OCR
Oxford Cambridge and RSA

Cambridge National

Engineering

Unit **R109:** Engineering materials, processes and production

Level 1/2 Cambridge National Award/Certificate in Engineering Manufacturing

Mark Scheme for January 2017

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Question			Answer / Indicative Content	Mark	Guidance
1	(a)	(i)	**Brass -** alloy **Bronze -** alloy **Copper -** pure metal **Lead -** pure metal **Tin -** pure metal **Titanium -** pure metal (6x1)	**6**	
	(b)		Up to two marks for each of two valid reasons Examples: Non-ferrous metals are often easier to form (1) into complex shapes (1) than ferrous metals Non-ferrous metal give a better finish (1) as they don't go rusty (1) like ferrous metals 2 x (2x1)	**4**	Accept other *valid* reasons 1 mark for simple reference to 'don't rust' Justified response needed for full marks e.g. not simply 'lighter'
2	**(a)**	**(i)**	Material is able to be formed / bent into shape (1) without breaking (1) (2x1)	**2**	
		(ii)	Ductility Conductivity / resistivity Hardness Corrosion resistance Elasticity / plasticity Thermal conductivity Toughness Machinability Strength Durability (3x1)	**3**	

Question			Answer / Indicative Content	Mark	Guidance
	(b)	**(i)**	GRP; Carbon fibre; concrete (2x1)	**2**	Accept wood-based composites
		(ii)	Up to three marks for a clear explanation. Example: Alloys are combinations of metals and combine the properties of those metals (1) to give different/improved overall characteristics (1). They are also often cheaper than using the pure metal alone (1) (3x1)	**3**	1 mark for basic reference to combining different metals Some reference to combining properties of metals required for full marks.
3	**(a)**		(Hex-headed) Bolt Wing nut Grub screw Nyloc (self-locking) nut (Socket-headed) Cap screw (5x1)	**5**	Accept <u>*slight*</u> variations
	(b)	**(i)**	(Tapping size) drill Taper tap Second tap Tap wrench Plug (bottoming) tap (3x1)	**3**	Tools not machines Do not accept consumables such as cutting oil / compound
		(ii)	Using a (split-circular) die Screwcutting on the lathe (2x1)	**2**	Accept ‘by hand’ and ‘on lathe/CNC lathe’

Question			Answer / Indicative Content	Mark	Guidance
4	(a)	(i)	Drilling Turning Milling Shaping Laser cutting Water jet cutting Threading (3x1)	3	Accept other lathework operations e.g. facing (off) Not 'sanding; filing; sawing' Must be machine based processes <u>not</u> machines
		(ii)	One mark for each of three relevant safety precautions Examples: wear goggles; be trained on use of machine; keep area clear; wear overall/apron; ensure guards are in place; know where safety cut-out/switch is; ensure workpiece is securely clamped; use correct speeds and feeds for the material; tie back long hair; do not leave machine unattended when in use (3x1)	3	Accept other precautions *relevant to material removal* processes Accept <u>suitable</u> PPE, but NOT 'wear gloves'
	(b)	(i)	Compression moulding	1	
		(ii)	Up to three marks for a justified explanation Example: Thermoplastics are generally more easily formed into complex shapes (1) than thermosets and more suited to high-volume/mass production (1). This means that products are able to be made in larger quantities at lower cost (1) (3x1)	3	Max 2 marks for unjustified points Do not accept re-heating and re-shaping of <u>products</u>, unless relating to re-use/recycling Clear and relevant explanation required for full marks

Question			Answer / Indicative Content	Mark	Guidance
5	(a)		Up to two marks for a brief but clear description. Description may include reference to: multiple operations carried out on a single machine; automatic changing of tooling / workpiece position; computer control of all machining requirements – speeds, feeds, tool changing; multi-axis operation; workpiece positioning (2x1)	**2**	Allow one mark for reference to computer controlled machine
	(b)		Up to two marks for a brief but clear description. Description may include reference to: computer control of operations; positioning of workpiece; selection of tooling elements; angle of bend; pressure required for bending (2x1)	**2**	

Question			Answer	Marks	Guidance	
					Content	Levels of response
	(c)*		Up to six marks for a discussion or detailed explanation of the impact of CNC machining on engineering production.	6	Responses may include reference to: Improved output through 24/7 working. More consistent quality / accuracy. Reduction in number of different machines needed. Reduction in machine operators needed. Smaller overall workforce. Need to re-train staff / employ workers with higher skills. Ability to change programs quickly. Potential to improve range of products made. Possible need to re-arrange layout of factory. Higher cost of machines compared with more traditional types. Potential loss of basic skills in workforce. Ability to produce more than one type of product in one working day.	**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the impact of CNC machining on engineering production. 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 impact of CNC machining on engineering production. 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 impact of CNC machining on engineering production. 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.

Question			Answer / Indicative Content	Mark	Guidance
6	(a)		One mark for each of three relevant cost issues Examples: Modern technologies/new machines are expensive to buy. It could be expensive to train/employ specialist staff. Payments to redundant workers Maintenance costs Cost of modifications to factory layout / services Improvements made has to justify the expense of changes Energy costs may rise Potential for reduced overall cost of production (3x1)	**3**	Accept other *relevant* issues
	(b)		Up to three marks for a justified explanation. Explanation may include reference to : Less manual work required; machines fully enclosed to reduce danger to operatives; machines / robots reduce need to work in hazardous conditions; air conditioning / sensors monitor and control air quality; handling of dangerous / heavy items done by machines / robots; automatic cut-out of machines when problems sensed	**3**	Justified response required for full marks Up to two marks maximum for a number of unjustified points

Question			Answer / Indicative Content	Mark	Guidance
	(c)		One mark for the technology used and a further mark for its use Examples: Drawings and technical data can be shared electronically (1) anywhere in the world (1) Video conferencing (1) enables companies to hold discussions about production (1) Secure websites (1) can be used to pass designs and information between companies (1) 2 x (2x1)	**4**	Reference to **use** of technology required for full marks, not benefits **of** use
			Total for paper	**60**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553