

Examiners' Report  
June 2012

GCE Design & Technology  
Resistant Materials 6RM02 01

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## **Introduction**

This is now a well established examination and students are clearly showing improved confidence in the way questions are addressed and answers structured. Strong candidates were able to show the depth of their knowledge in some of the longer questions, whilst weaker candidates were still able to access some marks all the way to the end of the ramped paper. It is clear that more centres are now addressing the issue of exam technique and actively teaching candidates to underline key words in the questions. This was evidenced by there being far fewer examples this year of apparent misreading of questions by candidates. Similarly, clear structured answers were much more common and often scored well as a result. Whereas, unstructured responses often left points unexplained and deviated from the focus of the question. On the whole the paper worked well, providing ample opportunity for students to demonstrate their knowledge and apply it to a wide range of topics within the specification.

### Question 1 (a) (i)

A straightforward introductory question to which almost every response was correct.

### Question 1 (a) (ii)

A straightforward introductory question to which almost every response was correct.

### Question 1 (a) (iii)

Students found identifying this warning sign much more challenging. Common responses were related to explosions, bright lights and sparks, with correct answers being in a small minority.

### Question 1 (b)

Many candidates clearly understood the mandatory nature of the signs rather than the warning nature, and gave examples to re-inforce their response. Having said this, there were a significant number of incorrect responses.

(b) Workshop signs come in different shapes.  
Outline the significance of circular shaped workshop signs. (1)

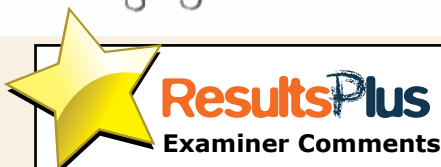
They give an order to someone rather than a warning.



A precise answer showing a clear understanding.

(b) Workshop signs come in different shapes.  
Outline the significance of circular shaped workshop signs. (1)

They are safety tips such as wear your goggles this therefore reminds you about health + safety



Although the 'wear goggles' sign is circular, it is an instruction rather than a tip. Marks were only awarded for responses that conveyed a clear understanding of a command, instruction or order, whether it be a 'do' or a 'do not'.

## Question 1 (c)

A wide range of responses were given here, many being correct but with an equal number incorrect. A significant number were wrongly focused on safe use of machinery, or safe processes rather than dealing with hazards relating to substances. Having said this, most responses in the mark scheme were frequently used with the most common being storage and disposal issues.

(c) Control of Substances Hazardous to Health (COSHH) regulations require employers to carry out risk assessments ensuring that employees are not put at risk from materials being used. One area these regulations deal with is the wearing of appropriate personal and protective equipment (PPE).

Outline **two** other areas that COSHH regulations cover.

(2)

- 1 ..... Maintenance and servicing of machinery in the  
..... work shop.
- 2 ..... Disposal of waste substances (eg acid to produce  
..... PCB's need to be disposed of in correct way)



**ResultsPlus**  
Examiner Comments

The first response is focused on a process rather than a substance, showing no understanding of the nature of COSHH regulations.

The second response is a good answer.

### **Question 2 (a) (i)**

A straightforward question with the vast majority of responses being correct. Polypropylene was the most common correct answer, and acrylic the most common incorrect response. The occasional answer named a metal, which comes down to candidates not reading questions carefully.

### **Question 2 (a) (ii)**

Injection moulding was correctly identified by the vast majority of candidates.

## Question 2 (b)

Virtually all candidates picked up some marks on this question, although relatively few were able to identify and correctly explain three key properties. Most candidates justified the need for strength, and many identified a second valid property drawing from across the mark scheme. Unfortunately the second most popular response was that mild steel is cheap, which was not accepted as it is not a property. Mild steel will **not** corrode was also frequently seen, which is a little concerning.

(b) The frame of the exercise equipment is manufactured from mild steel.

Explain **three** key properties that make mild steel a suitable material for this situation.

- 1 it is strong so it is able to <sup>(6)</sup> support the weight of person and other equipment
- 2 it is tough so it is able to ~~to~~ won't break if it is hit or something is dropped on it.
- 3 it is malleable so it can be shaped ~~easy~~ easily.



### ResultsPlus Examiner Comments

This response gained the full 6 marks for three correctly justified key properties. The poor quality hand writing in this instance was not a problem, although a minority of candidates do lose marks due to illegible responses.



### ResultsPlus Examiner Tip

Take care with hand writing, as some answers are marked wrong every year simply because the hand writing cannot be deciphered.

(b) The frame of the exercise equipment is manufactured from mild steel.

Explain **three** key properties that make mild steel a suitable material for this situation.

(6)

- 1 Its a strong, durable material.  
And can therefore withstand large amounts of weight and pressure.
- 2 Easy to fasten and construct together. Not too heavy or complicated for users to build exercise equipment.
- 3 cheap and easy to manufacture on a large scale.



**ResultsPlus**

**Examiner Comments**

The first point identifies and explains the need for strength, and gained 2 marks.

The second response describes a relevant property, but the following explanation is unrelated and invalid. Hence this was awarded 1 mark.

The third response is invalid as cost is not a property.

Total marks for this response was therefore 3.



**ResultsPlus**

**Examiner Tip**

Read your responses carefully and make sure you have explained the point made rather than deviated into an unrelated area.



