Published Mark Scheme for GCE A2 Technology and Design Summer 2010

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

MARK SCHEMES (2010)

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.

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ADVANCED
General Certificate of Education
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Technology and Design

Assessment Unit A2 1

assessing

Systems and Control

[AV211]

FRIDAY 28 MAY, MORNING

MARK SCHEME

AVAILABLE MARKS

In all cases, correct alternative responses will be given full credit.

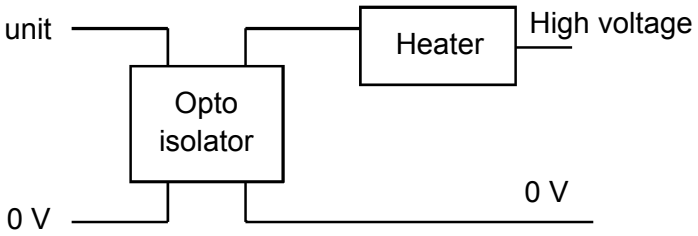
Section A

Electronic/Microelectronic Systems

1 (a) (i) The system shown has no feedback from the output [2]

(ii) Diagram showing a temperature sensing block with feedback arrow to control block [3]

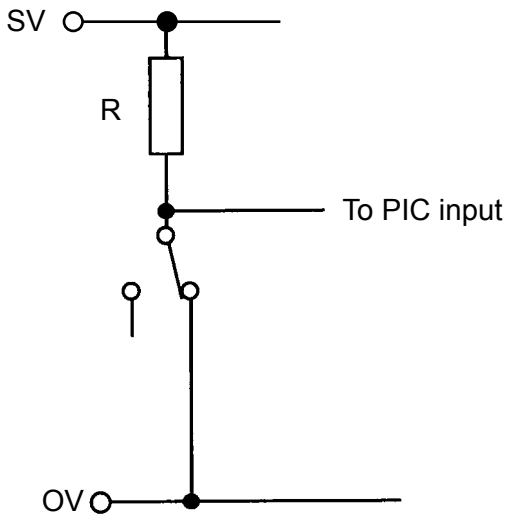
(iii)



Electrical isolation is achieved because there is no physical connection between the two circuits. Therefore the transfer of the signal can occur without any interference from the high voltage circuit. [4]

(b) A reed switch could be used – non contact – drawing showing magnets embedded in the disc and reed switch protected behind casing. [3]

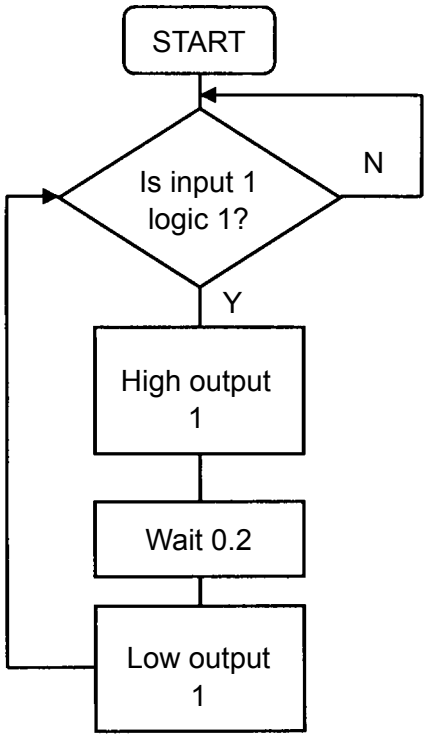
(c) (i)



[4]

AVAILABLE MARKS

(ii)



[4]

(iii) if pulse duration is 0.2 seconds then maximum revolution per second is 1.25 therefore maximum RPM /< 75. [3]

