

**Qualification title:** Level 2 Technical Award in Engineering (1145-20)

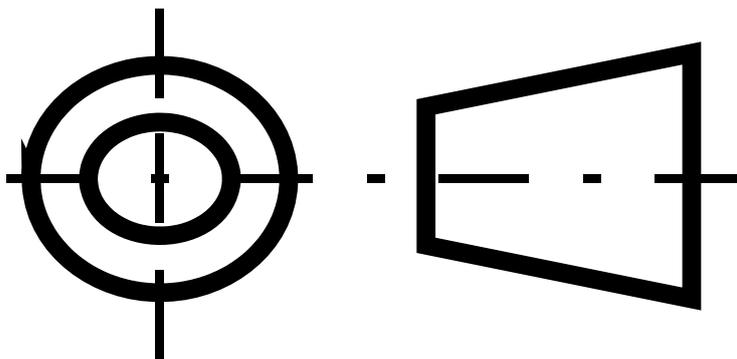
**Test title:** Externally set, externally marked

**Version:** Sample

**Base mark:** 80

**1a**

What does this symbol represent on an orthographic drawing?



**Answer:**

- **Third angle projection.**

Award 1 mark for correct response.

**Test spec reference:** 201.01

**Total marks:** 1

**1b**

The following types of line are used on an orthographic drawing:



What letter represents the line for:

- i. Hidden detail
- ii. Centre line
- iii. Visible outline

**Answer:**

- i. C
- ii. A
- iii. D

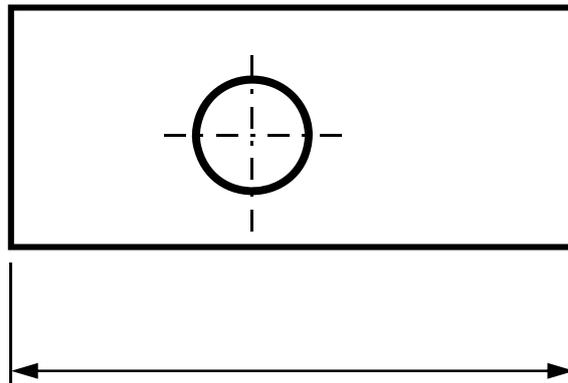
Award 1 mark for each correct response.

**Test spec reference: 201.01**

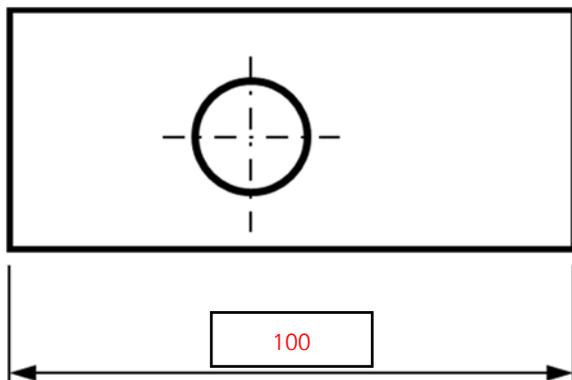
**Total marks: 3**

**1c**

A component has a length of 100. Place the value in the correct location on the drawing.



**Answer:**



Award 2 marks for the correct location, as shown in the diagram above.

Award 1 mark if it is central but below the dimension line  
Award 1 mark if it is above the dimension line but not central.

**Test spec reference: 201.01**

**Total marks: 2**

**1d**

Explain the purpose of:

- i. orthographic drawings
- ii. exploded views
- iii. isometric views.

**Answer:**

- i. Orthographic drawings communicate sizes (1) so that manufactures can accurately make the components (1).
- ii. Exploded views show how the parts fit together (1) so that products can be assembled correctly (1).
- iii. Isometric views show a 3D image of the product (1) to give a better visual representation of the final product (1).

For each response, award 1 mark for a basic explanation or 2 marks for a detailed explanation to a maximum of 6 marks.

