



Rewarding Learning

General Certificate of Secondary Education
2022

Centre Number

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Candidate Number

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Engineering and Manufacturing

Unit 3
assessing
Materials, Processes and Systems



GEM31

[GEM31]

WEDNESDAY 22 JUNE, MORNING

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all eleven** questions.
Answer **all** questions in Sections **A** and **B**.
Questions 1, 2, 3, 4 and 5 of Section A refer to the pre-release material, a copy of which has been provided for you.

You may use a calculator for this paper.
Quality of written communication will be assessed in Question 5.

INFORMATION FOR CANDIDATES

The total mark for this paper is **100**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each part question.

| For Examiner's use only | |
|-------------------------|-------|
| Question Number | Marks |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |

| | |
|--------------------|--|
| Total Marks | |
|--------------------|--|

Section A

Questions in this section refer to the pre-release material.

- 1 (a) (i) State a mechanical property that makes low carbon steel a suitable material for the body of the trolley jack.

_____ [1]

- (ii) Suggest a suitable finish for the main body of the trolley jack.

_____ [1]

- (b) The trolley jack will fail at a load of 2 tonnes. The trolley jack has a factor of safety of 2. What weight should be indicated on the maximum load label of the trolley jack?

_____ [2]

- (c) (i) The trolley jack castor support bracket is made by press forming. Using an annotated sketch, show the process of press forming for the castor support bracket.

[4]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

(ii) When drilling the holes in the castor support bracket, the manufacturer used a jig.

Why would a jig be used for this process?

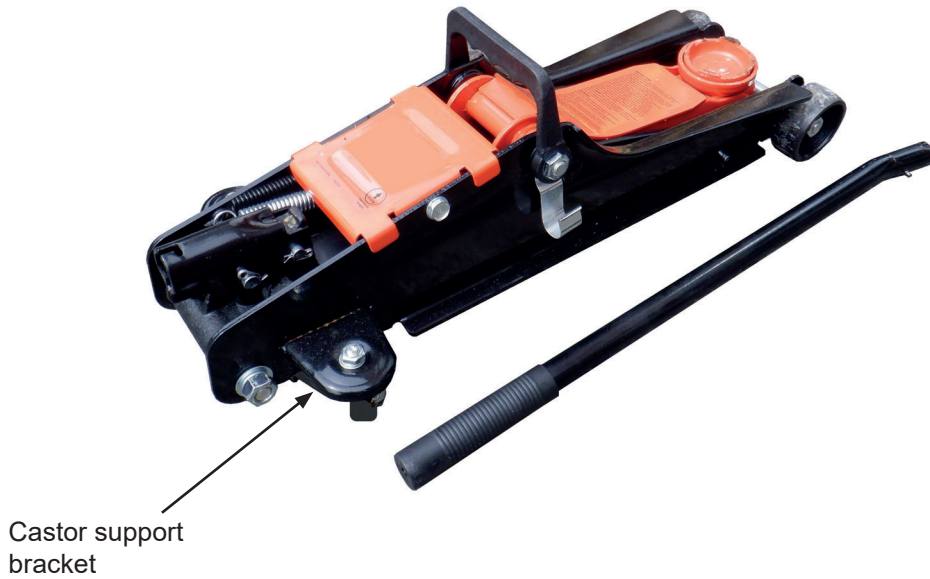
_____ [1]

(iii) Other than cost, why have rivets been used to attach the castor support brackets to the body of the jack?

_____ [1]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

4 Fig. 1 shows the castor support bracket on the trolley jack.



© Examiner

Fig. 1

In the space provided, use 2D, assembly and exploded annotated sketches, with appropriate terminology, to show how the castor support bracket is secured to the main body of the trolley jack.

Marks will be awarded for:

Detail contained in the sketches

Quality of sketches

Annotation

[4]

[4]

[4]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

Show your response to Question 4 in the space below.

Examiner Only

Marks Remark




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(Questions continue overleaf)

Section B

6 (a) Complete **Table 1** by inserting the name for the sign shown.

Table 1

| Sign | Name |
|---|------|
|  | |
|  | |
|  | |

Source: © CCEA

[3]

(b) Pneumatics are used in a range of transport systems.

Outline **two** applications of pneumatics in transport systems.

1. _____
_____ [1]

2. _____
_____ [1]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

8 (a) Outline the difference between a ferrous metal and a non-ferrous metal.

[1]

(b) Chipboard, plywood and glass reinforced plastics (GRP) are used for many applications in engineering.

(i) Outline the difference in the structure between chipboard and plywood.

[2]

(ii) Name a product that is made from GRP.

[1]

(c) Complete **Table 2** by stating the most suitable permanent joining method for each of the materials listed.

Table 2

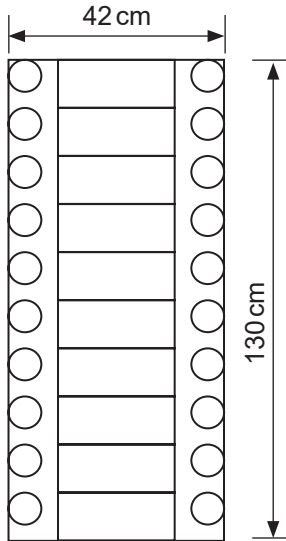
| Materials to be joined | Most suitable permanent joining method |
|--------------------------------------|--|
| Acrylic to acrylic | |
| Wood to wood | |
| Low carbon steel to low carbon steel | |

[3]

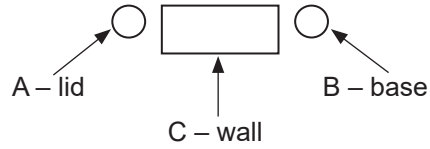
| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

- (iii) For a different sized can it was calculated that 10 cans could be made from a single sheet measuring 42 cm by 130 cm as shown in Fig. 4. Calculate the percentage waste from the single sheet shown in Fig. 4.