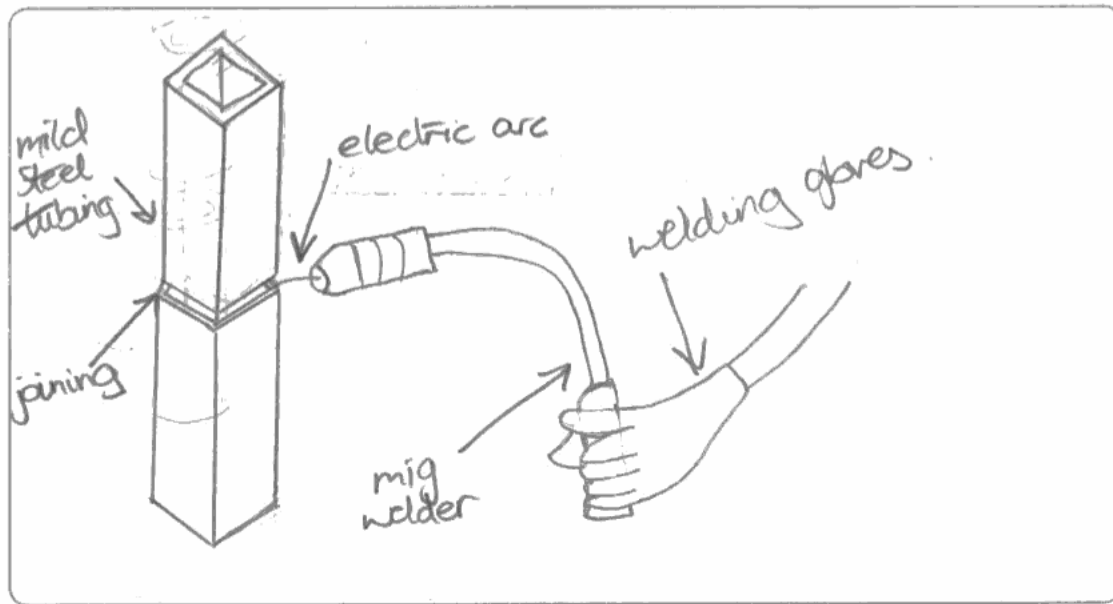
## Question 2 (c)

Candidates found this a challenging question as few responses scored full marks, although most picked up a single mark for showing that they understood the process 'melted' the metals together. Many candidates described oxyacetylene welding, with many more mixing together characteristics of both MIG and oxyacetylene. A common mistake was burning the argon to generate heat. Clearly this topic would benefit from being more carefully studied. The quality of diagrams was generally weak.

(c) The mild steel tube is assembled using a metal inert gas (MIG) welding system.

Outline, using notes and/or annotated sketches, the features of the MIG welding process.

(4)



The mig welder feeds mig wire from a roller machine through the hand held welder and out through the end. The wire has electric flowing through it and when it connects with the metal an electric arc is formed. The electric arc then melts the wire and the wire flows onto the metal. This is done between the two joints. Once the molten wire is on the metal it is left to cool which then hardens. This creates a permanent joint. The user must use protective clothing, welding gloves and a welding mask to prevent burn or eye injury.



**ResultsPlus**

**Examiner Comments**

One of the few good answers with a clearly sketched welding gun (1 mark) showing a protruding filler rod (1 mark) and a labeled electric arc (1 mark). The text also identifies that the metals are 'melted' together (1 mark). It should be noted that the candidate has shown no knowledge of the gas shield, but has shown enough knowledge to gain full marks.



**ResultsPlus**

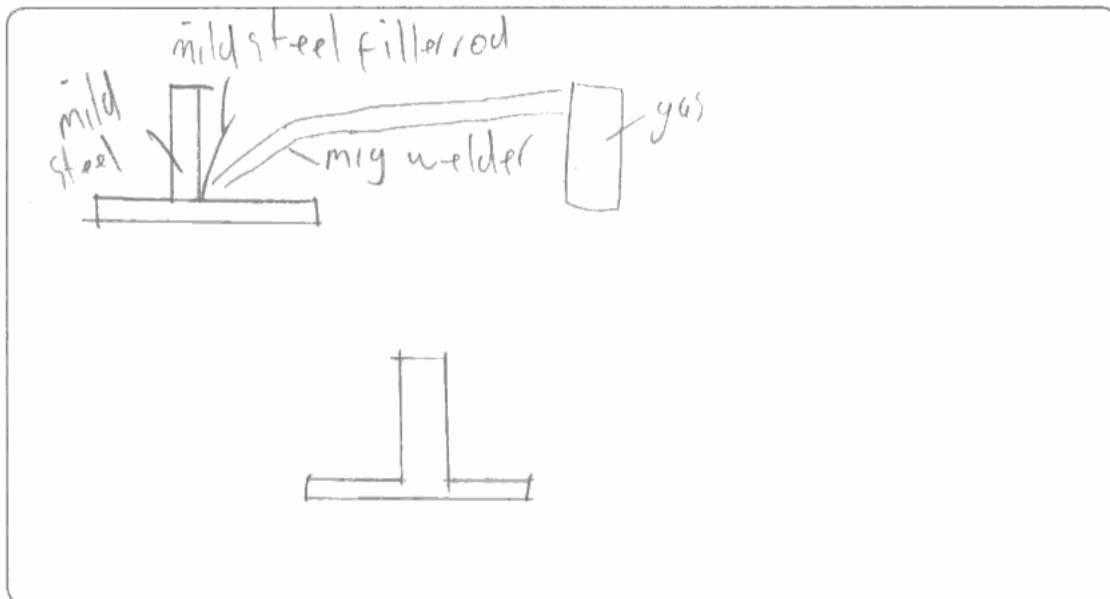
**Examiner Tip**

Make diagrams large and clear as features will not be awarded marks unless they are clearly visible. Labels are also a significant help in communicating knowledge clearly.

