OCR
Oxford Cambridge and RSA

CAMBRIDGE NATIONALS

Examiners' report

PRINCIPLES IN ENGINEERING AND ENGINEERING BUSINESS

J830, J840

R101 Summer 2018 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper R101 series overview

R101 is one of four units that make up the Cambridge National in Principles of Engineering Business. Candidates will either work towards the Award to complete R101 and R102, or the Certificate, R101, R102, R103, and R104. R101 is the only externally examined unit with the other units being centre assessed. To do well on this examination paper, candidates will have needed to gain knowledge and understanding of mechanical, electrical and fluid power systems and be able to apply this in a written description of practical applications, including integrated power systems.

Many candidates attempted all of the questions on the paper although there were exceptions amongst some lower ability candidates.

Candidate performance varied across the range of abilities. Some part questions were answered well across the ability range and likewise there were parts which were less well answered across the ability range.

Candidate performance overview	
Parts which candidates answered well	***Parts that were less well answered***
• Energy conversion for the filament lamp 1(a)(i) • Ohms law current calculation 1b(a)(i) • Drawing of parallel circuit 3(a) • Energy conversion of an electric motor 3(b)(iii) • Change in the number of gear teeth 5(a)(iv)	• Disadvantage of using AC as a power source 1(b)(iv) • Add labels to the motor 3(b)(i) • Hydraulic system description 4(b)(i) Mechanical system to connect motor and gear train 5(b)

Candidates generally performed well on the parts involving calculations. Candidates were able to correctly use the information given to perform calculations for Ohms law in part 1b(i), work done in part 2(b)(i) and cross sectional area in 4(c). Some parts required candidates to give the correct units to be credited with the full marks. Centres are advised to ensure candidates are prepared to be able to state the units, as this forms an important part of demonstrating understanding within Learning Outcome 1 of the unit.

Once again, there were three questions which had a higher incidence of omitting to answer (No Response) than anticipated. For questions 2(c)(ii), (3(b)(i) and 5(a)(i) candidates were required to annotate a diagram, but may have missed the instruction to do so. This is despite clear instructions that were used to make it clear to candidates that they need to annotate the drawing, such as 'Add a label to Fig…' or 'Draw an arrow…'. It is most important that candidates take the time to read through the question paper before attempting to answer questions, and ensure that they have responded to all questions including annotating diagrams where required.

Candidates are required to have knowledge and understanding of fluid power systems and components, which forms a significant proportion of the specification for R101/01. Although candidates demonstrated some knowledge of pneumatic and hydraulic system applications, only a very limited understanding of pneumatic and hydraulic components was evident.

Question 1 (a) (i)

1 Fig. 1 shows a filament lamp.

Fig. 1

(a) (i) Complete the statement below.

The lamp converts ..... energy to ..... energy. **[2]**

This question was answered correctly by the vast majority of candidates. Candidates were required to complete the statement using the correct terms. In this case, a range of terms were not provided for the candidates to use.

Question 1 (a) (ii)

(ii) Give **one** other form of energy produced by the lamp when a current is applied.

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

As per part (a)(i), the vast majority of candidates also gave the correct answer for this question.

Question 1 (b) (i)

(b) (i) A kettle is connected to a 230 VAC supply and has a power rating of 1.8 kW.
Calculate the current used.
Use the formula I = P/V

.....

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

Most candidates correctly calculated the current. Some candidates incorrectly divided the Voltage by the Power, or multiplied the two figures given. For this part, candidates were not required to give the units to gain the full marks.

Question 1 (b) (ii)

(ii) Explain what is meant by the term Alternating Current (AC).

.....

.....

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

This question was less well answered with few candidates achieving the full marks available. Some candidates were able to demonstrate some understanding, stating that the current constantly changes direction. It was expected that higher ability candidate would give answers that included a reference to frequency, to gain the full marks.

Exemplar 1

(ii) Explain what is meant by the term Alternating Current (AC).

The current constantly swaps direction ✓

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

This response is a simplistic answer showing some understanding that the AC current constantly changes direction, credited with 1 mark.

Question 1 (b) (iii)

(iii) Give **one** other example of a product that uses AC.

