Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2018

Technology and Design

Assessment Unit AS 1

assessing

Systems and Control or Product Design

[STE12]

MONDAY 14 MAY, AFTERNOON

MARK SCHEME

General Marking Instructions

Introduction

The main purpose of the mark scheme is to ensure that examinations are marked accurately, consistently and fairly. The mark scheme provides examiners with an indication of the nature and range of candidates' responses likely to be worthy of credit. It also sets out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives
Below are the assessment objectives for GCE Technology and Design.

Candidates should be able to:

AO1 Demonstrate specific knowledge and understanding, be able to apply that knowledge and understanding in combination with appropriate skills in their designing, communicate ideas and outcomes, and demonstrate strategies for evaluation.

AO2 Apply skills, knowledge and understanding of relevant materials to produce suitable and appropriate outcomes; communicate ideas and outcomes, and demonstrate strategies for evaluation.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 17- or 18-year-old which is the age at which the majority of candidates sit their GCE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 17- or 18-year-old GCE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Marking Calculations
In marking answers involving calculations, examiners should apply the 'own figure rule' so that candidates are not penalised more than once for a computational error. To avoid a candidate being penalised, marks can be awarded where correct conclusions or inferences are made from their incorrect calculations.

Types of mark schemes
Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response
In deciding which level of response to award, examiners should look for the 'best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement.

The following guidance is provided to assist examiners.

- ***Threshold performance***: Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.

- ***Intermediate performance***: Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.

- ***High performance***: Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

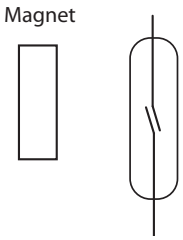
Section A

Electronic and Microelectronic Control Systems

AVAILABLE MARKS

1 **(a)** AND logic [1]

(b) Sketch [1]



Description: When the door is closed the magnet is near the switch so the magnetic field will keep the contacts closed. When the door is opened the magnet will move away from the switch and the contacts will open.
Award [2] for a full description and [1] for a limited description [3]

Correct alternative responses will be given full credit.

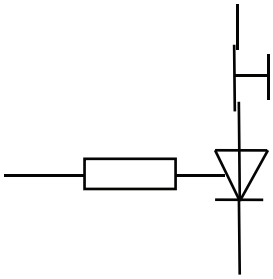
(c) On/off [1]

Justification – The switch contacts are either open or closed so the thyristor will either conduct or not. [1] [2]

(d) When the switch contacts are open the resistor will effectively connect to the power supply. Vo will therefore be 'high' or 6 volts.

Award [2] for a full explanation and [1] for a limited explanation. [2]

(e)



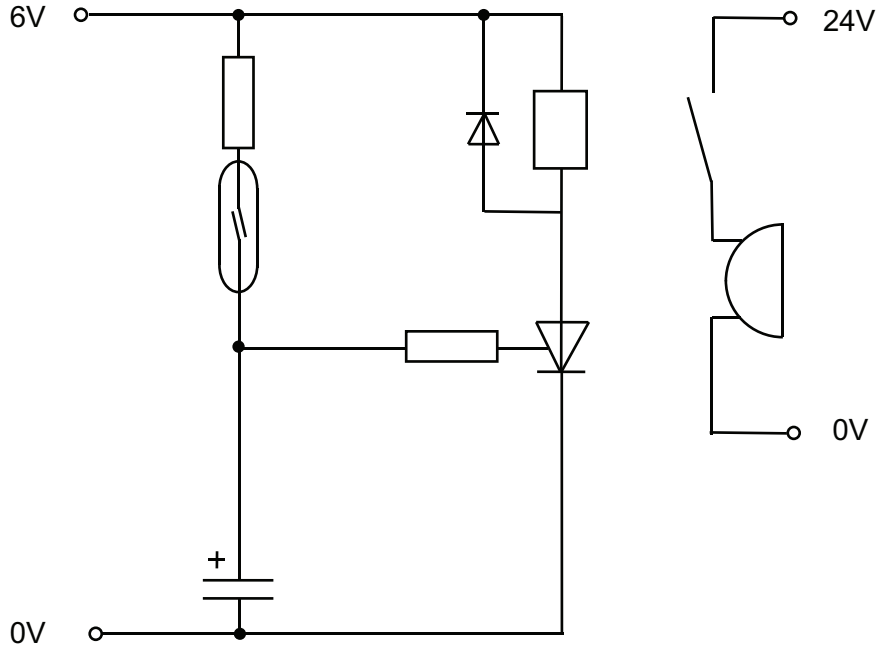
Correct position of switch [1] Correct label [1] [2]

