Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education

Technology and Design

Assessment Unit AS 1

assessing

Systems and Control or Product Design

[STE12]

Assessment

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 teachers 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, teachers 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, teachers are expected to use their professional judgement to assess the validity of answers. You must not draw inferences or interpret what you think the candidate has meant. Teachers should carefully read and consider every response.

Positive marking
Teachers 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. Teachers 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, teachers should apply the 'error carried forward 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. Award full marks if a candidate gives the correct answer but does not show the working out.

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.

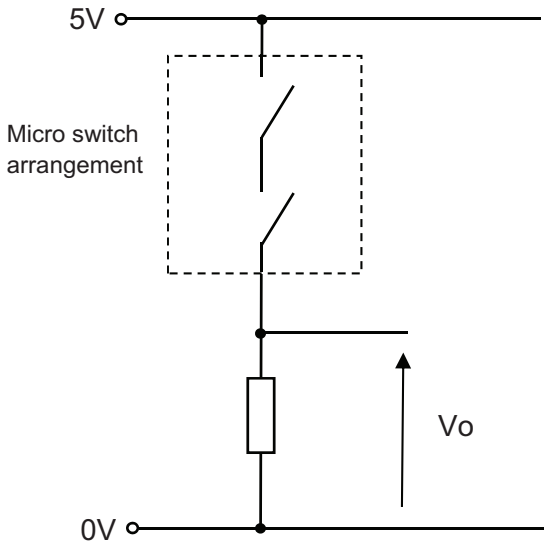
Section A

AVAILABLE MARKS

Electronic and Microelectronic Control Systems

1 (a) (i) They require a **small** movement at the point of activation in order to operate the switch mechanism.
(1 × [1]) [1]

(ii) Sample answer – SPST symbols [1] appropriate connection. [1]
(2 × [1]) [2]



Source: © CCEA

(iii) The pull down resistor ensures that Vo will be connected to the negative rail or 'grounded' [1] in the event that either of the micro switches are opened. [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit

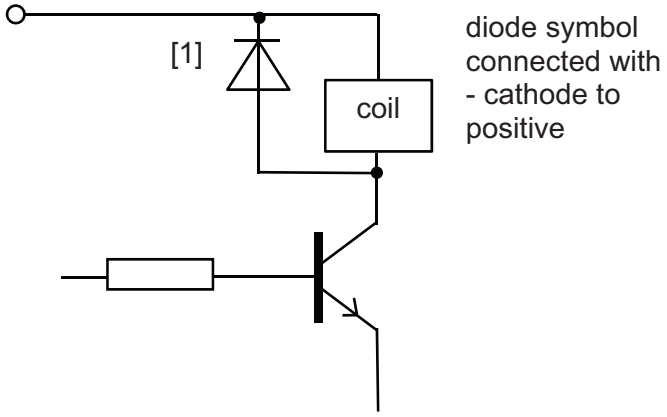
(b) (i) Ic = 5V/8 Ω = 625mA [1]
Ib = 625/60 = 10.4mA [1]
Rb = 5V – 0.6V/10.4mA [1] = 423 Ω [1]
(4 × [1]) [4]

Correct alternative responses should be given full credit

(ii) Power dissipated = 5V × 625mA [1] = 3.125 W [1]
Award full marks if a candidate gives the correct answer but does not show the working out.
(2 × [1]) [2]

Correct alternative responses should be given full credit

(iii) Sample answer.



Source: © CCEA

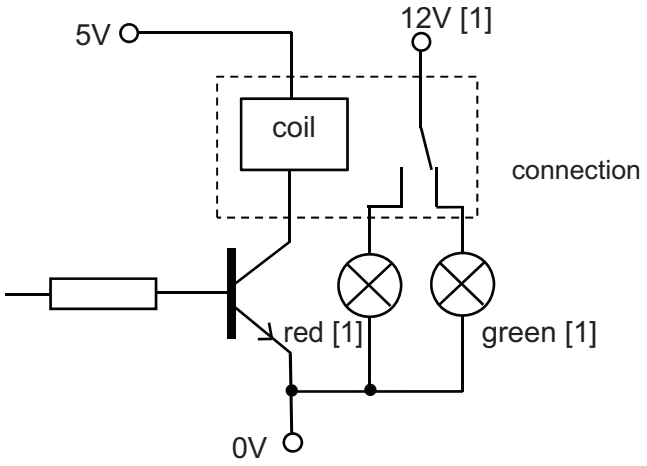
(1 × [1]) [1]

Correct alternative responses should be given full credit

(iv) Sample answer.
When the coil is energised the reverse biased diode will not conduct. When the coil is de-energised the back emf [1] that may occur across the inductor and damage the transistor is dissipated by the forward biased diode [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit

(v) Sample answer.



