OCR

SPECIMEN

LEVEL 1/2 CAMBRIDGE NATIONAL AWARD/CERTIFICATE IN ENGINEERING MANUFACTURE

R109: Engineering materials, processes and production

Candidates answer on the question paper.

OCR Supplied Materials:
- None

Other Materials Required:
- None

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

1. Use black ink. HB pencil may be used for graphs and diagrams only.
2. Complete the boxes above with your name, centre number and candidate number.
3. Answer **all** the questions.
4. Write your answer to each question in the space provided.
5. Do **not** write in bar codes.

INFORMATION FOR CANDIDATES

1. The total number of marks for this paper is **60**.
2. The number of marks for each question is given in brackets [ ] at the end of the question or part question.
3. Dimensions are in millimetres unless stated otherwise.
4. This document consists of **12** pages. Any blank pages are indicated.

Answer **all** questions.

1 Materials are used in the manufacture of engineered products.

(a) **(i)** What is meant by the term non-ferrous metal?

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

(ii) Give **two** examples of non-ferrous materials.

.....

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

(b) **(i)** Describe what is meant by the term composite material.

.....

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

(ii) Name **two** composite materials used in engineered products.

.....

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

(c) Explain, using **one** example, why a polymer might be preferred to a metal for making an engineered product.

Example.....

.....

.....

.....

.....

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

2 (a) Malleability and Ductility are two properties of materials.
Describe what is meant by:

Malleability .....

.....

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

Ductility .....

.....

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

(b) Give **three** characteristics that should be considered when choosing materials for engineered products.

1 .....

2 .....

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

(c) Describe, using **one** example, what is meant by the term 'smart material'.

Example .....

.....

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.....

.....

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

3 Fig. 1 shows a drilling machine.

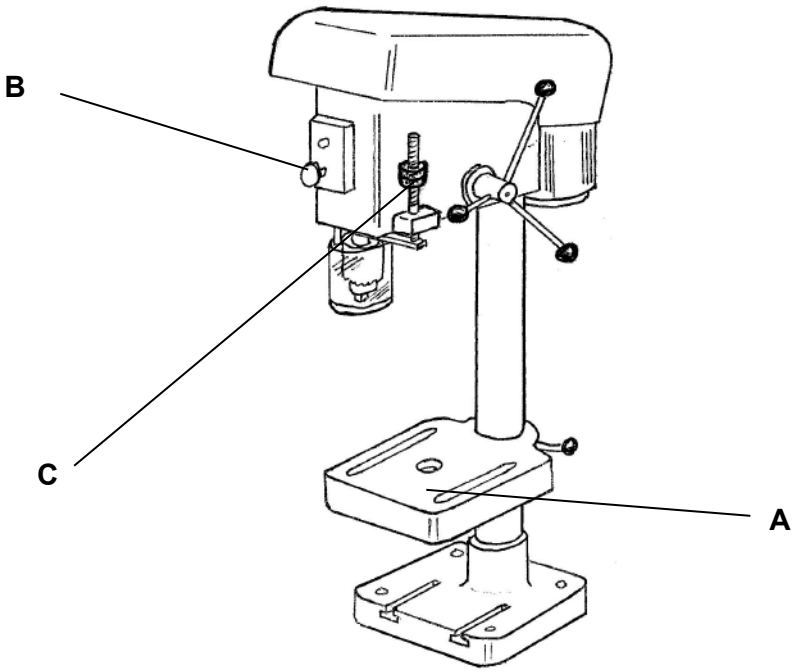

Fig. 1

(a) **(i)** Using the list below, name the **three** parts of the drilling machine that have been labelled in Fig. 1.

Depth stop	**Operating handle**
Drilling table	**Start button**
Locking handle	**Stop button**

A .....

B .....

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

(ii) Give **two** reasons why cast iron is a suitable material for the base of a drilling machine.

1 .....

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

(iii) Give **three** safety precautions that should be taken when operating a drilling machine, other than using Personal Protective Equipment (PPE).

1 .....

2 .....

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

(b) State **two** processes used in the high-volume manufacture of plastics products.

1 .....

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

4 (a) State **three** surface finishing processes that could be used to improve the corrosion resistance of a product made from mild steel.

1 .....

2 .....

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

(b) Heat treatment processes are used to modify the properties of engineering materials.

The list below gives the stages needed to harden and temper a centre punch made from high carbon steel.

Clean end of centre punch with emery cloth
Heat end of centre punch to purple
Heat end of centre punch to red hot
Quench in oil
Quench in water

(i) Complete the chart below by adding the missing stages in the correct order.