Correct alternative responses will be given full credit.

(f) R3 = 6V – 3.2 [1] / 2 × 10 mA [1] = 140 Ohms [1] [3]

E12 value = 150 Ohms [1]

(g)



[4]

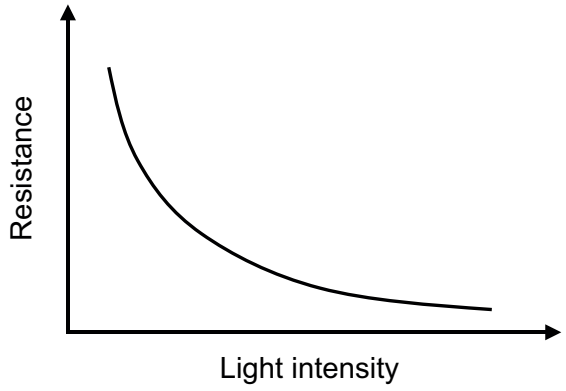
Capacitor and resistor [1] relay [1] diode [1] reed switch [1]

(h) Power dissipated = 24 × 0.5 [1] = 12 Watts [1] [2]

AVAILABLE MARKS

20

2 (a) (i)



Source: CCEA

[2]

(ii) The voltage Vo will increase in value. [1]

(iii) 2/5 = 2.7/(2.7 + Rv) [1]
2.7 + Rv = 6.75 [1]
Rv = 6.75–2.7

Required value of Rv = 4050 Ohms [1] [3]

(b) (i) Operational amplifier or Comparator [1]

(ii) 2.5 volts [1]

(iii) negative [1]

Justification – The voltage at input 3 (inverting input) is greater than the voltage at input 2 (non-inverting input) therefore the output will be inverted or negative with respect to zero volts. [3]
Award [2] for a full justification and [1] for a limited justification.

(c) (i) NOR gate [1]

(ii)

A	B	C	D	F
0	0	1	1	1
0	1	1	0	0
1	0	0	0	0
1	1	0	0	1

Columns C [1] column D [1] and column F [3] [5]

(iii) Exclusive NOR gate [1]

(iv) Reason – a Darlington pair has a high current gain along with a high collector current capacity making it both sensitive and capable of switching high current loads.

Award [2] for a full explanation and [1] for a limited explanation. [2]

Section A

AVAILABLE MARKS
20
40

Section B

Mechanical and Pneumatic Control Systems

AVAILABLE MARKS

3 **(a)** Lever [1]

(b) Correct internal symbol arrangement
Exhaust symbol [1]

(See sample answer) [1]

(c) A sample answer could involve the use of cams connected to the shaft. The cams could be positioned to rise at alternate times during a rotation. The cams could activate roller trips connected to the three port valves.

Correct alternative responses will be given full credit.

	Marks awarded
Detailed annotated sketch. The design is complete, enabling the valves B and C to be activated alternately.	[4]–[5]
Good annotated sketch. The design allows for partial activation of valves B and C alternately.	[2]–[3]
Limited annotated sketch. The design allows for partial activation of valves B or C.	[1]
Level of response not worthy of credit	[0]

[5]

Correct alternative responses will be given full credit.