Source: © CCEA

(3 × [1]) [3]

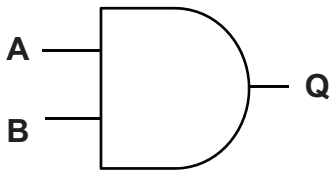
Correct alternative responses should be given full credit

(vi) The relay could be replaced by a latching relay [1]. The relay can be reset by using a push to make switch [1] to connect the reset coil to the power supply. This will effectively break the switch contacts until the transistor is switched on again. [1]
(3 × [1]) [3] 20

Correct alternative responses should be given full credit

AVAILABLE MARKS

2 **(a)**



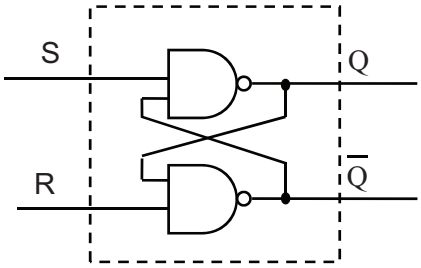
[1]

input A	input B	output Q
0	0	1
0	1	0
1	0	0
1	1	1

[1]

(2 × [1]) [2]

(b) **(i)**



Award [1] for symbols
Award [1] for connections
(2 × [1]) [2]

(ii)

Sw A pressed?	Sw B pressed?	Logic state at S	Logic state at R	Q logic state	$\overline{Q}$ logic state
no	no	1	1	0	1
yes	no	0	1	**1**	0
no	no	1	1	1	**0**
no	yes	**1**	0	0	1

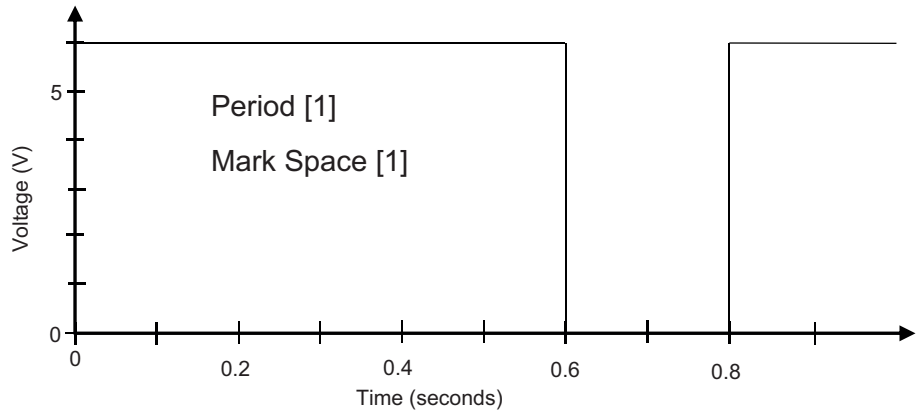
[1] for each correct logic state

(3 × [1]) [3]

(iii) The resistor values are organised into a set of preferred values that are spaced such that the top of the tolerance [1] band of one value and the bottom of the tolerance band of the next cover a wide range of values. [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit

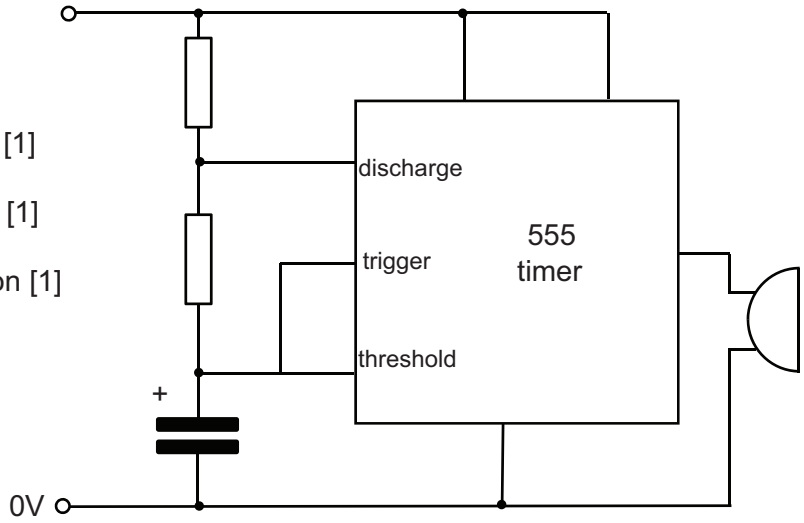
(c) **(i)**



(2 × [1]) [2]

Correct alternative responses should be given full credit

(ii)



Resistors [1]

Capacitor [1]

Connection [1]

(3 × [1]) [3]

(iii) Trigger pin turns the output [1] on when the voltage at the pin drops below 1/3 of the supply voltage.

