CAMBRIDGE
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DESIGN AND TECHNOLOGY **0445/41**

Paper 4 Systems and Control **May/June 2025**

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 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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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 descriptions 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standard isation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	Unclear
	Benefit of the doubt
	Incorrect point
	Error carried forward
N/A	Highlighting areas of text
	No benefit of doubt given
N/A	Off-page comment – allows comments to be entered off the page
	Repeat
	Indicates that the point has been noted, but no credit has been given
	Indicates that the point has been noted, but no credit has been given (big)

Annotation	Meaning
	Correct point
TV	Too vague
DET	Relevant detail

Question	Answer	Marks	Guidance
Section A			
1(a)	Fossil fuels could be: • Coal • Natural gas • Oil / oil derived products. [2 × 1]	**2**	Do not allow 'wood'
1(b)	Solar generated electricity can be stored by **charging a battery** during daytime [1] and then the battery discharges at night, releasing electricity for use. [1]	**2**	Maximum 1 mark if 'storage' mentioned without 'battery'. Allow reference to newer types of solar panel that can generate in low light.

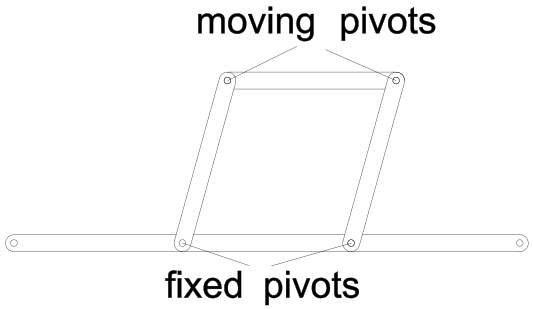
Question	Answer	Marks	Guidance
2	**Frame** structure, 1 mark.	**1**	

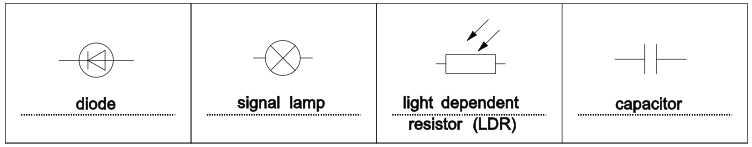
Question	Answer	Marks	Guidance
3	Triangulation will hold parts of a frame in the strongest position, giving **stability** / **rigidity**.	**1**	Allow mark for understanding shown. Do not allow 'stronger' without qualification.

Question	Answer	Marks	Guidance
4	Tension is a pulling force, [1] examples could be wires / cables in a suspension bridge. [1] Torsion is a twisting force, [1] example could be torsion spring on a car. [1] Static load is a load applied to a structure, [1] that does not move or change. [1]	**6**	Accept any other valid response for examples.

Question	Answer	Marks	Guidance
5	Explanation for using spur gears will include: • Where slippage is undesirable • Where changing a gear ratio / speed is required • To change direction of rotation • To multiply torque • To position parts of a system precisely. [2 × 1]	**2**	Accept any other valid response Allow reference to fitting into a small space.

Question	Answer	Marks	Guidance
6	A change of direction when using spur gears is achieved by using an idler gear, [1] shafts on gear systems with an odd number of elements will rotate in the same direction. [1]	**2**	Allow mark for understanding shown.

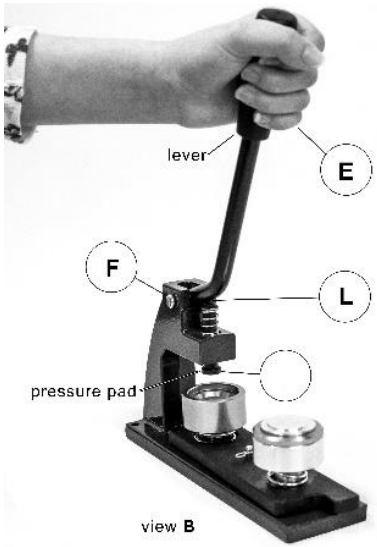
Question	Answer	Marks	Guidance
7	 Shape of linkage [1], positions of either fixed or moving pivots marked. [1]	**2**	