(d) Sketch outlining the spline and housing attachment method. [2]

Annotation [1]

(e) $F = P \times A$

Piston rod area = $3.14 \times 3 \times 3 = 28.26\,mm^2$ [1]

$28.26 \times 0.5 = 14.13\,N$ [1]

$F = 80 + 14.13$ [1]

Ans = 94.13 N outstroke force [1]

(f) 3PV positioned at outstroke [1]

Appropriate activation method [1]

Appropriate piping to D [1]

Appropriate piping to 5PV [1]

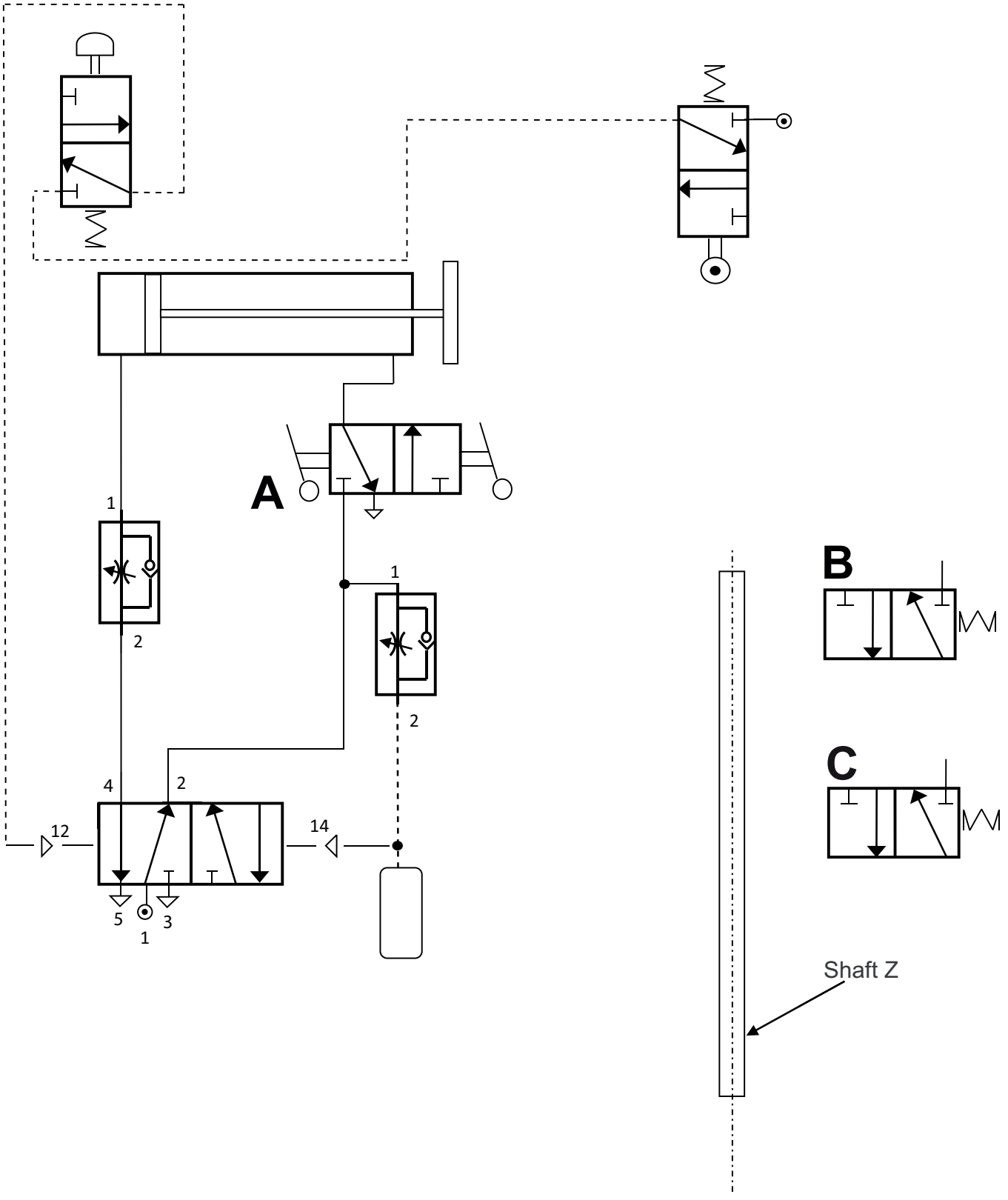
Instroke slowly [1]