Stage
Quench in oil
Quench in water

[3]

(ii) Explain why it is necessary to temper a centre punch after hardening.

.....

.....

.....

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

(c) State **two** other heat treatment processes.

1 .....

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

5 Computer Numerically Controlled (CNC) machines are widely used in engineering production.

(a) State **three** different types of CNC machines.

1 .....

2 .....

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

(b) Identify **three** benefits to a manufacturer of using CNC machines for engineering production.

1 .....

.....

2 .....

.....

3 .....

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

(c) Explain, using **one** example, what is meant by 'additive manufacturing'.

Example .....

.....

.....

.....

.....

.....

.....

..... **[4]**

6 (a) Explain **two** benefits to the workforce of using modern technologies in engineering production.

Benefit 1 .....

.....

.....

.....

.....

Benefit 2 .....

.....

.....

.....

.....**[4]**

(b)* Discuss the impact of 'global manufacturing' on engineering production.

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.....

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

[END]

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SPECIMEN

LEVEL 1/2 CAMBRIDGE NATIONAL AWARD/CERTIFICATE IN ENGINEERING MANUFACTURE
R109: Engineering materials, processes and production

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

SPECIMEN

Question			Expected Answer(s)	Mark	Guidance
1	(a)	(i)	Any metal, including alloys, that does not contain iron.[1]	[1]	Accept ferrites in place of iron Properties such as low weight, higher conductivity, non-magnetic or resistance to corrosion should not be rewarded.
		(ii)	One mark for each correct answer Non-ferrous metal – aluminium alloys, copper, lead, tin, titanium and zinc, and alloys such as brass, bronze.	[2]	Accept other valid examples of non-ferrous materials such as: nickel, gold, silver, platinum and exotic or rare metals such as cobalt, mercury, tungsten.
	(b)	(i)	Two marks for a clear description. Composite materials are engineered materials made from two or more constituent materials [1] with significantly different physical or chemical properties [1] which remain on a separate level within the finished structure.[1]	[2]	Any variants of: Two or more materials, Different physical / chemical properties. Separate level in a structure.
		(ii)	One mark for each correct answer Concrete, GRP, carbon fibre.	[2]	Accept other valid examples such as: M.D.F, asphalt, chipboard.
	(c)		One mark for a relevant example; one mark for a reason for using a polymer; one mark for a comparison/reason for not using a metal. Example: A child's toy (1) might be made from a polymer rather than a metal because it would be lighter and safer than a metal one (1). The metal toy could have sharp corners but polymers can be used to make smooth rounded shapes more easily (1). 1 + (2x1)	[3]	Details of differences without example – 2 marks max. Allow one mark for an example without explanation if product is viable in both metal and polymer.
2	(a)		Up to two marks for each clear description. Malleability – the ability of a material to be formed into shape without breaking (2) Ductility – the ability of a material to be drawn out into lengths without breaking (2)	[4]	Simplistic responses e.g. bends easily – 1 mark only.

Question			Expected Answer(s)	Mark	Guidance
	(b)		One mark for each of three relevant characteristics. Examples: availability; relative cost; ease of use/storage; safety in use; forms of supply; sustainability. (3x1)	**[3]**	Accept any other relevant characteristic such as suitability for manufacturing process.
	(c)		One mark for an example and up to two further marks for a description. Description must include reference to material responding to external stimuli/changes.(heat/light/pressure). Example: The use of thermochromic inks in thermometers (1). As the temperature rises, the ink changes colour (1), but goes back to its original colour when it cools (1). 1 + (2x1)	**[3]**	Example of material or product required for full marks.
3	**(a)**	**(i)**	**A –** Drilling table **B –** Stop button **C –** Depth stop (3x1)	**[3]**	
		(ii)	One mark for each of two relevant reasons. Examples: Easy to cast into awkward shapes; heavy weight to help stability; strong in compression; relatively inexpensive; good machinability. (2x1)	**[2]**	One mark for two simplistic responses. e.g. cheap and heavy – one mark max.
		(iii)	One mark for each of three appropriate precautions. Examples: Workpiece clamped/held in vice; chuck guard in place; remove chuck key; keep workspace clear; keep hands away from moving parts. (3x1)	**[3]**	No marks for PPE.
	(b)		One mark for each process: Injection moulding; blow moulding; extrusion; rotational moulding; vacuum forming. (2x1)	**[2]**	

