

**GCSE**

**Technology  
and Design**

**Summer 2009**

**Mark Schemes**

Issued: October 2009



**NORTHERN IRELAND GENERAL CERTIFICATE OF SECONDARY EDUCATION (GCSE)  
AND NORTHERN IRELAND GENERAL CERTIFICATE OF EDUCATION (GCE)**

**MARK SCHEMES (2009)**

**Foreword**

***Introduction***

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

***The Purpose of Mark Schemes***

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.



## CONTENTS

	<b>Page</b>
Foundation Tier	1
Higher Tier	9





*Rewarding Learning*

**General Certificate of Secondary Education  
2009**

---

**Technology and Design**

Foundation Tier

**[G9501]**

**THURSDAY 21 MAY, MORNING**

---

**MARK  
SCHEME**

1 (M)

- Rack and Pinion [1]
- Danger [1]
- Double Acting Cylinder [1]



- Electronic [1]
- Pneumatic Control [1]
- Shuttle Valve [1]
- Mechanical Control [1]
- Sprocket and Chain [1]

2 Complete **Table 2** below by ticking (✓) the one correct box which relates to each material.

**Table 2**

Material	Hardwood	Plastic	Ferrous metal	Manufactured board	Softwood	Non-ferrous metal
Pine					✓	
Mild Steel			✓			
Chipboard				✓		
Acrylic		✓				
Aluminium						✓
Mahogany	✓					

- 3 Switch labelled (a) = Toggle switch
- Switch labelled (b) = Micro switch
- Switch labelled (c) = Push button switch
- Switch labelled (d) = Slide switch
- (4 × [1]) [4]

AVAILABLE MARKS

10

6

4



			AVAILABLE MARKS	
4	(a)	Manufactured board is made of compressed particles or thin sheets of wood (veneer) together with adhesive	[2]	8
	(b)	Sheet form; large size; different texture; No knots or grain; widely available;	[2]	
	(c)	Flat pack furniture; work surfaces; Kitchen units; shelves, etc. (2 × [2])	[4]	
5	(a)	(i) Remove chuck key; wear goggles; tie hair back;		6
		(ii) One person at the machine; (2 × [1])	[2]	
	(b)	G clamp; machine vice; vice grips, toggle clamp.	[2]	
	(c)	Drill the acrylic slowly; use masking tape; support underside of acrylic.	[2]	
6		Wheelbarrow Class 2 See-saw Class 1 Tweezers Class 3 Car park barrier Class 1 (4 × [1])	[4]	4
7	(a)	3/2 valve Pressure source Pipeline junction 5/2 valve (4 × [1])	[4]	8
	(b)	(i) A or B		
		(ii) Press button D		
		(iii) Clamping speed		
		(iv) Pilot actuated pilot reset (4 × [1])	[4]	

8

Name	Metal	Reason for choice
<b>Car body</b>	Mild steel or steel	Tough; Ductile; Malleable; Strong; High tensile strength
<b>Saucepan</b>	Aluminium or Stainless steel or Copper or Cast Iron	Lightweight; Good conductor of heat; Corrosion resistant; Malleable; Non-toxic; suitable for food;
<b>Nameplate</b>	Brass or Bronze	Hard metal; Corrosion resistant; Can be polished; Easy to Machine;
<b>Water pipes</b>	Copper	Malleable; Ductile; Corrosion resistant; Non-contaminating;

(8 × [1])

[8]

8

- 9 (a) (i) A Pear-shaped  
B Eccentric  
C Heart-shaped  
(3 × [1])

[3]

(ii) Roller

[1]

- (b) (i) pear-shaped or A

(ii) part of profile at constant radius  
(2 × [2])

[4]