(2 × [1]) [2]

Correct alternative responses should be given full credit

(iv) 1.25 = 1.44/(450 + 2000) × C [1]
1.44/1.25 = 2450 × C [1]
C = 1.152/2450 [1]
Value for capacitor = 470 μF [1]
Award full marks if a candidate gives the correct answer but does not show the working out.

(4 × [1]) [4]

AVAILABLE MARKS

20

Section B

Mechanical and Pneumatic Control Systems

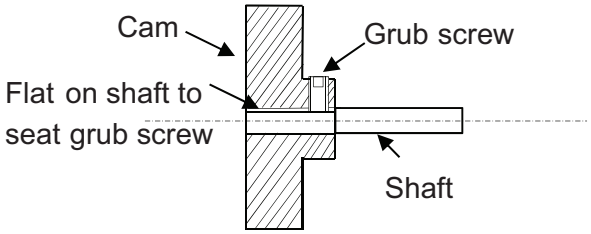
AVAILABLE MARKS

3 (a) (i) Correct sketch of pear-shaped cam profile [1]
Correct sketch of heart-shaped cam profile [1]
(2 × [1]) [2]

(ii) The rise is the section of the cam which causes lift [1]
The dwell is the section of the cam where there is neither rise or fall [1]
The stroke length is the distance between the highest and lowest points on the cam [1]
(3 × [1]) [3]

Correct alternative responses should be given full credit.

(iii) Drawing of grub screw to hold cam on shaft.



Appropriate cam and shaft [1]
Grub screw and housing [1]
Indication of flat on shaft [1]
(3 × [1]) [3]

(b) (i) Valve A with air supply to valve B [1]
Solenoid operation at valve B [1]
Valve B activates 5PV [1]
Flow control valve on line 4 of 5PV (correct orientation) [1]
See **Fig. 9**
(4 × [1]) [4]

(ii) Main air, flow control and valve D activation [1]
Main air at D and connection at D to 14 of 5PV [1]
See **Fig. 9**
(2 × [1]) [2]

(iii) Main air at C and air to shuttle valve [1]
Correctly drawn shuttle valve and piped to include valve C and connection to 14 of 5PV [1]
See **Fig. 9**
(2 × [1]) [2]