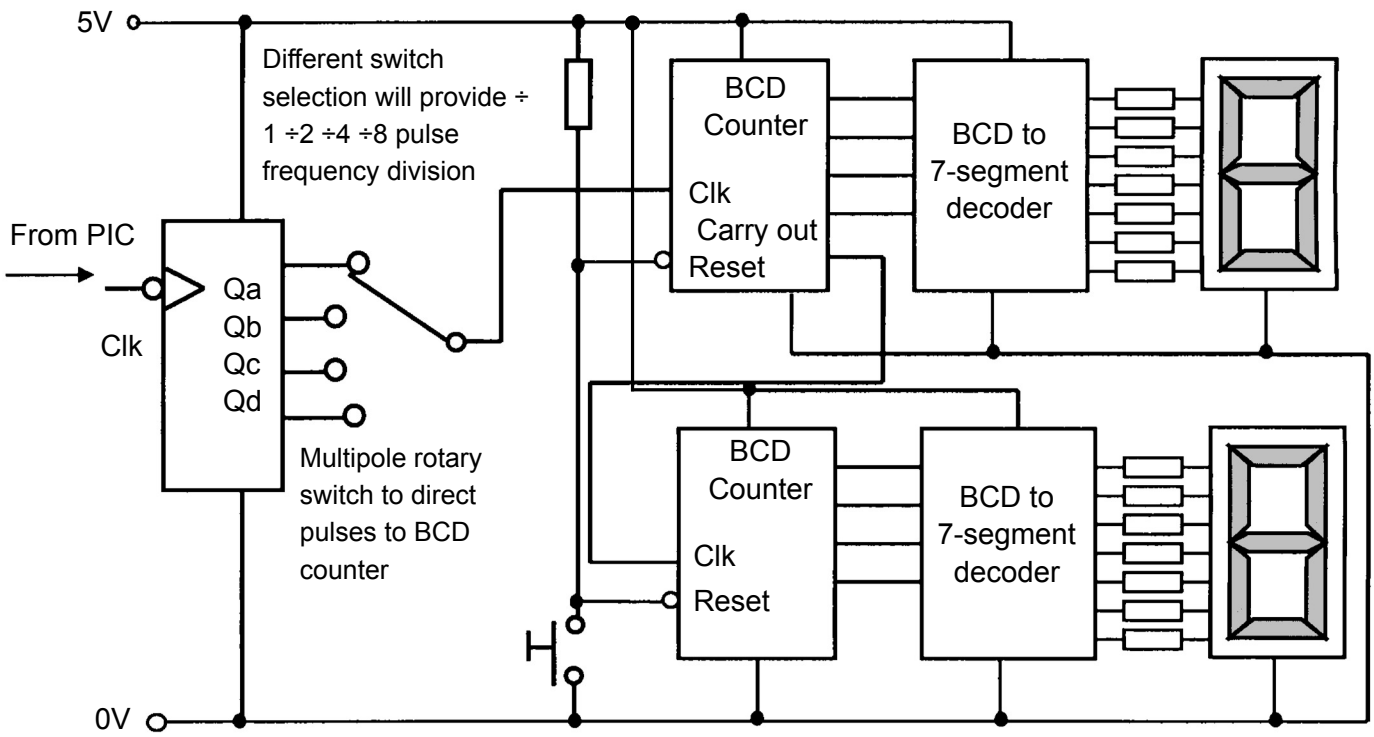
(d) **(i)** To generate the signals required to illuminate the appropriate segments for each 4 bit binary output from the counter. [2]

(ii) A binary counter will provide a hexadecimal output on the 7 segment display. A BCD counter is more appropriate since it is easier for most people to read decimal numbers. [3]

(iii) Diagram likely to show a pull up resistor in series with a push to make switch (the reset requires a negative edge trigger) . [2]

AVAILABLE MARKS

(e) Bullet point 1 & 2. [10]



AVAILABLE MARKS

2 **(a)** **(i)** Resistance decreases as temperature increases. [1]

(ii) The voltage divider arrangement provides a voltage that changes with changes in resistance [1]

(iii) At 5 °C Vo = 5.29 V At 15 °C Vo = 5.12 V [4]