10 cans fitted on sheet



Layout of one can



Area for parts A, B and C

$$A = 50.24 \text{ cm}^2$$

$$B = 50.24 \text{ cm}^2$$

$$C = 301.44 \text{ cm}^2$$

Fig. 4

Show your working out in the space below.

Answer _____ % [3]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

(b) Give **two** reasons why food cans are electroplated.

1. _____
_____ [1]

2. _____
_____ [1]

(c) Outline **two** reasons why steel cans are recycled.

1. _____
_____ [1]

2. _____
_____ [1]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

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(Questions continue overleaf)

11 (a) An engineering company is considering adopting the just-in-time production method.

Outline **two** characteristics of the just-in-time production method.

[2]

(b) The automotive industry is shifting its focus from the use of internal combustion engines to a range of new technologies to power vehicles.

Discuss the impact this will have on the workforce in the automotive industry.

Your answer should focus on **two** impacts.

[4]

| Examiner Only | |
|---------------|--------|
| Marks | Remark |
| | |

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WEDNESDAY 22 JUNE, MORNING

**PRE-RELEASE
MATERIAL**

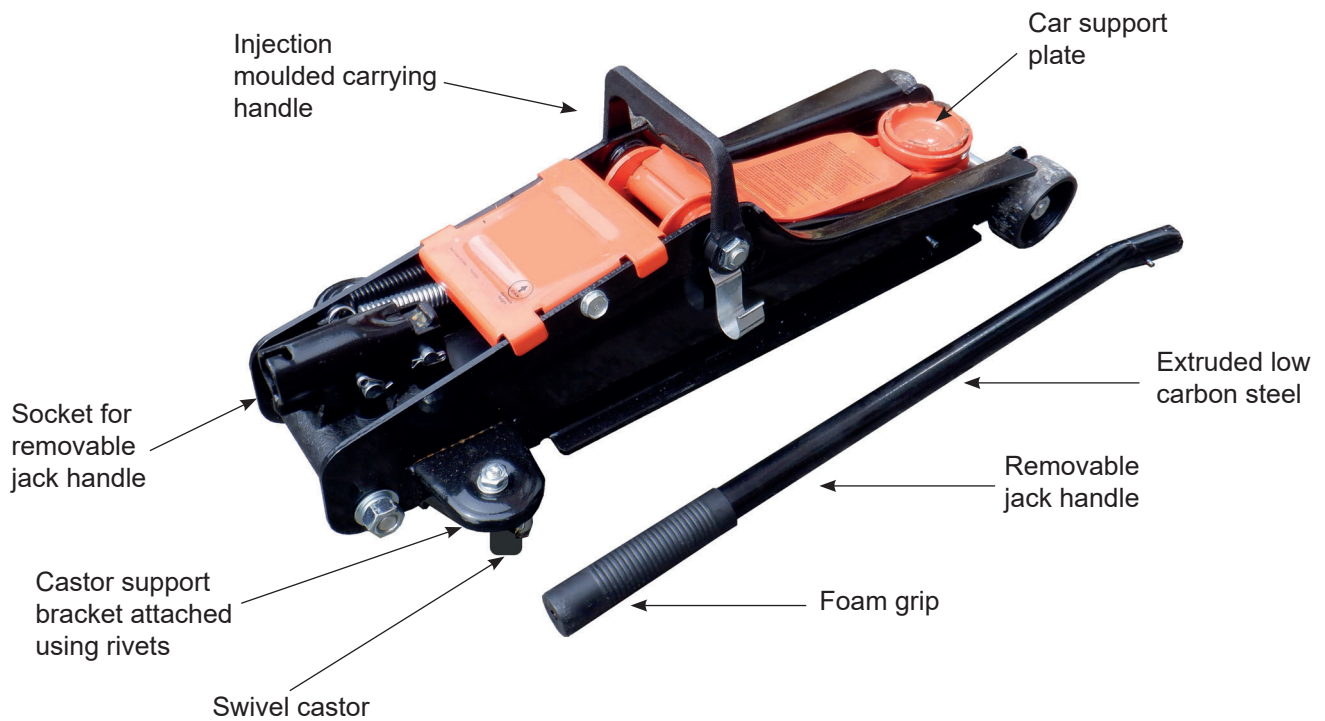
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Fig. 1 and Fig. 2 show a trolley jack.



© Getty Images

Fig. 1



© Examiner

Fig. 2

Product features include:

- Folded sheet, low carbon steel main body;
- Swivel plastic castors;
- Low carbon steel castor support brackets;
- Injection moulded carrying handle;
- Jack handle with foam grip;
- Dimensions (assembled) Height (200 mm) – Length (500 mm) – Width (200 mm); and
- A Maximum indicated load.

Pre-release investigation:

You should investigate the possible impact and use of the following where appropriate, in the design and production of the trolley jack:

- Materials and components: including application, properties, form, supply and types of finish;
- Manufacturing processes: including joining, folding, assembly and the use of standard parts;
- Environmental issues relating to the disposal and manufacture of the product or parts of the product;
- Quality control and quality assurance; and
- Costing: including direct and indirect costs incurred in the manufacture of the trolley jack.

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