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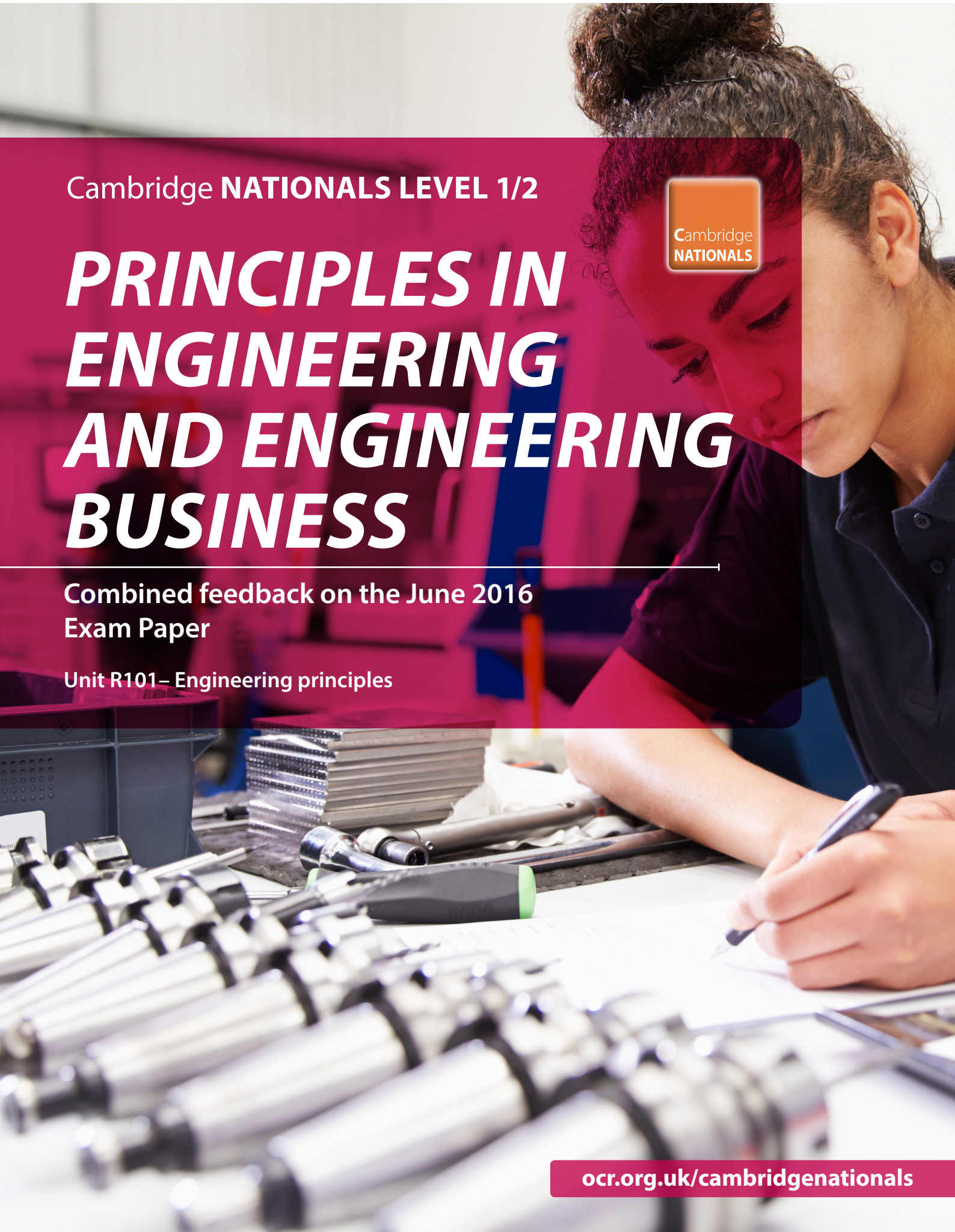