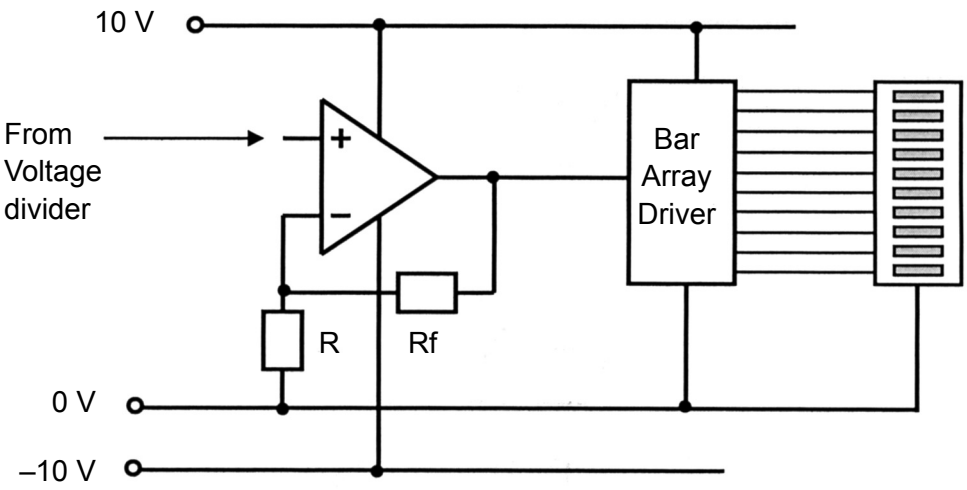
(iv) Total R at 20 °C 1.2 + 6 = 7.2 k therefore I = 0.83 mA
therefore Power = 5 mW [2]

(v) To allow for trimming or adjustment of the output voltage Vo. [2]

AVAILABLE MARKS

(b) (i) As the input voltage changes between a lower and upper limit, the output lines to the segments or bars will be switched on/off. [2]

(ii)



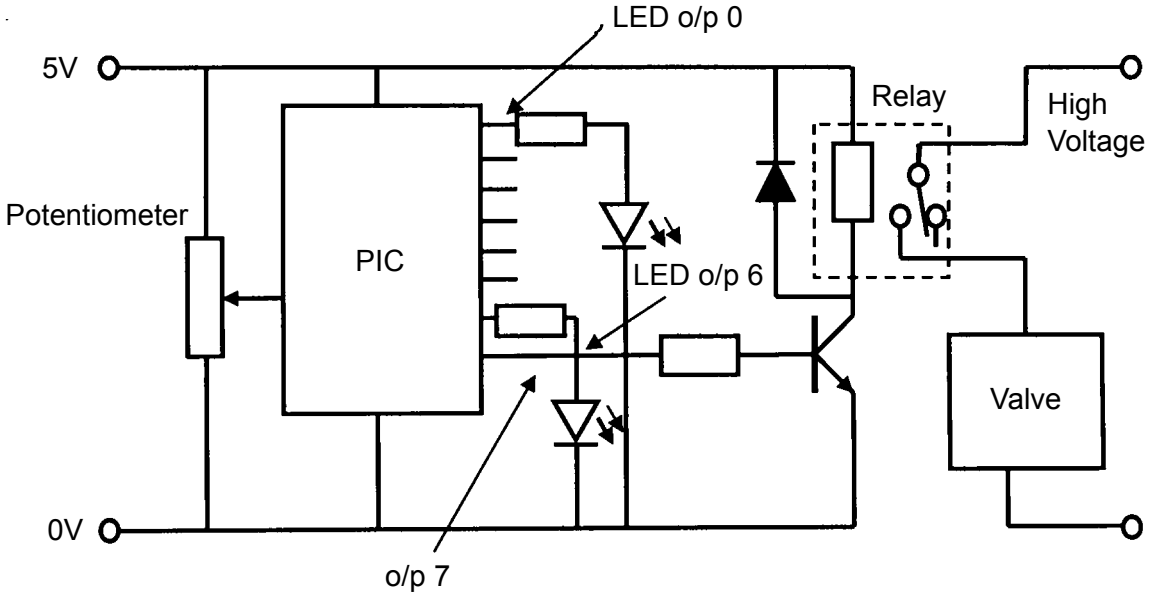
[2]