8

AVAILABLE  
MARKS

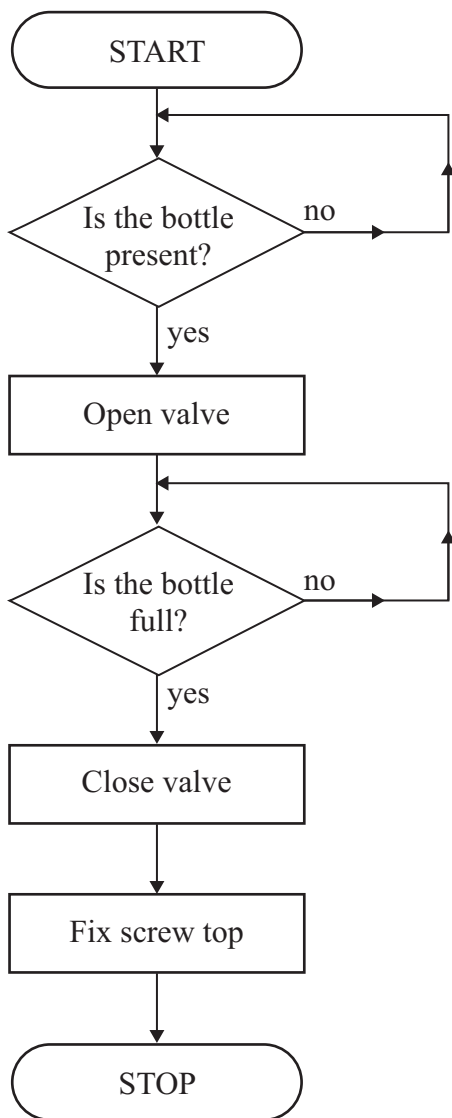
			AVAILABLE MARKS
<b>10</b>	<p><b>(a)</b> Current = Amps Voltage = Volts Resistance = Ohms (3 × [1])</p>	[3]	
	<p><b>(b)</b> <b>(i)</b> LED = Light emitting diode</p> <p><b>(ii)</b> Used to indicate circuit on or other suitable answer</p> <p><b>(iii)</b> To protect the LED from damage (3 × [1])</p>	[3]	
	<p><b>(c)</b> <b>(i)</b> Purpose: Conductor = To enable the current to flow in the circuit</p> <p><b>(ii)</b> Purpose: Insulator = To prevent a short circuit or suitable alternative</p> <p><b>(iii)</b> Example: Conductor = Copper wire</p> <p><b>(iv)</b> Example: Insulator = Plastic cable (4 × [1])</p>	[4]	10
<b>11</b>	<p><b>(a)</b> <b>(i)</b> A</p> <p><b>(ii)</b> B</p> <p><b>(iii)</b> B</p> <p><b>(iv)</b> A (4 × [1])</p>	[4]	
	<p><b>(b)</b> <b>(i)</b> 480 rev/min</p> <p><b>(ii)</b> 360 rev/min (2 × [1])</p>	[2]	
	<p><b>(c)</b> <b>(i)</b> fit an idler</p> <p><b>(ii)</b> none (2 × [1])</p>	[2]	8

12 (a) Correct order of operations  
(5 × [1])

[5]

(b) Correct loops  
(2 × [2])

[4]



13 (a) (i) Single acting cylinder  
(ii) Outstroke  
(iii) Avoid damage to plastic  
(iv) Adjust restrictor on B  
(4 × [1])

[4]

(b) (i) plunger  
(ii) press A and lower guard  
(2 × [1])

[1]

[2]

AVAILABLE  
MARKS

9

7

		AVAILABLE MARKS
<b>14 (a)</b>	Mechanical toy – Spring; Flywheel; Coil (1 × [1])	[1]
	Electrical toy – Battery; Solar power (1 × [1])	[1]
	Pneumatic toy – Air; Pump; Compressed air; Syringe (1 × [1])	[1]
<b>(b)</b>	Sketches and notes (3 × [1])	[3]
	Attachment to rear wheel; method of power (3 × [1])	[3]
<b>15 (a)</b>	Milling machine	[2]
<b>(b)</b>	Tap and wrench	[2]
<b>(c)</b>	Die or split die and die handle/holder	[2]
<b>(d)</b>	Mark out position for holes Drill holes Tap or cut thread Oil or other suitable stages (3 × [1])	[3]
<b>(e)</b>	Mark out and drill holes in plate Holes must align with existing holes Use 4 M6 machine bolts or screws Removable plate (4 × [1]) Sketches and notes (2 × [1])	[6]
	<b>QWC</b>	6
	<b>Total</b>	<b>126</b>

The assessment of quality of written communication.

Marks are to be allocated to QWC in accordance with the following criteria.

<b>Performance Level</b>	<b>Criteria</b>	<b>Marks</b>
Threshold	Candidates spell, punctuate and use the rules of grammar with reasonable accuracy; they use a limited range of specialist terms appropriately.	0, 1, 2
Intermediate	Candidates spell, punctuate and use the rules of grammar with considerable accuracy; they use a limited range of specialist terms with facility.	3, 4
High	Candidates spell, punctuate and use the rules of grammar with almost faultless accuracy; deploying a range of grammatical constructions; they use a wide range of specialist terms adeptly and with precision.	5, 6



*Rewarding Learning*

**General Certificate of Secondary Education  
2009**

---

**Technology and Design**

Higher Tier

**[G9502]**



**THURSDAY 21 MAY, MORNING**

---

**MARK  
SCHEME**

**Part 1**

**AVAILABLE MARKS**

- 1  [1]
- Rack and Pinion [1]  
 Danger [1]  
 Double Acting Cylinder [1]
-  [1]
- Electronic [1]  
 Pneumatic Control [1]  
 Shuttle Valve [1]  
 Mechanical Control [1]  
 Sprocket and Chain [1]

10

- 2 Complete **Table 2** below by ticking (✓) the one correct box which relates to each material.