Question			Expected Answer(s)	Mark	Guidance
4	(a)		One mark for each of three appropriate processes. Examples: painting; galvanising; plastic/powder coating; electroplating. (3x1)	[3]	Accept oil blueing/blackening.
	(b)	(i)	One mark for each stage in the correct order: **Heat end of centre punch to red hot** Quench in oil **Clean end of centre punch with emery cloth** **Heat end of centre punch to purple** Quench in water (3x1)	[3]	
		(ii)	Explanation to include reference to removing excess hardness to increase toughness and reduce brittleness. Tempering is a process of heat treating, and used to increase the toughness of (iron-based alloys) (1) Tempering reduces some of the excess hardness by heating the metal to a lower temperature (1) which reduces the brittleness (1) (2x1)	[2]	Accept any named references to iron based alloys such as steel
	(c)		One mark for each of two processes. Case hardening; annealing; normalising; nitriding. (2x1)	[2]	Do not accept hardening and tempering
5	(a)		One mark for each of three CNC machine types. lathe; milling machine/router; machining centre; laser cutter; water jet cutter; punching machine; press brake. (3x1)	[3]	
	(b)		One mark for each of three benefits to a manufacturer. Examples of identified benefits: • The products will be more consistently accurate • There will be fewer workers needed to operate the machines. • Increased output from 24/7 operating. (3x1)	[3]	Benefits must be specific to the manufacturer.

Question			Expected Answer(s)	Mark	Guidance
	(c)		One mark for an example and up to three further marks for a clear explanation of additive manufacturing Example: Complex product produced in ABS on a 3D printer (1). Explanation is to include reference to the building-up of shaped products in individual layers (1) from a computer generated 3D image (1). Layers are 'added' to produce the solid 3D shape (1). (4x1)	**[4]**	
6	**(a)**		Up to two marks for each explanation of a benefit. Examples: • Use of automation (1) means less need for people to work in hazardous conditions (1) • More automated machinery (1) means cleaner/safer work (1) • Less heavy lifting/carrying (1) due to use of automation/AGVs (1) • Better control of air quality (1) through sensors and air conditioning systems (1) (2x2)	**[4]**	Benefits must be relevant and relate to the workforce.
	(b)*		**Level 3 (5–6 marks)** • Detailed discussion showing a thorough understanding of the impact of global manufacturing on engineering production. • Makes reasoned judgements about both positive and negative impacts that global manufacturing has had on engineering production, supported using relevant examples. • Information is presented clearly and accurately, with correct use of appropriate technical language and engineering terminology. • Accurate use of spelling, punctuation and grammar. • **Level 2 (3–4 marks)**Adequate discussion showing some understanding of the impact of global manufacturing on engineering production. • Makes some appropriate judgements about both positive and negative impacts that global manufacturing has had on engineering production, supported using some relevant examples. • Information is presented clearly and with some accuracy. Appropriate technical language and engineering terminology is used on some occasions. • Occasional errors in spelling, punctuation and grammar.		Up to six marks for a discussion or detailed explanation of the impact of global manufacturing on engineering production. Responses may include reference to: • Cheaper manufacturing costs. • Manufacturing near to raw materials. • More centralised locations for product market. • Manufacturing near to skills base. • Ease of exchanging data/information/views electronically. • Cost and environmental impact of transporting

Question			Expected Answer(s)	Mark	Guidance
			Level 1 (1–2 marks) • Basic discussion showing limited understanding of the impact of global manufacturing on engineering production. • Makes some basic statements about the impact of global manufacturing, supported using limited examples. May focus only on positive impacts. • Information presented is basic and may be ambiguous or disorganised. There will be little or no use of technical language and engineering terminology. • Errors of spelling, punctuation and grammar may be intrusive.	**[6]**	goods/products around the world. • Concentration of manufacturing facilities affects the local environment. • Loss of skills base in other countries. • Loss of jobs in 'parent' country.
			0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response.		
			Total marks for paper	**60**	

Question number			Content Area			
			LO1	LO2	LO3	LO4
1	a	i	1			
1	a	ii	2			
1	b	i	2			
1	b	ii	2			
1	c		3			
2	a		4			
2	b		3			
2	c		3			
3	a	i		3		
3	a	ii	2			
3	a	iii		3		
3	b			2		
4	a			3		
4	b	i		3		
4	b	ii		2		
4	c			2		
5	a				3	
5	b					3
5	c				4	
6	a					4
6	b*					6
Total Marks			**22**	**18**	**7**	**13**