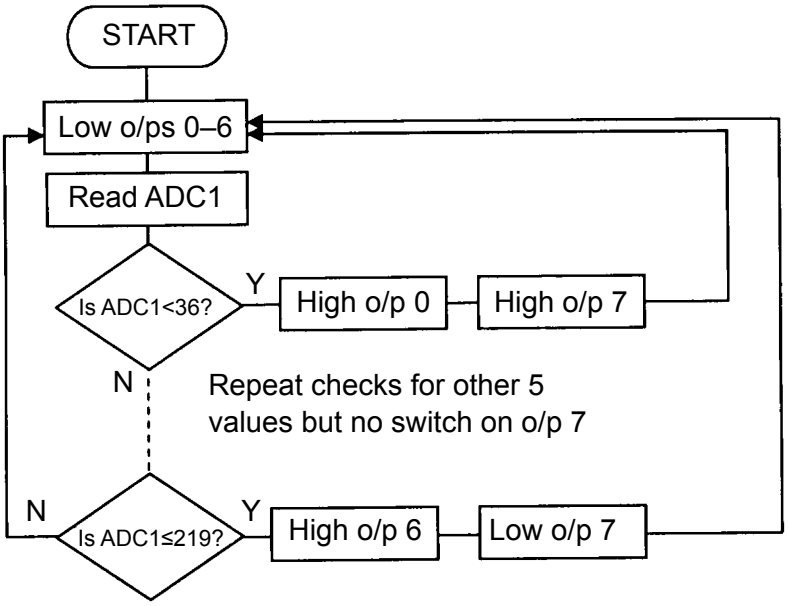
(iii) Non-Inverting Amp. Gain = 40 so Rf/R = 39, let R 10 kΩ and R = 390 kΩ. [3]

(c) (i) An analogue can be a varying voltage which can be read or quantified by the PIC. A digital input must be a discrete value to be recognised as a digital '1' or high or '0' or low. [2]

AVAILABLE MARKS

(ii) sample answer





[12]

(iii) Answer likely to refer to needs of school projects such as;

1. flexibility - to change control functions during development
2. Versatility - range of logic functions easily achieved such as latching and counting
3. ADCs often available on board – ease of interface with sensors
   A hard wired solution can be chosen in preference to a PIC for of the shelf subsystems that are well known such as timers and op amps – these can be much cheaper. [5]

	AVAILABLE MARKS
Quality of written communication	

Poor selection and use of a writing form and style appropriate to the content. The script content is poorly organised and little use is made of appropriate technological vocabulary. The writing is barely legible and the spelling, grammar and punctuation is inaccurate.	0–2
Good selection and use of a writing form and style appropriate to the content. The script content is organised and use is made of appropriate technological vocabulary. The writing is legible and the spelling, grammar and punctuation is accurate.	3
Very good selection and use of a writing form and style appropriate to the content. The script content is well organised and good use is made of appropriate technological vocabulary. The writing is legible and the spelling, grammar and punctuation is very accurate.	4

[4] 4

Total **80**

AVAILABLE MARKS

Section B

Mechanical and Pneumatic Control systems

3 **Fig. 3(a)** shows a cam and follower which is to be used to raise and lower eyebrows on a comedy face which forms part of a fairground attraction. The cam rotates in a clockwise rotation and the roller follower is offset to the right of the cam centre line by 10 mm.

(a) **(i)** Name and sketch **one** other follower, apart from a knife edge or roller, which can be used with cams.

Ans = Flat + Sketch. [2]

(ii) The cam rotates at 120 rev/min with a torque of 1.75 Nm. Calculate the power expended.

Ans = $P = T\omega$

$\omega = 2\pi \times 120/60 = 12.57$ rad/s [1]

$P = 12.57 \times 1.75 = 22$ W [2]

(iii) On the pro forma provided (answer number **3(a)(iii)**), construct a performance/displacement diagram which would accurately produce the following motion:

Ans =

- 0–120 rise 60 mm with uniform acceleration and retardation [2]
- 120–180 rise 20 mm with uniform velocity [1]
- 180–360 fall 80 mm with simple harmonic motion. [2]

A scale of 1 mm = 1 mm should be used

(b) On the pro forma provided (answer number **3(b)**), using appropriate formal drawing techniques, construct a cam profile which would accurately follow the performance/displacement diagram as shown in **Fig. 3(b).** The diameter of the offset roller follower is 10 mm and the minimum cam diameter is 25 mm. Your answer may be drawn to a suitable scale.

