OCR
Oxford Cambridge and RSA

CAMBRIDGE NATIONALS

Examiners' report

ENGINEERING MANUFACTURE

J832, J842

R109 January 2020 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. A selection of candidate answers is also provided. 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 R109 series overview

R109 is an un-tiered, externally examined, mandatory component of J832 and J842, these being the Award and Certificate respectively, in Engineering Manufacture. This component assesses candidates' knowledge and understanding of engineering materials and processes. The paper requires short and extended written answers and includes synoptic assessment and assessment of the quality of written communication.

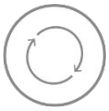
Candidates in general appeared to have been well prepared for this session. Most candidates attempted all questions and there were few instances of no response. Candidates also used their time appropriately and virtually all candidates completed the paper within the allocated time. Very few candidates used extra pages/continuation sheets but where they were used these extra pages were in nearly all cases clearly and accurately labelled indicating the question that the additional response was referring to.

Several centres enabled candidates to make use of the Equality Act by using exam access arrangements, most obviously through the use of word-processed answer sheets. In many but not all cases candidates answered on the question paper where it was most suitable to do so and used the word-processed sheets to support their written responses. It would benefit candidates in future sessions if they were well practised in which types of questions are best answered on the paper and which to use word processing for. Some candidates were able to organise their word-processed responses well and produced answer sheets that were very clear and easy to follow which question their response referred to. This was however not always the case; centres could help candidates who answer using a word processor by training them to make good use of line spacing and white space to help candidates to organise their responses so that it is clearer and easier for both the candidate to check their work and the examiner to assess it.

A wide range of marks were gained in this paper. Often it was clear that some candidates had transferred synoptic knowledge and understanding gained practically in the centre assessed units. Indeed, some candidates had a clear and in-depth practical knowledge/experience of the processes and manufacturing methods they were answering about. There were also clear differentials between candidates who had learned subject content from across the whole of the specification relating to R109 and those who had not. It should be borne in mind that direct questions can be asked of any of the unit content that is shown with an "i.e.". The success of candidate responses can be generalised as follows:

Most successful responses	*Least successful responses*
• Had detailed knowledge and understanding of engineering manufacture especially with respect to properties and uses of materials. • Showed broad knowledge drawn from across the whole of the R109 specification statements. • Demonstrated an understanding and familiarity with the different command verbs, e.g. identify, describe, explain and discuss. • Gave broad and balanced responses that incorporated several points, which were often developed, when answering the longer written answer questions. • Were able to name manufacturing processes.	• Lacked basic knowledge and understanding of materials, for example confusing properties such as malleability and ductility. • Found it difficult to apply what they had learned to different scenarios and instead gave answers that were simply a repeat or rewording of what was given in the stem of the question. • Lacked specificity with reference to grades of material, for example when writing about steel or iron. • Repeated the same point in different ways when answering the longer written responses. • Simply referred to named tools or machines instead of named processes.

Instances of poor examination technique that were seen included misunderstanding of command verbs. In contrast to earlier sessions there were very few instances of candidates circling or ticking more responses than were asked for.

	**AfL**	Centres can train their candidates to deconstruct questions, paying attention to locating the command verbs; the exact meaning of command verbs and the demand that the command verb requires in the response. The last point for example can be taught explicitly by instead of asking the candidate for the answer to a question, to ask for an example of what the answer would look like. This can be done for a variety of command words with increasing demand, e.g. name/state, suggest, describe, explain, evaluate, etc. while keeping the remaining stem of the equation the same as far as possible.

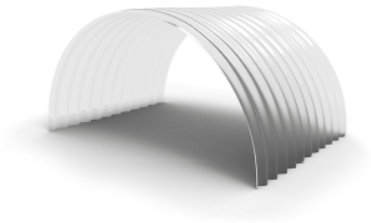
	**OCR support**	Candidates could be directed to the OCR Cambridge Technicals Command Verbs guidance document available from the OCR website: https://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf This explains the meaning of command verbs and their use in assessments, along with examples. While intended for the Cambridge Technicals, this will nevertheless provide useful guidance on command verbs used in the Cambridge Nationals.

Question 1 (a)

1 (a) The table below shows four manufactured items.

Complete the table by selecting a material from the list that is suitable for each item **and** give one reason for your selection.

