



Oxford Cambridge and RSA

**Tuesday 10 January 2023 – 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

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

Candidate number

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

First name(s)

---

Last name

---

**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 [ ].
- Dimensions are in millimetres unless the question says something different.
- Quality of written communication will be assessed in questions marked with an asterisk (\*).
- This document has **16** pages.

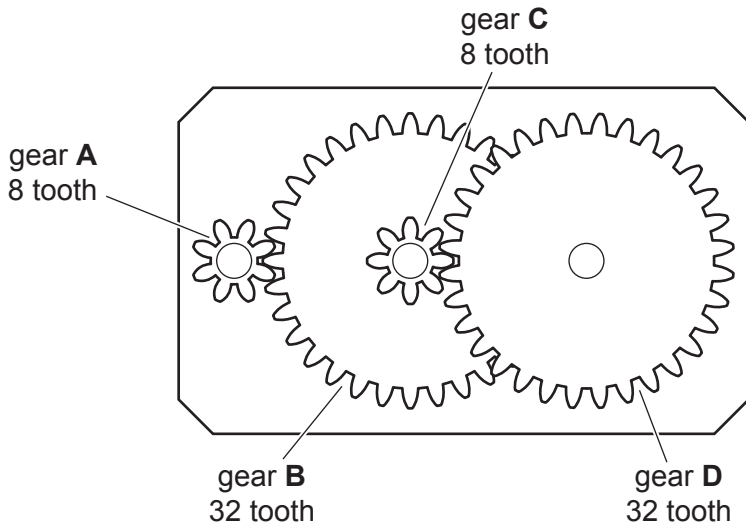
**ADVICE**

- Read each question carefully before you start your answer.

Answer **all** the questions.

1 **Fig. 1** shows a gear train used in a toy.

**Fig. 1**



(a) (i) Gear **C** is attached to the face of gear **B**.

State the type of gear train shown in **Fig. 1**.

..... [1]

(ii) Calculate the gear ratio of the part of the gear train, from gear **C** to driven gear **D**.

Show your calculation workings, giving your answer as a ratio.

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

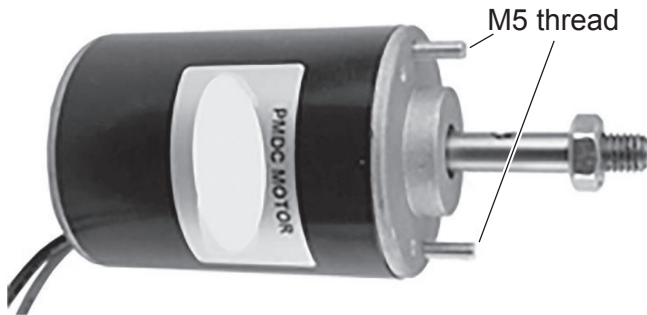
(iii) When using the gear train in **Fig. 1**, driven gear **D** will turn at a slower rate than driver gear **A**.

Give **one** other effect on driven gear **D**.

..... [1]

(b) Fig. 2 shows a permanent magnet DC motor.

Fig. 2



(i) Describe the operation of the permanent magnet DC motor, using **some** or **all** of the terms given below.

**armature                      brushes                      commutator                      permanent magnet**

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

(ii) State the effect of reversing the polarity of the motor power supply.

..... [1]

(iii) Describe a mechanical method of securely mounting the permanent magnet DC motor shown in Fig. 2 to a bracket.

