



**General Certificate of Secondary Education
2022**

Technology and Design

Unit 2

Option B: Mechanical and Pneumatic
Control Systems

[GTY22]

THURSDAY 16 JUNE, AFTERNOON

**MARK
SCHEME**

General Marking Instructions

Introduction

Mark schemes are intended to ensure that the GCSE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses. The mark schemes should be read in conjunction with these general marking instructions.

Assessment objectives

Below are the assessment objectives for GCSE Technology and Design.

Candidates must:

- Recall, select and communicate their knowledge and understanding of Technology and Design in a range of contexts;
- Apply skills knowledge and understanding, including quality standards in a variety of design contexts. Plan and carry out investigations and making tasks involving an appropriate range of tools, equipment, materials and processes; and
- Analyse and evaluate evidence, design proposals and outcomes, make reasoned judgements and present conclusions and recommendations.

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 16-year-old which is the age at which the majority of candidates sit their GCSE 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 an unanticipated answer, 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 16-year-old GCSE 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.

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

Tasks and questions requiring candidates to respond in extended writing are marked in terms of 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.

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.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level 1: Quality of written communication is limited.

Level 2: Quality of written communication is satisfactory.

Level 3: Quality of written communication is very good.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

Level 1 (Limited): The level of accuracy of presentation, spelling, punctuation and grammar is limited. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary.

Level 2 (Satisfactory): The level of accuracy of presentation, spelling, punctuation and grammar is satisfactory. The candidate makes a satisfactory selection and use of an appropriate form and style of writing supported with appropriate use of diagrams as required. Relevant material is organised with some clarity and coherence. There is some use of specialist vocabulary.

Level 3 (Very Good): The level of accuracy of presentation, spelling, punctuation and grammar is very good. The candidate successfully selects and uses the most appropriate form and style of writing, supported with precise and accurate use of diagrams where appropriate. Organisation of relevant material is very good. There is very good use of appropriate specialist vocabulary.

COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

1	<p>(a) Jockey Pulley [1] C [1] Compound Gear [1] D [1] Heart Shaped Cam [1] E [1] Lever [1] A [1] Meshed Bevel Gear [1] B [1]</p>	[10]
	<p>(b) (i) A Eccentric Cam [1] B Pear Shaped Cam [1] C Snail Cam [1]</p>	[3]
	<p>(ii) B C A</p>	[1] [1] [1]
	<p>(iii) C or Snail Cam</p>	[1]
	<p>(iv) Any two from: Reduces friction between the cam & follower Reduces wear between the cam & follower Follows the cam profile more precisely/more accurately (2 × [1]) All relevant, valid responses will be given credit.</p>	[2]
	<p>(c) (i) A Compound Gear Train</p>	[1]
	<p>(ii) A large speed change can be achieved or A large speed decrease can be achieved or A large speed increase can be achieved More compact than a simple gear train/takes less space</p>	[1]
	<p>(iii) 30/60 × 40/90 [1] 0.5 × 0.44444 [1] 0.222222 or 0.22 [1]</p>	[3]
	<p>(iv) 600/0.22222 [1] 2700 [1] rpm [1]</p>	[3]
	<p>(v) C = 75 D = 30 [2] 600/3000 = 0.2 0.2/0.5 = 0.4 [1] 30/75 = 0.4 [1]</p>	[4]
	<p>(d) (i) Worm [1] and Wormwheel [1]</p>	[2]
	<p>(ii) MA = L/E E = L/MA [1] E = 3600/40 [2] = 90 [1] N [1]</p>	[5]
	<p>(iii) 1 turn of the handle = 1/40 turn of the wormwheel [1] = 1/40 turn of the shaft [1] = 1/40 π [1] × 0.25 [1] = 0.0196 [1] m [1]</p>	[6]
	<p>(iv) For one turn of the handle VR = Effort distance/Load Distance VR = 2 × π × 0.4 [1] / [1] 0.0196 [1] VR = 128 [1] or 1:128</p>	[4]