Ans =

0–180 rise 60 mm with uniform velocity [5]

180–360 fall 60 mm with uniform velocity [5]

(see answer)

(c) The gearbox which provides the drive/motion for the cam uses a lubricant with a specific classification. Explain how lubricants are classified, discussing the mechanics of lubrication and viscosity and the factors to be considered when justifying the choice of a particular application.

Ans = SAE classification explanation
Viscosity levels changing
Effects of temp on viscosity
Lubrication reducing heat & wear
Factors justifying choice [5]

Quality of written communication

Poor selection and use of a writing form and style appropriate to the content. The script content is poorly organised and little use is made of appropriate technological vocabulary. The writing is barely legible and the spelling, grammar and punctuation is inaccurate.	0–2
Good selection and use of a writing form and style appropriate to the content. The script content is organised and use is made of appropriate technological vocabulary. The writing is legible and the spelling, grammar and punctuation is accurate.	3
Very good selection and use of a writing form and style appropriate to the content. The script content is well organised and good use is made of appropriate technological vocabulary. The writing is legible and the spelling, grammar and punctuation is very accurate.	4

[4]

(d) A universal joint has been has been used to transmit motion from the gearbox to the cam. Describe one main problem which is likely to be encountered during operation.

Ans = The rotation of the output of the universal joint is not uniform. There are periods of faster part rotations than others. [1]

(e) Design and draw a mechanical system which would achieve the following requirements:

Answer needs to complete the following: Sample

- gearing system will change the direction of the wheels when required. (moveable idler gear)
- Sketch showing how a manually activated system will engage and disengage the transmission of motion from the motor to the rest of the system. (lever /clutch arrangement) [10]

40

AVAILABLE MARKS

4 (a) (i) Briefly describe three safety issues associated with using pneumatics.

Any three from the following:
- Maintenance of moving parts
- Checking of pipes and components
- regulated air pressure.
- The need for safety valves [3]

Or other suitable answer

(ii) The work done by a cylinder during the outstroke is 785 J. The cylinder has a stroke length of 100 mm and is supplied with an air pressure of 1 N/mm^2. Calculate the diameter of the piston. Assume π = 3.14.

Ans =
785 ÷ 0.1 = 7850
7850 = 3.14 × 50 × 50
Diameter = 50 + 50 = 100 mm [3]

(b) **Fig. 4(a)** shows part of the pneumatic-based mass production line used to stamp and sort boxes according to their size.

- Cylinder A outstrokes to close the gate.
- Cylinder B outstrokes and stamps the underside of the box.
- Cylinder B instrokes.
- Cylinder C outstrokes slowly to push the box onto the lower conveyor belt.
- Cylinder C instrokes.
- Cylinder D instrokes once the box activates the **Air Bleed** to open the trap door.
- Cylinder A instrokes.
- Cylinder D outstrokes.

On the pro forma provided (answer number **4(b**) draw a suitable interlocking /cascade sequential pneumatic circuit to achieve the desired sequence.

Ans = Method of activating cylinder A+ [1]
Method of activating cylinder B+ [2]
Method of activating cylinder B- [1]
Method of activating cylinder C+ [2]
Method of activating cylinder C- [1]
Method of activating cylinder D+ [1]
Method of activating cylinder D- [2]
Method of activating cylinder A- [1]
Method of activating cylinder D+ [1]
Group system [4]
See sample answer

	AVAILABLE MARKS

(c) **Fig. 4(b)** shows a single acting cylinder **Q** which is to be used to stamp rejected boxes at a further stage in the production line. On the pro forma provided (answer number **4(c)**) add any necessary components and piping to enable the cylinder to be operated with a different air pressure from the normal when switch **X** is pressed.