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

2 Alternating current (AC) and Direct current (DC) each have benefits depending on the application required.

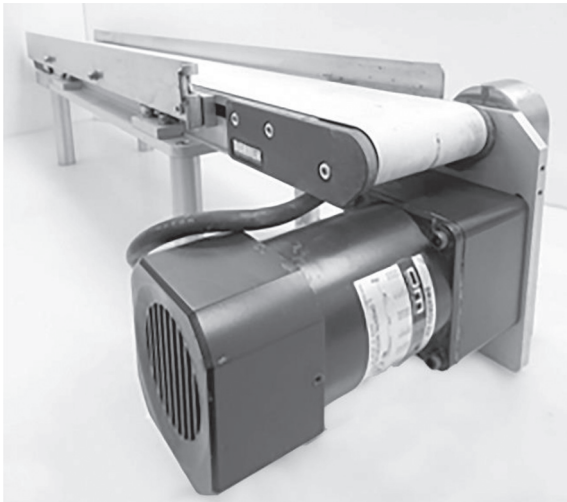
(a) Complete the table below by adding the words 'True' or 'False' to each benefit. One has been completed for you.

| Source of power supplies    | Benefit  | True/False  |
|-----------------------------|--|-------------|
| AC High Tension power lines | Voltage can be stored                              |             |
| AC mains power supply       | Constant supply                                    |             |
| DC battery/cells            | Rechargeable and non-rechargeable types, portable  |             |
| Petrol-driven AC generator  | Portable supply                                    | <b>True</b> |
| Rectified low voltage DC    | Widely used for electronics, lighting and charging |             |

[4]

(b) Fig. 3 shows a conveyor driven by an electric motor.

Fig. 3



(i) Give **two** advantages of using electrical energy as a source of power to control the conveyor shown in Fig. 3.

1 .....

.....

2 .....

.....

[2]

(ii) Describe a system that could be used to mechanically connect the motor to the conveyor belt, allowing the conveyor belt to be controlled manually or automatically.

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

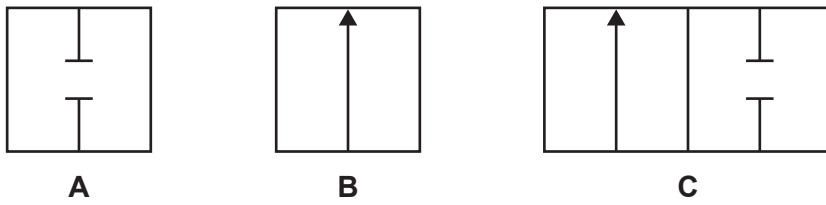
(iii) The motor has a torque rating of 36 Nm at its maximum rpm.

Give the meaning of 'torque' in this example.

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

3 Fig. 4 shows three fluid power symbols used in circuit diagrams showing flow.

Fig. 4



(a) (i) State the meaning of symbol A.

..... [1]

(ii) State the meaning of symbol B.

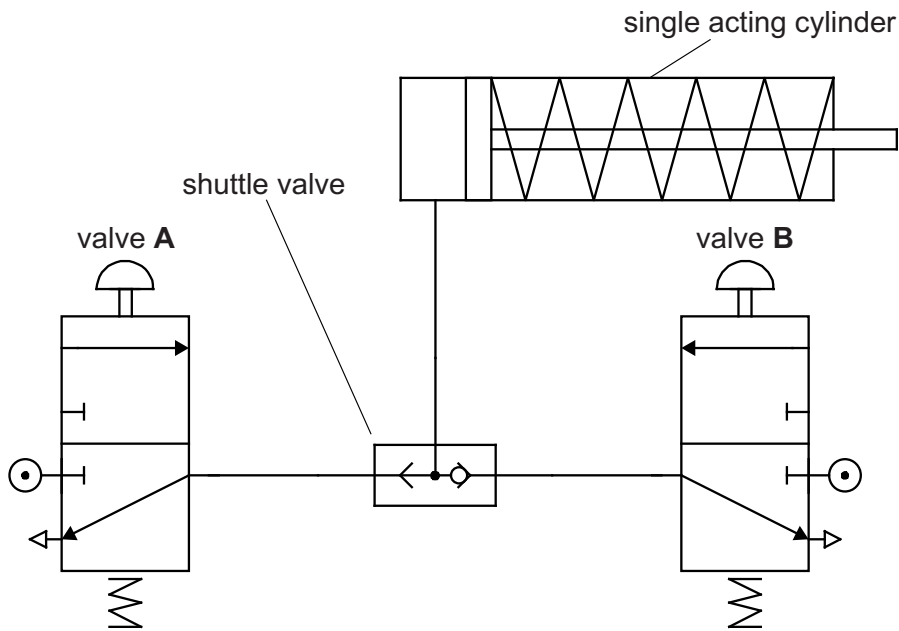
..... [1]

(iii) Give the number of positions for symbol C.