See sample answer

Correct alternative responses will be given full credit.

AVAILABLE MARKS

20



Answer **3(b)** and **(f)**

				AVAILABLE MARKS
4	**(a)**	Bevel gear	[1]	
	(b)	A–F A–C 60/120 = 0.5	[1]	
		D–E 40/80 = 0.5	[1]	
		E–F VR = 0	[1]	
		0.5 × 0.5 = 0.25 [1]		
	(c)	VR F–G 30/30 = 1	[1]	
		VR between J and rotating disc	[1]	
		OS = IS/VR 20 = 48/2.4	[1]	
		30 × 2.4 = 72 teeth	[1]	
	(d)	Clockwise moment 75 N	[1]	
		Clockwise moment 75 N × 50 mm = 3750 N mm	[1]	
		Anticlockwise moment to produce equilibrium = 3750 = ? × 250 = 15 N	[1]	
	(e)	**(i)** The lubricator puts very small droplets of oil into the compressed air which lubricates the components.		
		Award [2] for a full explanation and [1] for a limited explanation [2]	[2]	
		Correct alternative responses will be given full credit.		
		(ii) A sample answer could involve the use of a cylinder to push the handle. The three port valves could be connected in an 'or' arrangement using shuttle valves.		
		Cylinder in position to push handle downwards	[1]	
		OR operation between two 3PVs	[1]	
		OR operation for remaining 3PV	[1]	
		Connection from 3PV 'or' arrangement to cylinder	[1]	
		Slowly	[1]	
		Plunger activation	[1]	
		Correct alternative responses will be given full credit.		20
			Section B	**40**

Section C

AVAILABLE MARKS

5 **(a)** A survey is when people are asked a question or series of questions in order to gather information about what most people think about a product.

Award [2] for a full explanation and [1] for a limited explanation. [2]

Correct alternative responses will be given full credit.

(b) Any **two** main characteristics associated with trademarks for example:

- It is used to identify and distinguish its products from those of others.
- The owner of the registered trademark is offered protection from infringement by other businesses.
- It must be distinctive, not deceptive and morally acceptable.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(c) Any **two** specific characteristics associated with attribute analysis for example:

- The attributes or characteristics of a design can be written down in the form of a table or matrix.
- Attribute analysis is a method of seeing the variables that create a situation in a way that allows us to change one or more to improve the design.
- It is considered as a very mechanical method for generating ideas.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(d) Any **two** main characteristics associated with British Standards for example:

- A standard which allows companies to ensure their products meet a recognised standard in safety and therefore ensure fitness for purpose.
- Companies will need to have their product tested to British Standard requirements.
- It is an independent organisation which is not government or industry owned so that it can be impartial and fair.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(e) Die cutting

Explanation of the process to include the knife pressing down and cutting through the material which is clamped. [2]
Annotated sketch – of die cutting process to include the card in position, die/sharp knife. [2] [4]

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit.

(f) (i) An appropriate design could be based on a recessed hinge on the lower side of the tray. This will ensure that the tray can only rotate through approximately 180 degrees when unfolded and is rigid. A clip could be used to lock the hinge in position.

