Cambridge National

Engineering Manufacture

R109/01: Engineering materials, processes and production

Level 1/2 Cambridge National Certificate/Award

Mark Scheme for January 2021

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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. These are the annotations, (including abbreviations), including those used in scoris, which are used when Marking

Annotation	Meaning of annotation
	Blank page
	Vague
	Tick
	Noted but no credit given
	Unclear
	Repeat
	Benefit of doubt
	Cross
	Development
	Example/Reference
	Knowledge
	Level 1
	Level 2
	Level 3

Question			Answer / Indicative Content	Mark	Guidance
1	(a)	(i)	Any two from: • It is dense/denser than water • Lead can be cast into various shapes/weights/easily formed • Can be recast / the lead is recyclable • Low cost/cheap • Corrosion resistant • Durable / water resistant (2x1)	2	**IGNORE** Heavy **IGNORE** Malleable **IGNORE** Tough
		(ii)	• Lead weights are poisonous / toxic / dangerous (to wildlife). • Small weights can be easily swallowed by birds or fish. • Weights can be easily lost in a river / discarded (1x1)	1	**IGNORE** unqualified pollution **ALLOW** Harmful **IGNORE** responses relating to legislation
	(b)	(i)	Bronze	1	
		(ii)	Alloy	1	
		(iii)	Any two from: • Can be formed / cast into various shapes/ shaped • Resistant to corrosion • Water resistant • High <u>tensile</u> strength / durable (2x1)	2	**IGNORE** Machined **IGNORE** strong (unqualified)
	(c)	(i)	Acrylonitrile-Butadiene-Styrene (ABS)	1	
		(ii)	Any two from • Lightweight • Available in a range of colours • Non-toxic • Tough / resistant to impact	2	**IGNORE** Hard **IGNORE** safe **ALLOW** not brittle

Question			Answer / Indicative Content	Mark	Guidance
			• Easily moulded into complex shapes / formed • Durable / hard wearing • Low cost / readily available (2x1)		**IGNORE** strong

Question			Answer / Indicative Content	Mark	Guidance
2	(a)	(i) (ii) (iii) (iv) (v)	**Copper** is a Non Ferrous metal **Stainless Steel** is a Ferrous metal **Glass** is a Ceramic **Polyester Resin** is a Thermosetting Resin **Nylon/PVC** is a Thermoplastic (5x1)	5	1 mark per correct answer
	(b)	(i)	A material that is made up of two or more different materials (1) to create a material with (significantly) different physical or chemical properties (1)	2	**NOT** two metals **ALLOW** (unqualified) materials = different materials for 1st mark **ALLOW** AW for differing properties or named changed property
		(ii)	• Glass reinforced plastic (GRP) - boat building, car bodies • Carbon fibre - bicycle frame / car parts / aircraft parts • Concrete - roads / bridges / buildings (2x1)	2	**ALLOW** any suitable composite material for the 1st mp **IGNORE** composite plastics **NOT** Plywood **NOT** Cement Use must match material given
		(iii)	Glass reinforced plastic (GRP) • Reason – can be moulded into complex shapes / strong / lightweight / water resistant. Carbon fibre • Reason – strong / light weight/ rigid. Concrete • Reason – can absorb and retain heat in the home / strong building material if reinforced / weatherproof / durable / Can be cast into complex shapes	1	**ALLOW** any appropriate reason for use

Question			Answer / Indicative Content	Mark	Guidance
3	(a)		Any two from: • Sawing • Filing • Threading / tapping / dieing • Drilling (2x1)	2	
	(b)		Any two from: • (CNC) turning • (CNC) milling, • (CNC) routing. • (CNC) Water jet cutting • (CNC) Laser cutting • (CNC) Drilling (2x1)	2	
	(c)		Any two from: • Soldering, • Brazing, • Welding, • Riveting, • Threaded fasteners, • Self-tapping screws (2x1)	2	**ALLOW** named versions
	(d)		• The mild steel is heated in an oven. • Use of temperature indicator • It is then held with tongs (or similar) and dipped into a fluidising tank containing plastic powder • The mild steel is removed and shaken to remove excess powder. • The powder melts onto the steel • The mild steel is then left to cool.	3	Any three in sensible order including reference to heating = 3 marks Any two or three without reference to heating = 2 marks max **ACCEPT** suitable description of Electrostatic Powder Coating