..... [1]

(b) Fig. 5 shows a fluid power circuit.

Fig. 5

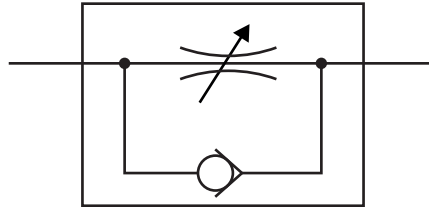


Describe the operation of the circuit shown in Fig. 5.

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

(c) Fig. 6 shows a fluid power component.

Fig. 6



(i) Name the component shown.

..... [1]

(ii) Draw an **arrow** on Fig. 6 to show the normal restricted direction of flow used to control the outstroke of an actuator. [1]

(iii) The component in Fig. 6 includes an integral check valve.

Describe the purpose of the integral check valve part of the component.

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

4 (a) (i) Name **two** components that are used to maintain pressure in a hydraulic system.

1 .....

2 .....

[2]

(ii) Describe how pressure is maintained within a hydraulic system.

.....

.....

.....

..... [2]

(b)\* Discuss, using examples, the benefits of using hydraulics in waste recycling and disposal.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

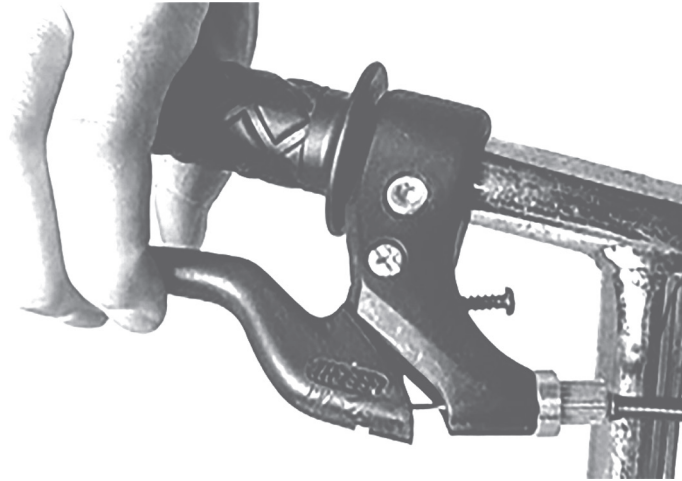
.....

..... [6]



5 (a) Fig. 7 shows a cycle brake lever.

Fig. 7



(i) Add labels to Fig. 7 to show the position of the **effort** and **fulcrum**. [2]

(ii) State the class of lever used in the cycle brake lever in Fig. 7.  
..... [1]

(iii) State how you identified the class of lever given for your answer in part (ii).  
.....  
..... [1]

(b) A car has broken down and needs to be moved. The car weighs 1200 kg.

Calculate the force required to move the car  $0.5\text{ m/s}^2$ .

Use the formula  $F = m \times a$  Give the units in your answer.

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

- (c) Energy conversion can take place using a force or a change in the relative starting point of an object.

Complete the statement below using **four** of the five terms from the list below.

**greater      moving      parallel      potential      static**

A ..... body is one that is stationary and held in place by gravity and friction. A force ..... to those holding it in place is required to move it.