Cambridge **NATIONALS LEVEL 1/2**

Cambridge NATIONALS

PRINCIPLES IN ENGINEERING AND ENGINEERING BUSINESS

Combined feedback on the June 2016 Exam Paper

Unit R101– Engineering principles

ocr.org.uk/cambridgenationals

CONTENTS

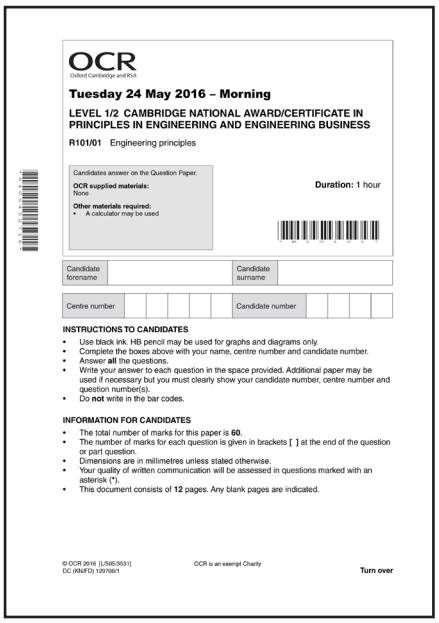
INTRODUCTION

This resource brings together the questions from the June 2016 examined unit (Unit R101), the marking guidance, the examiners comments and the exemplar answers into one place for easy reference.

The marking guidance and the examiner's comments are taken straight from the Report to Centre for this question paper.

The Question Paper, Mark Scheme and the Report to Centre are available from:

https://interchange.ocr.org.uk/



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Tuesday 24 May 2016 – Morning

LEVEL 1/2 CAMBRIDGE NATIONAL AWARD/CERTIFICATE IN PRINCIPLES IN ENGINEERING AND ENGINEERING BUSINESS

R101/01 Engineering principles

Candidates answer on the Question Paper.
OCR supplied materials: None
Other materials required: • A calculator may be used

Duration: 1 hour

Candidate forename | Candidate surname

Centre number | Candidate number

INSTRUCTIONS TO CANDIDATES
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES
- The total number of marks for this paper is **60**.
- The number of marks for each question is given in brackets [ ] at the end of the question or part question.
- Dimensions are in millimetres unless stated otherwise.
- Your quality of written communication will be assessed in questions marked with an asterisk (*).
- This document consists of **12** pages. Any blank pages are indicated.

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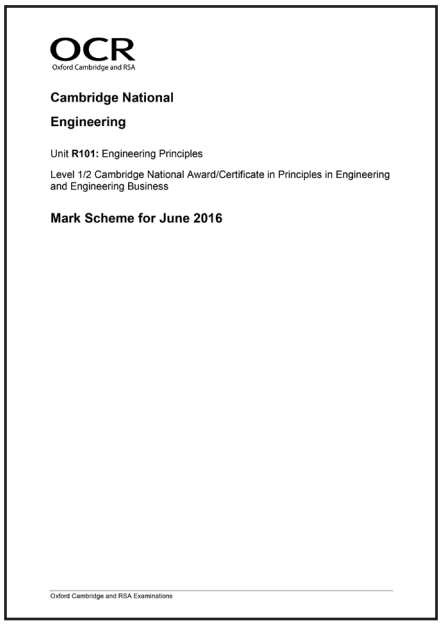
Turn over



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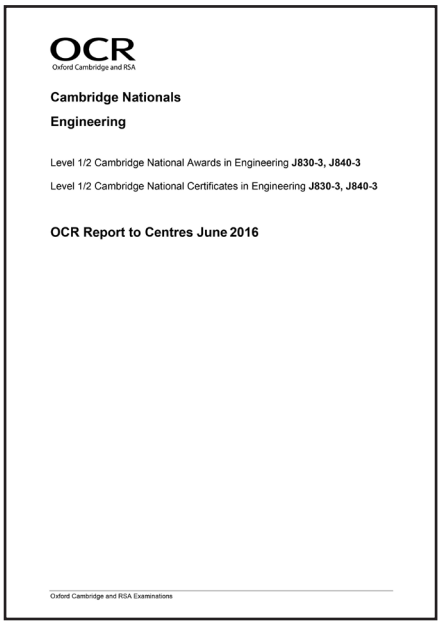
Cambridge National
Engineering

Unit **R101:** Engineering Principles

Level 1/2 Cambridge National Award/Certificate in Principles in Engineering and Engineering Business