AVAILABLE MARKS

Description	Marks awarded
Detailed annotated sketches representing an appropriate design that will allow the user to fold the car steering wheel tray along X--X to facilitate storage. The design ensures that the car steering wheel tray is rigid when in use.	[4]
Both the sketches and annotation are good. The ideas represent improvements but lack the finesse appropriate for the product.	[2]–[3]
Limited sketches lacking detail and appropriate annotation. Difficulties in not only determining if the design will allow the user to fold the car steering wheel tray along X--X but also if the design ensures that the car steering wheel tray is rigid when in use.	[1]
Level of response not worthy of credit	[0]

Correct alternative responses will be given full credit. [4]

(ii) An appropriate design may involve the use of a plastic clip which is part of the injection moulded tray with a spring inserted. The user would press the clip to allow the napkin to be inserted and the spring will maintain pressure on the napkin to maintain its grip.

Description	Marks awarded
Detailed annotated sketches representing an appropriate design of the front area of the car steering wheel tray. This would allow the user to quickly secure a paper napkin to the front of the tray.	[4]
Both the sketches and annotation are good. The ideas represent improvements but lack the finesse appropriate for the product.	[2]–[3]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design is appropriate and would allow the user to quickly secure a paper napkin to the front of the tray.	[1]
Level of response not worthy of credit	[0]

Correct alternative responses will be given full credit. [4]

20

AVAILABLE MARKS

6 **(a)** Any **two** specific criteria that a designer would need to include in an engineering specification. E.g. Garden hand tool:

- A metric value – The maximum dimensions (mm) that the garden hand tool must not exceed.
- An engineering unit – The overall weight (kilograms) that the garden hand tool must not exceed.
- A target value – The acceptable tolerance (dimensions) of the tool end section to ensure that it can be press fitted into the handle.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(b) Any **two** main benefits to the company of using 3D computer simulation for the hand tools for example:

- Does not require any physical components therefore saving on money.
- Can speed the production process.
- Ideas can be edited.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(c) **(i)** Any **two** main characteristics associated with concurrent engineering for example:

- Stages of the design process can overlap.
- Good communication essential between all stages.
- Aim is to design/manufacture with maximum efficiency.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(ii) Any **one** main benefit to the company of adopting concurrent engineering for example:

- Saves time and money.
- Allows designers to be more involved in the production of a new product. [1]

(d) Any **two** main characteristics associated with a flow process chart for example:

- This will involve the order of assembly of parts or components.
- It will list the tools, equipment and processes required.
- Quality control checks will be specified.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(e) **(i)** The purpose of quality control is to make sure the product meets required standards. [1]

(ii) Any **two** specific quality control checks for example – car steering wheel tray:

- Dimensional accuracy of the overall tray.
- Surface quality check on both sides of the tray.
- Colour consistency.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(f) Any **two** main reasons why the company may want to use glass reinforced plastic for the handle of the tools for example:

- It is a lightweight.
- It provides a weather resistant finish.
- Can be produced with a variety of surface textures.

(2 × [1]) [2]

Correct alternative responses will be given full credit.

(g) Formative evaluation is ongoing and occurs every time you make a decision or judgement regarding your work. Summative evaluation occurs at the end of the project. It specifically judges how well the final manufactured product meets the specification.

Award [2] for a full explanation and [1] for a limited explanation. [2]

Correct alternative responses will be given full credit.

(h) A solution based on left hand threaded male ends on the tool part. A female threaded bush could be press fitted into the handle. This will allow any threaded tool ends to be screwed into the handle.

Description	Marks awarded
Detailed annotated sketches representing an appropriate design that will enable the user to quickly and easily remove the handle and secure it onto a different garden tool.	[4]
Both the sketches and annotation are good. The ideas represent improvements but lack the finesse appropriate for the product.	[2]–[3]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design will enable the user to quickly and easily remove the handle and secure it onto a different garden tool.	[1]
Level of response not worthy of credit	[0]

Correct alternative responses will be given full credit. [4]

20

Section C **40**

Total **40**

AVAILABLE MARKS