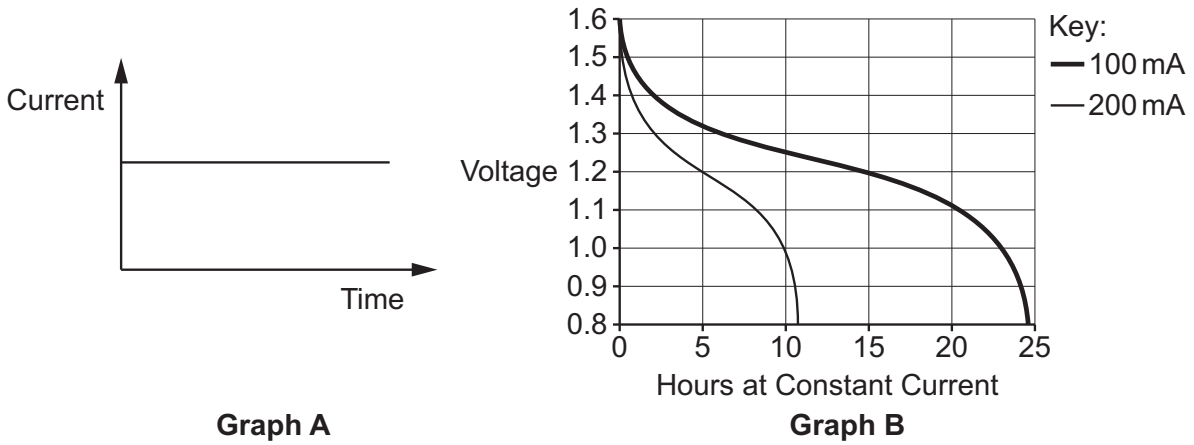
A dynamic ..... body or load is one moving using a form of kinetic or gravitational ..... energy.

**[4]**

- 6 (a) Small battery cells provide a useful source of energy for low current drawing uses.

Fig. 8 shows **two** graphs for a single 1.5V cell used in a lamp circuit.

Fig. 8



- (i) State the type of current shown in **Graph A**.  
 ..... [1]

- (ii) Describe what **Graph B** is showing about the performance of the cell.  
 .....  
 .....  
 ..... [2]

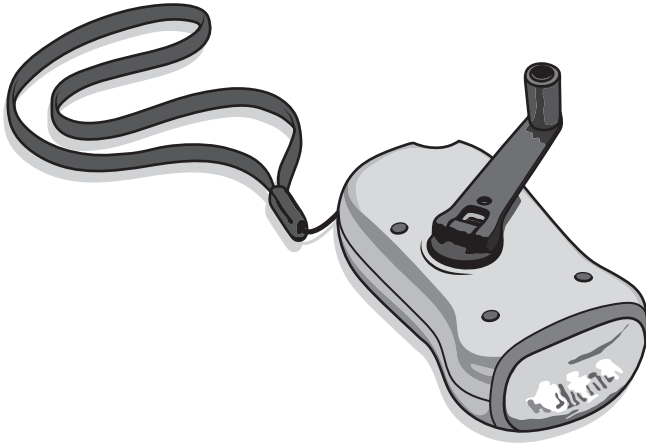
- (iii) State the effect on battery cell performance if a second 1.5V cell is added in parallel.  
 ..... [1]

- (iv) The 1.5V lamp draws a constant current of 200 mA.  
 Calculate the power consumption of the lamp.  
 Use the formula  $P = IV$  Give the units in your answer.  
 .....  
 .....  
 ..... [2]

- (v) Energy conversion from electrical to light energy takes place when the lamp is illuminated.  
 Give **one** other form of energy conversion for the lamp circuit.  
 ..... [1]

(b) Fig. 9 shows a wind-up torch lamp.

Fig. 9



Describe how the mechanical method of operation provides sustained electrical power for the torch.

.....

.....

.....

.....

.....

.....

..... [3]

**END OF QUESTION PAPER**

**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, consisting of 25 horizontal dotted lines. A solid vertical line runs down the left side of the page, creating a margin. The rest of the page is open for writing.

Handwriting practice sheet with 30 horizontal dotted lines and a vertical margin line on the left.



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.



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series. If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of Cambridge University Press & Assessment, which is itself a department of the University of Cambridge.