AVAILABLE MARKS

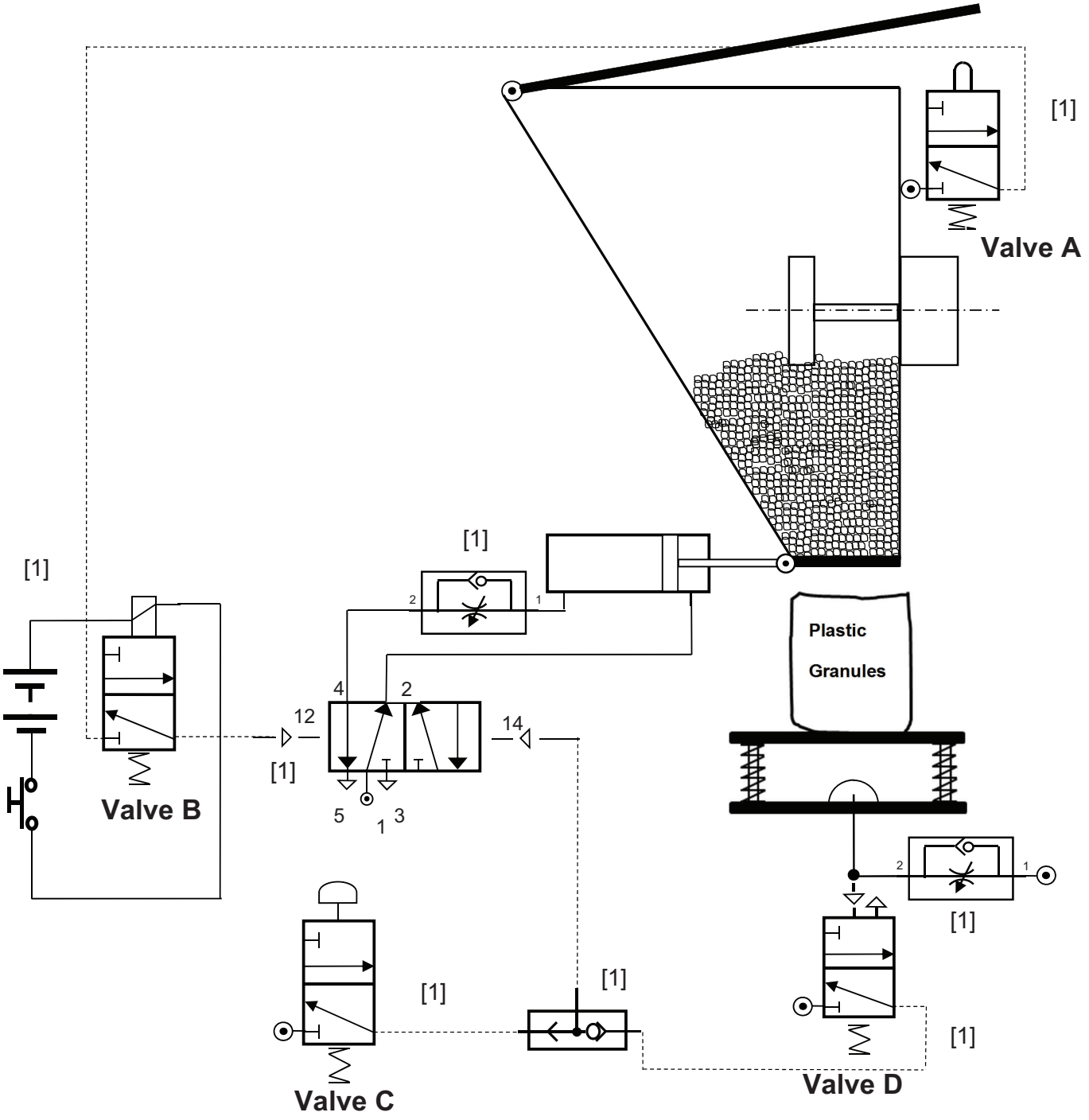


Fig 9

(c) 100/80 x 125.6 = 157 [1]
157/2 = 78.5 [1]
78.5/3.14=√25 [1]
Diameter = 10 mm [1]
(4 × [1]) [4]

20

AVAILABLE MARKS

4 (a) (i) Naming of crank and slider [1]
Sketch of crank and slider [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit

(ii) Velocity ratio E–D = 3[1]
C–A =1 [1]
Q–R = 30 [1]
Total VR = 90 [1]
60 × 90 = 5400 rev/min [1]
Award full marks if a candidate gives the correct answer but does not show the working out.
(5 × [1]) [5]

(iii) Efficiency = Mechanical advantage/velocity ratio
0.8 = MA/20 [1]
MA = 16 [1]
MA = Load/effort
16 = L/8 [1]
Load = 128N [1]
Award full marks if a candidate gives the correct answer but does not show the working out.
(4 × [1]) [4]

(iv) Any **two** main reasons why a vee belt would be used in preference to a flat belt to transmit the drive from pulley D to pulley E for example:

- There is a larger gripping area on a vee belt than on a flat belt of the same width for this application. [1]
- Using a vee belt instead of a flat belt means that smaller pulleys and belts can be used for the prototype mechanical system. [1]
- vee belts are more efficient than flat belts and lose almost no energy through slippage which would be required for this application. [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(b) (i) Any **one** safety issue which arises when using pneumatics for example:
- Fingers can get injured from moving parts [1]
- Disconnected pipes can whip round and cause injury if the main air supply is turned on [1]

Any **one** main procedure which could minimise this issue for example:
- Have guards on moving parts [1]
- Isolate air supply during adjustments [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(ii) Outstroke slowly with flow regulator [1]
Instroke slowly with flow regulator [1] and reservoir [1]