Aluminium alloy	**Copper**	**Polyvinyl Chloride (PVC)**	
Polycarbonate	**High Speed Steel**	**Polyethylene**	**Brass**

Item	Suitable material	Reason for selection
 Curved corrugated roof panel		
 Wheel rim		
 Plumbing pipe fitting		
 Twist drill		

[8]

As the first question in the paper this question was intended to be accessible to all candidates but also one that would differentiate clearly between candidates of differing abilities.

In general pass level candidates were able to at least select four suitable materials whereas distinction level candidates were able to do this and suggest at least three reasons for the selection.

A few candidates lost marks in this question by suggesting more than one material for each use. Marks that were lost for other reasons often included either vague responses or for example with aluminium alloy referring to the strength of the alloy without linking this to the alloy being lightweight.

Question 1 (b)

(b) Explain why tungsten carbide is used in engineering.

.....

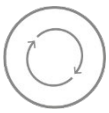
.....

.....

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

This question was intended to differentiate higher ability candidates. So, although many candidates recognised that tungsten carbide was hard, very few compared this to the hardness of either other materials used in drill or cutting tool bits or the hardness of materials that tungsten carbide can be used to cut.

Candidates also commonly lost marks here by describing the uses of tungsten carbide in engineering and not explaining why it is used.



AfL

Losing marks because candidates have clearly not understood the meaning of command words in the stem of the question is a common observation throughout this paper. It is imperative that candidates understand command words and can apply them correctly to the questions.

The command words used are given in the Appendix D of the specification, e.g.

Evaluate	Make a qualitative judgement, taking into account different factors and using available knowledge/experience
Explain	Set out the purposes or reasons

Strategies that centres could use to better equip candidates at using command words effectively could include presenting past paper questions and not asking for the answer but asking what the answer would look like.

This could be taken further by taking a question and asking students to answer the question repeatedly but with the command word changed (e.g. name, give, state, describe, explain, discuss) while keeping the stem the same as far as possible. Thereby making it explicit as to exactly what a command word requires of the candidate.

Centres can train their candidates to deconstruct questions, paying attention to locating the command verbs as well as the exact meaning of command verbs and the demand that the command verb requires in the response.

Question 2 (a)

2 (a) Complete the table by stating the material group that each material belongs to. The first one has been completed for you.

Material	Material Group
Brass	Non-Ferrous metal
Polypropylene	
Carbon Steel	
Epoxy Resin	
Carbon Fibre	
Glass	

[5]

Generally, this question was answered very well, with candidates clearly demonstrating sound knowledge of the material groups that materials belong to.

There were very few instances of candidates showing very little knowledge of material groups. One material that did cause problems for some candidates was epoxy resin which many candidates incorrectly gave an application (adhesive) instead of its material group

Question 2 (b) (i)

(b) (i) Describe what is meant by the term 'shape-memory alloy'.

.....

.....

.....

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

Many candidates correctly stated that the material could be bent / deformed when cold but would return to its original shape when heated. Examiners also gave benefit to candidates who by virtue that the material returned to its original shape when heated had implied that the bending was done when cold.

There were a significant number of candidates who gave vague answers that could describe any material with elastic properties.

Exemplar 1

the metal can be shaped in to a certain shaped but will return to its orgin-
al shape. ~~For example a spring will re-~~
For example braces, the wire is bent and shaped to the mouth of the patient,
the wire is then attached to there teeth, as it returns to its original it will bring the [2]
This is to reallign the teeth too.

Exemplar 2

(b) (i) Describe what is meant by the term 'shape-memory alloy'.

A Shape memory alloy is a
mixture of two or more metals
that once bent can return
to its original shape when heated [2]

Exemplar 1 typifies both a vague answer in the first two lines and also writing which while correct does not answer the question in lines 3 and 4. The response is vague because the candidate is simply describing elastic properties; there is no mention of bending when cold and returning to its original shape on the stimulus of heat which is the definition of a shape memory allow. This response was given 0 marks.

By comparison Exemplar 2 was given both marks for "returning to its original shape when heated" and for being bent with the implication that because the metal was heated the bending was done cold

Question 2 (b) (ii)

(ii) Give **one** example of a use for a shape-memory alloy.

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

Generally, this question was answered well by candidates, with a common answer being dental brace(s) (wires) perhaps indicating the familiarity of many candidates with this use.

There were however a significant number of candidates who did not answer the question presented and instead named a material that is commonly used as a shape memory alloy.

Question 2 (b) (iii)

(iii) Name **two** other smart materials.

1 .....

2 .....

[2]

There were a wide range of other smart materials that candidates could give here and in general most candidates scored highly here.