(c) The mild steel tube is assembled using a metal inert gas (MIG) welding system.

Outline, using notes and/or annotated sketches, the features of the MIG welding process.

(4)



MIG welding uses the works by lighting the gas which inturn melts the metal which when cools becomes one solid piece of metal and is as strong as the original metal, firstly the surfaces must be cleaned with an abrassive, and then they are fluxed so they join properly.



**ResultsPlus**  
Examiner Comments

The quality of this diagram is poor showing little attempt to communicate clearly. The torch, although labeled 'MIG welder' (which is given in the question) looks like a blow torch, neither is it labeled as a 'gun' so does not gain a mark. The filler rod is clearly separate rather than protruding from the gun, so is also worth no marks. The function of the gas is not identified in the process, so again it is awarded no marks. A single mark is awarded for identifying in the text that the metal is 'melted' together.

## Question 2 (d)

A wide range of responses presented. A good number of candidates scored well clearly understanding how the use of jigs reduced manufacturing costs. A number of candidates lost marks by not explaining the 'speed' and 'accuracy' points made. A minority of candidates were trying to gain marks with the 'cheaper' response which was given in the question, hence evidencing the fact that some candidates still need to read questions more carefully.

(d) Welding jigs are used during the manufacturing of the frames.

Explain **two** reasons why jigs reduce the costs of manufacture.

(4)

- 1 because less errors occur meaning a reduction of waste. As jigs allow a process to be repetitively done whilst still remaining accurate.
- 2 Jigs are reasonably cheap to produce, and they may enable jobs to be done by less skilled workers than they would otherwise have to, reducing labour costs.



**ResultsPlus**

**Examiner Comments**

Two clear points made and explained gaining the full 4 marks, although the beginning of the second response is invalid, as even a cheap jig is still going to cost additional money to manufacture.

(d) Welding jigs are used during the manufacturing of the frames.

Explain **two** reasons why jigs reduce the costs of manufacture.

(4)

- 1 they can be re-used - new jigs wont be needed for each ~~other~~ manufacturing process.
- 2 reduces waste materials - which means the overall cost will be reduced.



**ResultsPlus**

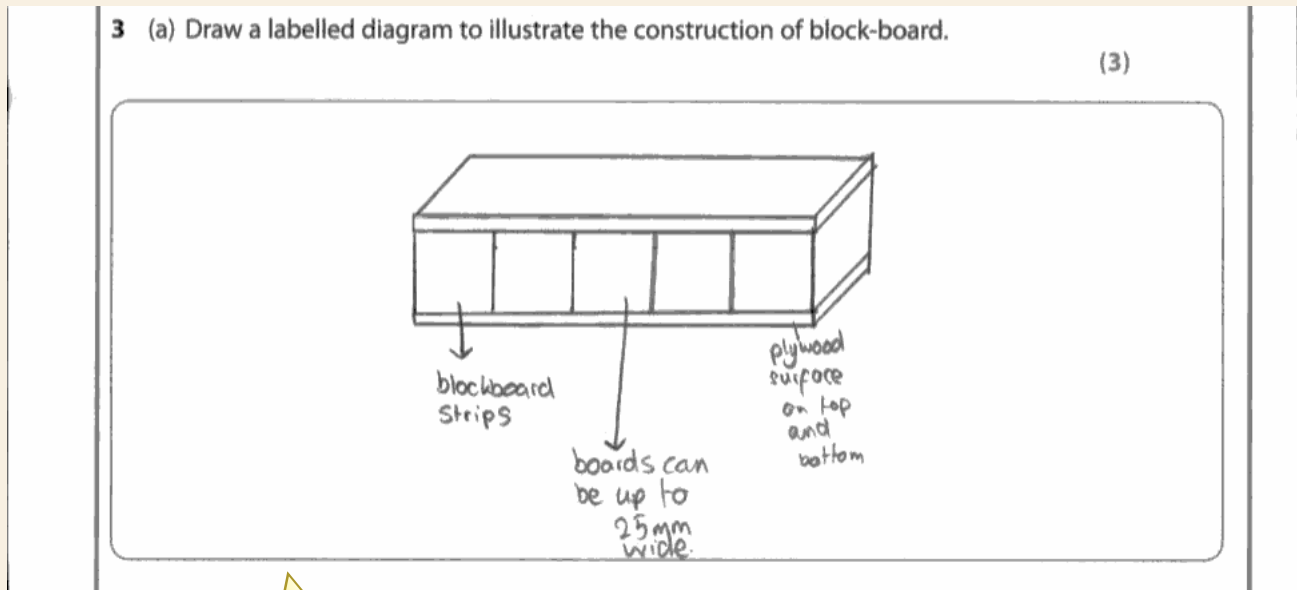
**Examiner Comments**

The first response is mis-directed as manufacturing even a single jig will cost money rather than save it.

The second response makes a valid point but does not explain how a jig achieves this. It was therefore awarded a single mark.

### Question 3 (a)

Well answered with most candidates scoring 2 or 3 marks. A minority presented alternative boards such as plywood or MDF and gained no marks. The quality of sketching here was quite reasonable, and often good.



**ResultsPlus**  
Examiner Comments

The full 3 marks awarded for the internal strips, the surface laminates and knowledge of an appropriate thickness.

