GCE

Design and Technology: Systems and Control Technology

Mark scheme

SYST3 Design and Manufacture
June 2016

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Question	Part	Marking Guidance	Mark	Comment
1	0 1	Suggest **one** appropriate **material** for each of the following products. Give specific reasons for your choice, making reference to the product's function, the material's properties, the manufacturing processes and the quantity of the product being produced. • Electrical wire • An external casing for a barbeque • A traffic cone • A bird feeding table Answers should make reference to; **Electrical Wire** Conduction of electricity, signals, connecting parts together, flexibility, ductility for drawing process, ability to join, continuous production, etc Materials, copper, aluminium, gold, etc. **Barbeque** Retaining contents, heat resistance, high melting point, ability to be shaped and joined, corrosion resistance, batch production etc Materials, steel, stainless steel etc **Traffic Cone** To warn motorist of danger, resistant to elements, tough, suitable for injection moulding or another suitable process, available in suitable colours, continuous production etc. Material, any suitable plastic for the process described, **Bird Table** Hygienic, easily cleaned, resistant to elements, can be joined, aesthetics, one-off production or batch, can be treated to resist corrosion etc. Material, Suitable hardwood, softwood, plastic or metal if it matches the explanation	**4 x 4**	

		Marks awarded as follows: ○ Basic information with evidence of only limited understanding or knowledge. There will probably be a lack of specific information. There will be inaccuracies and confusion. 0 -1 mark ○ Candidate shows some sound knowledge but there will be some lack of detail and reference to specifics. The candidate has a good grasp of the principles but there is a lack of detail. Straightforward ideas are expressed clearly. 2 – 3 marks ○ Candidate shows detailed knowledge and understanding of the principles and will clearly explain the reasons why they are not suitable. There will be a variety of examples to support points made. Complex ideas will be expressed clearly. 4 marks		

1	**0 2**	Compare and contrast **two** alternative methods of testing electronic circuit prototypes before a Printed Circuit Board (PCB) is produced. Answers should use examples and make reference to; The process eg computer simulation – bread-boarding using discrete components – strip-board and soldering the components in place etc Equipment requirements for the processes – reliability and accuracy of the processes – speed and ease of prototyping – ease of testing and modification if required – similarity of the prototype to the future PCB layout – ease of conversion to a real PCB layout – testing facilities available within the process – testing opportunities –capital and running costs – etc. **Marks awarded as follows:** • Basic information with evidence of only limited understanding or knowledge. There will probably be a lack of specific information. There will be inaccuracies and confusion. 0 – 4 marks • Candidate shows some sound knowledge but there will be some lack of detail and reference to specifics. The candidate has a good grasp of the methods and there suitability, but there is a lack of detail. Straightforward ideas are expressed clearly. 5 - 8 marks • Candidate shows detailed knowledge and understanding of the methods and will clearly explain the reasons why they are suitable, especially at the top end of the mark range. There will be a variety of examples to support points made. Complex ideas will be expressed clearly. 9 – 12 marks	**12**	

1	**0 3**	Explain how anthropometric data would have been used when each of the following products was designed. • Piano keyboard • The handle of a hammer • A drinking mug • A staircase **Piano keyboard** Length of fingers, separate parts of fingers, width of hand, width of fingers, spread of fingers and force the fingers can produce. This data should be referenced to its effect on the dimensions and attributes of the keyboard. **The handle of a hammer** Length of fingers, width of hand, width of fingers, grip of the hand and force it can produce. The length of the forearm for swinging the hammer This data should be referenced to its effect on the dimensions and attributes of the handle. **A drinking mug** Length of fingers, width of hand, width of fingers, grip of the hand and force it can produce. This data should be referenced to its effect on the dimensions and attributes of the mag body and the size and shape of the handle. **A staircase** Length and width of foot, length of parts of leg, articulation range of leg. This data should be referenced to its effect on the dimensions of the tread and riser of the staircase. The weight of individuals could also be considered when considering the forces acting on the staircase.	**4 x 4**	

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2	**0 4**	Compare and contrast the suitability of Computer Numerical Control (CNC) machining and manual machining for the one-off **and** the batch production of metal components. Answers should use examples and make reference to; Machine types set up and running costs – Operator skill level and training requirements – scale of production either one-off or batch – ease of modification to design or process – time to reset the facilities when changing production to another component – accuracy of the manufacturing process, how this is maintained – repeatability of the process to produce identical products - etc **Marks awarded as follows:** Basic information with evidence of only limited understanding or knowledge. There will probably be a lack of specific information. There will be inaccuracies and confusion. 0 – 4 marks Candidate shows some sound knowledge but there will be some lack of detail and reference to specifics. The candidate has a good grasp of the methods and there suitability, but there is a lack of detail. Straightforward ideas are expressed clearly. 5 – 8 marks Candidate shows detailed knowledge and understanding of the methods and will clearly explain the reasons why they are suitable, especially at the top end of the mark range. There will be a variety of examples to support points made. Complex ideas will be expressed clearly. 9 – 12 marks	**12**	