Valve A lever set/reset symbol [1]
Piping from 3PV to 5PV [1]
See Fig. 13

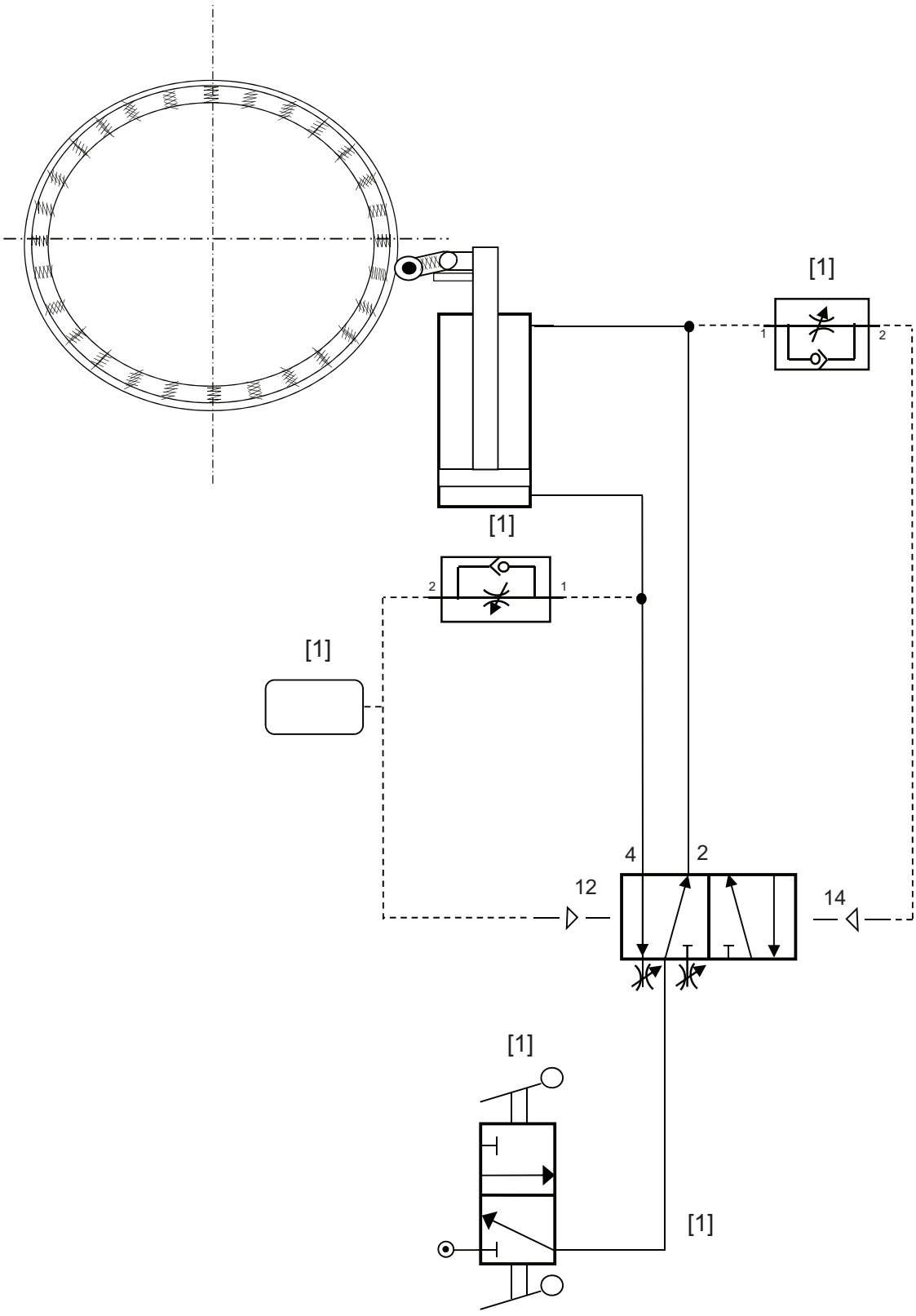


Fig.13

(5 × [1]) [5] 20

Correct alternative responses should be given full credit.

Section C

AVAILABLE MARKS

5 **(a)** Any **two** reasons why a company would produce a detailed design specification for the plastic pots for example:

- A detailed design specification would provide a clear list of requirements that the plastic pots must fulfil [1]
- A detailed design specification could serve as a key check on performance criteria [1]
- A detailed design specification could save the company time and money by reducing the need for further questioning and clarification [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

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

- Involves shorter runs than mass around 100 to 1000 products [1]
- It requires skilled labour on the factory floor [1]
- Can produce variations of the same item [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(c) Any **two** main characteristics associated with flexible manufacturing systems for example:

- Based on flexible workforce and flexible machinery [1]
- People are semi-skilled – ability to offer a variety of tasks [1]
- Works best with batch production- flexibility essential [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(d) **(i)** Any **one** main characteristic associated with light-emitting polymers for example:

- Converts electrical power into visible light [1]
- By engineering the chemical structure of the LEP all emission colours can be obtained [1]

(1 × [1]) [1]

(ii) Any **one** other specific application for example:

- Television screens [1]
- Handheld game consoles [1]

(1 × [1]) [1]

Correct alternative responses should be given full credit.