### Question 3 (b)

This question differentiated well with most candidates giving the 'cheaper' point, followed by a wide range of appropriate and inappropriate responses resulting in relatively few achieving full marks. All points in the mark scheme were frequently used showing a well understood topic. Common incorrect responses included MDF being light weight, stronger, and more environmentally freindly as trees did not need to be cut down to make it!

(b) Explain **three** reasons why medium density fibreboard (MDF) might be selected for furniture manufacture in preference to solid timber.

(6)

1. MDF is alot cheaper than solid timber  
so furniture can be made at a cheaper cost  
so more profit can be made or furniture can be sold cheaper.
2. MDF can be bought in large sheets so its easy to cut the sizes you need. Solid timber can be hard to get in such large sheets.
3. MDF will not twist, cup or warp after a while or being in heat. If solid timber was not dried out properly there is a chance of that happening.



**ResultsPlus**

**Examiner Comments**

A good response with the first two points clearly explained. The last point states that MDF will not twist, cup, warp, then goes on to state that solid timber will. This is stating 'both sides of the coin' rather than explaining why the point is relevant, hence it was only awarded 1 mark, giving a total of 5 for the question.



**ResultsPlus**

**Examiner Tip**

Stating the same thing twice from two different view points will only gain 1 mark.

(b) Explain **three** reasons why medium density fibreboard (MDF) might be selected for furniture manufacture in preference to solid timber.

(6)

1. MDF is dense therefore will not soak up any liquid substance which can lead to it swelling and breaking down.

2. MDF is flat therefore is not heavy and the manufacturer can deal with it in ease.

3. MDF is stiff, this makes the material strong and hard allowing it to withstand indentation, abrasion and scratches.



**ResultsPlus**

**Examiner Comments**

This response shows no firm understanding of the material with largely un-linked explanations.



**ResultsPlus**

**Examiner Tip**

Make sure you explain the point you are making rather than diverging onto something completely different.

### Question 4 (a)

A commonly used topic well understood by candidates with many scoring 3 or the full 4 marks, although it was clear that some found identifying four reasons difficult. A common error was to state the same point twice using different words.

- 4 Figure 2 shows an image of a trophy made up of a polystyrene moulding and a hardwood base.

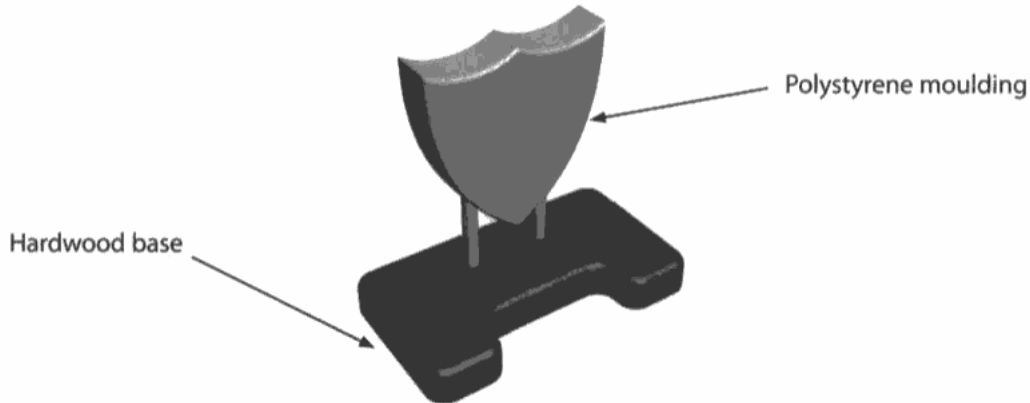


Figure 2

- (a) Give **four** reasons why a computer numerically controlled (CNC) router was selected to manufacture the hardwood base of the trophy.

(4)

- 1 Computer controlled devices reduce the chance of human error.
- 2 The programmed device means all the units will be exactly the same size and shape.
- 3 Computer controlled tools gets rid of the need for labour workers, reducing the labour / costs of manufacturing.
- 4 CNC is a much faster form than manual methods.



**ResultsPlus**  
Examiner Comments

This response shows a clear example of where a candidate has repeated the same point from two different perspectives, and has therefore lost a mark. The last two points were both awarded a mark making the total 3.



- 4 Figure 2 shows an image of a trophy made up of a polystyrene moulding and a hardwood base.

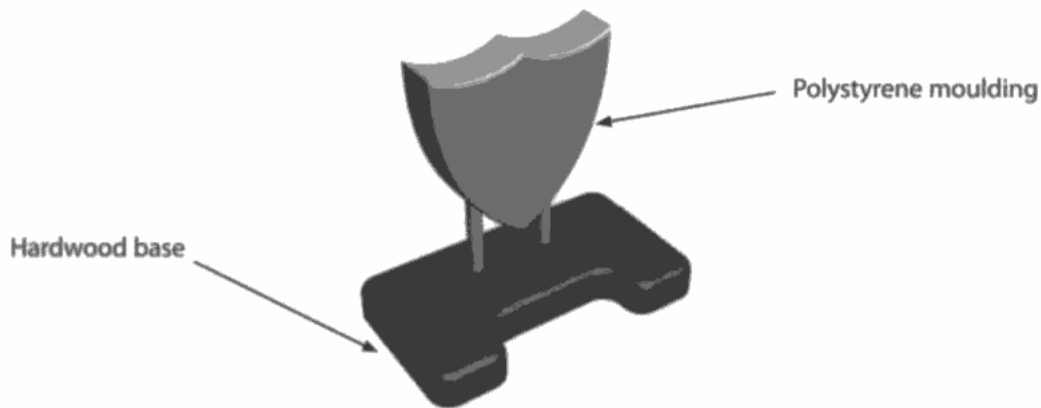


Figure 2

- (a) Give **four** reasons why a computer numerically controlled (CNC) router was selected to manufacture the hardwood base of the trophy.