**Table 2**

<b>Material</b>	<b>Hardwood</b>	<b>Plastic</b>	<b>Ferrous metal</b>	<b>Man made board</b>	<b>Softwood</b>	<b>Non-ferrous metal</b>
<b>Pine</b>					✓	
<b>Mild steel</b>			✓			
<b>Chipboard</b>				✓		
<b>Acrylic</b>		✓				
<b>Aluminium</b>						✓
<b>Mahogany</b>	✓					

[6]

6

- 3 Switch labelled (a) = Toggle switch  
 Switch labelled (b) = Micro switch  
 Switch labelled (c) = Push button switch  
 Switch labelled (d) = Slide switch  
 (4 × [1]) [4]

4



			AVAILABLE MARKS	
4	(a)	Manufactured board is made of compressed particles or thin sheets of wood (veneer) together with adhesive	[2]	8
	(b)	Sheet form; large size; different texture; widely available;	[2]	
	(c)	Flat pack furniture; work surfaces; Kitchen units; shelves, etc. (2 × [2])	[4]	
5	(a)	(i) Remove chuck key; wear goggles; tie hair back;		6
		(ii) One person at the machine; (2 × [1])	[2]	
	(b)	G clamp; machine vice; vice grips, toggle clamp	[2]	
	(c)	Drill the acrylic slowly; use masking tape; support underside of acrylic	[2]	
6		Wheelbarrow Class 2 See-saw Class 1 Tweezers Class 3 Car park barrier Class 1 (4 × [1])	[4]	4
7	(a)	3/2 valve Pressure source Pipeline junction 5/2 valve (4 × [1])	[4]	8
	(b)	(i) A or B		
		(ii) Press button D		
		(iii) Clamping speed		
		(iv) Pilot actuated pilot reset (4 × [1])	[4]	

8

Name	Metal	Reason for choice
<b>Car body</b>	Mild steel or steel Aluminium	Tough; Ductile; Malleable; Strong; High tensile strength
<b>Cooking pot</b>	Aluminium or Stainless steel or Copper of Cast Iron	Lightweight; Good conductor of heat; Corrosion resistant; Malleable; Non-toxic; suitable for food;
<b>Nameplate</b>	Brass or Bronze	Hard metal; Corrosion resistant; Can be polished; Easy to Machine;
<b>Water pipes</b>	Copper	Malleable; Ductile; Corrosion resistant; Non-contaminating;

(8 × [1])

[8]

8

- 9 (a) (i) A Pear-shaped or A  
B Eccentric  
C Heart-shaped  
(3 × [1])

[3]

(ii) Roller

[1]

- (b) (i) Pear-shaped or A

(ii) Part of profile at constant radius  
(2 × [2])

[4]

8

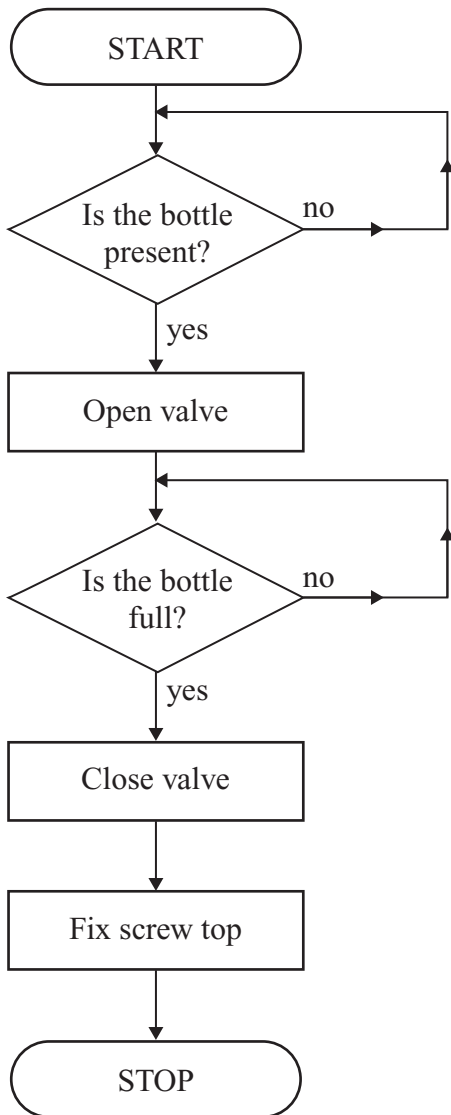
			AVAILABLE MARKS
<b>10</b>	<p><b>(a)</b> Current = Amps Voltage = Volts Resistance = Ohms (3 × [1])</p>	[3]	
	<p><b>(b) (i)</b> LED = Light emitting diode</p> <p><b>(ii)</b> Used to indicate circuit on or other suitable answer</p> <p><b>(iii)</b> To protect the LED from damage (3 × [1])</p>	[3]	
	<p><b>(c) (i)</b> Purpose: Conductor = To enable the current to flow in the circuit</p> <p><b>(ii)</b> Purpose: Insulator = To prevent a short circuit or suitable alternative</p> <p><b>(iii)</b> Example: Conductor = Copper wire</p> <p><b>(iv)</b> Example: Insulator = Plastic cable (4 × [1])</p>	[4]	10
<b>11</b>	<p><b>(a) (i)</b> A</p> <p><b>(ii)</b> B</p> <p><b>(iii)</b> B</p> <p><b>(iv)</b> A (4 × [1])</p>	[4]	
	<p><b>(b) (i)</b> 480 rev/min</p> <p><b>(ii)</b> 360 rev/min (2 × [1])</p>	[2]	
	<p><b>(c) (i)</b> fit an idler</p> <p><b>(ii)</b> none (2 × [1])</p>	[2]	8

12 (a) Correct order of operations  
(5 × [1])

[5]

(b) Correct loops  
(2 × [2])

[4]



13 (a) (i) Single acting cylinder

(ii) Outstroke

(iii) Avoid damage to plastic or reference to B

(iv) Adjust restrictor on B

(4 × [1])