Mark Scheme for June 2016

Oxford Cambridge and RSA Examinations



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Cambridge Nationals
Engineering

Level 1/2 Cambridge National Awards in Engineering **J830-3, J840-3**

Level 1/2 Cambridge National Certificates in Engineering **J830-3, J840-3**

OCR Report to Centres June 2016

Oxford Cambridge and RSA Examinations

GENERAL EXAMINER COMMENTS ON THE PAPER

For the June 2016 series, candidate entry numbers are similar to June 2015 but the cohort is made up of predominately Year 11 candidates, compared to June 2015 when it was as expected for the first year of teaching, made up of mainly Year 10 candidates.

Most candidates attempted all of the questions on the paper but, there was some evidence that candidates had not read questions carefully enough before answering. It is most important that candidates take the time to read through the question paper before attempting to answer questions.

Knowledge of basic engineering principles appeared to have improved in some aspects. Candidates demonstrated understanding of electrical principles although confused AC with DC.

Knowledge and understanding of pneumatic systems, hydraulic systems and components forms a significant proportion of the specification for R101/01. Generally, candidates' knowledge of hydraulic systems and components was variable. Candidates demonstrated very little recognition and knowledge of pneumatic systems and components.

Question 1

1 (a) Fig. 1 shows a workshop tool that uses a lever to operate.

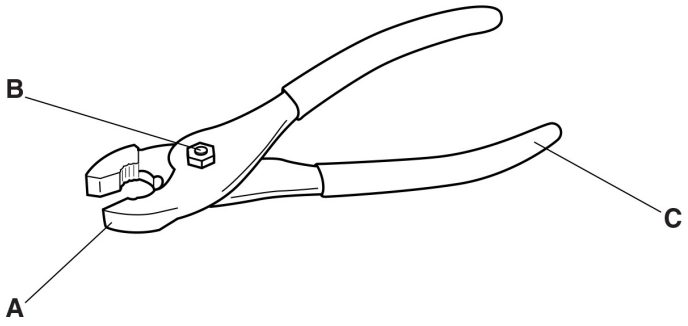


Fig. 1

(i) Match the terms below to the parts identified in Fig. 1.

Fulcrum **Load** **Effort**

A .....

B .....

C .....

[3]

Candidates match the correct term with the correct label
A = Load
B = Fulcrum
C = Effort

(ii) State the class of lever shown in Fig. 1.

..... [1]

Class 1 Lever

(iii) Give **one** other example of a lever mechanism.

..... [1]

Any type of recognised lever e.g.
- BBQ tongs
- Tweezers
- Scissors
- Playground seesaw
- Wheelbarrow
- Spanner

(b) Fig. 2 shows a gear arrangement.

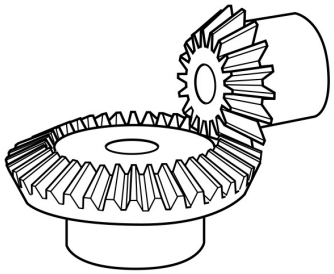


Fig. 2

(i) State the type of gears shown in Fig. 2.

..... Bevel gear ..... **[1]**

(ii) State **one** practical application for this type of gear.

..... **Any appropriate application of bevel gears e.g.**
- Differential
- Hand drill
- Hand mixer
- Change the rotation through 90 degrees
- Change the rotation direction
- Lathe/milling machine
- Differential/gearbox

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

(c) Fig. 3 shows a toothed drive belt on a pulley.

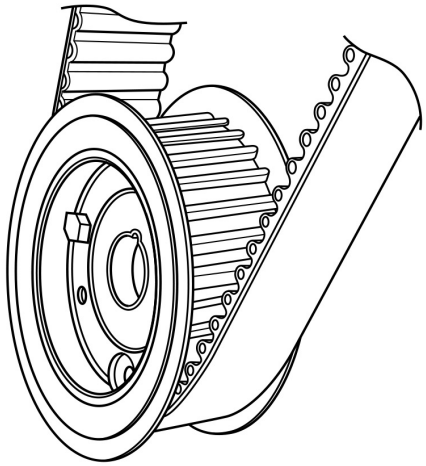


Fig. 3

(i) State **two** benefits of using a toothed drive belt.