(4)

- 1 It is for more accurate than humans.
- 2 It can cut it easily, easy to work.
- 3 It can line up the holes for the mould exactly.
- 4 There will be no mistakes such as cutting the wrong part.



**ResultsPlus**  
Examiner Comments

This is a particularly interesting although weak response with a valid first point and an invalid second. Both the last two points are just repeats of the first.



**ResultsPlus**  
Examiner Tip

Ensure all your points are different, as repeat points in different words will not gain further marks.

### Question 4 (b) (i)

The majority of candidates understood the need for the two parts to be mixed, with many using the technical term 'catalyst', which was pleasing to see. Common incorrect responses included mix with water, shaken and heated.

### Question 4 (b) (ii)

This question also differentiated well with most candidates scoring 1 or 2 marks, and a minority reaching 3 marks. The most common answers were strength, speed of curing and the ability to bond dissimilar materials.

(ii) Outline **three** reasons why this adhesive was selected. (3)

- 1 This is a fast process that will reduce the time to manufacture the product increasing profit.
- 2 This <sup>high</sup> adhesive produces a very strong bond that will hold the trophy together.
- 3 This adhesive can bond wood and polystyrene together unlike others. It has a slow <sup>drying</sup> bonding time meaning adjustments can be made to it before drying.

(Total for Question 4 = 8 marks)



**ResultsPlus**  
Examiner Comments

A strong response with three clearly stated reasons.

(ii) Outline **three** reasons why this adhesive was selected. (3)

- 1 Corrosion resistant
- 2 The adhesive is ~~strong~~ creates a strong bond
- 3 heat resistant



**ResultsPlus**  
Examiner Comments

Both the first and third responses, although true are characteristics not required in this situation, and as such were not awarded. The second reason is valid and was awarded a mark.



**ResultsPlus**  
Examiner Tip

Apply your knowledge to the specific situation given, as some characteristics may not be relevant and so will not be accepted, even if they are true.

### Question 5 (a) (i)

Only a small minority of candidates were able to correctly identify the worm gear. Many candidates made descriptive guesses such as 'threaded gear', 'rotary gear' and 'screw gear', none of which gained marks.

### Question 5 (a) (ii)

Very poorly answered question with few candidates showing an understanding of the large gear ratio and the self holding characteristics of the worm gear. Many responses identified the 90 degree axis change, but this characteristic is not significant in this situation, and therefore gained no marks.

(ii) Explain **two** reasons why these gear systems are suitable for use in winches. (4)

1. Can work under stress without fail, used in places such as a working line.
2. Quick and easy to use, very reliable.



**ResultsPlus**

**Examiner Comments**

Two very general responses which could be applied to any gear system. Neither identifies specifically why a worm is suitable.

(ii) Explain **two** reasons why these gear systems are suitable for use in winches. (4)

1. The worm makes it possible to turn the handle at a 90° angle.
- ② This type of gear allows easier movement which ensures the load is easier to lift.



**ResultsPlus**

**Examiner Comments**

This response gained a single mark for recognising that the system makes it easier to lift, although the point has not been explained.

## Question 5 (b)

High scoring responses were rare for this question. Many responses identified that plain bearings were cheaper, but did not explain why. Some also identified that they had a greater load bearing capacity, but again failed to explain why. Maintenance and lubrication issues were frequently described from both points of view, but since 'no maintenance' versions of both plain and ball bearings are available these answers were invalid.

\*(b) Plain bearings are used on the axles of the winch.

Justify why plain bearings were selected in preference to ball bearings in this situation.

(4)

One reason why plain bearings were used instead of ball bearings is because they make the gear system work smoother and easier. Another reason why is because they are cheaper to use than ball bearings. The third reason is that plain bearings are easier to get a hold of than ball bearings.



**ResultsPlus**  
Examiner Comments

A typical response gaining a single mark for 'cheaper'. The remainder shows little specific knowledge concerning bearings.

## Question 6 (a)

A wide range of responses here with both strong and weak answers occurring frequently. All points in the mark scheme were regularly used indicating that students had a wide knowledge base.

- 6 Figure 4 shows one of a batch of machine vices, the body of which has been manufactured using sand casting.

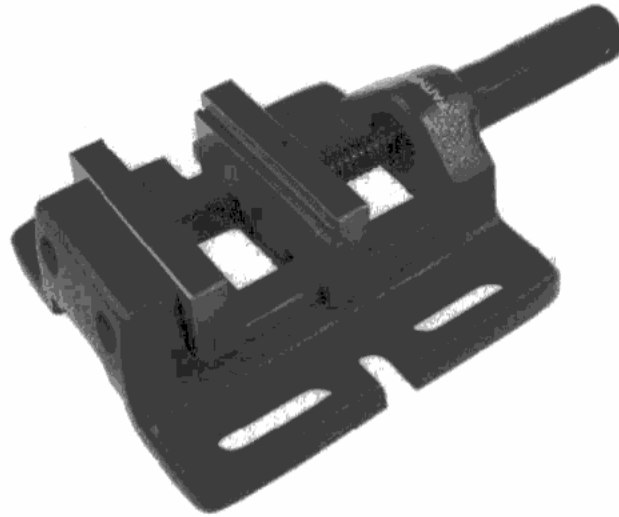


Figure 4

- (a) Outline **two** reasons why sand casting is an appropriate method for manufacturing the body of the machine vice.

