Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

DESIGN AND TECHNOLOGY (9–1) **0979/42**

Paper 4 Systems and Control **May/June 2022**

MARK SCHEME

Maximum Mark: 50

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **14** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

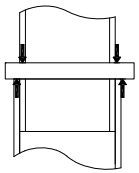
Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks	Guidance
	Section A		
1(a)	Suitable properties include: • Strong in tension • Resists torsion • Resists compression • Malleable / ductile • Resists bending • Can be joined easily • Low cost / readily available • Can be easily recycled. 3 × 1 marks.	**3**	Allow other valid properties. E.g. durable. Do not allow 'strong' unless justified.
1(b)	Description may include the following: • Frame structure • Welded joints • Ties on each face • Triangulated.	**2**	2 marks for a description that includes two valid points. Allow 2 marks for a single point fully explained.
1(c)	Sketches / notes to show two opposing compressive / parallel forces, [1] pushing in opposite directions at the point of contact, [1]. 	**2**	

Question	Answer	Marks	Guidance
2(a)	Reasons for reducing friction will include: • Reducing wear on parts • Lower running costs • Reduce noise • Improve efficiency in the mechanism • Reduce heat 2 × 1 marks.	**2**	Allow other valid reasons
2(b)	Methods will include: • Use of lubrication • Use of bearings/bearing material • Reduction of area of mating parts • Use of materials with low coefficient of friction e.g. nylon 2 × 1 marks for valid methods.	**2**	

Question	Answer	Marks	Guidance
3	Benefits of ability to disassemble products will include: • Ability to repair and replace parts • Ease of transport • Ease of storage • Ease of packaging • Product can be modified • Different materials / parts can be separated for recycling and reuse. 2 × 1 marks.	**2**	Allow other valid benefits

Question	Answer	Marks	Guidance
4(a)	**Oscillating** motion is produced by the pendulum.	**1**	
4(b)	**Rotary** motion is produced by the clock hands.	**1**	

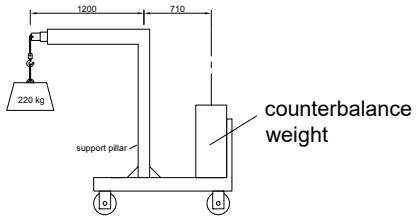
Question	Answer	Marks	Guidance
5	Examples will include: • Keeping inventories • Bar codes / QR codes / RFID to track parts • Online ordering of parts Relevant example, [1]. How it is used by the manufacturer, [1]. How efficiency is increased, [1].	**3**	Examples must relate to stock control

Question	Answer	Marks	Guidance
6	A switch is used **to connect** or **disconnect** components in an electrical circuit, [1].	**1**	

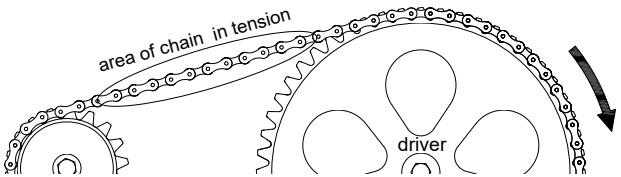
Question	Answer	Marks	Guidance
7(a)	Switch **A** is a **reed** switch. Switch **B** is a **toggle** switch, 2 × 1 marks.	**2**	Allow **SPDT** or '**flick**' for toggle switch
7(b)	Switch **A** uses a magnet, [1] to open / close the contacts, [1].	**2**	Only allow second mark if magnet is correct.

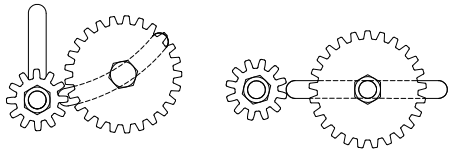
Question	Answer	Marks	Guidance
8	Method **C** is **series** connection, [1]. Method **D** is **parallel** connection, [1].	**2**	

Question	Answer	Marks	Guidance
	Section B		
9(a)(i)	Any three forces from: tension, compression, torsion, shear, bending, 3 × 1 marks.	**3**	
9(a)(ii)	Benefits of lamination will include: • Retaining shape during assembly • Defects in wood can be avoided • Short grain avoided when shaping • Less waste than cutting from a solid piece • Curves can be formed. 1 mark for each benefit in description, maximum 3.	**3**	Allow other valid benefits Allow 2 marks for a full description of a single point.
9(b)(i)	Benefits of CAM technology include: • Accuracy • Repeatability / all joints will be the same size, • Speed of production. • Reduction in manual labour required 1 mark for valid benefit.	**1**	
9(b)(ii)	Benefits of hand methods include: • Low cost of tools required • No time spent in setting up a machine • No electricity needed • No specialist machine knowledge / expertise required • No problem with fitting work onto a machine. • Errors can be identified quickly and corrected 1 mark for valid benefit.	**1**	Accept other valid benefits. Do not allow ‘faster’ unless it is justified.