[4]

(b) (i) Plunger

[1]

(ii) Press A and lower guard

(2 × [1])

[2]

AVAILABLE  
MARKS

9

7

			AVAILABLE MARKS
<b>14 (a)</b>	Mechanical toy – Spring; Flywheel; Coil (1 × [1])	[1]	9
	Electrical toy – Battery; Solar power (1 × [1])	[1]	
	Pneumatic toy – Air; Pump; Compressed air; Syringe (1 × [1])	[1]	
	<b>(b)</b> Sketches and notes (3 × [1])	[3]	
	Attachment to rear wheel; method of power (3 × [1])	[3]	
<b>15 (a)</b>	Milling machine	[2]	15
	<b>(b)</b> Tap and wrench	[2]	
	<b>(c)</b> Die or split die and die handle/holder	[2]	
	<b>(d)</b> Mark out position for holes Drill holes Tap or cut thread Oil or other suitable stages (3 × [1])	[3]	
	<b>(e)</b> Mark out and drill holes in plate Holes must align with existing holes Use 4 M6 machine bolts or screws Removable plate (4 × [1])	[4]	
	Sketches and notes (2 × [1])	[2]	
<b>Part 1</b>			<b>120</b>

**Part 2**

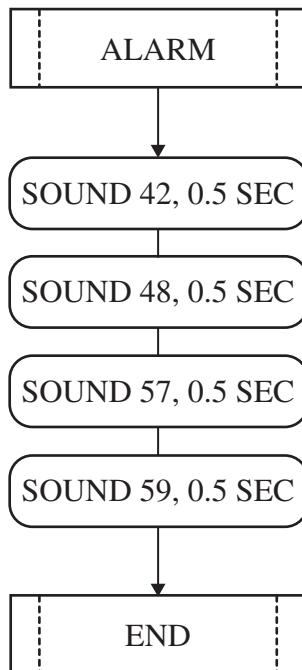
AVAILABLE  
MARKS

Answer any **two** questions

**Option 1: Computer Systems and Control**

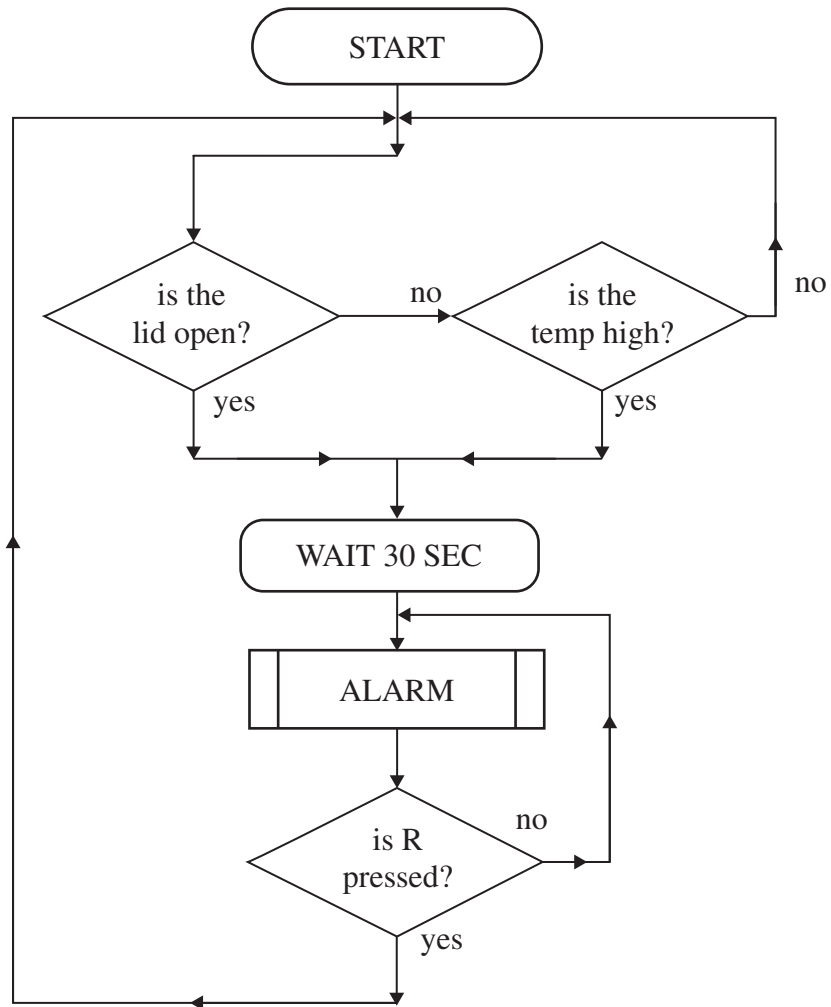
- 16 (a) (i)** Reed (magnetic) switch; pressure switch; micro switch [1]
- (ii)** Digital, Analogue [1]
- (iii)** Digital sensor must have two contacts open (0) and closed (1) as the circuit must be connected to the computer. Analogue output from sensors can have a continuous range of values. [1]
- (b) (i)** Thermistor [1]
- (ii)** RAM, Flash, EE Prom, E<sup>2</sup> Prom, Pic control [2]
- (c)** Input – keypad, data  
Control – Processor  
Output – Alarm; buzzer; display  
(3 × [1]) [3]

