Published Mark Scheme for GCE AS Technology and Design

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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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New Specification

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2010

Technology and Design

Assessment Unit AS 1

assessing

Product Design and Systems and Control

[AV111]

WEDNESDAY 20 JANUARY, MORNING

MARK SCHEME

			AVAILABLE MARKS
	In all cases, correct alternative responses will be given full credit.		
	Section A		
1	Briefly explain what is meant by the following properties:		
	• Electrical conductivity relates to how well electricity passes through a material	[1]	
	• Thermal conductivity relates to how well heat travels or is conducted through a material	[1]	
	• Durability – property which allows the material to resist wear	[1]	
	• Brittleness – a material that fractures with little or no deformation.	[1]	4
2	Metals are supplied in a range of forms.		
	(i) Any **four** forms that metal are supplied in from the following: sheet, strip, round bar, square bar, flat bar, angle, pipe and channel, I beam, wire.	[2]	
	(ii) High carbon steel would be used to manufacture drill bits two main reasons – can withstand wear. – economical – hard material – suitable for heat treatment	[2]	4
3	Garden hose pipes are manufactured by the process of extrusion.		
	(i) Any **two** main reasons why extrusion is the most suitable process for the manufacture of this product from the following: • Suitable process for a long hollow product • Relatively quick one stage process • One stage process produces a high quality finish.	[2]	
	(ii) A suitable material for the extrusion process from the following: • PVC • Polythene • Nylon.	[1]	
	(iii) Suitable sketch of the extrusion process to include the hopper, heated chamber and screw, die and cooling chamber.	[2]	
	Annotation.	[1]	6

			AVAILABLE MARKS
4	**(i)**	Briefly explain the difference between a composite and an alloy – Composites are made up of two or more different materials. Alloys are formed by mixing two or more metals. [2]	
	(ii)	**One** main characteristic for shape memory alloy: • Easily shaped when cool/returns to a remembered shape when heated above a certain temperature • Can be formed into practically any shape. [1]	
		One main characteristic for piezoelectric materials: • Good insulator but produces a momentary electrical voltage if rapidly compressed. • Increase in size when current passes through [1]	
		One specific application for shape memory alloy. E.g. mechanical actuation in robotic devices. [1]	
		One specific application for piezoelectric materials. E.g. loudspeaker elements for talking greeting cards. [1]	6
5	**(i)**	Distinguish between permanent and semi-permanent methods used in the joining of materials. Permanent methods do not allow disassembly whereas semi-permanent allow disassembly. [2]	
	(ii)	Brazing and welding are widely used methods in the joining of metals.	
		Briefly outline **two** main characteristics for Brazing from the following Brazing – Any one from the following: • Higher melting point required around 600–900 °C • Produces a strong joint • Used to joint a thinner profile of material than welding. [2]	
		Briefly outline **two** main characteristics for Welding from the following: • Very high melting point required around 3000–3600 °C • Produces a very strong joint • Used for joining a wide thicknesses of metal. [2]	6

			AVAILABLE MARKS
6	**(i)**	**Two** main characteristics associated with the Trades Description Act from the following: • Ensures that the consumer is informed of the country of origin • Protects the consumer by making it an offence for a trader to wrongly describe goods or services. [2]	
	(ii)	Briefly explain what is meant by the following terms: British Standards – reference to the standard set by the British Standards Institute. Safety standard – fitness for purpose. [2]	4
7	**(i)**	Outline **three** main characteristics associated with continuous production. • One product produced • Production 24 hours for a continual period of time • Small workforce required • Costly to stop and restart production. [3]	
		Clear and coherent explanation using good English grammar. [1]	
	(ii)	State **one** example of a product – glass, paper, aluminium [1]	5
8		Culture and social changes can have an influence on the design of products. With reference to the car, briefly outline **one** main culture change and **one** main social change and explain how these changes have influenced the design of the car. Typical example Culture changes/design influence Reference to changes in environmental concerns – engine design and fuel use Reference to changes in safety – internal developments in safety design [2] Social changes/design influence Reference to the change of the age group of drivers – a range of physical changes to the car Reference to how the car is used – internal developments of the family car or developments in communications for business or pleasure [2]	
		Clear and coherent explanation using good English grammar. [1]	5
		Section A	**40**

AVAILABLE MARKS

Answer Section B **or** Section C

Section B

9 **(a)** **(i)** Nand gate [1]

(ii) SR Flip Flop or cross-coupled Nand gates. [1]

(iii) Pull up resistors – to ensure a logic 'high' when switches are open [2]

(iv)

S	**R**	**Q**	$\bar{\mathbf{Q}}$
0	0	na	na
0	1	1	0
1	0	0	1
1	1	ne	ne

[5]

(b) **(i)** 280 ohms [2]

(ii) 330 ohms – the nearest **higher** value. [1]