Question	Answer	Marks	Guidance
9(b)(iii)	Properties of adhesive will include: • Setting time must allow for assembly of frame, • May need to be water resistant, • Must be strong in tension, • Should dry clear / not leave any marks on the wood. 1 mark for valid property.	**1**	
9(c)(i)	2 marks for differences identified in each item, 3 × 2 marks **Beam**, freestanding with supports at both or either ends6, [1] will resist bending [1] There will be compression on the top face and tension on bottom face. [1] **Strut**, fixed at two points in a frame. [1] Will resist compression and help to maintain the shape of the frame / made from a rigid material. [1] **Tie**, fixed at two points in a frame. [1] Structure resisting tension, can be made from a flexible material. [1]	**6**	Points made must relate to differences between the items not just a description of the individual item.
9(c)(ii)	Natural defects in wood will include: large knots, shakes, splits, warping, bending, insect / termite damage, excessive moisture, 2 × 1 marks.	**2**	
9(c)(iii)	Suitable example e.g. GRP, concrete, carbon fibre, [1]. Reference to materials in the composite, [1]. Improvements made in performance of structure as a result, [1].	**3**	Accept other composites
9(d)(i)	 1 mark for label in suitable position.	**1**	

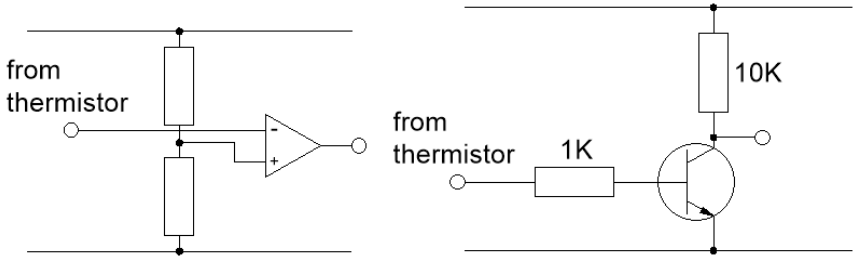
Question	Answer	Marks	Guidance
9(d)(ii)	220 × 1200 = 710 × counterbalance, [1]. 220 × 1200 / 710 = **371.8** kg, [1].	**2**	Award 2 marks for correct answer with no working. Allow rounding errors, e.g. 374 kg.
9(d)(iii)	Factors to be considered will include: • How far can the lifting arm be extended? • The breaking strain of the lift cable • Strength of the materials used • Labelling on hoist to inform user of safe working loads • Percentage reduction from the absolute maximum that can be lifted.	**2**	1 mark each for 2 points mentioned. Allow 2 marks for a single point fully explained / justified.

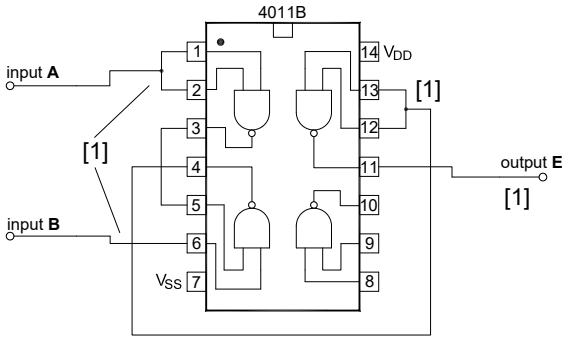
Question	Answer	Marks	Guidance
10(a)(i)	**Spur gears benefit** – direct connection, no slipping, ratio can be adjusted, compound gear trains can be used, direction of rotation can be changed, does not take up much space, 1 mark. **Vee belt benefit** – not as likely to slip as a flat belt, allows pulleys to be spaced apart from each other, reduced noise, limited slip can take place, 1 mark. **Chain drive benefit** – no chance of slipping, axles can be some way apart, chain will last longer than a vee belt, high torque transfer 1 mark.	**3**	Allow any other valid alternatives for each method.
10(a)(ii)		**1**	Accept circle anywhere on top portion of chain.

