Cambridge National

Engineering

R109/01: Engineering Manufacture: Engineering materials, processes and production, written

Level 1/2 Cambridge National Certificate/Award

Mark Scheme for January 2022

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

1. Annotations

Annotation	Meaning of annotation
BP	Blank page
VG	Vague
	Tick
SEEN	Noted but no credit given
	Unclear
REP	Repeat
BOD	Benefit of doubt
	Cross
DEV	Development
EG	Example/Reference
K	Knowledge
L1	Level 1
L2	Level 2
L3	Level 3

MARK SCHEME

Question			Answer / Indicative Content	Mark	Guidance
1	(a)	(i)	Stainless steel	1	
		(ii)	• High tensile strength / strong • Can be formed into shape / malleable • Doesn't affect the taste of the food • Doesn't rust / corrode / long lasting / attractive / water resistant • Non toxic • Hard / Scratch resistant / Hygienic / durable • (Relatively) low cost / cheap / inexpensive • Recyclable / environmentally friendly / sustainable (2x1)	2	Any **two** answers from list **IGNORE** Cast / moulded into shape **DO NOT ALLOW** Non-corrosive **DO NOT ALLOW** doesn't bend **IGNORE** references to magnetism **IGNORE** Light weight Accept any other valid response
	(b)	(i)	Polyester resin	1	
		(ii)	Thermosetting plastic	1	Allow **ECF** for tin – pure metal or GRP – composite.
		(iii)	Casting / moulding	1	**DO NOT ACCEPT** injection moulding or compression moulding (as this question involves liquid resin).
		(iv)	Because pieces would be made using liquid resin.	1	
	(c)	(i)	Rotational moulding / blow moulding	1	**ALLOW** gas injection moulding
		(ii)	• Lightweight • Available in a range of colours • Easily formed (using heat) / suitable for mass production • Non toxic • Low cost / cheap / readily available • Recyclable • Durable / weather resistant /resistant to corrosion • Strong / tough /elastic (2x1)	2	Any **two** answers from list **IGNORE** easily produced / unqualified manufactured **IGNORE** reference to complex shapes **DO NOT ALLOW** environmentally friendly **ALLOW** hard wearing **ALLOW** high strength to weight ratio= 1 mark for strength

Question			Answer / Indicative Content	Mark	Guidance
2	(a)	(i)	High speed steel Carbon steel (2x1)	2	1 mark per correct answer
		(ii)	Tungsten Carbide Glass (2x1)	2	1 mark per correct answer
		(iii)	Shape memory alloy Quantum Tunnelling Composite (QTC) (2x1)	2	1 mark per correct answer
	(b)		Shape memory alloy Example - **Fire alarm sprinkler system** Wire inside alarm shrinks with heat switching system that allows jet of water to flow. Quantum Tunnelling Composite (QTC) Example – **Alarm mat** Acts as a switch when an object steps on the mat a circuit is made setting off the alarm. (2x1)	2	1 mark for correct example,1 mark for application that matches example given **ALLOW** other appropriate uses including: (Dental) braces – shape memory alloy Stent – shape memory alloy Actuators – shape memory alloys. Pressure / membrane switches – QTC Blood pressure cuffs – QTC Speed controllers - QTC
	(c)		• Non Ferrous metals do not rust • Use – Can be used for items that will go outdoors and be exposed to moisture / water./ more durable	2	**ALLOW** corrosion resistance. **IGNORE** references to cost **ALLOW** other appropriate properties and uses for the property identified. Eg Magnetism Conductivity Machinability

Question			Answer / Indicative Content	Mark	Guidance
3	(a)		Joining - **Brazing** Heat treatment - **Nitriding** Surface finishing - **Linishing** Hand forming - **Bending** (4x1)	4	
	(b)		• Ductility / brittleness • Conductivity/resistivity • Hardness • Corrosion resistance • Elasticity/plasticity • Malleability • Strength / tensile strength • Toughness • Durability • Flexibility • Resistance to heat • Density / weight (3 x1)	3	Any **three** properties from the list. **DO NOT ALLOW** machinability as this is given in the question. **DO NOT ALLOW** material characteristics eg cost / form of supply ease of use
	(c)		• Copper sheet is heated • to a (dull) red colour / cherry red / 200 – 400^{o}C • then quenched in water (3x1)	3	**DO NOT ALLOW** air cooling / unqualified cooling / quenched in oil