**Test spec reference: 201.01**

**Total marks: 6**

**1e**

Discuss the advantages and disadvantages of using CAD software instead of manually creating drawings of products.

**Answer:**

**Indicative content:**

Advantages

- Increased accuracy.
- Drawings can be changed quickly.
- You can edit a previous drawing – you do not have to restart it from scratch.
- Drawings can be shared electronically.
- People in different parts of the world can work on the same drawing at different times of the day.
- Electronic files can be sent directly to machines to make products
- Products can be tested virtually
- Different renders can be applied to see what the drawing looks like
- Libraries of standard parts can be used

Disadvantages

- Training may be required to use the software
- The CAD software can be quite expensive
- Any other appropriate response

**Band 1 1-2 marks**

Advantages and disadvantages of using CAD software are stated

**Band 2 3-4 marks**

Advantages and/or disadvantages of using CAD software are presented with some reasoning

**Band 3 5-6 marks**

Advantages and disadvantages of using CAD software are discussed

Example answers:

**Band 1**

There is increased accuracy and drawings can be changed easily.

**Band 2**

Drawings can be changed more easily as you can edit a drawing that has been made before.

**Band 3**

Drawings can be changed more easily as you can edit a drawing that has been made before, if it has been made using the same software. However the software is expensive and without security it could be stolen by a competitor.

**Test spec reference: 201.02**

**Total marks: 6**

**2a**

Define the following properties of materials.

- i. Tensile strength
- ii. Hardness

**Answer:**

Tensile strength - The ability to resist being broken due to a pulling force

Hardness - The ability to resist abrasion and scratches

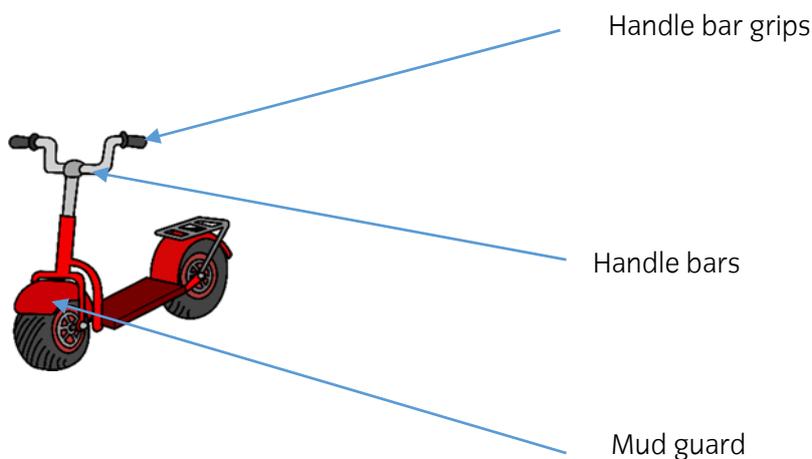
Award 1 mark for each correct response to a maximum 2 marks.

**Test spec reference: 202.01**

**Total marks: 2**

**2b**

The picture below shows a child's scooter.



For **each** part of the scooter identified, state a suitable material that it could be made from. Explain why your choice is suitable.

- i. Handle bar grips

- ii. Mud guard
- iii. Handle bars

**Answer:**

- i. Award 1 mark for rubber or a suitable named polymer material (1)

2 marks can be awarded for two separate reasons or one reason explained in detail.

Good grip (1), resistant to sweat or rain (1), can be formed by injection moulding so is cost effective (2)

- ii. Award 1 mark for any of a suitable named polymer, stainless steel, aluminium or painted mild steel

2 marks can be awarded for two separate reasons or one reason explained in detail.

Rigidity (1), resistant to corrosion which is important as the scooter is likely to come into contact with water (2), formability (1)

- iii. Award 1 mark for stainless steel, aluminium or painted mild steel

2 marks can be awarded for two separate reasons or one reason explained in detail.