Question			Answer / Indicative Content	Mark	Guidance
			• When cool the surface is checked and unwanted plastic removed from the surface. (3x1)		
	(e)		• Painting, • Galvanising • Electroplating • Flame spraying • Nitriding • Stove enamelling • Blueing (1x1)	1	

Question			Answer / Indicative Content	Mark	Guidance
4	(a)		**A** - Heater **B** – Mould shelf **C** - Clamping frame **D** - Shelf lever **E** – Vacuum pump switch (5x1)	5	
	(b)		F | **I** | **J** | **H** | **G** | K ~~Stage 1 - *Place the mould in the vacuum former.*~~ Stage 2 Lower the shelf supporting the mould. Stage 3 Clamp a sheet of plastic into position. Stage 4 Heat the plastic sheet until it is flexible. Stage 5 Raise the shelf and switch on the vacuum pump. ~~Stage 6 - *Leave the plastic sheet to cool and then remove from the vacuum former.*~~	3	One answer in correct order – 1 mark Two answers in correct order – 2 marks Three or four answers in correct order – 3 marks
	(c)		Strip heating/line bending Blow moulding (2x1)	2	Process must relate to moulding of plastic sheet

Question			Answer / Indicative Content	Mark	Guidance
5	(a)		(Manual production is making a product) <u>without the use of automated or computer controlled machines</u> (1). Example given of a suitable product, process or machine (1). (2x1)	2	1 mark for definition **IGNORE** controlled by people 1 mark for appropriate example MP2 can be awarded even if MP1 is not
	(b)	(i)	• Selective laser sintering / SLS • Stereolithography / SLA • 3D Printing / FDM • Direct metal laser sintering / DMLS • Electron beam melting / EBM (1x1)	1	
		(ii)	*Example* *Selective laser sintering* • A computer generated image is created /load programme • a laser scans the image generated • deposits powder on the machine bed /melts powder • the powder is fused together • the image is scanned again and • deposits additional layers • repeated until the required shape is built up. • Allow product to cool before removal from bed (3x1)	3	**ALLOW** an appropriate explanation for the system identified in 5(b)(i) Responses given must be logical sequence to gain 3 marks
	(c)		Any four of the following: • Faster production / quicker / higher production rate • Less mistakes / Reduction of human error / more accurate / greater precision • Work continuously / 24/7 production • Improved safety / safer • Less labour required / reduced labour costs • More cost effective in the long term (4x1)	4	One mark for each relevant point up to a maximum of 4

Question			Answer / Indicative Content	Mark	Guidance
6	(a)		Any one from: • Carbon fibre composite • Nanotechnology / Nanocomposites • Advanced metals and alloys • QTC • Shape memory alloy / polymers • Thermochromic materials (1x) Any three from: • Particular properties of the materials such as conductivity of heat, electricity • Operating temperatures • Weight reduction • Magnetic properties • Cutting properties of tools • Cost related reasons • Manufacturing related reasons • Design requirements – aerospace industry • Medical advances (3x1)	4	**ALLOW** any other valid example. **IGNORE** unqualified composites **ACCEPT** other new materials Reasons **MUST** relate to new and emerging material given

Question			Answer	Marks	Guidance
	(b)*		**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the advantages and disadvantages of modern technology when compared with traditional processes 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 and disadvantages of modern technology when compared with traditional processes. 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 and disadvantages of modern technology when compared with traditional processes 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 advantages and disadvantages of modern technology when compared with traditional processes. Advantages may include reference to: • Leaner / more skilled workforce. • Better reputation. • Less waste. • Increased sale price • Reduction of the human error. • Reduced energy costs / cost effective long term • Repeat procedures 24/7. • Improved safety • Faster production (rates) • Automatic adjustment to maintain accuracy of machines. • Better consistency / quality of products from CNC machines. • Facilitates global manufacturing Disadvantages may include reference to: • Cost of replacing machines. • Redesign of floor space / requirement for new premises • Downtime replacing machines with new technology. • High automation costs. • Upskilling work force – costs and training
			Total for paper	**60**	

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