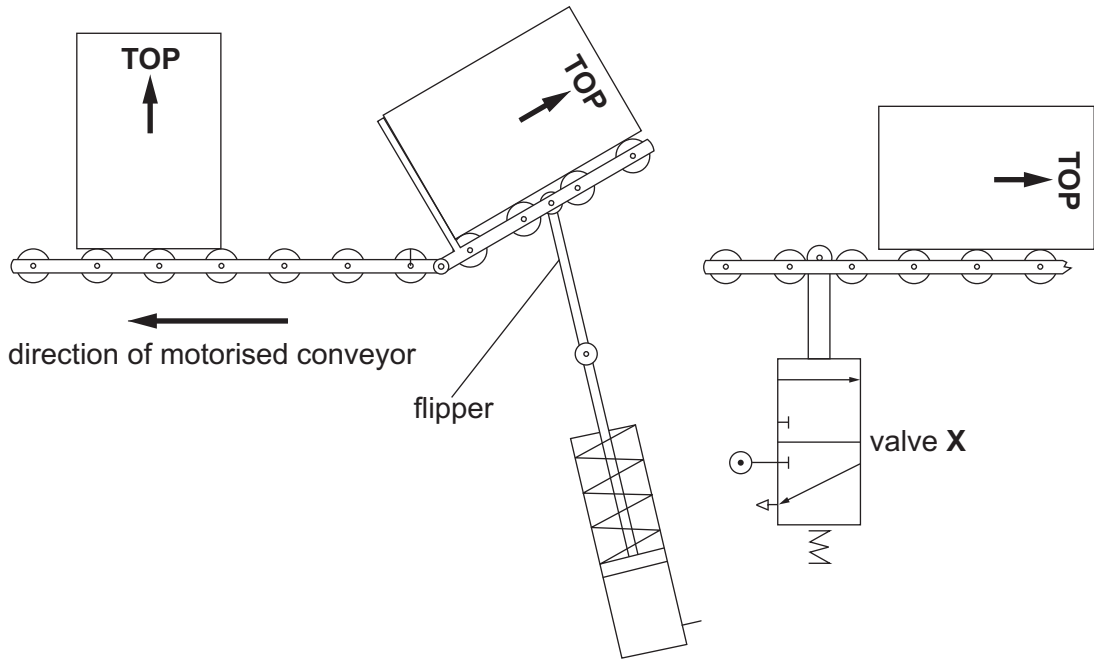
- (vi) Valves B and D are manually operated.

These valves could be replaced with electro pneumatic solenoid valves to add automation to the process.

State what is meant by the term 'electro pneumatic'.

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

5 (a) Fig. 6 shows a mechanism to flip a box upright on a conveyor belt used in manufacturing.



Flow diagram of flipping mechanism

Fig. 6



6 (a) Fig. 7 shows a hydraulic vane pump.

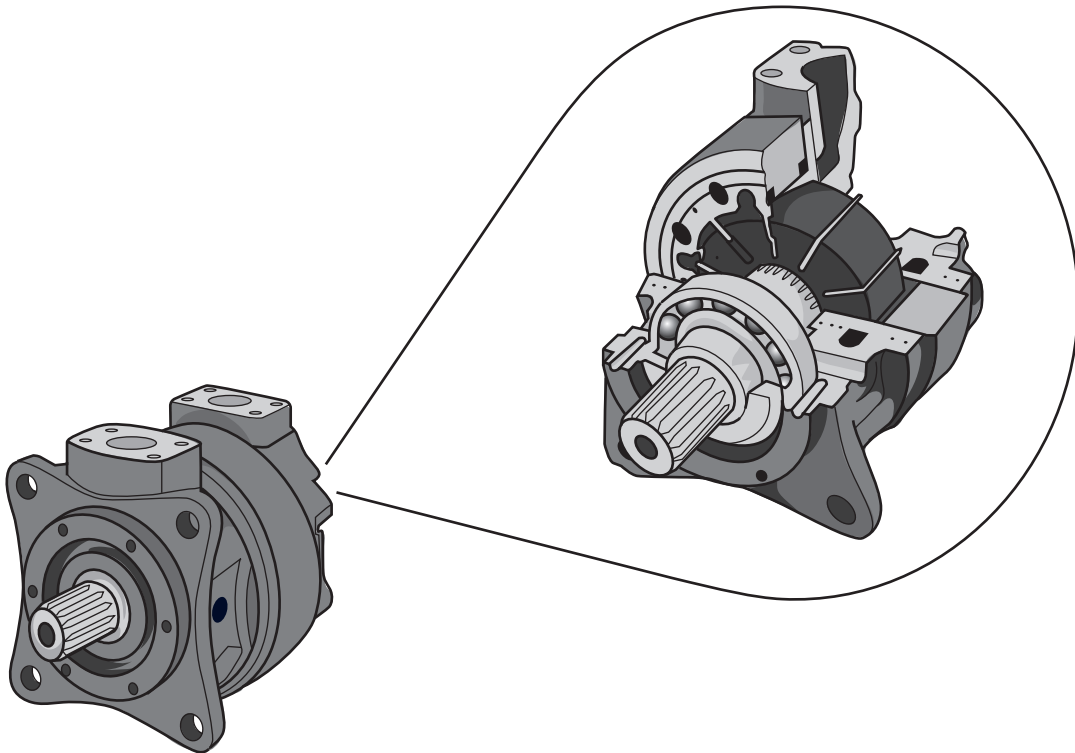


Fig. 7

(i) Give **one** application that could use this type of pump.

..... [1]

(ii) Describe how the pump can be secured and connected in a fixed position.

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

(iii) Give **one** method of mechanically driving the pump.

..... [1]



**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing answers. It features a vertical margin line on the left side and horizontal dotted lines for writing. The lines are evenly spaced and extend across the width of the page.



A large area of the page is reserved for writing, featuring a vertical solid line on the left side and horizontal dotted lines extending across the page.



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