Rigidity (1), strength (1), toughness so it doesn't break when dropped or hits something (2)

**Test spec reference: 202.01**

**Total marks: 9**

**2c**

It has been suggested that the scooter should have a lighting system. The design criteria for this system are:

- Weatherproof
- Shock proof
- Aesthetic
- Energy efficient
- Low cost
- Low maintenance

The product will have:

- A light source
- A power source
- A case

Suggest how the prototype should be developed to meet these requirements. Justify your suggestions.

**Answer:**

Indicative content

- LEDs - low power consumption, long life, low cost, small size
- Batteries - lightweight, potentially rechargeable
- Use kinetic energy from the scooter
- Case – durability, size, weatherproof (non-corrosive), impact resistant
- On/off switch – weatherproof, small size
- Internal connections – PCB or stripboard, screwed connections

**Band 1 1-3 marks**

Responses focus on what should be in the final product rather than consideration of how it meets the design criteria.

**Band 2 4-6 marks**

Suggestions are made with some reasons for how they relate to the design criteria. Limited reference to prototyping.

**Band 3 7-8 marks**

All design criteria addressed with reasoned suggestions related to prototyping.

Example answers:

**Band 1**

There should be LED light as the light source. There should be a battery to power the light. These would be in a plastic case.

**Band 2**

Light source – use LEDs as they are energy efficient and will not require replacement.

Power source – battery which gives long life and is light and small so aesthetic.

Case – ABS case as it would be lightweight and readily available in different sizes as a modular kit it would be easy to put in a prototype.

**Band 3**

Light source – use LEDs as they are energy efficient and will not require replacement. They are small size so aesthetic and PCB mountable. It is also possible to select LEDs for specific applications so it is easy to try different ones to determine the best.

Power source – battery such as lithium which gives long life and is light and small so aesthetic. It is possible to calculate how long it would last as part of prototype testing.

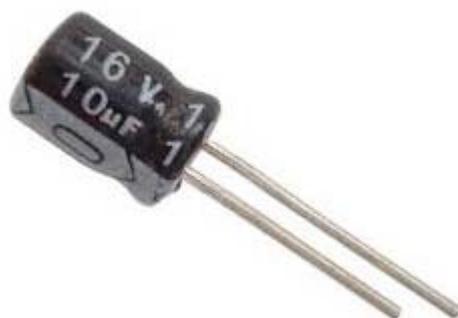
Case – ABS case as it would be lightweight, weatherproof and shockproof. It is also low cost and readily available in different sizes as a modular kit it would be easy to put in a prototype. It also means that it doesn't have to be tested as it has already been proven and this will save time.

**Test spec reference: 201.03, 202.01, 202.03, 202.04**

**Total marks: 8**

**3a**

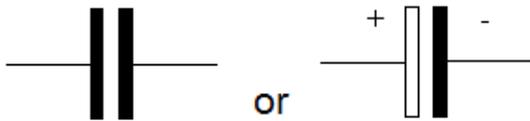
This picture shows a capacitor.



- i. What is the purpose of a capacitor?
- ii. State the unit in which capacitance is measured.
- iii. Draw the circuit symbol for a capacitor.

**Answer:**

- i. It stores electrical charge
- ii. Farads
- iii.