Question	Answer	Marks	Guidance
8	 [4 × 1]	4	For signal lamp allow 'bulb'

Question	Answer	Marks	Guidance
9	lowest value … highest value 82R | 4.7kΩ | 100kΩ | 3MΩ [3 × 1]	3	

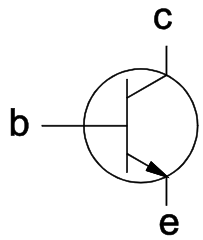
Question	Answer	Marks	Guidance
Section B			
10(a)(i)	Each of the steel rods is in **tension**.	**1**	
10(a)(ii)	The sleeve can be used to reduce or increase the effective length of the rods, [1] using a right-hand thread in one and a left-hand thread in the other [1]. Turning the sleeve will act on both rods at the same time. [1]	**3**	Award marks for understanding shown. Allow 2 marks for a single point fully explained.
10(a)(iii)	Part **X** is a gusset plate, [1]. The plates reduce / prevent movement [1], which could distort the two poles. [1]	**3**	Allow reference to the gusset plate supporting the joint or distributing the load.
10(a)(iv)	The links will allow some movement in the rods.	**1**	
10(a)(v)	• Concrete is strong in compression • It can be poured on site • Concrete provides a solid foundation with no movement • The concrete pile will be below the frost line so has little chance of moving or being damaged by frost • Will resist water damage. • Durable / no maintenance required [2 × 1]	**2**	No mark for 'strong material' with no indication that it is 'strong in compression'.
10(b)(i)	The wheelbarrow is a **second order** / **class 2** lever.	**1**	
10(b)(ii)	The structural member at **X** is a **strut**.	**1**	Allow 'brace'.
10(b)(iii)	The explanation should include: • In wheelbarrow **A** the load is closer to the fulcrum • The lever will give increased mechanical advantage • This will increase the efficiency • Wheelbarrow **B** is less efficient.	**3**	1 mark for each valid point made. Award 2 marks for a single point fully explained.

Question	Answer	Marks	Guidance
10(b)(iv)	• When the wheelbarrow is stationary, resting on the ground it will be in equilibrium, it is effectively a tripod • When the handles of the wheelbarrow are lifted the device will be unstable • The user's hands pulling / pushing on either handle maintain equilibrium in a moving wheelbarrow.	**2**	Accept any other valid response Any two valid points mentioned in the description. Allow 2 marks for a single point fully described.
10(b)(v)	The load is 38 × 2.1 × 9.81 = **782.8 N** [1] 240 × 782.8 = 1220 × Effort [1] Effort = 240 × 782.8 / 1220 = **153.9 N** [1]	**3**	Award full marks for correct answer with no working.
10(c)(i)	Advantages of nail plates will include: Allows offsite construction • Low cost • Secure method • Can be applied using a press • Less skill required • Increased speed of production. [2 × 1]	**2**	Allow any other valid alternatives
10(c)(ii)	Defects that can be avoided during selection include: • Bent / warped pieces • Large knots • Splits / shakes • Signs of insect damage • Signs of rot.	**3**	Award marks for understanding shown. 1 mark for each valid point in description. Allow 2 marks for a single point fully described Allow mark for checking moisture level.

Question	Answer	Marks	Guidance
11(a)(i)	Second order or second class lever.	**1**	
11(a)(ii)	 1 mark for each correctly labelled.	**3**	No mark for two labels showing the same letter in different positions.
11(a)(iii)	**Oscillating** motion [1] is converted to **reciprocating** motion [1].	**2**	
11(a)(iv)	The spring will return the pressure pad when the lever is raised.	**1**	
11(b)(i)	VR = **5** [1] MA = 5 × 0.88 = **4.4** [1] Effort = 1250 / 4.4 [1] = **284.1 N** [1]	**4**	Award full marks for correct answer with no working.
11(b)(ii)	Loss of efficiency will be due to: • Friction in pulley bearings • Quality of the bearings • Increased number of pulleys in the system • Loss of energy due to heat and sound generated. [2 × 1]	**2**	Accept any other valid response 1 mark for each point included in the explanation. Allow 2 marks for a single point fully explained. 1 mark only for reference to a lack of lubrication.

