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| Write your name here  |  |  |   |
| Surname   |  | Other names  |   |
| <b>Pearson</b><br><b>Edexcel GCE</b>  |  | Centre Number  | Candidate Number  |
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| <h1 style="margin: 0;">Engineering</h1> <h2 style="margin: 0;">Unit 1: Engineering Materials, Processes and Techniques</h2> |  |  |   |
| Monday 15 May 2017 – Morning  |  | Paper Reference  |   |
| <b>Time: 1 hour 30 minutes</b>  |  | <b>6931/01</b>   |   |
| <b>You do not need any other materials.</b>   |  |  | Total Marks<br><div style="border: 1px solid black; height: 40px; width: 100%;"></div>  |

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

### Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (\*) are ones where the quality of your written communication will be assessed  
– *you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*

### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

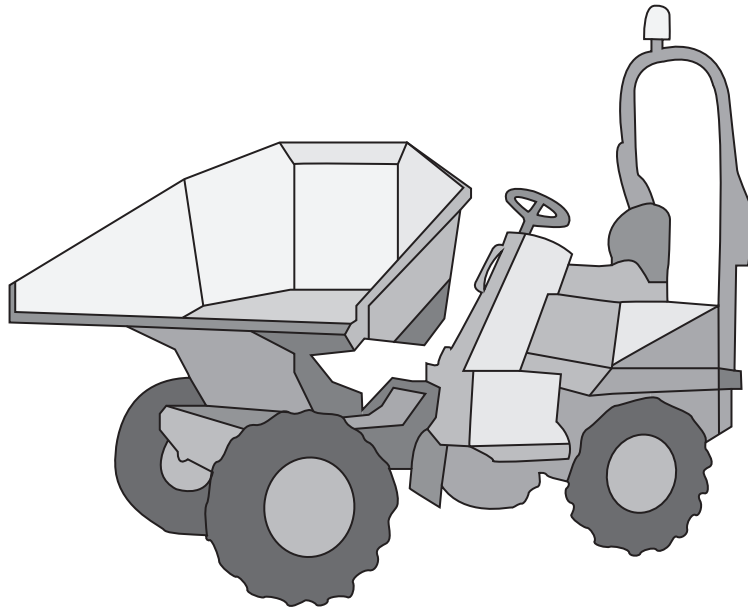
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**Answer ALL questions. Write your answers in the spaces provided.**

Some of the questions in this paper relate to a dumper truck, as shown in **Figure 1**.



**Figure 1**

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- 1 The materials used to manufacture the dumper truck can be grouped into classes.

From the materials listed, complete the following table by naming:

- the class of each material
- **one** significant property of each material.

Each answer must be different.

| Specific material      | Class of material | Significant property of material |
|------------------------|-------------------|----------------------------------|
| High carbon steel      |                   |                                  |
| Polyamide (nylon)      |                   |                                  |
| Urea formaldehyde (UF) |                   |                                  |

(Total for Question 1 = 6 marks)

2 The table below lists four processes used in manufacturing the dumper truck.

Complete the table by giving:

- **one** risk involved in each process
- **one** different precaution/control measure to prevent injury.

Each answer must be different.

| Process            | Risk | Precaution/Control measure |
|--------------------|------|----------------------------|
| Metal drilling     |      |                            |
| MIG welding        |      |                            |
| Spray painting     |      |                            |
| Handling hot metal |      |                            |

(Total for Question 2 = 8 marks)

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- 3 The table below shows the properties of some materials used in the manufacture of the dumper truck.

| Material         | Density $\text{kg m}^{-3}$ | Electrical resistivity $\text{ohm-m}$ | Tensile strength $\text{MN m}^{-2}$ |
|------------------|----------------------------|---------------------------------------|-------------------------------------|
| Rubber           | 1200                       | $>10^{11}$                            | 30                                  |
| Copper           | 8960                       | $1.68 \times 10^{-8}$                 | 215                                 |
| Low carbon steel | 7860                       | $10.6 \times 10^{-8}$                 | 690                                 |
| Aluminium        | 2700                       | $27.0 \times 10^{-8}$                 | 82                                  |
| Brass            | 8360                       | $9.0 \times 10^{-8}$                  | 500                                 |
| Cast iron        | 7000                       | $10 \times 10^{-8}$                   | 200                                 |

Using the information in the table and your knowledge of materials, select the most appropriate material to use for the following parts of the dumper truck and explain your choice.

- (a) The electric cables that supply power to the instruments

(i) Material

(1)

(ii) Explanation

(2)

(b) The tyres that move the dumper truck

(i) Material

(1)

(ii) Explanation

(2)

(c) The engine block that supports the pistons to provide the power to move the dumper truck

(i) Material

(1)

(ii) Explanation

(2)

(d) The axle that provides power to rotate the wheels

(i) Material

(1)

(ii) Explanation

(2)

**(Total for Question 3 = 12 marks)**

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4 **Figure 2** shows an illustration of a crankshaft.



**Figure 2**

- (a) Explain why hardness and toughness are important properties in the smooth running of the crankshaft.

(4)

- (b) Describe, with the aid of diagrams, a hardness test for low carbon steel. Name the hardness test and state the units of measurement.