**(d) (i)**



[2]

(ii)



(9 × [1])

[9]

20

AVAILABLE MARKS

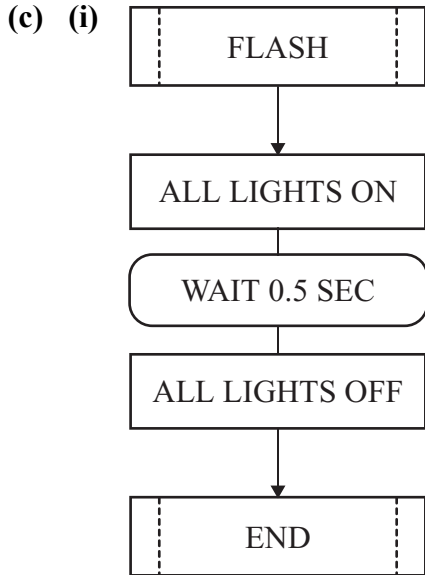
17 (a) (i) To store memory/run programs/read inputs;

(ii) To control or operate the system  
(2 × [1])

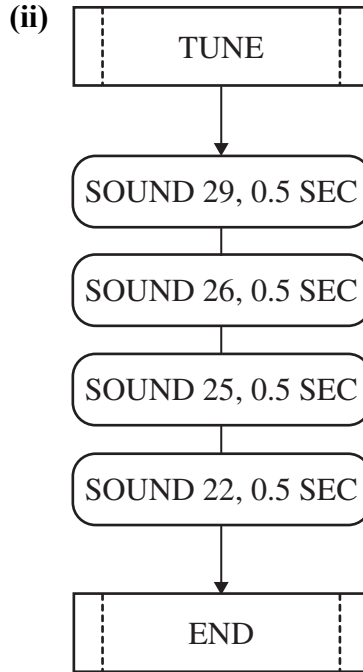
[2]

(b) Small component; low power; readily available; range of colours; no filament to burn out; low current  
(2 × [1])

[2]



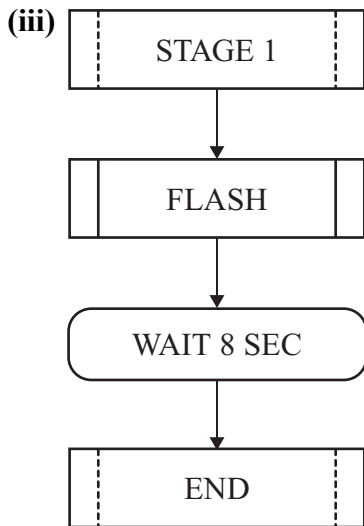
[3]



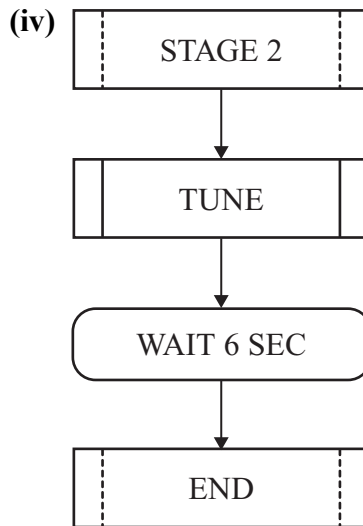
[2]

[3]

[2]



[3]



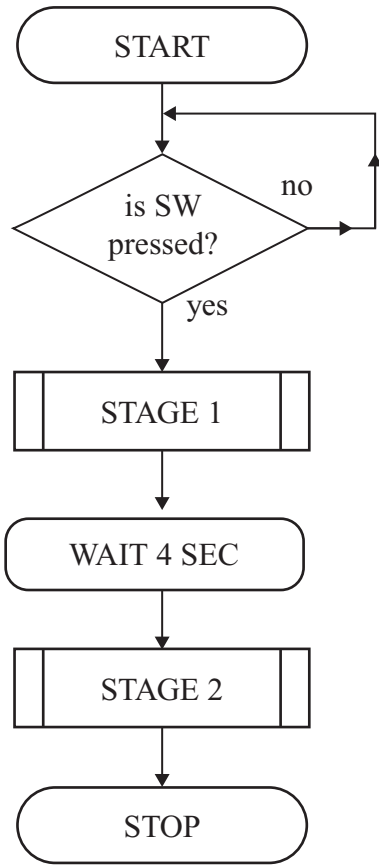
[3]

[3]

[3]



(d)



[5]

20

AVAILABLE MARKS
20

Option 2: Electronic Systems and Control

AVAILABLE MARKS

- 18 (a) Series [1]  
 Parallel [1]

- (b) (i) The current passing through a resistor is proportional to the voltage across it, i.e. if the voltage across a resistor was doubled, the current flowing through that resistor would double, if V trebled I would and so on.  
 $R = V/I$  e.g.  $10 = 20/2$      $10 = 40/4$      $10 = 60/6$  .....