- (2)
- 1 The body does not need to be finished to a high standard so a higher quality method is not needed.
  - 2 The process is ~~is~~ inexpensive in comparison to others where ~~higher~~ there are higher startup costs.



**ResultsPlus**  
Examiner Comments

Two clearly made points showing a good understanding in this area.

- 6 Figure 4 shows one of a batch of machine vices, the body of which has been manufactured using sand casting.

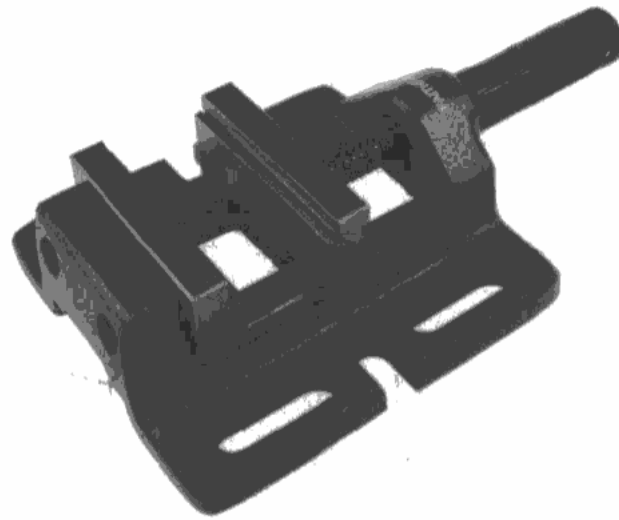


Figure 4

- (a) Outline **two** reasons why sand casting is an appropriate method for manufacturing the body of the machine vice.

(2)

1 Sand casting can cast intricate shapes

2 Screw threads can be put into moulds so they come out in the final product.



**ResultsPlus**  
Examiner Comments

Two good answers that are effectively the same point resulting in a single mark.



**ResultsPlus**  
Examiner Tip

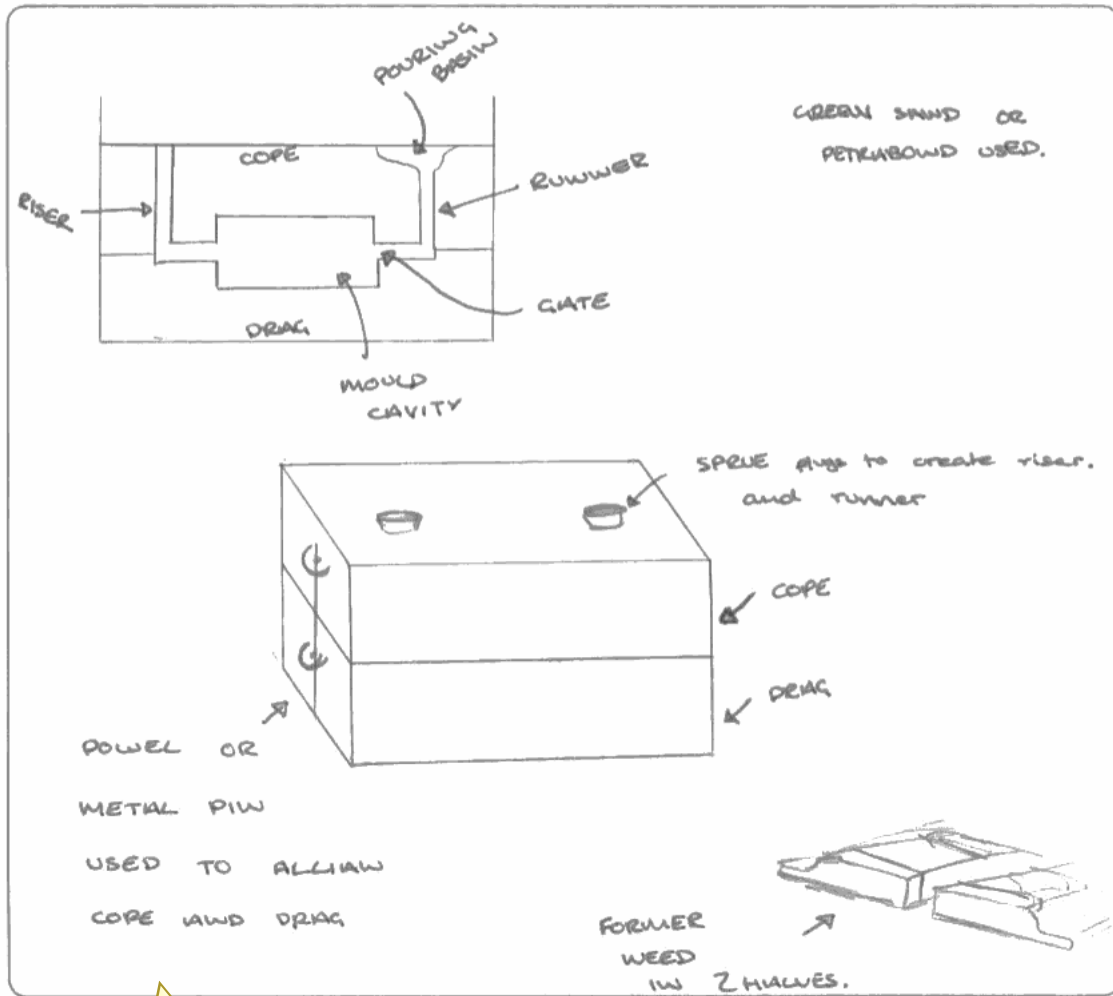
Candidates need to be made much more aware of how frequently they repeat answers in different words, resulting in lost marks.

