Rewarding Learning

General Certificate of Secondary Education
January 2019

Technology and Design

Unit 2: Systems and Control Element 2: Mechanical and Pneumatic Control Systems

[GTD22]

FRIDAY 11 JANUARY, 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.

Students must:
- recall, select and communicate their knowledge and understanding of technology and design in a range of contexts (AO1);
- apply skills, knowledge and understanding, in a variety of contexts and in designing and making products (AO2); and
- analyse and evaluate products, including their design and production (AO3).

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)** **(i)** Single Acting [1]

(ii) 3/2 Valve or three Port Valve [1]

(iii) Pushing, Ejecting, Clamping [1]
Alternative answers will be considered

(iv) F = P × A F = 0.5 × 250
F = 125 [1] N [1] [2] [5]

(b) **(i)** **A** = Push Button 3/2 Valve [1]
B = Flow Regulator [1]
C = Reservoir [1]
D = Air Operated 3/2 Valve [1] [4]

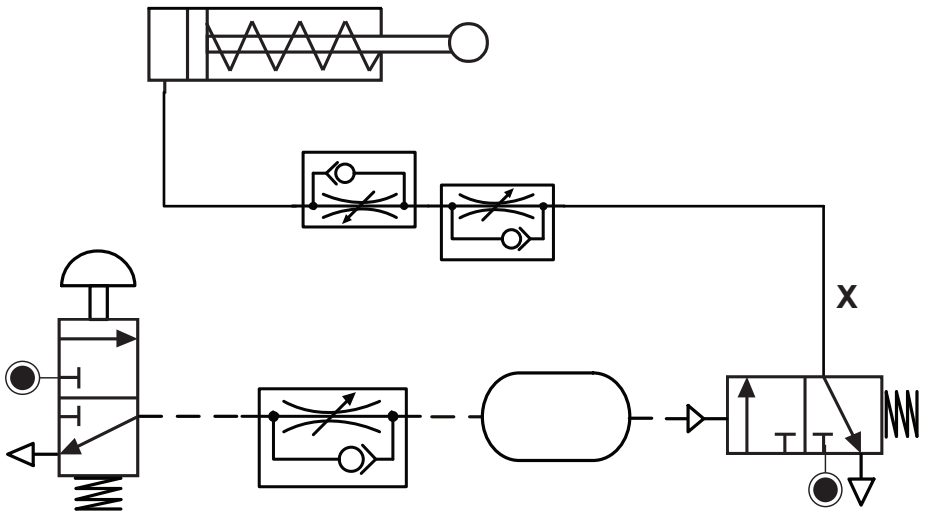
(ii)

Name an alternative method of actuating valve **A**	Lever, Roller or Plunger
Name the method of resetting valve **A**	Spring
How do you adjust valve **B**?	Screw

[3]

(iii) Reference to:
Operate push button to start circuit [1]
Air travels from the 3PV to the Flow Regulator [1]
Flow Regulator **B** slows the air into **C** [1]
C fills with air [1]
B and **C** together produce a Time Delay [1]
Signal received at **D** [1]
Valve **D** operates [1]
Valve **D** gives signal at **X** [1] [8]

(iv) Diagram must include:
- two Unidirectional Flow Restrictors the correct way round (2 × [2]) [4]
- correct piping of components [1] [5]



				AVAILABLE MARKS
(c)	**(i)**	Stroke length, Diameter, Air Pressure available (Any two)	[2]	
	(ii)	OR Logic	[1]	
	(iii)	$F = P \times A$ $F = 0.5 \times \pi R^2$ [1] $F = 0.5 \times (3.14 \times 400) = 0.5 \times 1256$ [2] $F = 628\,N$ [1]	[4]	
	(iv)	$A = \pi R^2 - \pi r^2 = (3.14 \times 400) - (3.14 \times 25)$ [2] $F = (0.5 \times 1256) - (0.5 \times 78.5)$ [2] $F = 628\,N - 39.25\,N$ [1] $F = 588.75\,N$ [1] **or** $F = 0.5\,[(\pi R^2) - (\pi r^2)]$ $F = 0.5\,[(3.14 \times 400) - (3.14 \times 25)]$ [2] $F = 0.5\,(1256 - 78.5)$ [2] $F = 0.5 \times 1177.5$ [1] $F = 588.75\,N$ [1]	[6]	
	(v)	The Piston rod reduces the area [1] of the piston's 'back' face. [1] **or** The Air Pressure on both sides is the same, however, The force produced will be less [1] for the piston going negative [1]	[2]	40

						AVAILABLE MARKS
2	**(a)**	**(i)**	Snail Cam [1] Heart Cam [1] Pear Shaped Cam [1]		[3]	
		(ii)	Knife Follower [1] Roller Follower [1] Flat Follower [1]		[3]	
		(iii)	**B** Heart [1] **A** Snail [1] **C** Pear [1]		[3]	
	(b)	**(i)**	Class 1 Lever		[1]	
		(ii)	Steel [1] Strength, Toughness [2]		[3]	
		(iii)	VR = $\frac{\text{distance moved by effort}}{\text{distance moved by Load}} = \frac{10}{1}$ VR = 10:1		[4]	
		(iv)	MA = $\frac{\text{Load}}{\text{Effort}}$ Load = MA × Effort [1] MA = $\frac{\text{distance of effort from fulcrum}}{\text{distance of load from fulcrum}}$ [1] MA = 150/5 = 30 : 1 [2] Load = MA × Effort Load = 30 × 20 N = 600 N [2] **or Using moments** Clockwise moments = Anti-clockwise moments [1] 20 × 150 = 5 × F [2] 5F = 3000 [1] F = 600 N [2]		[6]	
	(c)	Rack and Pinion [1] C [1] Worm and Wormwheel [1] D [1] Compound Gear Train [1] A [1] Bevel/Mitre Gears [1] B [1]			[8]	
	(d)	**(i)**	$\frac{\text{No. of teeth on Driven Gear B}}{\text{No. of teeth on Driver Gear A}} = \frac{40}{20} = \frac{2}{1}$ [2] $\frac{\text{No. of teeth on Driven Gear D}}{\text{No. of teeth on Driver Gear C}} = \frac{30}{20} = \frac{3}{2}$ [2] GR = $\frac{2}{1} \times \frac{3}{2} = \frac{6}{2} = \frac{3}{1} = 3:1$ [2]		[6]	
		(ii)	Output Speed = VR of A = 1/3 × 240 RPM [1] = 80 [1] RPM [1]		[3]	40
				Total		**80**