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

Question 1(b)(iii) and (iv) were not well answered with most candidates across the ability range stating inappropriate examples. Many candidates confused AC with DC applications.

Question 1 (b) (iv)

(iv) State **one** disadvantage of using AC as a power source.

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

Relatively few candidates gave a correct answer to this question.

Question 2 (a) (i)

2 **(a)** A loaded pallet resting on the ground is an example of a static body (load).

(i) Give **one** example of a moving load.

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

Candidates often gave vague answers that did not state there was a load being moved. Example responses included 'a lorry' rather than 'a loaded truck in motion'. The latter would gain the mark.

Exemplar 2

2 **(a)** A loaded pallet resting on the ground is an example of a static body (load).

(i) Give **one** example of a moving load.

A pallet being lifted by a forklift [1]

This answer clearly describes a moving load.

Question 2 (a) (ii)

(ii) State the name for the unit of force.

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

Most candidates were able to correctly name the unit of force.

Question 2 (b) (i)

(b) **(i)** A loaded pallet with a force of 780 N is to be lifted 1.5 m onto a truck.
Calculate the work done showing the units.
Use the formula work done = force × distance.

.....

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

Most candidates were able to correctly calculate the work done. Fewer candidates gave the correct units as Joules, to be credited with the full marks, although many candidates did.

Question 2 (b) (ii)

(ii) Give **one** way to reduce the amount of work done.

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

This question was very well answered with the majority of candidates giving correct answers.

Question 2 (c) (i)

(c) Fig. 2 shows a stapler.

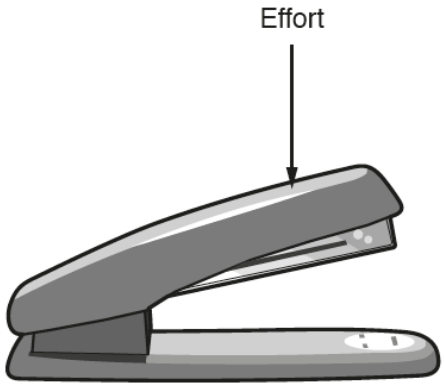


Fig. 2

(i) State the class of lever represented by the stapler.

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

Overall, question 2(c) challenged many candidates. About 50% of candidates gave the correct class of lever in part (i).

Question 2 (c) (ii)

(ii) Add labels to the stapler in Fig. 2 to show the position of the **load** and **fulcrum**. **[2]**

There are three questions within this examination which required candidates to add labels to the diagram shown. A higher than expected number of candidates did not respond, suggesting that the candidates did not read the instruction to add labels, before moving on to part (iii).

Of those candidates that did add labels, the majority correctly labelled the fulcrum and the load.

Exemplar 3

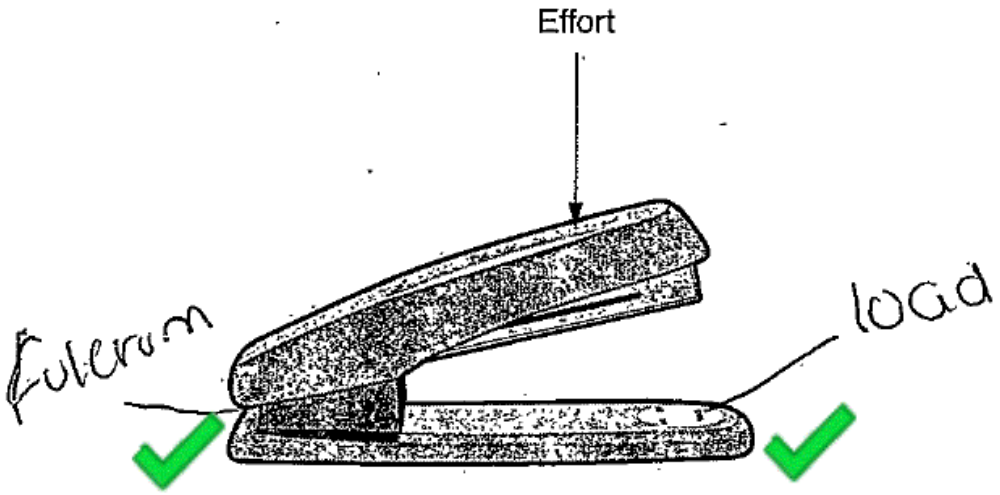


Fig. 2

Question 2 (c) (iii)

(iii) Place a tick (✓) next to the statement below that gives the correct description of the stapler operating as a machine.