Or the triangle explained



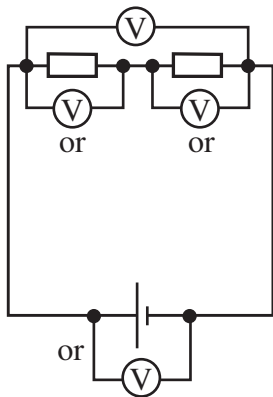
- (ii) For (a)  $R_t = R_1 + R_2$   
 $1k + 1k = 2k$  ohms

$I = V/R = 9/2 = 4.5$  mA

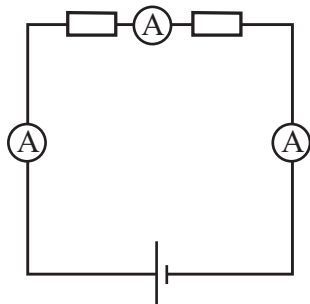
For (b)  $1/R_t = 1/R_1 + 1/R_2 = 1/1 + 1/1 = 2/1$   
 $R_t = 1/2 = 0.5$  k ohms

$I = V/R = 9/0.5 = 18$  mA [6]

- (iii) Voltmeter in circuit as shown [2]



- (iv) Ammeter in circuit as shown [2]



- (c) The bulb in circuit (b)  
Because when resistors are connected in parallel the effect is to reduce the overall resistance therefore more current will flow. [2]
- (d) Circuit Voltage = 9V, LED rating = 2V, 20 mA
- $V = 9 - 2 = 7V$   
 $R = 7/20$   
 $R = 0.35 \text{ k ohms or } 350 \text{ ohms}$  [4]

AVAILABLE  
MARKS

20

- 19 (a) (i) (1) Electrolytic/Radial  
(2) Polyester  
(3) Ceramic [3]
- (ii) Polarised (+ and – leads) Capacitor therefore they must be connected the correct way in a circuit + to + and – to – [1]
- (b) (i) Battery symbol at B  
Either capacitor symbol at C  
(2 × [1]) [2]
- (ii) **Fig. 18(a)** Switch completes circuit and the capacitor charges up from the energy stored in the battery until fully charged.
- Fig. 18(b)** Switch completes a short circuit and the energy stored in the capacitor now discharges  
(2 × [2]) [4]
- (c) (i) To create a time delay/smoothing/decoupling [1]
- (ii)  $\mu\text{F}$  microfarads  
nF nanofarads [3]
- (iii) When S1 is closed a time delay is created by the resistor and the capacitor. The capacitor charges via the resistor  
When fully charged and voltage at base of transistor is about 0.6 V/0.7 V the transistor will turn on otherwise it is off  
When transistor is switched it will operate relay and switch on the bulb. The diode protects the relay from back e.m.f.  
The switch in parallel with the capacitor is used to discharge the capacitor as required [6]

AVAILABLE  
MARKS

20

**Option 3: Mechanical Systems and Control**

**AVAILABLE MARKS**

20 (a)

Example	Type of belt
Timing for a car	<b>Toothed</b>
Vacuum cleaner	<b>Round</b>
Drilling machine	<b>V</b>
Conveyor system	<b>Flat</b>

(4 × [1])

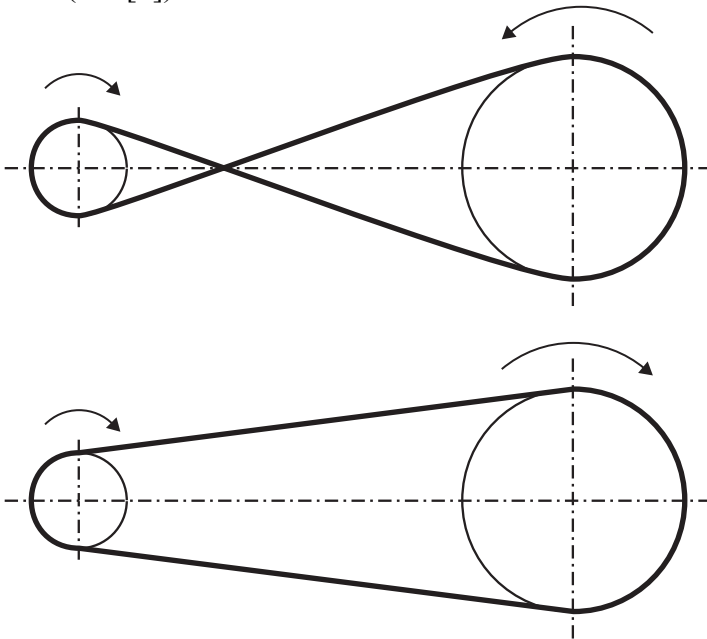
[4]

(b) Lathe; Milling machine; Power hacksaw; compressor, etc.