1 ....

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

2 correct benefits of using toothed belt drives e.g.
- To provide increased grip
- To provide synchronous timing
- Quiet drive
- No lubrication required
- Reduced wear/no metal to metal
- No slippage/reduced slipping/more friction
- High torque applications
- Improved power transfer

(ii) State **one** alternative drive system other than a toothed belt.

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

- Gears
- Chain drive
- Flat belt
- Round belt
- Vee belt

(d) Fig. 4 shows a drive system. The position of component **X** is adjustable.

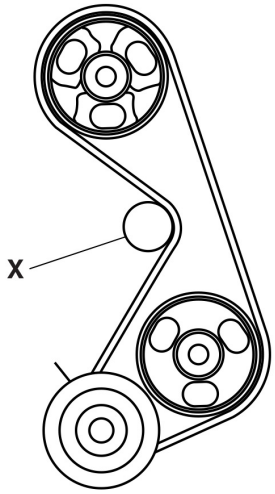


Fig. 4

State the purpose of component **X**.

- Component **X** is used to set the belt tension
- Tighten the belt/reduce slack
- To enable the belt to be changed

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

Mark Scheme Guidance

1 (a) (ii)

Accept a pair of Class 1 levers

1 (b) (ii)

Do not award 'car' unless exemplified with 'gearbox'/'differential'/'gear train'.

1 (c) (ii)

Accept references to gears and pulley systems

Zero marks

Answers with no valid content.

Examiner comments

1(a)(i)	Most candidates achieved full marks for this part, correctly matching the terms.
1(a)(ii) & (iii)	Many candidates correctly gave the class of lever required and were able to give a lever application in part (iii).
1(b)(i)	Some candidates were able to correctly identify the type of gear as a bevel gear, but the majority of candidates were not able to. Where candidates recognised the bevel gear, they were able to give an appropriate application in part (b)(ii). However there was not necessarily a dependency on this as many more candidates gained marks in part (b)(ii).
1(c)(i) &(ii)	Candidates performed well on these questions with most candidates achieving at least one mark, and many candidates were able to correctly identify alternative drives for part (c) (ii).
1(c)(iii)	Candidates across the ability ranges gave correct responses to this part demonstrating some practical knowledge and application of drive belts.

Question 2

2 (a) Give **two** examples of a dynamic load.

1 .....

2 .....

Description of a dynamic load e.g.
- A live load that can vary or move
- A car moving across a bridge
- The wind against a structure
- A person carrying a load
- Pushing a wheel barrow
- Child on a seesaw
- Any load that can change when applied with motion

[2]

(b) A vehicle travels from 0 m/s to reach a speed of 20 m/s after 4 seconds. Calculate the acceleration.

Use the formula:

$$a = \frac{v - u}{t}$$

.....

.....

.....

$a = \frac{v - u}{t}$

$a = \frac{20 - 0}{4}$ (1)

$20/4 = 5$ (1)

Answer $5 m/s^{-2}$ (3)

[3]

(c) Explain, using **one** example, what is meant by the term 'potential energy'.

.....

.....

.....

Up to 2 marks for clear explanation, 1 mark for example/ application.

An object can store energy as the result of its position (1). For example, the heavy ball of a demolition machine (1) is storing energy when it is held at an elevated position/This stored energy of position is referred to as potential energy (1).

An object that can store energy/How much energy something could release (1) for example, a stretched elastic band/spring under tension (1)

[3]

Mark Scheme Guidance

2 (a)

Do not accept one word answers e.g. wheelbarrow/crane.

Answers must be exemplified with a description of how the load is dynamic.

2 (b)

1 mark for correct values in formula

2 marks for correct answer without units

3 marks for correct answer with units - m/s^{-2}

Examiner comments

2 (a)(i) Very few candidates achieved any marks for this part although most candidates attempted this part.

2 (b) Most candidates achieved at least 2 of the available 3 marks for this part, correctly applying the acceleration calculation. The third mark was awarded for stating the units which many candidates correctly gave.

2 (c) Candidates performed well on this question with the majority of candidates achieving two out of the available three marks.