Question			Answer / Indicative Content	Mark	Guidance
4	(a)		~~B~~ | D | A | F | ~~C~~ | E	3	One answer in correct position – 1 mark Two answers in correct positions – 2 marks 3 or 4 answers in correct positions – 3 marks
	(b)		• Check that the work is held securely. • Check the drill is held securely / remove the chuck key • Drill guard in place and working. • Check speed of drill is correct. • Know where emergency stop is / is working correctly • Can access on/off button. • Work area clear/no hazards. / machine clear of swarf • Adequate training / supervision (2x1)	2	Any **two** from the list. **DO NOT ALLOW** responses relating to PPE / tying hair back **ALLOW** one person in the work zone
	(c)		• Paint • Powder / plastic dip coating • Electroplating • Galvanising (2x1)	2	Any **two** appropriate responses. **ALLOW** electrolysis
	(d)	(i)	(CNC) Milling machine / router / water jet cutter	1	
		(ii)	• More accurate / reduction of human error • Faster • 24/7 / no breaks needed • Repetition of shape • Same quality each time • More cost effective for mass manufacture / continuous manufacturing possible / reduced staffing / automated • Safer (2x1)	2	Any **two** appropriate responses.

Question			Answer / Indicative Content	Mark	Guidance
5	(a)	(i)	• can be partially or fully computer controlled / uses G and M codes • it can have 3 axis, 4 axis or 5 axis • the cutting tool / part can be rotated / • complex designs and geometrical detailing • improved accuracy / less human error • quicker / shorter cycle / manufacturing time • processing multi-sided parts in a single setup • variety of tools that can be changed automatically (4x1)	4	Any **four** appropriate responses. **IGNORE** multi directions / axis **ALLOW** given number of axis / directions **ALLOW** cutting at different angles
		(ii)	• (Machine is computer controlled/automated so) no need for any human interaction during the manufacture once set up. • Totally enclosed units with safety guards in place including sensors to cut off if guards open. • Cut out sensors if machine is faulty/breaks down.(2x1)	2	Any **two** appropriate points.
	(b)		• Cost of purchasing (named modern technology / CNC) is high. • Cost of downtime while new technology is installed. • Cost of re designing/reorganising factory layout to accommodate new technology/is space available or will it need extra building/reduction in building. • (Ongoing) maintenance and service costs • Energy costs – will these increase/decrease? • Reduced workforce – redundancy payments / less staffing cost • Retraining – increased cost of re training. • Time taken to recoup additional / upfront costs with production savings (2x2)	4	Any **two** points justified/explained. 1 mark for identifying a cost factor 1 mark for explanation/justification/description associated with the cost factor Single word answers 1 mark maximum but **IGNORE** unqualified cost

Question			Answer	Mark	Guidance
6	(a)	(i)	• Shorter / quicker production times. • Work 24/7 • Less rejects/defects. • Consistent quality • JIT production / lean manufacturing (2x1)	2	**ALLOW** any **two** appropriate responses **OR** any **one** of the marking points with a justification/explanation for 2 marks **IGNORE** references to design / unqualified speed **ALLOW** Kanban system or other named computer controlled
		(ii)	Expensive, complicated machinery (needs to be controlled and maintained) so that machinery is maintained / set up safely / set up correctly to prevent injury to employees / damage to machine / quality of product. (2x1)	2	**ALLOW** any valid alternative answers. Eg. those relating to mandated aspects of training and legal follow up **ALLOW** Reverse arguments

Question			Answer	Mark	Guidance
6	(b)*		**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the advantages of quality control when manufacturing products in mass. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar. **Level 2 (3–4 marks)** Adequate discussion showing an understanding of the advantages of quality control when manufacturing products in mass. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar. **Level 1 (1–2 marks)** Basic discussion showing limited understanding of the advantages of quality control when manufacturing products in mass. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive. 0 = a response that is irrelevant and/or not worthy of a mark. • Annotate with 'Seen' at end of response.	**6**	Up to six marks for a discussion or detailed explanation of the advantages of quality control when manufacturing products in mass. • Mass production is production of large quantities of standardised products. • (Quality control department) samples product to ensure made to same standard / accuracy / tolerance / to relevant International Standards (ISO BS) • (Products to be checked) to meet client's expectations. • Check machines so that batch/mass all the same. • Testing of products in house and consumer. • Sensors on system to monitor production. • Reference to increased cost of testing • Reference to increased revenue from sales • Increased revenue of sales outweighs increased cost of testing • Customer confidence / satisfaction • Manufacturers reputation/building a successful business/increased sales • Consistency/zero defects. • Less wastage. • Right first time production system/minimises waste/rejects/returns/recalls. • Reduction in production costs due to increased effective inspection.

			Total for paper	**60**	

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