The stapler gives no advantage or disadvantage to the user.

The stapler gives a mechanical advantage to the user.

The stapler gives a mechanical disadvantage to the user. **[1]**

This part was very poorly answered across the ability range with very few candidates giving the correct answer, that the stapler gives mechanical disadvantage.

Question 2 (c) (iv)

(iv) The stapler is capable of stapling 5 pieces of paper, each being 80 grams per square metre (gsm).

State what is meant by the term 'grams'.

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

Part (iv) was very well answered with the majority of candidates recognising that grams is the unit of weight or mass.

Question 3 (a)

3 Fig. 3 shows a circuit using two lamps. If one lamp fails, the other lamp will also fail to light.

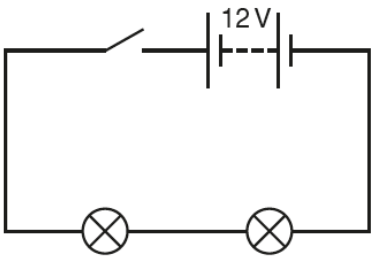


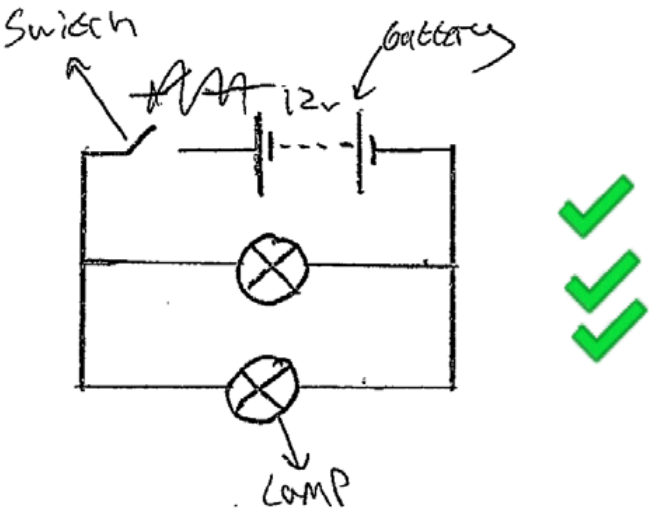
Fig. 3

(a) In the space below draw a circuit using the same components but allowing one lamp to remain lit when the other has failed.

This question was particularly well answered with the majority of candidates being credited with the full marks available. There were few instances where candidates only gained 1 mark. Candidates demonstrated a full understanding of the difference between connecting components in a series and parallel circuits.

In Exemplar 4, the candidate has very clearly drawn a functional parallel circuit correctly, using all of the components, for full marks. It was not necessary for candidates to label their drawing to achieve marks.

Exemplar 4



[3]

In Exemplar 4, the candidate has very clearly drawn a functional parallel circuit correctly, using all of the components, for full marks. It was not necessary for candidates to label their drawing to achieve marks.

Question 3 (b) (i)

(b) Fig. 4 shows a motor.

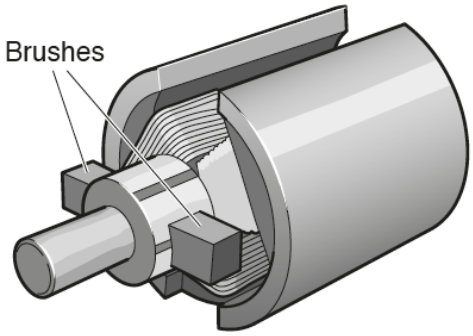


Fig. 4

(i) Add labels to the motor in Fig. 4 to show **two** other components. **[2]**

This is the second question within this examination, which required candidates to add labels to the diagram shown. Again more than an expected number of candidates omitted to respond suggesting that the candidates did not read the instruction to add labels, before moving on to part (ii).

Of those candidates that did answer, the majority gave incorrect labels to parts of the motor.

Question 3 (b) (ii)

(ii) Describe the operation of the motor in Fig. 4 when current is applied to the brushes.