There were instances where candidates clearly did not know of other smart materials and named other materials, many of which had been mentioned in other parts of the paper; while this rarely gained marks for the candidates it must be preferable to not responding.

Question 3 (a)

3 Fig. 1 shows a plastic bottle which has been formed by blow moulding.

Fig. 1

(a) The table below shows the processes used to form the bottle.

Stage	Process
A	A split die the shape of the bottle is closed
B	Mould is cooled, opened and bottle removed
C	Plastic granules are fed into a hopper
D	Plastic takes the shape of the bottle
E	Air is forced into mould
F	Plastic is heated and fed into the mould

Put the processes in the correct order. Two have been completed for you.

A					B

[3]

Candidates generally scored highly on this question demonstrating either a knowledge of the blow moulding process or the ability to work through the required processes in a logical order.

Question 3 (b) (i)

(b) (i) State why urea-formaldehyde is an unsuitable material for the body of the bottle.

.....

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

Many candidates correctly responded that urea-formaldehyde is a thermoplastic. Marks commonly lost were either due to vague responses such as inability to recycle the material or responses that were incorrect for example referring to the toxicity.

Question 3 (b) (ii)

(ii) State **one** forming process suitable to make the plastic screw cap used with the bottle.

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

Many candidates correctly stated injection moulding. Common incorrect responses included blow moulding or vacuum forming.

Question 3 (c)

(c) State **two** safety precautions, other than Personal Protective Equipment (PPE), that must be observed when carrying out heat forming processes on thermoplastics.

1 .....

.....

2 .....

.....

[2]

Many candidate were able to state safety precautions that must be observed when heat forming plastics.

Common responses that met the requirements of this question well included appropriate training/risk assessments; allowing items to cool down before they are touched; locations of emerge stops or fire extinguishers. Less commonly a means to quench items if necessary was given as a correct answer.

Like previous R109/01 sessions a significant number of candidates did not gain credit because they gave responses which related to items of PPE. This may reflect those candidates' comprehension of the words "other than" in the stem of the question.

Question 3 (d)

(d) Explain the benefits of using plastic to produce bottles.

.....

.....

.....

.....

.....

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

Many candidates scored highly in this question. Common correct responses often referred to low cost or the ability of plastic to be recycled or reused.

Question 4 (a)

4 Fig. 2 shows a pedestal grinder.

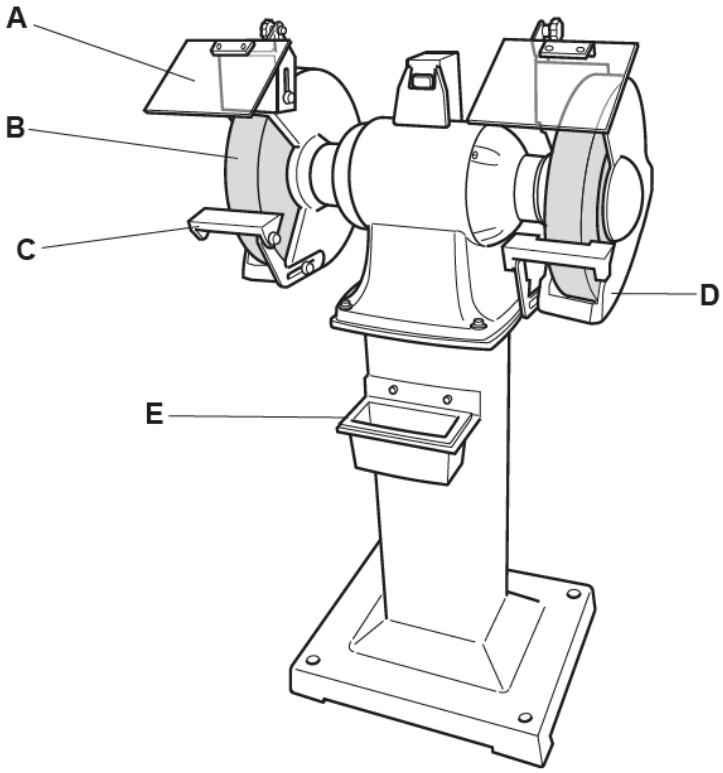


Fig. 2

(a) Using the list below, name the **five** parts that have been labelled in Fig. 2.

Spark deflector **Wheel** **Stand** **Spindle**

Tool rest **Water trough** **Eye shield** **Wheel guard**

A .....

B .....

C .....

D .....

E .....