[2]

(c) (i) Sketches  
(2 × [2])

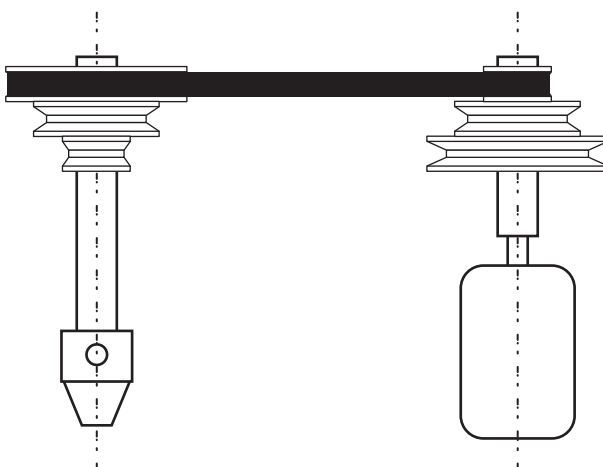
[4]



(ii) Transmit speed; can slip for safety reasons; cover a set distance;  
(2 × [1])

[2]

(d)



[4]

(e) Method 1: Jockey wheel  
Method 2: Motor mount adjustment  
(2 × [2])

[4]

20

- 21 (a) (i) bell crank [1]
- (ii) clockwise moments = anticlockwise moments  
 $F \times 480 = 400 \times 300$  [1]  
 $F = 250 \text{ N}$  [1]
- (iii) High frictional properties/heat resistant/wear resistant (any **one**) [1]
- (b) (i) One hole in middle of vertical link [1]
- (ii) One hole in vertical link towards top [1]
- (iii) One hole in each vertical link at same height [1]
- (c) (i) A rack and pinion [1]  
 B worm and wormwheel [1]
- (ii) Gear train [2]
- (iii) •  $1440 \times \frac{1}{30}$  [2]  
 = 48 rev/min [1]
- $48 \times 20 \times 6$  [2]  
 = 5760 mm/min [1]  
 = 5.76 m/min [1]
- (iv) Use pinion with more teeth or [2]  
 Use wormwheel with fewer teeth

AVAILABLE  
MARKS

20

**Option 4: Pneumatic Systems and Control**

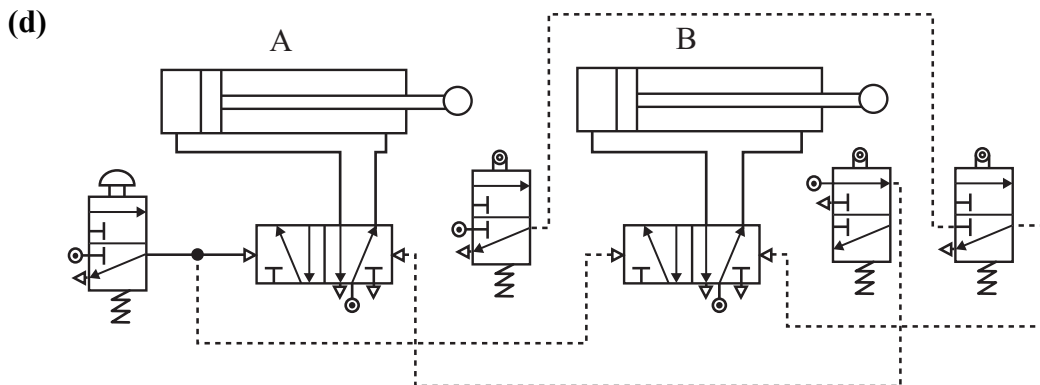
**AVAILABLE MARKS**

- 22 (a) (i) Piston reciprocates [1]  
 (ii) Move roller operated valves [1]  
 (b) (i) A instroked [1]  
 B any position [1]  
 C outstroked [1]  
 (ii) B [1]  
 (iii) Releases driving air immediately [1]

(c)

BUTTON PRESSED				OUTPUT	
A	B	C	D	X	Y
0	0	0	0	0	0
1	0	0	0	1	1
0	1	0	0	1	1
0	0	1	0	0	1
0	0	0	1	0	1

(4 × [1]) [4]

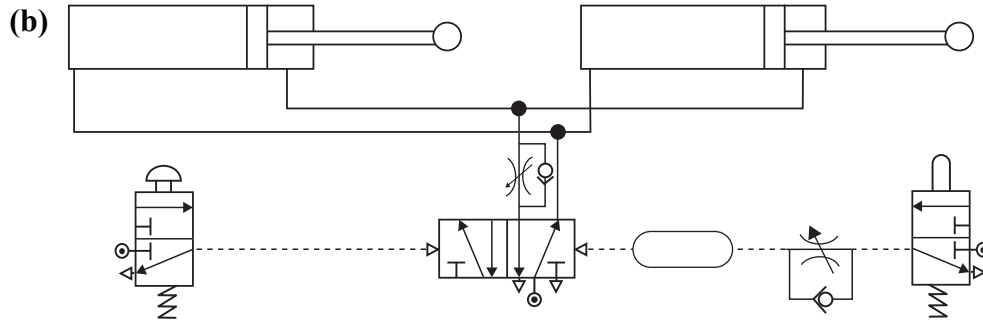


- Signal from Start valve to 5/2 valve for A [1]  
 Signal from Start valve to 5/2 valve for B [1]  
 3/2 valve inserted at A+ [1]  
 3/2 valve inserted at B+ [1]  
 Anding signals from 3/2 at A+ and 3/2 at B+ [2]  
 Signal from 3/2 valve at B+ to 5/2 valve at B [1]  
 3/2 valve inserted at B- [1]  
 Signal from 3/2 valve at B- to 5/2 valve at A [1]