(e) (i) With reference to a manufacturing process briefly explain any **four** stages from the five stage risk assessment for example:
Manufacturing process – Drilling.

1. Hazard identified – When drilling a piece of plastic or metal there is the potential for the material to rotate. [1]
2. Who is at risk and how? – The user is at risk. Injury may be as a result of rotating material with possible sharp edges. [1]
3. Precautions – The user should ensure that the material is adequately clamped, use guards and ensure that the appropriate drill is fitted and the feed/speed is correct for the material. [1]
4. Record findings – A record of any finding or observations on the process should be made. These findings should be kept simple and not too elaborate. [1]
5. Review your assessment – Review over a set time period and make any improvements, changes as needed. [1]

(4 × [1]) [4]

Correct alternative responses should be given full credit.

(ii) Any **two** main characteristics associated with Quality Assurance(QA) for example:

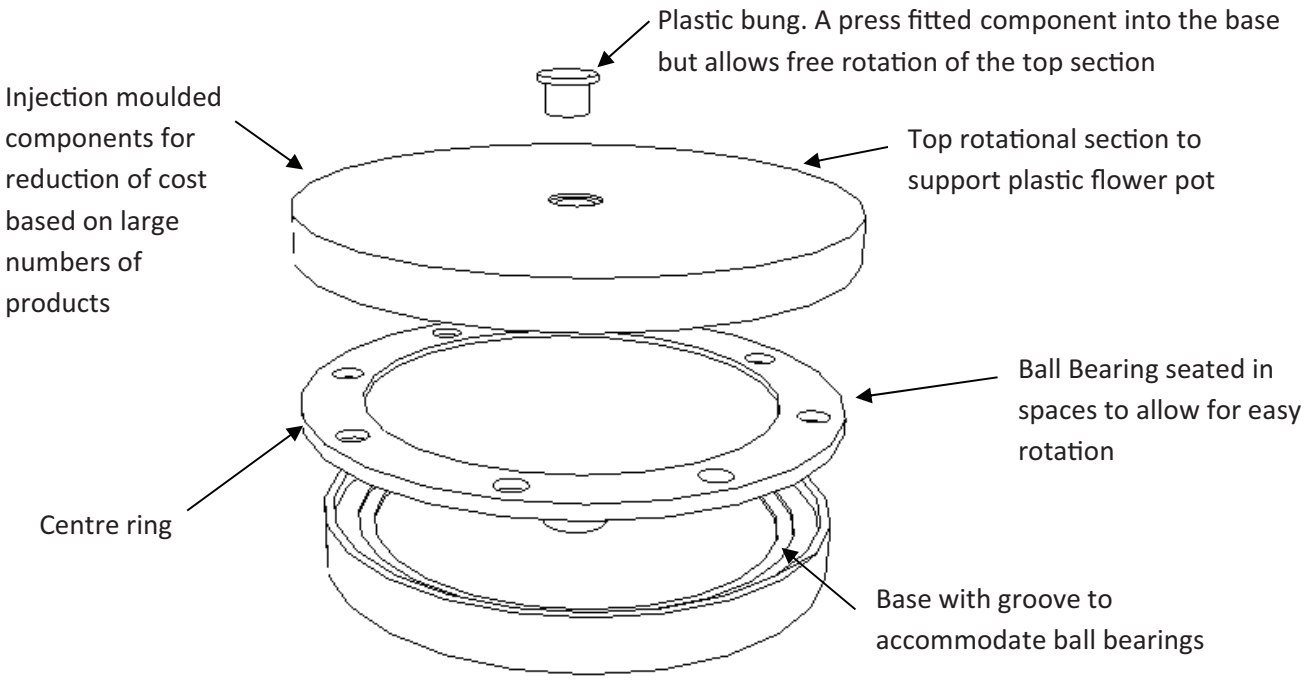
- Quality assurance is about setting standards and meeting them. [1]
- Quality assurance involves every stage from design to delivery to customer. [1]
- Organisations which meet these quality assurance standards are awarded the ISO 9000, the international standard of quality. [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(f) A low cost design for a rotating platform that would enable a person to rotate the plastic flower pot around in order to face the sunlight.