[5]

Candidates also scored well in this question, the majority gaining full marks. Common mistakes were to label C as the stand or spindle and/or D as the tool rest.

Question 4 (b)

(b) State **one** use of a grinding wheel.

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

Candidates performed well on this question. If marks were lost it was usually due to vague responses which repeated the stem of the question, for example "grinding metal".

Question 4 (c)

(c) State **two** items of Personal Protective Equipment (PPE) that should be worn when operating a grinding machine.

1 .....

2 .....

[2]

Most candidates clearly had a good working knowledge of PPE. Lost marks were commonly due to vague answer, such as unqualified "apron" whereas "leather apron" would have been an appropriate response or glasses which is also too vague. Gloves/gauntlets was also not accepted as this is an entanglement hazard.

Question 4 (d)

(d) Grinding is classified as a material removal process.
Name **two** other material removal processes.

1 .....

2 .....

[2]

There were a wide range of responses that would have gained credit for this question. Many candidates however lost marks for either vague or inaccurate responses such as cutting or lathing. Alternatively, candidates lost marks for naming tools or machines that could be used instead of naming processes.

Question 5 (a)

5 Fig. 3 shows a metal plate being cut using a water jet cutter.

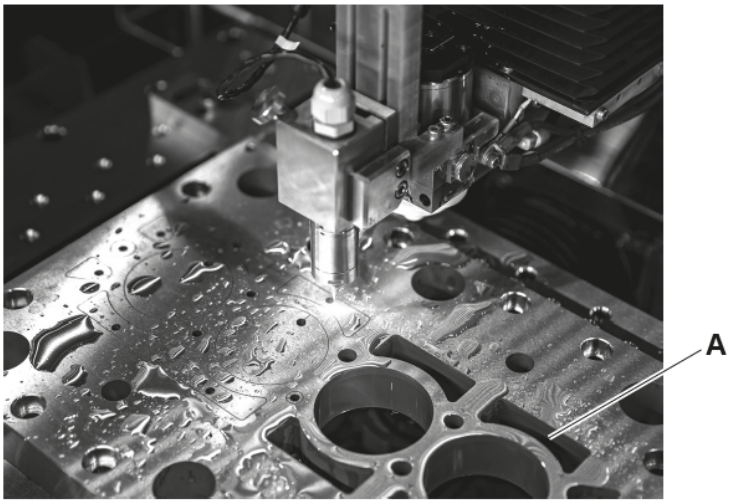


Fig. 3

(a) Explain the benefits of water jet cutting as a method of production.

.....

.....

.....

.....

.....

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

The majority of candidates were able to describe one or two benefit that water jet cutting has as a production method and thereby gained one or two marks. Far fewer candidates explained these benefits and so dropped at least one mark

Exemplar 3

(a) Explain the benefits of water jet cutting as a method of production.

It doesn't create any waste. It creates a smooth finish on the metal. It can cut through thick metal. It is cheaper than a laser cutter

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

Exemplar 3 shows a response that gained 2 marks as the candidate has given 2 benefits of using a water jet cutter.

The candidate has actually provided three benefits from the mark scheme. However, without explanation the candidate has not fully satisfied the question and hence was not given 3 marks.

Exemplar 4

(a) Explain the benefits of water jet cutting as a method of production.

....can cut multiple pieces and components at once which reduces the ~~time~~ ~~the~~ time taken.....

....~~re~~ clean cuts this means that ~~no re~~ no to little second any processes are required.....

....for the surface finish.....

....can achieve precise cuts, can creat a accurate component repeatedly.....

By contrast Exemplar 4 shows an excellent candidate response to this question which achieved the full 3 marks.

The response actually gives four benefits, although only two are given credit. The third mark was given for the explanation that starts on line 3 and continues to line 4.

Question 5 (b)

(b) Name **one** other process that could be used to cut out hole **A** shown in Fig. 3.

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

Many candidates were able to respond correctly with a suitable process. However, in common with 4(d), there were a significant number of candidates who named machines instead of processes.

Exemplar 5

(b) Name **one** other process that could be used to cut out hole **A** shown in Fig. 3.

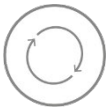
a lazer cutter..... **[1]**

Exemplar 6

(b) Name **one** other process that could be used to cut out hole **A** shown in Fig. 3.

laser cutting..... **[1]**

Exemplars 5 and 6 highlight the differences between naming processes and tools perfectly. In Exemplar 5 no marks were given because the tool was named in contrast to Exemplar 6 which did gain the mark for correctly naming the process.