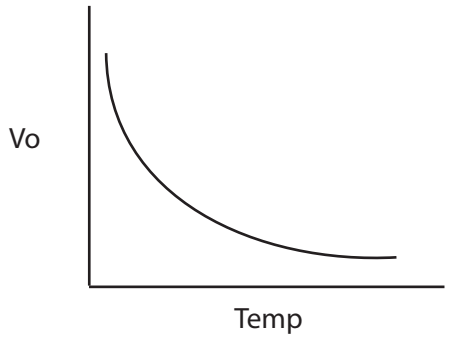
(iii) 0.053 Watts therefore 0.25 Watt resistor would be chosen. [3]

(c) Circuit to show transistor with relay and protective diode and Motor on secondary circuit. [4] 19

	AVAILABLE MARKS

10 (a) (i) As the temperature increases the resistance decreases. [1]

(ii)



[3]

(iii) 1.8 Volts [2]

(b) (i) Open loop because the output is not measured and does not influence the input. There is no feedback. [2]

Clear and coherent explanation using good English grammar. [1]

(ii) When sw is pressed and released the LED will be illuminated. The capacitor C will begin to charge through the variable resistor R2. When the threshold voltage is approximately 2/3 the supply voltage the capacitor will discharge and the LED will be turned off. [4]

Clear and coherent explanation using good English grammar. [1]

(iii) 9090–45454 Ohms [4]

(c) Advantages
1. Lower component count
2. More accurate for longer time delays.

Disadvantage
Cost [3] 21

Section B **40**

AVAILABLE MARKS

Section C

11 **Fig. 11** shows a mechanical system incorporating a motor pulley and gears.

(a) **(i)** Name a belt type which can be used on pulleys at 90° angles from each other.
Ans = Round belt. [1]

(ii) State the direction of rotation at **G** if **A** rotates in an anticlockwise direction.
Ans = Anticlockwise. [1]

(b) **(i)** Calculate the overall velocity ratio between **A** and **K**.

Ans = $A - B = \frac{45}{60} = \frac{3}{4}$

$J - K = \frac{45}{135} = \frac{1}{3}$ [1]

$\frac{3}{4} \times \frac{1}{3} = \frac{1}{4}$ or 0.25 [1]

(ii) Calculate the overall velocity ratio between **A** and **I**.

Ans = $A - B = \frac{45}{60} = 0.75$

$C - D = \frac{80}{100} = 0.8$ [1]

$E - F = \frac{45}{30} = 1.5$

$G - I = \frac{100}{100} = 1$[1]

$0.75 \times 0.8 \times 1.5 \times 1 = 0.9$ [2]

(iii) Calculate the difference in output speeds between **D** and **K** if the motor rotates at 240 rev/min.

Ans = $A - K = 0.25$ OS $= \frac{240}{0.25} = 960$ rev/min [1]

$A - D = 0.75 \times 0.8 = 0.6 =$ OS $= \frac{240}{0.6} = 400$ [1]

$960 - 400 = 560$ rev/min [1]

AVAILABLE MARKS

(c) **(i)** Pulley **A** is attached to the motor shaft using a key and keyway. Using an annotated sketch outline the main features of this arrangement.
Ans = Suitable annotated sketch of a key [1]
Keyway [1]
Integration of shaft

(ii) Name one other method of attaching pulleys to shafts apart from a key and keyway or grub screw.
Ans = Cotter pins. [1]

(d) Occasionally the heavy motor needs to be raised and lowered from the ground to aid pulley belt replacement. Using an annotated sketch name and draw a linkage system which could keep the base level with the ground.
Ans = Parallel linkage [1]
Annotated sketch of linkage arrangement. [2]

(e) The mechanical system is to be attached to a cam and follower. Briefly describe the following terms:

(i) Dwell.
Ans = Period in time when the cam is rotating but the follower does not rise or fall. [1]

Clear and coherent explanation using good English grammar. [1]

(ii) Stroke length.
Ans = The distance between the highest and lowest points the follower moves during one complete rotation. [1]

Clear and coherent explanation using good English grammar. [1]

20

12 **Fig. 12** shows part of an incomplete pneumatic system incorporating a single and double acting cylinder.

(a) **(i)** Name the activation method at **A**.
Ans = Push button. [1]

(ii) Name the activation method at **C**.
Ans = Solenoid. [1]

(iii) Name the activation method at **X**.
Ans = Pilot [1]

(iv) Drawing of air bleed [2]

	AVAILABLE MARKS

(b) On the pro forma provided (answer number **12(b), (c) & (d)**) complete the circuit enabling the double acting cylinder to outstroke if 3 port valves **A and B and C or D** are activated.

Ans = Appropriate operation of A [1]
Appropriate operation of B [1]
Appropriate operation of C [1]
Appropriate operation of D [1]
Appropriate operation of system with cylinder.

See sample answer below.

(c) On the pro forma provided (answer number **3(b), (c) & (d)**) complete the circuit enabling the single acting cylinder to outstroke slowly as the double acting cylinder instrokes.