.....

.....

.....

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

Many candidates found this question difficult. Credit was given where candidates were able to demonstrate some understanding of a current passing through the coil (armature) in a magnetic field. A simplistic answer such as "the motor will spin" or similar response was credited with 1 mark.

Exemplar 5

(ii) Describe the operation of the motor in Fig. 4 when current is applied to the brushes.

when current is applied to the brushes it flows through the commutator into a coil inside the magnet causing the coil to turn **[2]**

This is an example of a high level response, including naming key components to show understanding.

Question 3 (b) (iii)

(iii) Complete the following statements by using the correct **three** terms from the list below.

heat **torque** **motion** **current**

An electric motor is a device that converts ..... into ..... .

The rotating force produced is called ..... .

[3]

This part was successfully answered by the majority of candidates with most candidates being credited with full marks.

Question 4 (a) (i)

4 Fig. 5 shows a hydraulic application including the hydraulic/cylinder ram and hydraulic fluid supply.

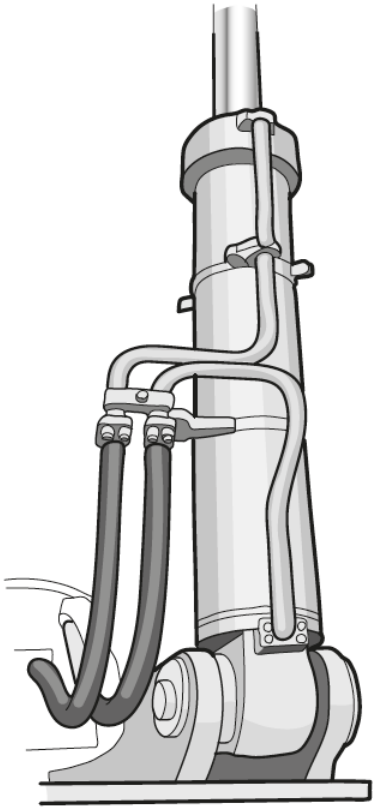


Fig. 5

(a) (i) State the type of hydraulic cylinder used in this application.

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

Question 4(a)(i) required candidates to recognise from Fig. 5 that the hydraulic cylinder shown has two hydraulic hoses, and therefore is a 'double acting cylinder'. This is the only valid answer for this part. In part (ii), candidates were required to explain that one hose is used to supply the cylinder and the other is to return the fluid to the reservoir. Candidates often gave simplistic answers related to "in and out" which was acceptable to be credited for the marks.

Question 4 (a) (ii)

(ii) Explain why this application uses two hydraulic hoses to the cylinder.

.....

.....

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

Exemplar 6

(ii) Explain why this application uses two hydraulic hoses to the cylinder.

One is for high pressure liquid to flow in whereas the other is for it to flow out. **[2]**

This example lacks technical references such as mention of the reservoir, however is correct in its description to be credited with full marks.

Question 4 (a) (iii)

(iii) State **one** impact of a hydraulic fluid leak from one of the hoses.

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

This part was very well answered with nearly all candidates giving a correct answer.

Question 4 (b)

(b) Fig. 6 shows a pump used in a hydraulic application, such as a digger excavator.

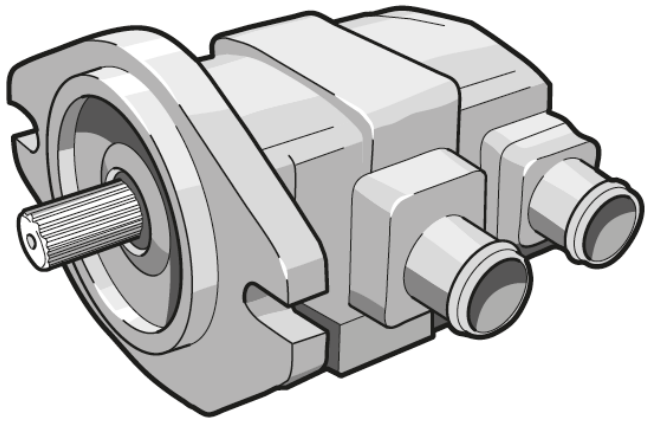


Fig. 6

Describe a system that could be used to drive the pump providing pressure to the hydraulic system.
Use the terms below in your answer.