Question	Answer	Marks	Guidance
11(b)(iii)	Efficiency can be increased by: • Lubricating the bearings on each pulley • Use of ball bearings or needle bearings on pulleys • Increase the diameter of the pulley. [2 × 1]	**2**	
11(c)(i)	The maintenance process for the gravity fed oiler will include: • Keeping the exterior clean to keep dirt out of the bearings. • Regular checks on the oil level. • Checks and adjustment of the oil flow • Check that oil is going to the bearings. [2 × 1]	**2**	Allow other valid points.
11(c)(ii)	The bearing is likely to be a plain bearing.	**1**	
11(c)(iii)	A sealed ball bearing or needle bearing will remove / re the need for lubrication and will prevent oil from getting onto the machine's exterior surface.	**1**	Bearing must be described as 'sealed' for mark.
11(c)(iv)	Drawbacks will include: • Belt can come off the pulleys more easily • More prone to slipping on the belt • Generally narrower section so will stretch more easily • Could be noisier than a vee belt or chain drive. [2 × 1]	**2**	Allow other valid disadvantages.

Question	Answer	Marks	Guidance
11(c)(v)	Clear sketches [2] Workable solution [1] Supporting notes [1] The method could be: • A spring tensioned roller pressing against the belt • One of the pulleys being movable, mounted on a slot • One pulley mounted on a quadrant which can be swung down to provide tension.	**4**	

Question	Answer	Marks	Guidance
12(a)(i)	Signal diode cathode can be identified by: • A stripe on the body of the diode. • Using a test circuit . • A multimeter with diode test facility. • LED cathode can be identified by: • Flat on the body • Shorter leg • Using a test circuit. [2 × 1]	**2**	Allow any other valid method
12(a)(ii)		**2**	1 correct = 1 mark 2 or 3 correct = 2 marks
12(a)(iii)	The two functions of a transistor are: • Switch • Current amplifier [2 × 1]	**2**	Accept ‘amplifier’

Question	Answer	Marks	Guidance
12(b)(i)	Substitution into formula $V_{out} = \underline{9 \times 4700}$ [1] (10 000 + 4700) $V_{out} = \underline{42\ 300}$ [1] 14 700 V_{out} = **2.88 V** [1]	**3**	Award 3 marks for correct answer with no working.
12(b)(ii)	• Two inputs inverting and non-inverting are compared • If non-inverting > inverting then output is high (9 V) • If inverting > non-inverting then output is low (0 V). Any two correct points for 2 marks	**2**	
12(b)(iii)	The non-inverting voltage (3.12 V) is greater than the inverting input (2.88 V). The voltage at point Y will be **+9 V**.	**1**	Allow ecf from **(b)(i)** Allow anything greater than +8 V.
12(b)(iv)	The IC will have a notch at one end and/or a dot next to pin 1 [1] The notch should be aligned with the notch in the IC holder [1]	**2**	
12(b)(v)	**A** **Benefit** extremely accurate when setting the resistance value. **Drawback** expensive, takes a long time to go through the range, bulky. **B** **Benefit** low cost standard component, readily available no special tools needed. **Drawback** lack of accuracy, high tolerance of values. **C** **Benefit** can be soldered directly to PCB, small size **Drawback** needs a small screwdriver to adjust, will be hidden inside a casing.	**6**	1 mark for each valid benefit / drawback. 6 × 1 marks

Question	Answer	Marks	Guidance
12(c)(i)	Technical description could include: • The coil voltage (9 V) • Switch configuration (SPDT) • Maximum voltage / current of contacts • Size of casing. [2 × 1]	**2**	
12(c)(ii)	• The multimeter should be set to measure resistance • The coil pins will return a low resistance value, typically 50 Ω – 100 Ω • There are 5 pins – a resistance check is carried out from first pin to all others • If no result check between second pin and all others. • Continue until the pins with a low resistance between them are identified.	**3**	Description with 3 valid points, 3 marks Allow 2 marks for a single point fully described.