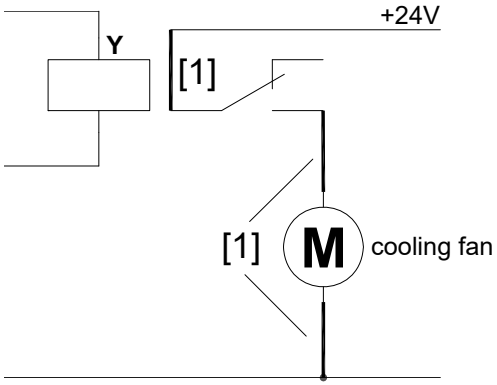
Question	Answer	Marks	Guidance
10(a)(iii)	Benefits of the joining link are: • It is quicker to join chain • Joining link is removable to change / maintain the chain • Does not increase width of chain • No danger of over tightening and causing a link joint to be stiff.	**2**	1 mark for each valid benefit. 2 × 1 marks
10(a)(iv)	Advantages of the toothed belt are: • A toothed belt cannot slip / more friction with toothed belt • Will allow the two pulleys to retain their relative position.	**1**	1 mark for valid answer.
10(b)	 Adjustment for one or both gears shown, 1 mark. Clear sketches or description, 1 mark. Method of fixing the gears into position e.g. nut / bolt shown, 1 mark. Functional solution for fixing, [1].	**4**	
10(c)(i)	Reasons for cover will include: • Safety, nothing can get caught in moving belt • Prevent any dust particles of belt from being breathed in by operator • To operate the cut-off switch that controls power to motor • If belt breaks it will contain the broken parts of belt. 2 × 1 marks.	**2**	Allow any other valid reasons
10(c)(ii)	∅ Driven pulley × 890 = ∅ driver pulley × driver rpm 85 × 890 = 36 × driver rpm, [1]. 85 × 890 / 36 = driver rpm, [1]. = **2101.4 rpm**, [1].	**3**	Award 3 marks for correct answer with no working.
10(c)(iii)	**First order lever** is used.	**1**	

Question	Answer	Marks	Guidance
10(c)(iv)	Notes and sketches to indicate that lever length is extended, [1]. Justification given for reduction in effort, [1].	**2**	Allow a method that reduces the distance between fulcrum and load.
10(d)	Benefits of the worm gear include: • Takes up less space than spur gears • Reduced friction as less contact area on teeth • Large reduction ratio possible • Direction of motion is changed by 90° • Worm gear cannot slip backwards. 2 × 1 marks.	**2**	Allow any other valid benefits
10(e)	Rotary to linear movement: **Rack and pinion** or **screw thread**, 2 × 1 marks. Rotary to reciprocating movement **Cam and follower** or **crank and slider**, 2 × 1 marks.	**4**	

Question	Answer	Marks	Guidance
11(a)(i)	Thermistor, [1].	**1**	
11(a)(ii)	Thermistor reading is 6.3 kΩ, [1]. Substituting into formula V_{out} = 9 × 1 kΩ / 7.3 kΩ, [1]. V_{out} = **1.23 V** [1].	**3**	Award 3 marks for correct answer with no working.
11(a)(iii)	The signal will be fluctuating, 1 mark. It is less than the lower threshold on the logic system, meaning that logic level will not change, 1 mark.	**2**	

Question	Answer	Marks	Guidance
11(a)(iv)	Functional method, [1]. Circuit diagram understandable, [1].  Output will be suitable to change logic level, [1].	**3**	
11(b)	<table><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table> 1 mark each for columns **C, D**, **E** correct.	**3**	
11(c)(i)	The 4011B is a quad NAND gate IC 1 mark for quad / 4, 1 mark for NAND gate.	**2**	

Question	Answer	Marks	Guidance
11(c)(ii)	 3 × 1 marks Input A – pins 1 and 2, Input B – pin 6 [1] Pins 3–5 joined, Pin 4 to 12 or 13, 8 or 9, Pins 12 and 13 or pins 8and9 joined [1] 1 mark for any 2 correct connections. Pin 11 to output [1]	**3**	Any three gates can be used, 4th gate not connected.
11(c)(iii)	The capacitor will prevent spikes in voltage (by storing and releasing charge), [1]. This will not then 1affect the logic levels, [1].	**2**	
11(d)(i)	Component **X** is a diode, [1]. Component **Y** is a SPDT relay, [1].	**2**	Accept ‘relay’ or reference to ‘magnetic switch’.
11(d)(ii)	The relay will: • Allow isolation of the different voltages • The motor requires 24 V to operate • Allow a higher current device to be driven on the output • Prevent any arcing on contacts 2 × 1 marks.	**2**	Allow any other valid reasons.

Question	Answer	Marks	Guidance
11(d)(iii)	 2 × 1 marks.	**2**	