Question 3

3 (a) Complete the statement below using the correct terms from the list.

resistors **cells** **voltage** **watts**

Voltage can be supplied to a circuit by a battery that can be made up of one or more ..... . Potential difference is the measure of ..... across a circuit component. **[2]**

1 mark for each correct response in the correct place i.e.

Voltage can be supplied to a circuit by a battery which can be made up of one or more cells. Potential difference is the measure of voltage across a circuit component.

(b) Fig. 5 shows two circuits, each using two identical lamps.

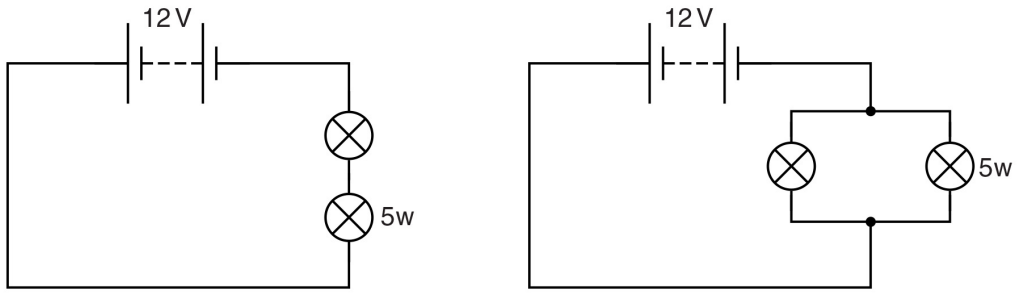


Fig. 5

(i) State the type of arrangement used to connect the lamps in Circuit 1.

..... Series ..... **[1]**

(ii) Give **two** benefits of using Circuit 2 over Circuit 1.

1 .....

2 .....

2 correct benefits e.g.

- The lamps will be brighter than in Circuit 1
- The voltage is the same across all parallel components/ voltage is shared
- If one lamp fails, the other will still work

[2]

(iii) Calculate the total current in Circuit 1.

Use the formula:

I = P/V

.....

.....

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

I = P/V

10/12 = .83A (1)

or 830mA (1)

(c) Fig. 6 shows a circuit used to operate a motor.

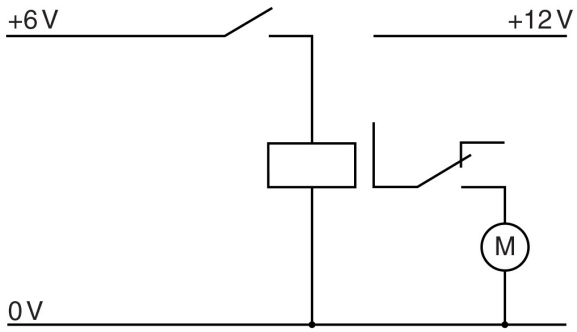
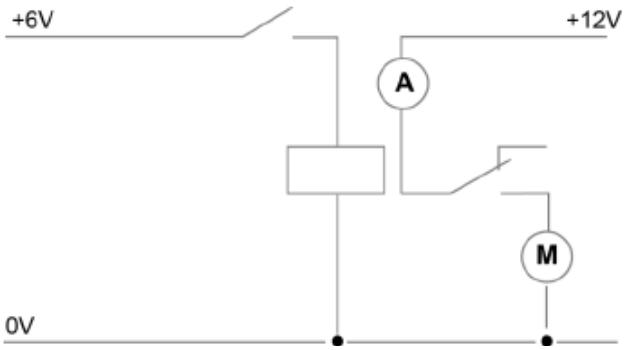


Fig. 6

(i) Draw an ammeter on the circuit in Fig. 6 to measure the motor current. **[1]**

In series with the motor

Accept the ammeter positioned in line under the motor.