3	**0 5**	Compare and contrast **three** different methods suitable for storing energy. Your answer should make reference to: • how the energy is stored • suitable applications • storage capacity • energy type • energy recovery. Energy can be stored in many forms and at different scales. The emphasis of the question is on comparing suitable methods of storing and recovering energy linked to suitable applications. Answers should reference the following **How the energy is stored and energy type** This should include how the energy is inputted and the form in which it held eq. Potential by position, chemical, rotating kinetic (flywheel), heat etc. **Possible application** Pump storage power stations, batteries for radios, spring in a watch, flywheel, compressed air for tools, heat reservoirs for central heating, stretched elastic band for model plane, chemical energy (oil) for internal combustion engine, etc. **Storage Capacity** The candidate should reference the limitations of capacity for the storage method given eg. A wind up spring is ideal for situations like a watch where a small output of force is required over a long period of time, but is not suitable for large power applications like cars. **Energy recovery** The candidate should reference how the stored energy is released, this could include any conversions that are required to provide it in a usable form.	**16**	

		Marks awarded as follows: • Basic information with evidence of only simplistic understanding. Candidate will probably offer only a narrow range of obvious suggestions with few, if any, appropriate examples to support points made, and possibly lack understanding of the concept. There will be many inaccuracies and confusion. 0 – 5 marks • Candidate shows some sound knowledge and understanding but there will be a lack of precise and accurate detail, at the lower end of the mark range. A number of relevant examples will be given. There are likely to be some inaccuracies and misunderstandings, especially at the lower end of the range. Straightforward ideas are expressed reasonably clearly. 6 – 10 marks • Candidate shows detailed knowledge and understanding of a wide variety of issues and gives a wide range of relevant examples. The information will be detailed and accurate. Complex ideas will be expressed clearly. 11 – 16 marks		

3	**0 6**	Describe in detail **two** different methods of converting non-finite (renewable) energy into a form of energy that can be stored. Use sketches to support your answer. Your answer should clearly show the energy conversions that take place. **Examples: Wave power to electricity, wind to lift water and produce potential energy.** Marks awarded as follows for systems that have an input of non-finite energy and an output of energy in a form that can be stored. Reference to the nature of the energy sources characteristics 1 mark Harnessing of the energy source 1 mark Conversion system (1) with explanation (1) 2 marks Explanation of energy conversions (1) to achieve suitable output (1) 2 marks	**2 x 6**	

Section 2

4	**0 7**	In many areas of the world people spend a long time in the sun and their skin can become damaged. Describe a system that will produce an audible warning when a person is at risk of skin damage from the sun. Use annotated sketches to support your answer. Your design should show: o how the intensity of the sunlight is determined o how the intensity of the sunlight controls the time period o how the suitable time period could be adjusted for different users o how the audible warning is activated and how the system is reset. **Marks awarded as follows:** **<u>Input Stage:</u>** Sensing and appropriate input Light Sensor (1) – variable input (1) 2 marks Explanation of how sunlight alters sensors output 1 mark **<u>Process Stage:</u>** Suitable power source 1 mark Timer system - suitable (1) explained (1) alterable (1) 3 marks Explanation of how output from input alters time period – partial (1) full (2) 2 marks Identification of user adjustment control (1) 1 mark Controls effect on time explained - partially - (1) fully (2) 2 marks **<u>Output Stage:</u>** Suitable audible warning device (1) matched to output (1) 2 marks Output latched (1) reset system (1) 2 marks	**16**	

4	**0 8**	Discuss the suitability of stepper motors, direct current motors and pneumatic cylinders for providing accurate movement in computer controlled machinery. The emphasis is on the production of accurate movement using the prime movers given. The answers should relate the advantages, problems and limitations of providing the accurate movement necessary using the different types of prime mover output. The examples could use **open** or **closed** loop control so reference could be made to; Movement type – linear – rotary – angular – bi-directional – reciprocating – speed of movement – force produced – force at different positions of movement – controllability – power source – control system – interfacing – monitoring – feedback requirements – additional mechanical systems required for conversion of movement – environment – etc. **Marks awarded as follows:** • Basic information with evidence of only limited understanding or knowledge. There will probably be a lack of specific information. There will be inaccuracies and confusion. 0 – 4 marks • Candidate shows some sound knowledge but there will be some lack of detail and reference to specifics. The candidate has a good grasp of the methods and there suitability, but there is a lack of detail. Straightforward ideas are expressed clearly. 5 – 8 marks • Candidate shows detailed knowledge and understanding of the methods and will clearly explain the reasons why they are suitable, especially at the top end of the mark range. There will be a variety of examples to support points made. Complex ideas will be expressed clearly. 9 – 12 marks	**12**	