Name of hardness test

Units of measurement

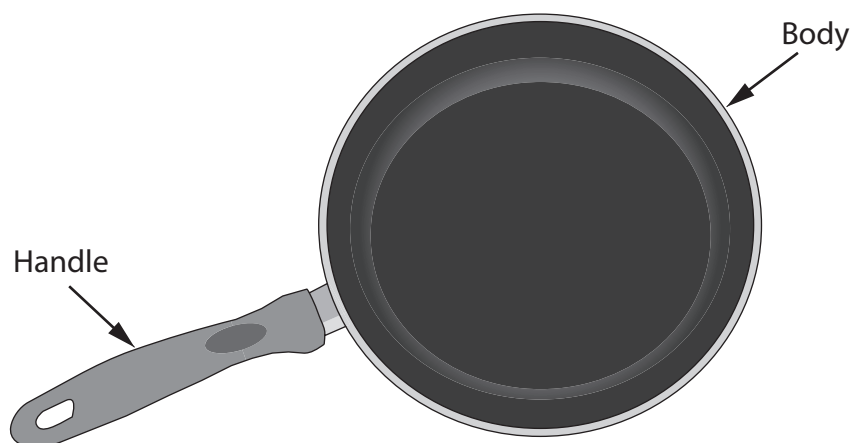
(6)

- (c) Describe, with the aid of diagrams, the difference between compressive strength and tensile strength.

(6)

(Total for Question 4 = 16 marks)

5 Figure 3 shows a frying pan.



**Figure 3**

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- (a) The frying pan body is made from aluminium alloy using the press forming process.

Describe, using notes and sketches, how the body of the frying pan is manufactured.

(4)

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(b) Explain **two** reasons why aluminium is a suitable material for the body of the frying pan.

(4)

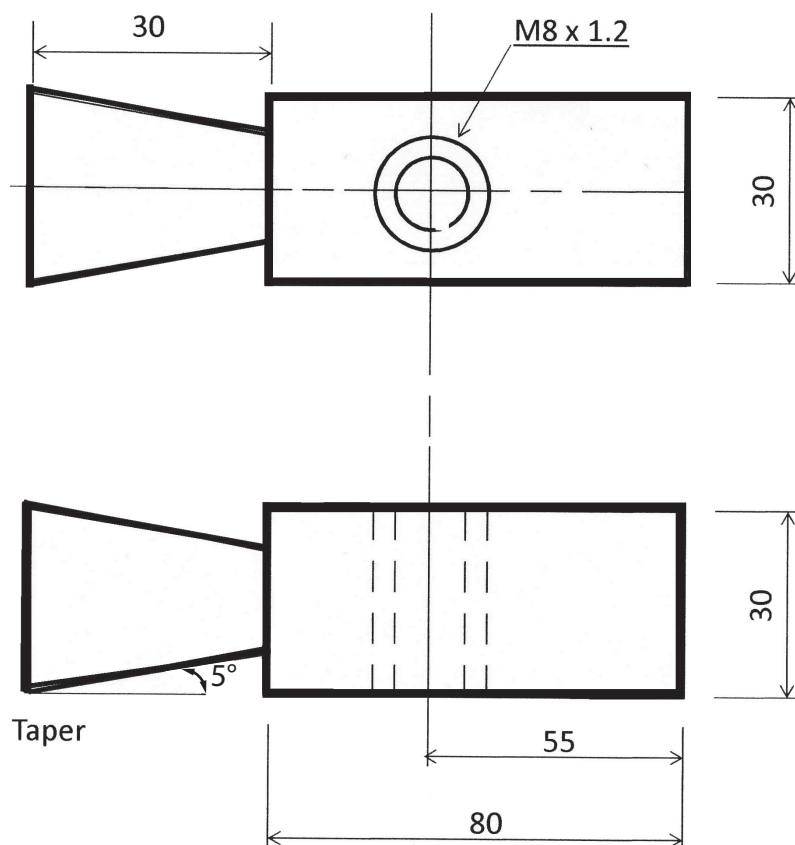
- (c) The frying pan handle is made from a thermosetting polymer. Using notes and diagrams, explain why a thermosetting polymer has been used in preference to a thermoplastic.

Your answer should refer to the molecular structure of each type of polymer.

(8)

(Total for Question 5 = 16 marks)

6 **Figure 4** shows a plan and front elevation of a hammer head.



All dimensions in millimetres

Not to scale

**Figure 4**

Describe, using notes and sketches, how the hammer head could be manufactured in a school workshop using a manual centre lathe.

Your description should include:

- a sequence of making tasks
- how the work is held centrally in the chuck
- how the taper is achieved
- how the screw thread is produced on the lathe using a tap
- how a drunken thread (a thread that wobbles in use) is avoided.



**Answer page for Question 6**

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**(Total for Question 6 = 12 marks)**

**7** A removable weatherproof canopy is required for the dumper truck.

Design a canopy that can be temporarily attached to the dumper truck.

Your design must include:

- a canopy that protects the driver from the weather
- a canopy that enables the driver to have an all-round view
- a temporary method of fastening the canopy to the dumper truck
- a safe working design that completely functions
- a justified choice of two materials used in the design of the canopy.

You should explain how each of the specification points have been achieved in your answer.

(10)

**Answer page for Question 7**

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**(Total for Question 7 = 10 marks)**

**\*8** The following materials were considered for the outer body of the dumper truck:

- mild steel
- aluminium alloy.

Evaluate the suitability of these materials with particular reference to performance requirements and ease of manufacture to determine the most appropriate material for the outer body of the dumper truck.

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(Total for Question 8 = 10 marks)

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**TOTAL FOR PAPER = 90 MARKS**