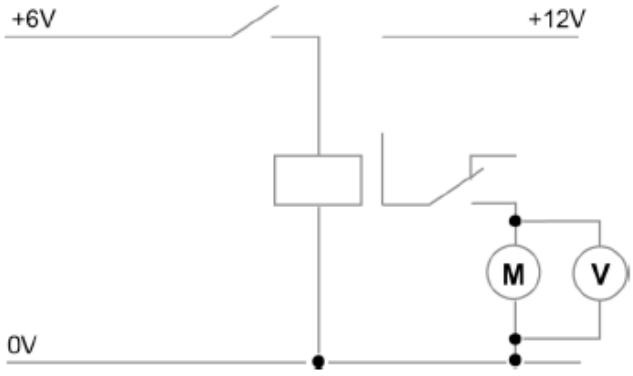


(ii) Draw a voltmeter on Fig. 6 to show the voltage at the motor. **[2]**

Voltmeter is drawn across the motor

Correct symbol (1)

Correct placement (1)



(iii) Explain how the circuit in Fig. 6 operates.

Explanation may include the following points:

The battery provides power to the relay and the motor (1). A switch is used to provide current to the relay coil (1) which is used to reduce the load on the switch contacts (1). The relay contacts close when the relay is switched (1) this causes current to flow through the fircuit to the motor (1). The motor circuit is isolated from the relay circuit (1) this allows the motor to run on a different supply voltage (1).

The battery supplies power to the motor when the switch is closed (1). When the switch is closed the battery provides power to the relay/solenoid/electromagnet (1) the relay contacts close which powers the motor (1). The motor circuit is isolated (1).

[4]

Mark Scheme Guidance

3 (b) (iii)

Award two marks for single point well explained.

Examiner comments

3 (a) - 3 (b) (iii) Part (a) was answered reasonably well, however, less so for the calculation in part (b) (iii). Candidates were required to recognise that they needed to add the wattage of both lamps to get the correct values for the calculation. Higher achieving candidates succeeded in doing this.

3 (c) (i) This question proved to be difficult for candidates as the majority either did not know that the ammeter needed to be placed in series with the motor, or found the circuit diagram difficult to interpret. In contrast to this, many cnaidates achieved at leas tone mark for part 3 (c) (ii) with the voltmeter.

3 (c) (iii) Similarly, this part proved challenging for candidates as most did not recognise the relay symbol and the application of the relay. Some candidates recognised, that in effect, there are two 'switches' in the circuit and credit was given where possible for this. Overall the marks were consistently low for this question.

Question 4

4 Fig. 7 shows a pneumatic system.

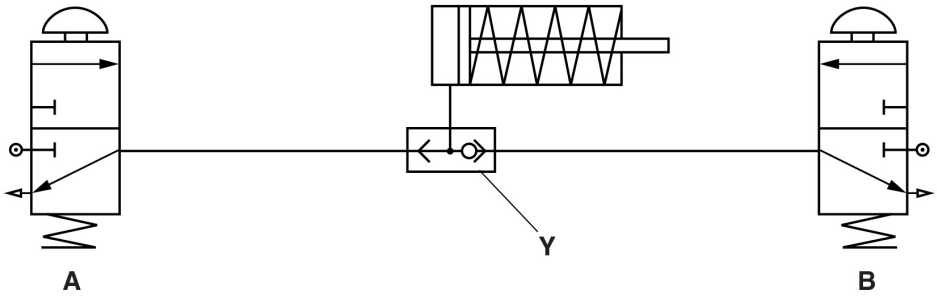


Fig. 7

(a) (i) Name component **Y** shown in Fig. 7.

Y = Shuttle valve **[1]**

(ii) Describe how component **Y** operates.

Air from the left hand side will go through to the output (1) and block off the right hand side input or vice versa (1)

[2]

(iii) Describe the operation of the circuit shown in Fig. 7.

When either valve **A OR B** is pressed/activated (1), the shuttle valve moves to allow air to the cylinder (1). The cylinder will outstroke or go to positive (1).

The single acting cylinder will go positive if valve **A OR** valve **B** are pressed (1) but not when both of them are pressed (1).

When the valve **A** or **B** button is released the single acting cylinder will retract. (1)

[3]

(b) (i) Describe what is meant by the term 'compressibility' in a pneumatic circuit.

Compressibility means compressing the air so that the compressed air provides force to act upon the cylinder or valve (1). The value of the force or pressure being pre-set (1).

The load acting on the cylinder (1) can have the effect of increasing the compression of the air (1).