5	**0 9**	Describe a system for producing a programmable sequence of musical notes. The system must be able to produce 8 different notes **and** a minimum sequence of 50 notes. Use annotated sketches to support your answer. Your answer should make reference to: • the method of inputting the sequence • sequence storage • how the sequence is changed • how notes are generated • how the notes are activated. **Marks awarded as follows:** **<u>Input Stage:</u>** Sensing and appropriate input Sensor (1) – form of input (1) 2 marks **<u>Process Stage:</u>** Storage component (1) method (1) alterable (1) 3 marks Explanation 8 outputs (1) Explanation min 50 seq. (1) 2 marks Explanation of how sequence changed- partial (1) full (2) 2 marks Note generator (1) 8 different notes (1) explain how different notes are produced (1) 3 marks **<u>Output Stage:</u>** Output from sequencer 1 mark Suitable for 8 different notes 1 mark How the notes are activated - partial (1) full (2) 2 marks	**16**	

5	**1 0**	With reference to fabricated products of your choice describe where **three** different jointing methods have been used and explain why each method has been used. The jointing systems given should be suitable for fabricated products, these can be of a permanent or temporary nature but a description should show why it has been used in a specific location. Reasons given could reference; Materials – forces – speed – other joints close by distortion – accessibility – stress – position – use – permanent / temporary– accuracy etc. Types of joints; Glues, adhesives, rivets, nuts and bolts, screws, nails, welding, brazing, soldering, interlocking, knocked down fittings etc. **Marks awarded as follows: (**The emphasis is on the why) o Basic information with evidence of only limited understanding or knowledge. There will probably be a lack of specific information. There will be inaccuracies and confusion. 0 -1 mark o Candidate shows some sound knowledge but there will be some lack of detail and reference to specifics. The candidate has a good grasp of the principles but there is a lack of detail. Straightforward ideas are expressed clearly. 2 – 3 marks o Candidate shows detailed knowledge and understanding of the principles and will clearly explain the reasons why they are not suitable. There will be a variety of examples to support points made. Complex ideas will be expressed clearly. 4 marks	**3 x 4**	

6	**1 1**	Describe in detail how the body of a saucepan for use on a gas cooker or an electric cooker could be manufactured by a deformation/redistribution process. Use annotated sketches to support your answer. Your answer should make reference to: • choice of material • manufacturing process **and** scale of production • any jigs, moulds or formers needed • finishing. Answer should make reference to: **Material choice** Suitable material eg. Steel, stainless steel, copper, aluminium, cast iron etc. Stock form eg. Sheet, bar, ingot etc. and how these relate to the process. Property requirements for saucepan eg. Melting point, corrosion resistance etc. Property requirements for manufacture eg. Machinability, ductility, methods of joining – etc. **Manufacturing process scale of production** Any suitable method eg. – spinning – raising – hollowing – hot forming – cold forming – stamping – sand casting – die casting – **Scale of production** The process given should match the scale of production eg. one/off – batch – mass Reference can also be made to - Any jigs, moulds or formers required – materials for – design requirements eg. Draft etc. – how and why they are needed – how they are produced **Finishing** The finish suitable finishing process should be linked to manufacturing process – material – saucepan aesthetic and hygiene requirements	**16**	

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6	**1 2**	Compare and contrast **two** different systems for the conversion of rotary motion to linear motion in control situations. Use examples to support your answer.	**12**	

		Answers should use examples and make reference to; Loading on the system - Working speed of the system - Accuracy requirements Input requirements - output requirements - Operating characteristics - Maintenance – Reliability - Flexibility of application – Amplification requirements –ease of use – complexity of output - etc. **Marks awarded as follows:** • Basic information with evidence of only limited understanding or knowledge. There will probably be a lack of specific information. There will be inaccuracies and confusion. 0 – 4 marks • Candidate shows some sound knowledge but there will be some lack of detail and reference to specifics. The candidate has a good grasp of the methods and there suitability, but there is a lack of detail. Straightforward ideas are expressed clearly. 5 – 8 marks • Candidate shows detailed knowledge and understanding of the methods and will clearly explain the reasons why they are suitable, especially at the top end of the mark range. There will be a variety of examples to support points made. Complex ideas will be expressed clearly. 9 – 12 marks		