20

- 23 (a) Factor 1 Load or force required  
Factor 2 Air pressure

[1]  
[1]



- Signal from Start valve to 5/2 valve [1]  
Connections from 5/2 valve to back of cylinders [1]  
Connections from 5/2 valve to front of cylinders [1]  
Flow regulator inserted in line from plunger operated 3/2 to 5/2 valve [1]  
Reservoir inserted in line from plunger operated 3/2 valve to 5/2 valve [1]

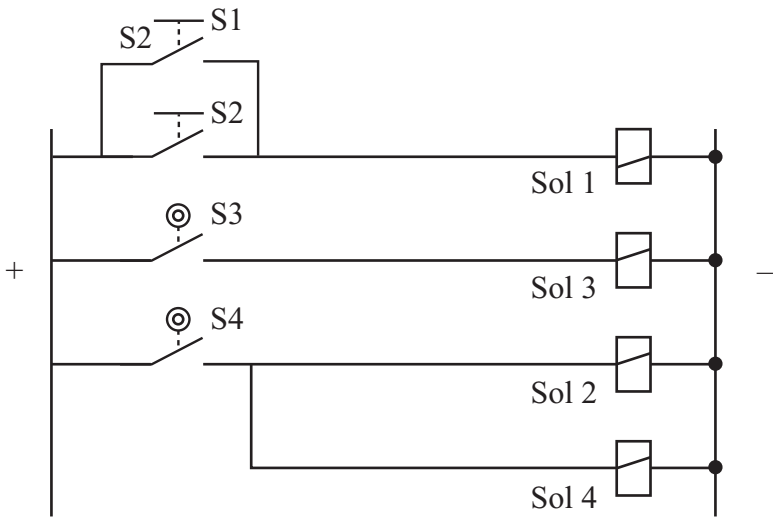
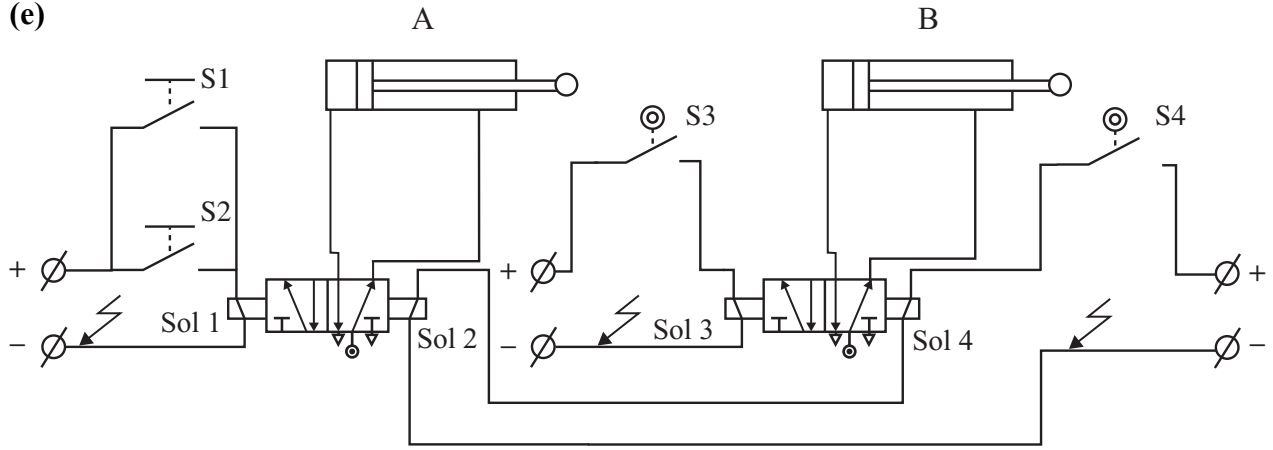
- (c) Flow regulator inserted [1]  
Correct position and orientation [1]

- (d) Normally open [1]  
Normally closed [1]

AVAILABLE  
MARKS



(e)



Electro pneumatic circuit diagram

S1 shown connected to Sol 1 [1]

S2 shown connected to Sol 1 [1]

S1 and S2 connected for OR logic [1]

S3 shown connected to Sol 3 [1]

S4 shown connected to Sol 4 and Sol 2 [2]

Ladder diagram

Correct connections to Sol 1 [1]

Correct connections to Sol 3 [1]

Correct connections to Sol 2 and Sol 4 [1]

**Part 2**

**40**

QWC

8

**Total**

**168**

AVAILABLE MARKS

20

The assessment of quality of written communication.

Marks are to be allocated to QWC in accordance with the following criteria.

<b>Performance Level</b>	<b>Criteria</b>	<b>Marks</b>
Threshold	Candidates spell, punctuate and use the rules of grammar with reasonable accuracy; they use a limited range of specialist terms appropriately.	0, 1, 2, 3
Intermediate	Candidates spell, punctuate and use the rules of grammar with considerable accuracy; they use a limited range of specialist terms with facility.	4, 5, 6
High	Candidates spell, punctuate and use the rules of grammar with almost faultless accuracy; deploying a range of grammatical constructions; they use a wide range of specialist terms adeptly and with precision.	7, 8