Gearbox **Engine** **Hydraulic hoses** **Control valve**

.....

.....

.....

.....

..... **[4]**

Candidates attempted to describe a system to drive the pump using the terms given, with some success. Others needed to develop a more logical order of a system, to demonstrate understanding that the gearbox would be driven by the engine, and the pump would be driven via the gearbox. A greater number of candidates stated that the control valve is used to control an application such as a bucket.

Question 4 (c)

(c) Calculate the cross-sectional area of a piston when the force exerted by the out-stroking piston is 10 kN and the working pressure in the cylinder is 500 kN/m^2.

Use the formula Cross-sectional area = force/pressure

.....

.....

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

This was the third question involving a calculation within this examination. The majority of candidates gave a correct answer without the units; the second available mark was credited where candidates stated the units with the correct numerical answer.

Question 5 (a) (i)

5 Fig. 7 shows a mechanism used in a toy car.

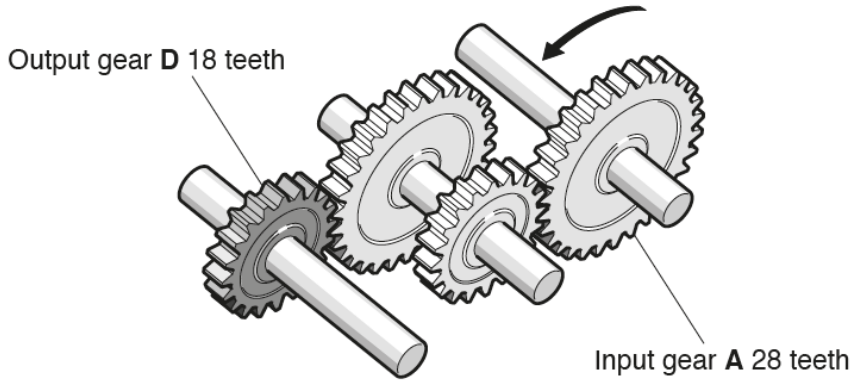


Fig. 7

(a) (i) Draw an arrow on Fig. 7 to show the direction of rotation for gear **D**. **[1]**

Candidates were required to draw an arrow on gear D in Fig. 7 to show the direction of travel. Similarly to parts 2(c)(ii) and 3b(i), more than an expected number of candidates omitted to respond, suggesting that the candidates did not read the instruction to draw an arrow, before moving on to part (ii).

Question 5 (a) (ii)

(ii) State the type of gear arrangement shown.

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

While many candidates answered correctly with "compound gears", not all candidates appeared to read the question correctly to give the type of gear arrangement shown, but instead simply stated "spur gears" with reference to the type of individual gears in Fig. 7.

Question 5 (a) (iii)

(iii) Give **one** advantage of using the type of gearbox shown in Fig. 7 for the toy car.

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

Fewer candidates than expected answered this questions correctly. Most candidates that answered correctly gave answers related to being able to fit many gears in a small space, or the output being faster than the input. Candidates could be awarded credit for simply stating "compact". The mark scheme allowed for candidates to state that the output speed could be greater than the input speed.

Question 5 (a) (iv)

(iv) State the effect on the rotational speed of the output gear caused by increasing the number of teeth on the input gear.

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

This question was successfully answered by the around 50% of candidates, with little correlation to candidates who had answered part (iii) correctly. Credit was given where candidates demonstrated understanding, even with a simple answer such as "faster".

Question 5 (b)

(b) A DC motor is to be connected to the gear train shown in Fig. 7 to power the car.

Describe a mechanical system that could be used to connect the motor to the gear train.

.....

.....

.....

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

Candidates across the ability range answered less well than expected for this part with very few candidates giving answers that could be credited with the full marks available. Candidates were required to describe a mechanical system to transmit power from the motor to the gearbox by connecting a motor to the gear chain shown in Fig. 7, such as using a driveshaft, pulley or worm gear arrangement. Some candidates incorrectly described how to power the motor rather than provide an answer to connect the motor to the gears.

Exemplar 7

(b) A DC motor is to be connected to the gear train shown in Fig. 7 to power the car.