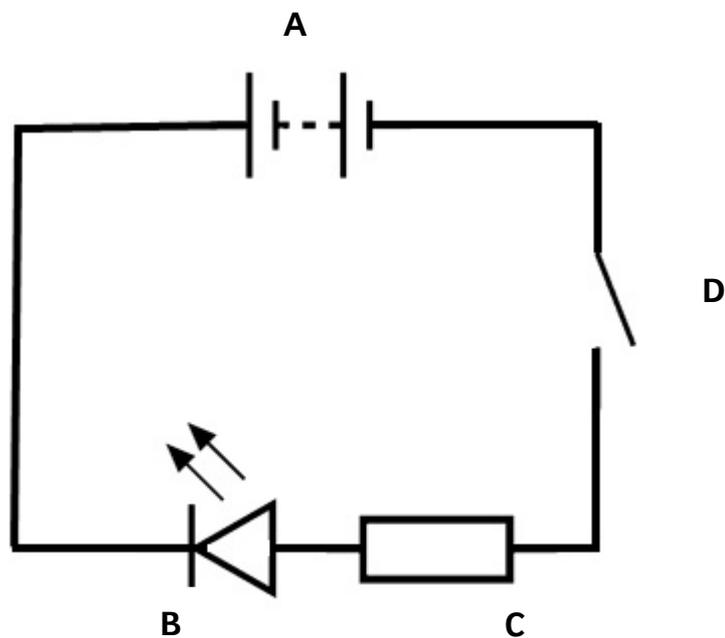
Award 1 mark for each correct response.

**Test spec reference: 201.01, 201.03, 201.04**

**Total marks: 3**

**3b**

- i) The diagram below shows an electrical circuit.



Identify the labelled components shown in the circuit.

**Answer:**

- A Battery (accept cell)
- B Light emitting diode (accept LED)
- C Resistor
- D Switch

Award 1 mark for each correct response

**Test spec reference: 201.03**

**Total marks: 4**

**3b**

- ii) A designer is deciding how to make a prototype of the circuit.

Explain two advantages and one disadvantage of using a breadboard to prototype the circuit

**Answer:**

Indicative content

Advantages

- It uses the actual components
- Components can be reused
- Changes can be made quickly

Disadvantages

- Components can be loose
- Components can be damaged

Award up to 2 marks for each response. 1 mark each for a basic explanation, 2 marks for detailed explanation to a maximum 6 marks:

- It uses the actual components that will be used in the circuit (1)
- Components can be reused (1) which will mean a cost saving (1)
- Changes can be made very quickly (1)
- Components can be loose / fall out of the breadboard (1) which will slow down the process/so will not work as anticipated (1)
- Components can be damaged (1)

**Test spec reference: 202.03**

**Total marks: 6**

**3c**

Describe how an electrical component should be fixed to a printed circuit board using soldering.

**Answer:**

Indicative content

- Place the component in the correct location on the PCB
- Tin the soldering iron
- Apply heat to the join / use the soldering iron
- Feed in the solder
- Any other appropriate response

Award 1 mark for each relevant action up to a maximum 3 marks.

**Test spec reference: 202.02**

**Total marks: 3**

#### 4a

A designer is thinking about making a product by vacuum forming.

- i. Describe the process of vacuum forming a product from start to finish.

**Answer:**

Indicative content

- Place mould in the machine
- Clamp plastic over the mould
- Heat the plastic
- Raise the plattern / mould
- Turn on the vacuum / suck the air out
- Blow back some air.
- Lower the plattern / mould.
- Remove the mould.
- Cut of any excess material
- Any other appropriate response

Award 1 mark for each relevant point in the process up to a maximum of 5 marks. Award 1 mark for correct sequence in a process where a minimum of four correct points in the process are given.

- ii. State a suitable material for vacuum forming.

**Answer:**

- Thermoplastic or any named thermoplastic

Award 1 mark for a correct response

- iii. Give two reasons why this material is suitable for vacuum forming.

**Answer:**

Award 1 mark each of any two of the following points:

- When heated it changes shape
- When cooled it retains the new shape
- It can be reshaped
- Any other appropriate response

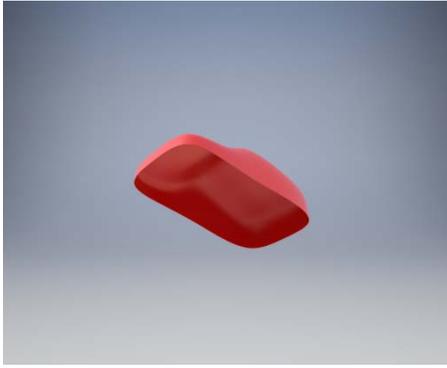
**Test spec reference: 202.02; 202.02**

**Total marks: 9**

#### 4b

A designer has created a plastic shell to be used as the body of a remote control car.