Ans = Appropriate signal from DAC [1]
Speed control on SAC [1]
Appropriate connections and piping. [1]

See sample answer below.

(d) On the pro forma provided (answer number **3(b), (c) & (d)**) complete the circuit enabling the double acting cylinder to instroke after a delay in time following an outstroke.

Ans = 3PV with suitable activation method. [2]
Time delay [1]
Signal at 5PV [1]
Or other suitable answer

See sample answer below.

(e) The double acting cylinder is supplied with an air pressure of $0.5\,N/mm^2$ and produces a force during the outstroke of 235.12 N and 210 N during the instroke. Calculate the piston rod diameter. Please assume π = 3.14.

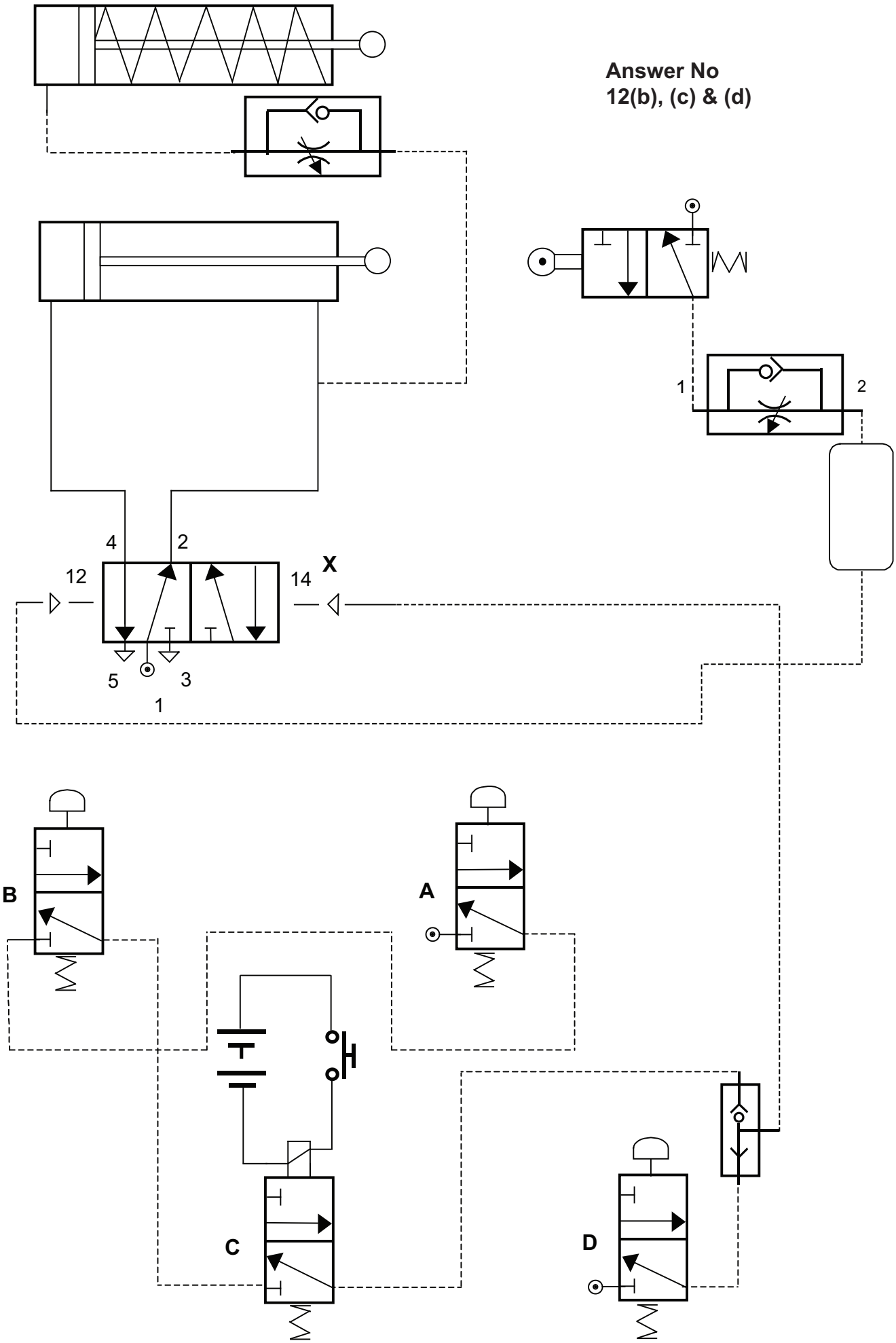
Ans = 235.12 – 210 = 25.12 [1]

$$\frac{25.12}{0.5} = 50.24$$ [1]

$$\frac{50.24}{3.14} = 16$$ [1]

$2 \times 4 = 8mm$ [1] 20

Section C **40**

Total **80**

Answer No
12(b), (c) & (d)