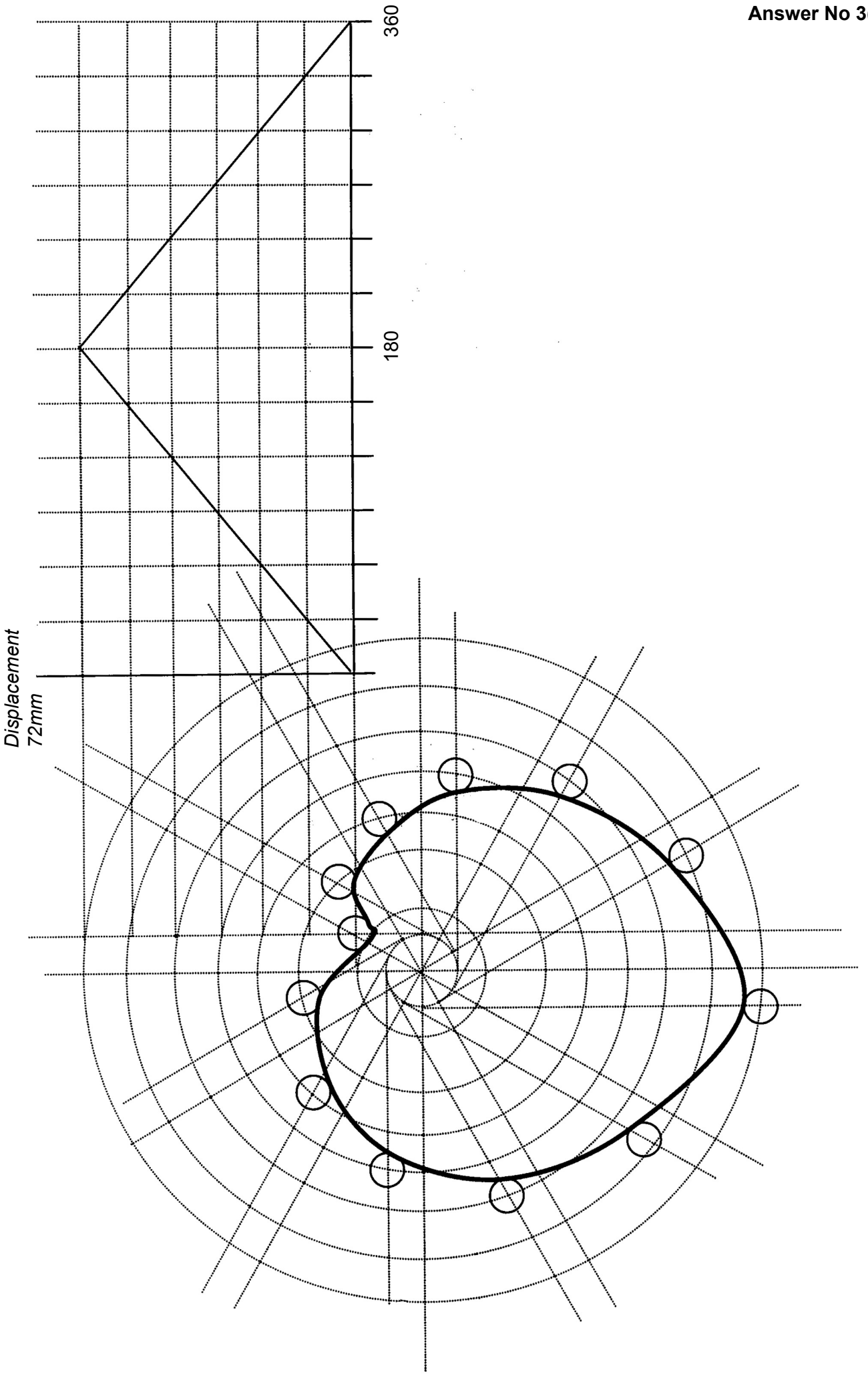
Ans = Method of activating alternate air supply. [3]
Method of connecting stable air supply. [3]
See sample answer

(d) On the pro forma provided (answer number **4(d)**) design and draw a pneumatic system which will stamp and remove oversized boxes (box 3) from the upper conveyor belt.

The system should
- Detect the box (air bleed)
- generate a signal to stop the motorised conveyor (cylinder activates micro switch
- then wait a few seconds (time delay)
- before stamping the box. (5PV operating cylinder)
- After completing the stamping the box should be pushed off the upper conveyor belt slowly. (5PV operating cylinder) [12] 40

Total **80**

Answer No 3(b)



Answer No 4(c)