Describe a mechanical system that could be used to connect the motor to the gear train.

battry to Creat force

to MAP it move SEEN

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

In this example, the candidate has described a method of electrically connecting the motor rather than a mechanical system as asked within the question. No marks were credited for this answer.

Question 5 (c) (i)

(c) Fig. 8 shows a rack and pinion gear arrangement.

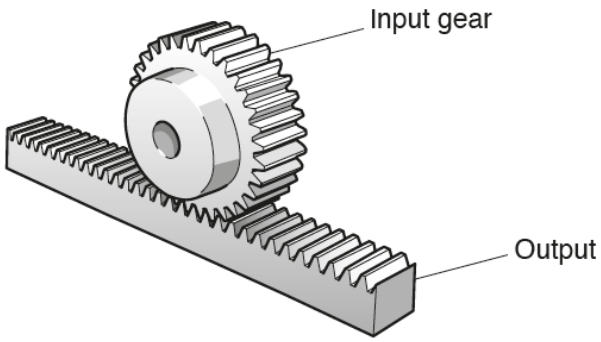


Fig. 8

(i) Give **one** application where this could be used.

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

This part was well answered by the majority of candidates recognising common applications such as a steering rack on a car.

Question 5 (c) (ii)

(ii) Describe the conversion of motion that takes place from the input gear to the output in Fig. 8.

.....

.....

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

Candidates were required to describe a rotary motion of the input gear is turned into a linear motion of the output in Fig. 8. Some candidates will have given simplistic answers to describe the motion of the output gear being moved along, although the majority of candidates were credited with at least 1 of the available 2 marks, with many achieving full marks.

Question 6 (a)

6 **(a)** Describe what is meant by the term 'fluid power'.

.....

.....

.....

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

Misconception Many candidates interpreted the term 'fluid power' to be restricted to examples of hydraulics, rather than hydraulics and pneumatics. Therefore answers were usually limited to a description of hydraulics in part (a) and only hydraulic applications in part (b). This did not impact on the credit given for valid answers containing a description of hydraulics in part (a) and a valid application in part (b).

Question 6 (b)

(b) Give **one** application of fluid power.

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

Fluid power applications given by candidates were limited to hydraulic applications, although these are correct, candidates could have given any hydraulic or pneumatic application to gain credit. Overall candidates gave a good range of hydraulic applications in their answers. Credit was not given for vague answers such as simply "hydraulics".

Question 6 (c)

(c)* Discuss the benefits of using fluid power applications in manufacturing.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

The candidates' Quality of Written Communication (QWC) is assessed in this question along with the technical content. Candidates were required to discuss the benefits of using fluid power in manufacturing. Higher ability candidates will have provided well-structured answers including specific examples of manufacturing processes, using fluid power applications such as a hydraulic press. Lower ability candidate answers were often limited to the mention of hydraulics being able to lift heavy loads.

Supporting you

For further details of this qualification please visit the subject webpage.

Review of results

If any of your students' results are not as expected, you may wish to consider one of our review of results services. For full information about the options available visit the OCR website. If university places are at stake you may wish to consider priority service 2 reviews of marking which have an earlier deadline to ensure your reviews are processed in time for university applications.

activeresults

Active Results offers a unique perspective on results data and greater opportunities to understand students' performance.

It allows you to:

- Review reports on the **performance of individual candidates**, cohorts of students and whole centres
- **Analyse results** at question and/or topic level
- **Compare your centre** with OCR national averages or similar OCR centres.
- Identify areas of the curriculum where students excel or struggle and help **pinpoint strengths and weaknesses** of students and teaching departments.

http://www.ocr.org.uk/administration/support-and-tools/active-results/

CPD Hub
Your route to OCR's teacher training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

https://www.cpdhub.ocr.org.uk

The small print

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

www.ocr.org.uk

OCR Customer Contact Centre

Vocational qualifications
Telephone 02476 851509
Facsimile 02476 851633
Email vocational.qualifications@ocr.org.uk

OCR is part of Cambridge Assessment, a department of the University of Cambridge. *For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored.*

Cambridge Assessment

LLOYD'S REGISTER · LRQA
ISO 9001
UKAS MANAGEMENT SYSTEMS
001