	**AfL**	Explicit and repetitive training of candidates to recognise the key word "process" in the stem of the question and to make sure that candidates responses end in "…..ing" is a quick and simple gain for both candidates and centres. While this is very simple change to how candidates can be prepared for future sessions it is worth pointing out because in this paper alone 5 of the 60 marks could be lost or gained just based on making this correction.

Question 5 (c) (i)

(c) (i) Explain what is meant by the term 'global manufacturing'.

.....

.....

.....

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

Although it was clear that many candidates had a reasonable idea as to the meaning of global manufacturing many candidates did not gain credit because their responses were either too vague for example "manufacturing in several locations" could be Rotherham and Sheffield or the responses simply repeated the stem of the question such as "manufacturing around the globe".

Question 5 (c) (ii)

(ii) State **two** benefits of global manufacturing.

1 .....

.....

2 .....

.....

[2]

In their responses many of the candidates correctly referenced the reduced labour/production costs and the proximity of the overseas manufacturing plants to raw materials.

Far fewer candidates responded about the ability of global manufacturing to increase capacity for high volume production, varying the products or finding replacement manufacturers.

Question 5 (c) (iii)

(iii) State **two** ways that ideas can be shared between global companies.

1 .....

.....

2 .....

.....

[2]

There were a wide range of responses that could gain credit for this question and so the vast majority of candidates gained full marks.

Question 6 (a) (i)

6 **(a)** Fig. 4 shows an aluminium key ring blank that has been stamped using a Computer Numerical Control (CNC) punching machine.

Fig. 4

(i) Name **two** processes that could be used to manually produce the shape.

1 .....

2 .....

[2]

Many candidates gained full marks with this question.

Where marks were lost it was due to suggesting processes which were either not manual or not suitable for manufacturing this product. More commonly candidates responded with names of tools as opposed to processes as is required from the response.

Question 6 (a) (ii)

(ii) Explain why using the CNC punching machine is a more suitable method of producing the shape than manually.

.....

.....

.....

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

Most candidates could correctly explain the advantages that CNC punching would confer to this manufacture, however very few linked this to the need to produce the die before CNC manufacture starting.

Question 6 (b)

(b)* 'The use of modern technology to design and manufacture products is very efficient but costly.'
Discuss this statement.

.....

.....

.....

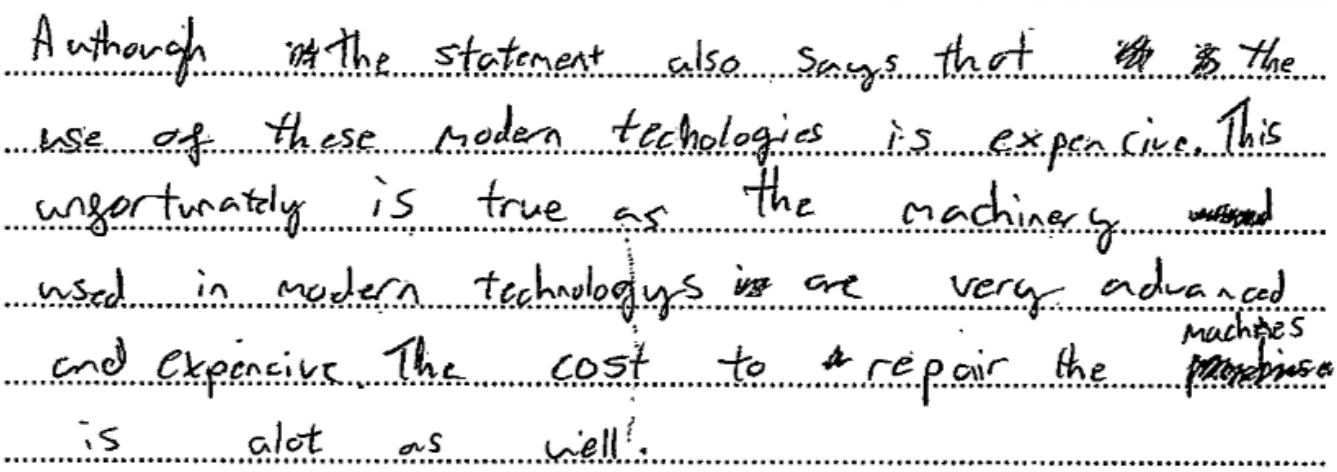
..... **[6]**

In contrast to the June 2019 series there were very few instances of no response to this extended response question. This probably indicates the candidates' general familiarity with the topic of the question.