AVAILABLE MARKS

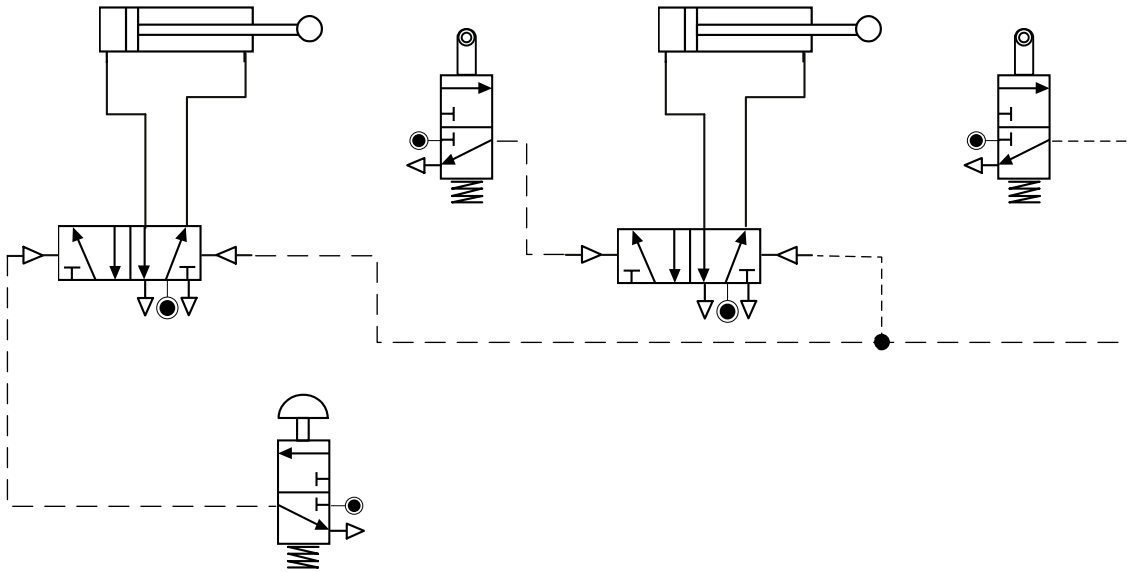
		AVAILABLE MARKS
	<p>(v) Any two of the following: Increase the crank handle radius or Longer handle/effort/lever or Decrease the diameter or Increase the number of teeth on the wormwheel or Decrease pitch of teeth (2 × [1])</p>	50
2	<p>(a) Spring return [1] Pilot pressure [1] Pipeline not connected [1] Pilot/Signal [1] Three port valve [1]</p>	[5]
	<p>(b) (i) Double Acting Cylinder</p>	[1]
	<p>(ii) 1st Class lever</p>	[1]
	<p>(iii) $F = P \times A$ $A = F/P$ $= 300/0.4$ [1] $= 750$ [1] mm² [1]</p>	[3]
	<p>(iv) $\pi r^2 = 113$ [1] $r^2 = \frac{113}{\pi}$ $r = \sqrt{\frac{113}{\pi}} = 6$ [1] $D = 12$ mm [1]</p>	[3]
	<p>(c) (i) 5/2 Valve [1] Unidirectional Flow Restrictor [1]</p>	[2]
	<p>(ii) Signal/pilot air [1] switches 5/2 valve B [1] Cylinder outstrokes [1] Roller Trip operated [1] on 3/2 valve D [1] Signal/pilot air [1] switches/resets 5/2 valve B [1] Cylinder instrokes [1] slowly [1] because of the unidirectional flow restrictor [1]</p>	[10]
	<p>(iii) An additional 3/2 valve [1] beside A [1] Plunger operated valve [1] Guard activates 3/2 [1]</p>	[4]

(d) (i) A+ [1], B+ [1], A– and B– [1]

[3]

(ii) [1] for correct connections at each end
(4 × [2])

[8]



(e) **Indicative Content:**

- Repetitive and mundane actions and processes in industry are now completed by pneumatic or mechanical machines.
- Repetitive and mundane actions carried out by workers made them unmotivated.
- With pneumatic/mechanical machines, the worker can get upskilled and have a better position within the company
- New jobs and opportunities are created in the design, manufacture and maintenance of the pneumatic/mechanical machines.
- Requirements to deliver mass produced products locally and world wide lead to job opportunities
- Supply of components, machines and resources lead to improved local indigenous industries
- Pneumatic robotic machines operate precisely & accurately.
- Pneumatic machines can work without sleep. So, they can work 24/7/365.
- Pneumatic systems are hygienic in food production.
- Pneumatic systems require air to operate successfully. As a result of air being extremely abundant, and free, it is easy to restock the system.
- Safety procedures need to be in place to protect workers from potential hazards. Safety training needs to be in place for all workers.
- As a result of pneumatic systems running on air, safety hazards are significantly reduced.
- There are limited occurrences of fires because air is non-flammable, and leakages in the system do not negatively affect the outside environment.
- The use of one pneumatic machine can replace many humans in factories.
- The people have to find new jobs or be retrained. They can take the place of humans in several situations. If the pneumatic robot machines begin to replace humans in every field, they will lead to unemployment.

AVAILABLE
MARKS

Response Type	Description	Mark Band
When response is not worthy of credit [0] should be awarded.		
Limited	Student discusses one or two features which have impacted on society. The level of accuracy of spelling, punctuation and grammar is limited in most cases. Form and style is generally inappropriate as is the use of technical vocabulary and specialist terms.	[1]–[3]
Satisfactory	Student discusses two or three features which have impacted on society. The level of accuracy of spelling, punctuation and grammar is satisfactory in most cases. Form and style is generally appropriate as is the use of technical vocabulary and specialist terms.	[4]–[7]
Very Good	Student discusses at least four features which have impacted on society. The level of accuracy of spelling, punctuation and grammar is very good. Form and style is very good as is the use of technical vocabulary and specialist terms.	[8]–[10]

[10]

Total

AVAILABLE MARKS

50

100