Compressibility is the amount the air can be compressed in the cylinder (1). The higher the compression/the more it is compressed the larger the force on the cylinder (1).

[2]

(ii) Describe how compressibility differs in a hydraulic circuit.

The hydraulic fluid cannot be compressed (1), the amount of fluid in the cylinder is used to vary the force (1). Therefore hydraulics is more suitable for heavy load applications.

[2]

(c) Compressed air is filtered before being supplied to system components.

Explain the purpose of the filter.

..... The filter is used to filter out contaminants (1) which can cause damage and wear to component/stop the system getting blocked. .....

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

Mark Scheme Guidance

4 (a) (ii)

Only allows air from one direction at a time/stops the air going to the valve B.

4 (b) (i)

Accept reference to 'change in matter'.

Examiner comments

4 (a) (i) - (iii) These questions were very poorly answered by all but a few candidates. Candidates were unable to demonstrate knowledge of the pneumatic components or their application, except for the filter in part (c) which was well answered. Overall, very few marks were awarded in these parts.

Question 5

5 (a) Fig. 8 shows a hydraulic pump that is used to power a hydraulic lifting arm.

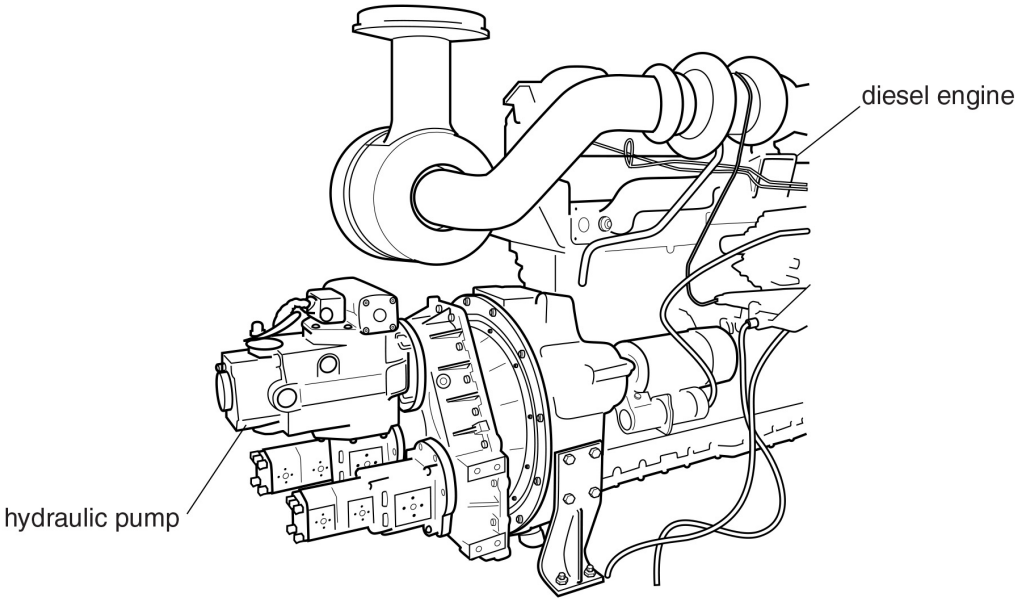


Fig. 8

(i) Select the type of power source from the list below that is used to drive the hydraulic pump.

mechanical **electrical** **pneumatic**

mechanical **[1]**

(ii) State **one** advantage of using this type of power source to produce hydraulic power.

Portable source of power as the vehicle take the hydraulic power source with it. (1)

No electrical power required (1) **[1]**

(iii) Give **one** other hydraulic application different to the example given in Fig. 8.

Appropriate hydraulic application e.g.

- Mechanical digger rams used to lift a bucket or shovel
- Fork lift truck rams used to lift forks
- Lifting platform or tail lift
- Car jack
- Car breaking/suspension system
- Hydraulic press
- Lifting machines

[1]

(b) (i) Give **one** type of energy conversion.

.... energy **[1]**

Appropriate energy conversion e.g.
Chemical to electrical
Solar/light to electrical
Kinetic to electrical

(ii) Describe **one** practical application of the type of energy conversion given in part **(i)**.