Good responses discussed both the implications of modern technology on the efficiency and cost of design and manufacture.

Exemplar 7

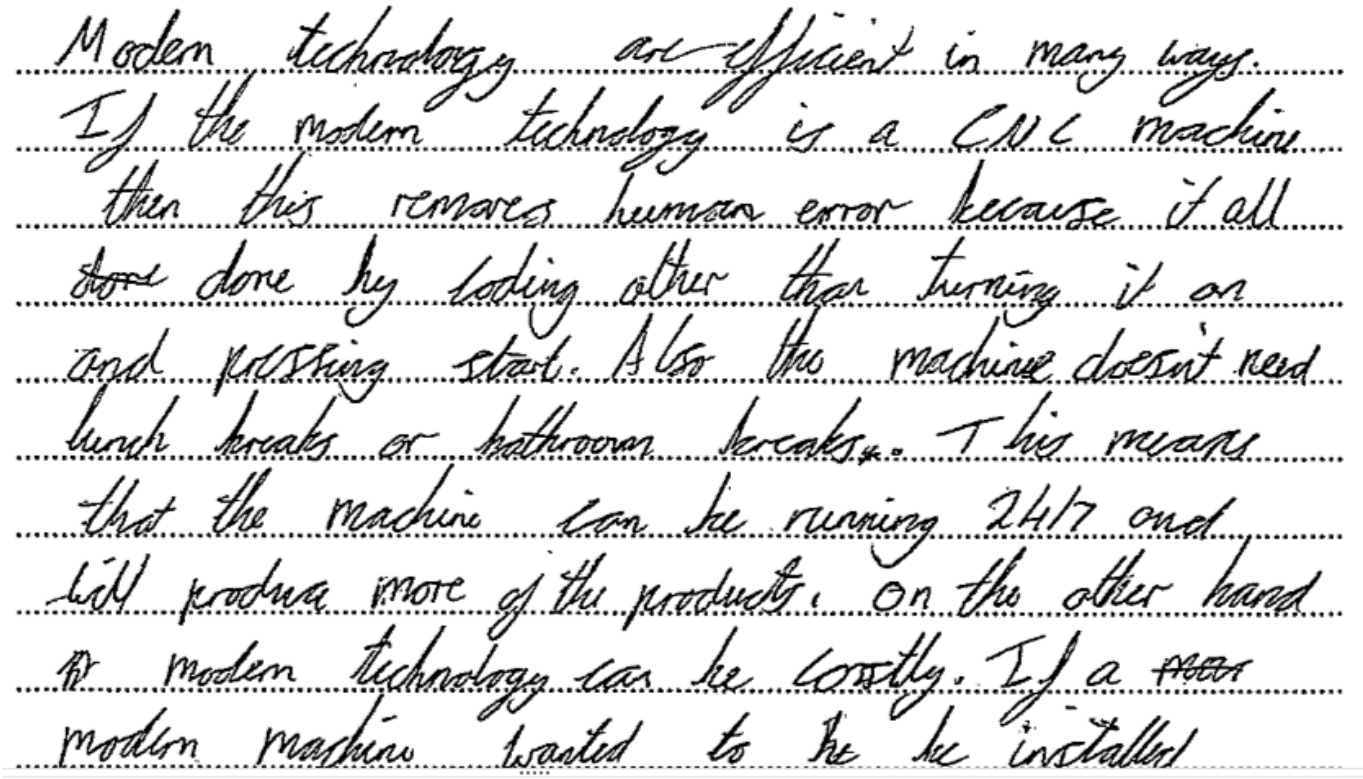
This statement says that design and manufacture products with moden technology is very efficient. This is true as we have made many advancements with modern technologie. This includes CNC machines, Design programs and new ways to share this information.



Even though the candidate wrote a significant number of lines, Exemplar 7 gained just one mark.

The response simply repeats information in the stem regarding cost and efficiency, provides very little in terms of credit worthy discussion of either of these. The response does however name some modern technology (CNC) and it was this that gained the mark.

Exemplar 8



into a trade factory or workshop, the actual machine costs a lot of money and to install it will cost a lot too. If the machines are CNC machines, then specialist training training is needed or a specialist operator will be needed which cost more than a normal operator would. [6]

By contrast the response in Exemplar 8 gained all 6 marks.

The candidate developed a balanced discussion on both the cost and efficiency that modern technology confirms on manufacturing as well as giving a named example of modern technology in manufacturing.

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