Rewarding Learning

General Certificate of Secondary Education
2019

Technology and Design

Unit 2
Option B: Mechanical and Pneumatic Control Systems

[GTY22]

FRIDAY 31 MAY, MORNING

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.

AVAILABLE MARKS

1 **(a)** Wheel and Axle
Rack and Pinion
Sprocket and Chain
Single Pulley [4]

(b) **(i)** Belt and Pulleys or Pulley System [1]

(ii) Input – B
Output – A [2]

(iii) Speed Driven = Speed Driver × $\frac{\text{Driver}}{\text{Driven}}$

Output Speed = Motor Speed × $\frac{\text{Driver}}{\text{Driven}}$

$= 2200 \times \frac{15}{60} = 550$ rev/min

[4]

(c) **(i)** Simple Gear Train or Gear Train [1]

(ii) Advantage: Doesn't slip, positive drive
Disadvantage: Needs lubrication, noisy, more accuracy to assemble
Correct alternative responses will be considered [2]

(iii) Speed Driven = Speed Driver × $\frac{\text{Driver}}{\text{Driven}}$

Output Speed = Motor Speed × $\frac{\text{Driver}}{\text{Driven}}$

$215 = \text{Motor Speed} \times \frac{20}{80}$

$\text{Motor Speed} = 215 \times 4$

$= 860$ rev/min [4]

(iv) Fit an idler gear between the two gears [1]

(v) None [1]

(vi) A Chain Drive [1]

(vii) Use a Compound Gear Train [1]

(d) **(i)** Class 2 Lever or Second Class Lever [1]

(ii) Material: Steel
Reason: Strength [2]

(iii) Take moments at Pivot
Anti Clockwise moments = Clockwise Moments
$F \times 100 = 90 \times 450$

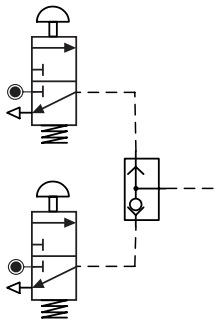
$F = \frac{90 \times 450}{100}$

$F = 405\,\text{N}$ [4]

(e) **(i)** Rack and Pinion [1]

(ii) Input Motion: Rotary [1]
Output Motion: Linear [1] [2]