Evaluate the suitability of using the vacuum forming process to make a prototype of this product.

**Answer:**

Indicative content:

- Smooth surfaces
- Rounded edges
- No overhang
- Draft angle
- Will need holes cut out for wheels etc
- Needs to be cut from main sheet
- Good for a prototype as quick
- Good if production is small scale
- Not suitable for mass production
- Requires a mould to build from

**Band 1 1-3 marks**

Answers should be written in full sentences. Response shows a basic evaluation and relationship between design and production/prototyping.

**Band 2 4-6 marks**

There is some structure and logic in development of concepts and ideas with answers written in full sentences. Response shows a reasoned evaluation and relationships between design and production/prototyping

**Band 3 7-8 marks**

There is well-structured and organised development of concepts and ideas. Answers are written in full sentences with effective use of technical language. Response shows a justified evaluation and clear relationship between design and production/prototyping

Example answers

**Band 1**

It would be good as it has round edges and no overhang.

**Band 2**

The car has been designed to have smooth surfaces and rounded edges to come out of the mould easily. This is a good method of prototyping this product because it is cheap process and quick. If this were for mass production, it is not suitable as several moulds would be need to be produced and this would be time consuming and costly.

**Band 3**

The car has been designed to be aerodynamic and so the surfaces are smooth and edges rounded. Without this vacuum forming couldn't take place as sharp edges would fracture or not

form. This is a good method of prototyping this product because it is a relatively cheap process and can be produced quickly. Modifications can be made quickly if testing shows that changes are needed. If this were for mass production, it is not suitable as several moulds would be need to be produced and this would be time consuming and costly. A process such as injection moulding would be more suitable. It is also quick but cheaper when producing large quantities. It is unclear whether this is to be mass produced, this would be shown in the design criteria.

**Test spec reference: 202.02, 202.04**

**Total marks: 8**

### 5a

A designer has made a prototype of the product shown below from a solid block of aluminium that was in the workshop.



- i. Explain why the designer might choose to use a different form of aluminium for the final product.

**Answer:**

- i. Award 1 mark for any of the following, up to a maximum of 2 marks:
- To reduce the amount of machining required (1), saving cost (1).
  - To reduce wastage (1) and environmental impact (1)
  - Any other appropriate response
- ii. Other than a solid block, name a form of aluminium that would be more suitable for making this product.

**Answer:**

- iii. Bar. No other response is acceptable.  
Award 1 mark for correct answer.

**Test spec reference: 202.01**

**Total marks: 3**

### 5b

The tolerance of a 10mm hole is  $\pm 0.2$  mm.

- i. What is the upper acceptable limit of the hole size?

**Answer**

i. 10.2mm

1 mark for correct answer. The SI unit must be stated for the mark to be awarded.

ii. Explain how the diameter of the hole would be accurately measured.

**Answer:**

Indicative content

- Vernier callipers.
- Plug gauge.
- Use the reverse side of the callipers
- Open callipers until they touch the edge.
- Insert a series of plug gauges until you find one of the correct size.

**Band 1 1-2 marks**

Responses are mainly descriptive

**Band 2 3-4 marks**

Responses include some reasoning and focus mainly on the measuring device rather than how used.

**Band 3 5-6 marks**

Responses are reasoned and include reference to the type of measuring device and the process to be followed

Example answers

**Band 1**

Vernier callipers should be used.

**Band 2**

Vernier callipers should be used because they are more accurate and can measure to an accuracy of 0.2mm.

**Band 3**

Vernier callipers should be used because they are more accurate and can measure to an accuracy of 0.2mm. To ensure repeatability the reverse side of the callipers would be used so that it touches the edges and this makes it more precise and accurate.

**Test spec reference: 201.01, 201.04;  
201.04**

**Total marks: 7**