AVAILABLE MARKS



Response band		Mark band
When a response is not worthy of credit, a [0] mark should be awarded.		
1	Basic drawing lacking detail. The design presents a basic or incomplete solution to the design problem.	1
2	Drawing and annotation are limited. The design lacks detailing showing the: – low-cost nature of the platform; and/or – rotation; and/or – the drawing is not exploded. The design presents a limited solution to the design problem.	2
3	Drawing and annotation are satisfactory. The design demonstrates the: – low-cost nature of the platform; and – rotation. – an incomplete exploded drawing. The design presents a satisfactory solution to the design problem.	3
4	Drawing and annotation are good. The design clearly demonstrates: – low-cost nature of the platform; and – rotation; however – the exploded drawing is missing some detail. The design presents a good solution to the design problem.	4
5	Drawing and annotation are very good. The design demonstrates: – low-cost nature of the platform; and – rotation; and – a very good, exploded drawing. The design presents a very good solution to the design problem.	5
6	Drawing and annotation are excellent. The design clearly demonstrates: – low-cost nature of the platform; and – rotation; and – an excellent fully exploded drawing. The design presents an excellent solution which clearly addresses the design problem.	6

[6]

AVAILABLE MARKS

20

AVAILABLE MARKS

6 **(a)** Any **two** main advantages of using a questionnaire for example:
- A relatively quick method of collecting information. [1]
- Responses are usually standardised and so makes interpretation easy. [1]
- Questionnaires can be conducted in a number of ways, e.g. face-to-face, by mail or online. [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(b) A design critique refers to analysing a design usually by a group through conversation [1] with the ultimate goal of improving the design by giving feedback on whether it meets its objectives. [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit.

(c) **(i)** The ISO 9001 standard is a quality management system which will help monitor and manage quality across all operations. [1] It outlines ways to achieve, as well as benchmark consistent performance. [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit.

(ii) Any **two** main characteristics associated with design rights for example:
- Design right is a free, automatic right that you get when you create an original design [1]
- It gives you the right to stop anyone copying your design for up to 15 years [1]
- Design right is concerned with the shape or configuration of the product [1]

(2 × [1]) [2]

Correct alternative responses should be given full credit.

(d) Any **two** main characteristics associated with critical path analysis for example:
- It is used to identify key stages to aid project management [1]
- Critical path analysis is used to ensure the project keeps to schedule [1]
- A critical path analysis is represented by a network analysis [1]

(2 × [1]) [2]

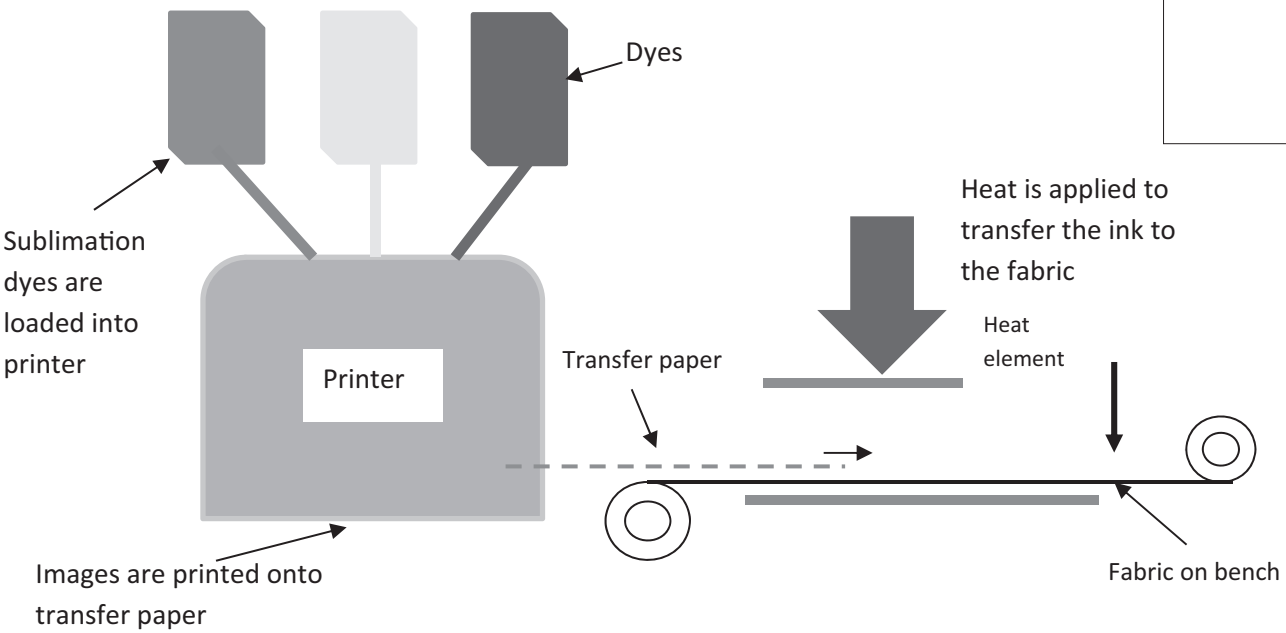
Correct alternative responses should be given full credit.