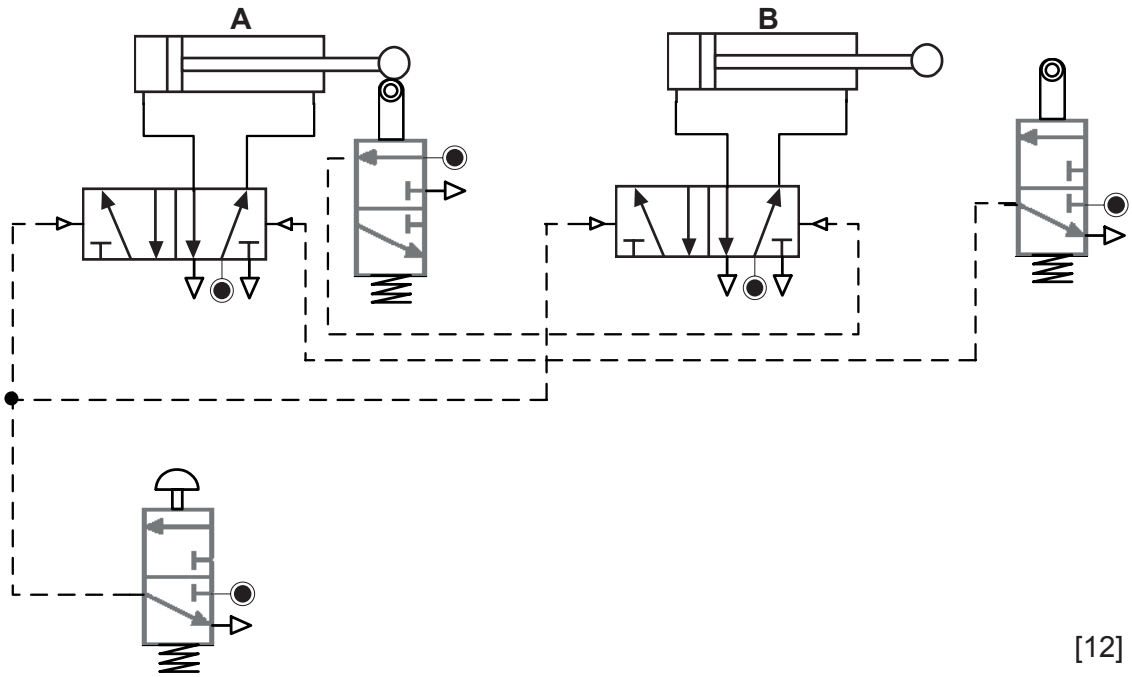
				AVAILABLE MARKS
		(iii) Oiling or greasing	[1]	
		(iv) Effort Distance = $\frac{\pi \times D}{4} = \frac{\pi \times 700}{4} = \frac{2198}{4} = 549.5\,mm$	[4]	
		(v) Distance M = $\frac{20 \times 5}{4} = \frac{100}{4} = 25\,mm$	[4]	
		(vi) Velocity Ratio = $\frac{\text{Distance moved by Effort}}{\text{Distance moved by load}} = \frac{549.5}{25} = 22$	[3]	
		(vii) 1. Increase the radius by increasing the length of the effort handle 2. Decrease the pitch of the teeth.	[2]	
		(viii) Clean sketch [2] with appropriate annotation [2]	[4]	50
2	**(a)**	**(i)** Plunger Push Button Lever Roller trip	[4]	
		(ii) Plunger Roller trip	[2]	
	(b)	**(i)** To adjust the time delay	[1]	
		(ii) Adjusting the restrictor [1] in or down or tighten [1] Use a larger/bigger [1] Reservoir [1]	[4]	
	(c)	**(i)** Signal to switch 5/2 valve **B** Cylinder C outstrokes slowly because of **E** 3/2 roller valve **D** operated Time delay begins because of **F** and **G** Signal to 5/2 valve **B** resets and Cylinder **C** instrokes	[5]	
		(ii) Adjust [1] Valve **E** [1]	[2]	
		(iii) Additional 3/2 start valve [2] Shuttle valve [2] Correct piping [2]		



[6]

AVAILABLE MARKS

(d) **(i)** Signal start to 5/2 valve at **A** [2]
Signal start to 5/2 valve **B** [2]
3/2 valve drawn at **B+** [2]
Signal to reset 5/2 valve **A** [2]
3/2 valve drawn at **A–** [2]
Signal to reset 5/2 valve **B** [2]



[12]

(ii) Insert a 3/2 valve [1] at **A+** [1]
Connect the signal from this valve [1] to the 3/2 valve at **B+** air intake [1] [4]

(e) Indicative content:
Reference to

- Checking all components are secured to the platform.
- Not continuing to operate the system if any air leaks are detected.
- Turning off main air supply before making alterations.
- Danger/protection from all moving parts.
- Danger to health/risk of misuse of compressed air as this can result in serious injury.
- Importance of tight pipe connections.
- Problem of loose pipes thrashing around when the air is turned on.
- Avoiding air lines going across the floor or between tables where people may fall over them.
- Importance of wearing safety glasses or goggles.

Response Type	Description	Mark Band
When a response is not worthy of credit, a **[0]** mark should be awarded		
Limited	Discussion/explanations are limited in content. Five points may or may not be considered. 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	Discussion/explanations are satisfactory in content. Five points may or may not be considered. The level of accuracy of spelling, punctuation and grammar is satisfactory. Form and style is satisfactory in most cases and technical vocabulary and specialist terms are used appropriately in some cases.	**[4]–[7]**
Very Good	Discussion/explanations are clear and comprehensive in content and explanation. Five points are considered. The level of accuracy of spelling, punctuation and grammar is very good. Form and style is of a high standard and technical vocabulary and specialist terms are used appropriately.	**[8]–[10]**

[10] 50

Total **100**

AVAILABLE MARKS