## Question 6 (b)

Generally a well answered question with the majority of candidates clearly understanding the structure of a split sand mould, although few gave sufficient detail to gain the full 5 marks available. Quality of sketching ranged from excellent to very poor, with marks only being awarded where features were clearly identifiable or labeled. Features that were regularly missed included the location pins for the cope and drag, a pouring basin, gates, parting powder and steam vents.

(b) Draw a labelled diagram to illustrate the structure of a split sand mould suitable for casting one of the vice bodies. (You do not need to show the detailed shape of the vice body.)

(5)



**ResultsPlus**  
Examiner Comments

A top quality answer with more than sufficient detail, clearly sketched and labeled to get the full marks.

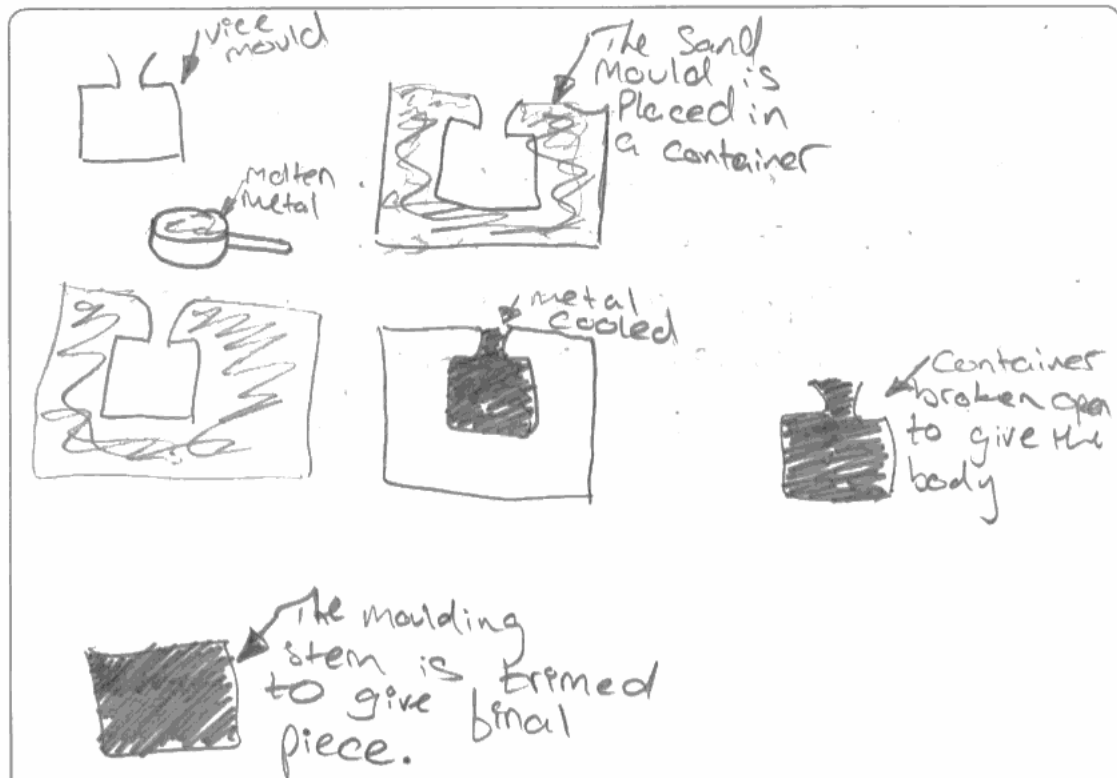


**ResultsPlus**  
Examiner Tip

Clear sketching shows a clarity of understanding and ensures that all details are identifiable.

(b) Draw a labelled diagram to illustrate the structure of a split sand mould suitable for casting one of the vice bodies. (You do not need to show the detailed shape of the vice body.)

(5)



### ResultsPlus Examiner Comments

This weak response shows the structure of an investment casting mould rather than a split sand mould and is therefore invalid.



## Question 6 (c)

Most candidates scored reasonably well here showing a solid understanding of the main characteristics of die casting, although few reached full marks. Three explained points are needed to gain the 6 marks available. Instead of structuring answers carefully, candidates frequently just wrote as much as they could. This often resulted in explanations missed and frequent deviations.

\*(c) A batch of one thousand machine vices are to be manufactured.

Justify the selection of die casting in preference to sand casting for this scale of production.

(6)

- Die casting moulds can be reused for every process. This makes it cheaper for the company.
  - Sand casting is very labour intensive and takes ~~more time~~ <sup>the cost</sup> of labour for sand casting is too great for batch production.
  - Sand casting is a long process in comparison to die casting this reduces how quickly the vices are produced decreasing company profit.
  - Sand casting can be very dangerous as hot liquid is used this can harm humans especially if green sand is used. Thus die casting is a lot safer to be used for production as it can be machine operated.
- Sand casting requires the human to be near while and can release toxic fumes that can harm people.
- Die casting produces much more <sup>of an</sup> exact product thus it will increase the accuracy and quality meaning it is more suitable than sand casting.
- Die casted products require less finishing than sand casted products where the runner and riser must be filed off.