(e) Miniaturisation has had an impact on the design of a product for example: the mobile phone. [1] Through miniaturisation the smart phone has become a device which is a combination of several previously independent devices. [1]
(2 × [1]) [2]

Correct alternative responses should be given full credit.

(f) An annotated sketch of dye sublimation process to include: sublimation dyes, printer, transfer paper, heat element and fabric roll.

AVAILABLE MARKS



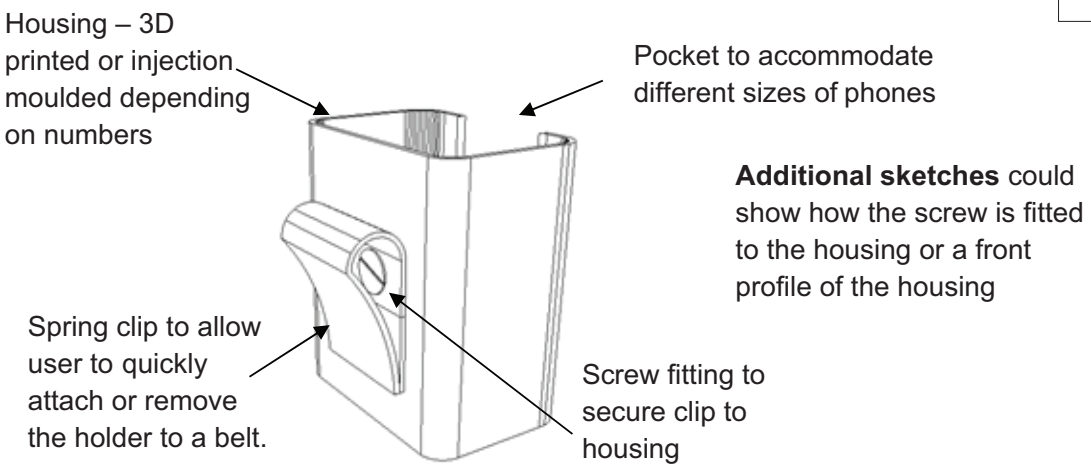
Response band		Mark band
When a response is not worthy of credit, a [0] mark should be awarded.		
1	Basic sketch lacking detail.	1
2	The sketch is satisfactory. Annotation is satisfactory with regards to the main aspects of the dye sublimation process.	2
3	The sketch is good. The annotation covers some of the main aspects of the dye sublimation process.	3
4	A detailed sketch. The annotation covers the main aspects of the dye sublimation process.	4

[4]

Correct alternative responses should be given full credit.

(g) A plastic mobile phone holder which allows the user to quickly attach or remove the holder to or from a belt whilst ensuring that the phone is secure.

AVAILABLE MARKS



Additional sketches could show how the screw is fitted to the housing or a front profile of the housing

Correct alternative responses should be given full credit.

Response band		Mark band
When a response is not worthy of credit, a [0] mark should be awarded.		
1	Basic sketch lacking detail.	1
2	Sketch(es) and annotation are satisfactory. The design lacks detail showing how: – the holder easily clips to a belt; and/or – the holder easily removes from the belt; and/or – the mobile phone is secure while in the holder.	2
3	Sketch(es) and annotation are good. The design shows: – the holder easily clips to a belt; and – the holder easily removes from the belt; and – the mobile phone is secure while in the holder.	3
4	Sketches and annotation are excellent. The design shows in detail: – the holder easily clips to a belt; and – the holder easily removes from the belt; and – the mobile phone is secure while in the holder.	4

[4] 20

Total **40**