Rewarding Learning

General Certificate of Secondary Education
2011

Technology and Design

Unit 2:
Systems and Control

Element 2: Mechanical and Pneumatic Control Systems

[GTD22]

MONDAY 6 JUNE, MORNING

MARK SCHEME

Element 2

Mechanical and Pneumatic Control Systems

AVAILABLE MARKS

1 (a) (i) Double acting cylinder [1]

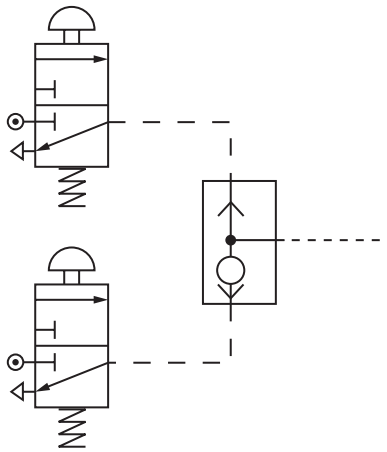
(ii) $F = P \times A$
$300 = 0.6 \times A$ [1]
$A = 300/0.6$ [1]
$= 500\,mm^2$ [1]
Piston Area $= 500 + 100 = 600\,mm^2$ [2]

(b) (i) A 3/2 valve
B 5/2 valve
C Reservoir
D One way flow restrictor or Flow control valve [4]

(ii) Signal to switch 5/2 valve **B**, cylinder **outstrokes** slowly [2]
3/2 roller valve **F** operated – **time delay** [2]
Valve B reset, cylinder **instrokes**. [2]

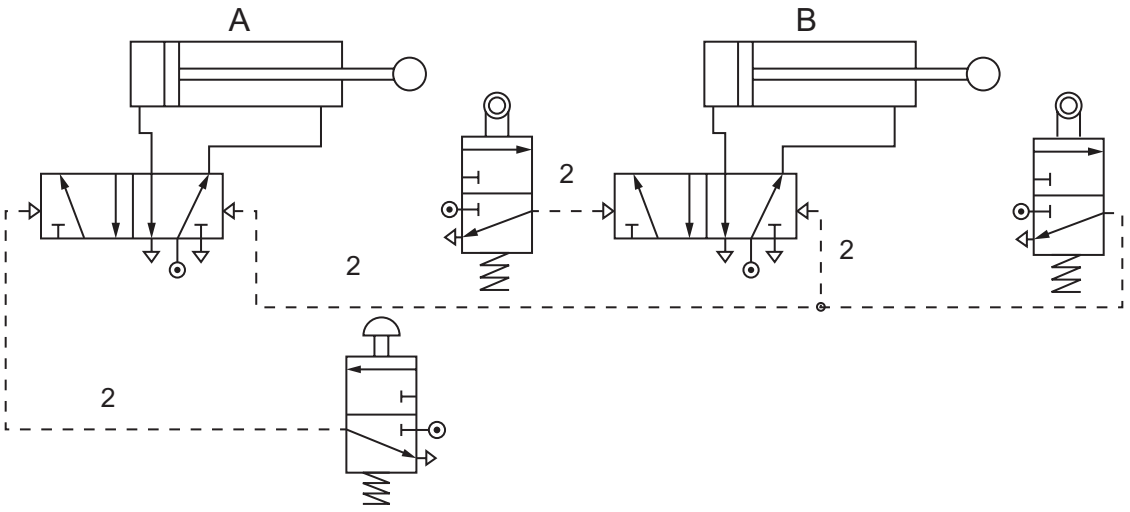
(iii) Adjust flow control valve E [3]
Change the position of valve F [3]

(iv) Additional 3/2 start valve [2]
Shuttle valve [2]
Correct piping for shuttle valve [2]



(c) (i)

AVAILABLE MARKS



Connection from start valve to 5/2 valve at cylinder A [2]
Signal from 3/2 roller valve at A+ to 5/2 valve at cylinder B [2]
Signal from 3/2 roller valve at B+ to 5/2 valve at cylinder A [2]
Signal from 3/2 roller valve at B+ to 5/2 valve at cylinder B [2]

(ii) Insert 3/2 roller valve at B– [2]
Connect signal from this valve to supply port of start valve [2] 40

2 (a) Solutions

AVAILABLE MARKS

Name	Function
Ratchet and Pawl	**B**
Worm and wormwheel	**D**
Compound gear train	**A**
Bell crank lever	**C**

8 × 1 [8]

(b) (i) The load transmitted
The distance between
Is an exact speed ration required
Can the transmission slip if overloaded etc
Any two appropriate factors 2 × 2 [4]

(ii) belts
Gears
Chains *any two* 2 × 2 [4]

(iii) Gears
Advantages: large loads, exact speed ratios etc *1 off*
Disadvantage: lubrication required, short distance etc *1 off*
Belts
Advantages: large distance, slip on overload, no lubrication etc *1 off*
Disadvantage: inexact ratios unless toothed, noisy etc *1 off*
Chains
Advantages: large loads, large distance, exact ratios *1 off*
Disadvantage: noisy, lubrication required etc *1 off*
Any two of the above methods [4]

				AVAILABLE MARKS
(c)	**(i)**	Rack and pinion	[2]	
	(ii)	Input – Rotary	[2]	
		Output – Linear	[2]	
	(iii)	Bore hole in handle and attach lever using adhesive. or Bore hole in handle, thread hole and end of lever. Screw on handle	[4]	
	(iv)	Effort distance $= \Pi \times D/4$		
		$= \Pi \times 600/4$	[2]	
		$= 471.2$	[2]	
		Drill distance $= \frac{20 \times 4}{4}$	[2]	
		$= 20$	[2]	
		Velocity ratio $= \frac{471.2}{20}$	[1]	
		$= 23.6$	[1]	40
			Total	**80**