### ResultsPlus Examiner Comments

A bullet pointed technique is initially used by this candidate which helped them stay focused, ie. make a point, explain it, then move on. Although not all points presented here are explained, the candidate has given more than needed to gain the maximum mark.

### ResultsPlus Examiner Tip

Although quality of written communication is taken into consideration in this question, indicated by the asterisk by the question number, this should not exclude the use of bullet points. Bullet points still allow candidates to communicate clearly and use technical language in well structured sentences.

\* (c) A batch of one thousand machine vices are to be manufactured.

Justify the selection of die casting in preference to sand casting for this scale of production.

(6)

It is easier than sand casting, cheaper than sand casting and faster than sand casting. Die casting also gives a better quality product when made in batch production, compared to sand casting which has a rougher finish. A another reason is that die casting takes alot less effort ~~and~~ than sand casting.



**ResultsPlus**  
Examiner Comments

The candidate has made a number of simple unjustified statements resulting in picking up limited marks.

### Question 7 (a) (i)

The majority of candidates responded correctly. Common incorrect responses were often vague, referring to testing against general 'safety' standards or wrongly focused onto BSI standards.

### Question 7 (a) (ii)

Few candidates had a clear understanding of why the CE mark was established resulting in a large majority of poor responses. Most incorrectly focused on protecting the consumer from poor quality products or being a sign of quality to the consumer. A small number of candidates identified that the mark was established to reduce the restrictions on businesses trading their goods across Europe.

(ii) Explain why the CE mark was established.

(2)

To monitor and control the standards of products being traded in and around Europe, making trading fairer and safer.



**ResultsPlus**  
Examiner Comments

One of the few clear responses. The candidate shows a clear understanding that the CE mark concerns trading across Europe.

(ii) Explain why the CE mark was established.

(2)

To protect the consumer from sub-standard goods that could potentially harm the user in some way.



**ResultsPlus**  
Examiner Comments

A more typical incorrect response that is focused on the consumer, and is more appropriate as to why BSI standards were established rather than the CE mark.

## Question 7 (b)

This final question showed a clear boundary between candidates who understood the thrust of TQM and its effects on the workforce, and candidates who simply presumed that TQM was just more and more testing. A good number of strong answers were presented, although some lost out on maximum marks as they failed to present a negative point along side the positives, which is a requirement in a 'discuss' question. Weak responses focused on increased levels of quality control, and it was not uncommon for this to lead to TQM being presented as wholly negative strategy, increasing costs and reducing production rates.

\*(b) Discuss the implications for a company that is considering upgrading its quality assurance systems to total quality management (TQM) practices.

(6)

many new machines would have to be purchased to check the quality of products. It would take longer for products to be totally manufactured as it would take longer to perform all the quality checks. CE marks would have to be established for the products. More safety checks would need to be considered what with the upgrading of the quality assurance systems.



**ResultsPlus**  
Examiner Comments

A weak response that failed to gain any marks. TQM is described as a negative move that is of no benefit, indicating that the candidate has no understanding of what TQM is really about.

\* (b) Discuss the implications for a company that is considering upgrading its quality assurance systems to total quality management (TQM) practices.

(6)

Total quality management practices would involve ~~the~~ each part or sector of the company knowing that the components other sectors have made are of a safe, reliable quality and have met standards and are therefore safe to work with. This could create a <sup>greater</sup> sense of teamwork around the company as they all know they are working together to achieve a safe reliable final product, improving job satisfaction. If the company is accredited with the ISO 9000 system then customers will know, due to the British Standards mark displayed on their product, that the product is of a safe reliable standard, and that the product has gone through quality control checks at each stage of manufacture. It could also save money as the products will be improved and be of a higher standard and therefore less material will be wasted, it will also make the product more appealing and the customers could buy it more. The company will also keep on ever improving as feedback will be given at every stage of development, including customer feedback, this feedback can be learnt from and improvements can therefore be constantly made.



### ResultsPlus Examiner Comments

A very thorough response showing a clear understanding of what TQM is and its implications above and beyond QA systems. The candidate has given more than enough points to score full marks, but has not been awarded the maximum due to all the points being positives. The 'discuss' command word requires a balanced argument hence at least one point has to be a negative for maximum marks



### ResultsPlus Examiner Tip

Ensure you give at least one positive and one negative point in response to a 'discuss' command word.

## Paper Summary

Most candidates have responded well to this paper and are likely to have been able to do justice to their abilities. Having said this, there are a small number of areas where centres can help their candidates to gain a sharper focus consolidating their performance.

**Quality of diagrams** - If detail in diagrams does not clearly communicate the required knowledge then marks will not be awarded. Careful drawn diagrams with clear labels are essential for high marks.

**Structured answers** - Candidates must be taught to take note of the number of marks available per question and give at least that many points.

**Command words** - Although clearly improving, a greater focus and more practice in responding to the different command words will enable candidates to gain all the marks their knowledge deserves.

**Mechanisms** - This was without doubt the area of the paper candidates found most challenging. These topics must be specifically taught and re-inforced.

**Common errors** - Candidates should be shown examples of common errors such as duplicating answers with different words, and stating the same point from two perspectives. Making them aware of these pitfalls will reduce the frequency of their occurrence. To emphasise this, several examples have been included in this report.

## **Grade Boundaries**

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