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

Description of any appropriate application e.g.
- A wind turbine is driven mechanically by the wind (1). This creates kinetic energy that is converted to electrical energy (1).
- A cell/battery (1) converts the energy reeleased from a checmical source to electircal energy (1).
- Fossil fuels are chemical energy. (1) Burning these in power stations generates heat (1)..

Mark Scheme Guidance

5 (b) (i)

Allow other valid examples.

Do not accept 'mechanical to kinetic' or 'chemical to kinetic'.

5 (b) (ii)

Do not award marks for a simple repeat of **(b)(i)** e.g. chemical to electrical.

Examiner comments

5 (a) (ii) Surprisingly, candidates appeared not to understand the application of the power source used in Fig. 8 to drive the hydraulic pump, and therefore most candidates did not achieve the mark available.

5 (b) (i) Many candidates deviated from the energy conversion examples within the specification, but markers gave credit where possible.

Question 6

6 (a) Fig. 9 shows a roller conveyor used to move products at a manufacturer's site.

Fig. 9

Describe a system that could be used to power and drive the conveyor.

.....

.....

.....

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

Appropriate/feasible description of a mean of driving the conveyor rollers e.g. using an electrical motor with pulleys, gears, belts to mechanise the rollers in motion, e.g.

An electric motor (1) is used with a pulley (1) and a chain drive or belt (1) to drive a pulley/drum or gears on the conveyor roller.

(b)* Discuss the reasons for choosing AC or DC power supplies for a range of applications.

Electrical currents are produced as alternating current and therefore there is no need to use rectifiers to convert to DC when AC supply is used.

In AC power supplies the current flows back and for the alternating in direction which is measured in Hertz per second. In DC power supplies the current is flowing in one direction only.

Generators produce alternating current which can be converted to DC.

AC is used for high voltage and continual high current applications. DC is used for low current applications requiring a set voltage.

When DC is generated at high voltages the generator commutator is prone to damage through arcing.

Alternating current is affected less by voltage drop over larger distances and resistance can be less in current carrying conductors.

Alternating current can be stepped up or down using transformers where needed.

Small current produces less heat and can be transmitted through a thin conductor. Thus it is possible to transmit AC at high voltages. This reduces the size of conductor, transmission losses and increases transmission efficiency.

Direct Current is safer to uses however is not suitable for transmission over large distances.

Mechanical generators can be used in a portable mode to produce AC.

DC allows for devises such as tools to become portable yet re-chargeable using AC.

[6]

Mark Scheme Guidance

6 (b)

Award up to six marks for a discussion or detailed explanation of the reasons for choosing AC or DC power supplies for a range of applications.

Level 3 (5 - 6 marks)

Detailed discussion showing clear understanding of the advantages of using Alternating Current rather than Direct Current.

Specialist terms will be used appropriately and correctly.

The information will be presented in a structured format.

The candidate can demonstrate the accurate use of spelling, punctuation and grammar.

Level 2 (3 - 4 marks)

Adequate discussion showing an understanding of the advantages of using Alternating Current rather than Direct Current.

There will be some use of specialist terms, although these may not be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar.

Level 1 (0 - 2 marks)

Basic discussion showing limited understanding of the advantages of using v Alternative Current rather than Direct Current.

There will be little or no specialist terms. Answers may well be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.

0 = a response that is irrelevant and/or not worthy of a mark.

Annotate with 'Seen' at the end of the response.

Examiner comments

6 (a) Candidates demonstrated their knowledge of mechanical principles quite well in this part, suggesting feasible answers on how to drive the conveyor. Many candidates achieved two of the available three marks.

6 (b)* Almost all candidates attempted this question, but marks awarded were generally quite low, as responses demonstrated little knowledge of different power sources, their differences and advantages. Many candidates confused AC with DC supplies. Where this was the case, markers gave the benefit of doubt where successive examples were given but were factually the wrong way around. Candidates recognised that AC could be transmitted over long distances but many suggested that the mains supply is DC, and that DC is dangerous. Few candidates recognised the use of DC in portable applications that utilise recharging.

The candidate's Quality of Written Communication (QWC) was assessed this question, and marks were awarded for well written answers, despite where the technical content of the response was limited.

The small print

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