Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

DESIGN AND TECHNOLOGY **0445/43**

Paper 4 Systems and Control **May/June 2018**

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.

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This document consists of **12** printed pages.

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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 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).
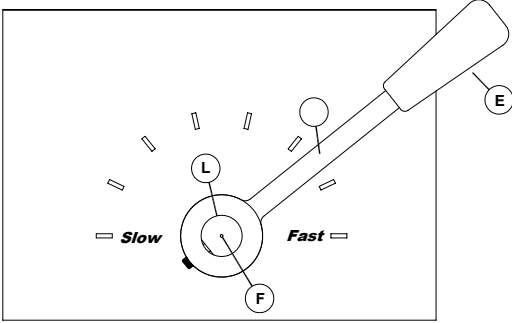
GENERIC MARKING PRINCIPLE 6:

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.

Section A

Question	Answer	Marks	Guidance
1(a)	Torque or torsion	1	Allow twisting
1(b)	Benefits of the nylon lining could include: • Reduce friction • Reduce the amount of lubrication required • Prevent water getting to inner cable • Prevent inner cable rubbing on outer 2 × 1 marks for suitable benefits	2	Allow any other valid benefit. E.g. lightweight, waterproof, flexible.
1(c)	Small radius bends will restrict the cable and prevent efficient movement of the inner cable. Permanent distortion of the outer cable could result. Possibility of cable snapping.	2	Full explanation of a single point, 2 marks. Explanation that includes two points, 2 marks. One point mentioned, 1 mark.

Question	Answer	Marks	Guidance
2(a)	Explanation should mention that steel is durable, ductile, strong in tension, can bend and is able to return to same position. Low cost material that can also be recycled after use.	2	Full explanation of a single point, 2 marks. Explanation that includes two points, 2 marks. One point mentioned, 1 mark.
2(b)	Tension	1	

Question	Answer	Marks	Guidance
3	Compression	1	

Question	Answer	Marks	Guidance
4(a)		3	
4(b)	Second order lever	1	Accept 2nd class lever

Question	Answer	Marks	Guidance
5		3	

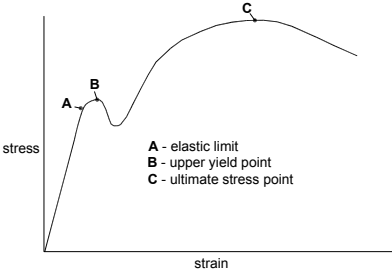| Requirement	Method
Transfer drive through 90° with no change in speed	**bevel gear**
Provide a large reduction in speed in a small space	**worm gear**
Make driver and driven shafts rotate in the same direction	**idler gear**

Question	Answer	Marks	Guidance
6	Thread pitch is **6 mm**	1	

Question	Answer	Marks	Guidance
7(a)	**A**〉—**Q1** **B** Name.....**NOR**....... **A**〉—**Q2** **B** Name....**NAND**...... 1 mark for each correctly named	2	
7(b)	1 mark for each correctly completed column 	A	B	Q1	Q2
0	0	1	1
0	1	0	1
1	0	0	1
1	1	0	0		2	

Question	Answer	Marks	Guidance
8(a)	The marking on the capacitors is the voltage (dc) [1] which should not be exceeded when connected to a circuit [1].	2	Allow marks for understanding shown.
8(b)	It will vary more because the tolerance is greater.	1	Allow marks for understanding shown.

Question	Answer	Marks	Guidance
9	Resistor, 1 mark.	1	Accept VR or potentiometer

Section B

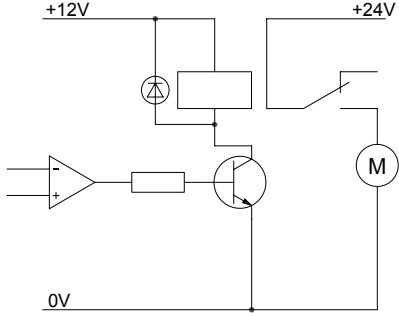| Question	Answer	Marks	Guidance
10(a)(i)	Scaffolding is a **frame structure**	1	
10(a)(ii)	Each face of the structure to be made rigid, minimum of three poles. 1 mark for each pole in the correct position.	3	Maximum of 2 marks for multiple added poles in any one plane.
10(a)(iii)	Features **X** and **Y** are to spread the load of the scaffold [1] and prevent it from sinking into soft ground. [1] They can also be used for levelling on uneven ground. [1]	2	1 mark each for any two correct points included.
10(a)(iv)	A factor of safety is the load carrying capacity of a structure [1] beyond the expected loads. [1] The factor of safety is a number that is multiplied by the total expected load giving a load that design of structure must carry. [1]	2	One mark for each valid point made, allow examples in the explanation. Allow 2 marks for one point fully explained.
10(b)(i)	The hard hat is a **shell structure**	1	
10(b)(ii)	Ribs have been moulded into the shell [1] to make the structure more rigid / prevent any flexing [1].	2	Both points needed for 2 marks.
10(c)(i)	 A - elastic limit B - upper yield point C - ultimate stress point	3	Smooth rise to elastic limit **A** [1] Sharp dip after upper yield point **B** [1] Gradual fall after ultimate stress point **C** [1]
10(c)(ii)	Material will stretch / elongate until this point. [1] Elastic limit is the point beyond which the material will not return to its original length and is permanently deformed. [1] Stress is directly proportional to strain up to the elastic limit. [1]	2	Two points needed for 2 marks.
10(d)(i)	**Gusset plate**	1	

Question	Answer	Marks	Guidance
10(d)(ii)	Reasons will include: • To keep parts of the structure at 90° to each other • Reinforce the corner • Does not take up as much room as a strut or tie • Does not interfere with clothing on the rack • Lightweight • Low cost 2 × 1 marks	2	Allow other valid reasons.
10(d)(iii)	 • Dial gauge taking reading from bottom of rail [1] • Tip of dial gauge in contact with centre of rail [1] • Method of supporting dial gauge shown [1] 3 × 1 marks	3	

10(e)	Stress on pillar **A** = 7000 / 31415.9 mm^2 = 7000 / 0.0314159 m^2
	                                        = **222817 N/m^2** 1 mark
	                                        = **0.223 N/mm^2**
	
	Stress on pillar **B** = 8000 / 30625 mm^2 = 8000 / 0.030625 m^2
	                                        = **261224 N/m^2** 1 mark
	                                        = **0.261 N/mm^2**
	Pillar **B** is subject to greatest stress, 1 mark
		3	Stress must be calculated for each pillar to gain marks.
			
			No ecf.1

Question	Answer	Marks	Guidance
11(a)(i)	To tension the chain or take up excess chain length, 1 mark To guide the chain onto different sprockets, 1 mark	**2**	Allow marks for understanding shown.
11(a)(ii)	2 chainrings × 10 sprockets, 1 mark = 20 gear ratios, 1 mark	**2**	Award 2 marks for 20
11(a)(iii)	The diameter of the wheel will affect the distance travelled.	**1**	
11(b)(i)	Reasons for lubricating a chain include: • Reduce friction between rollers / links • Reduce wear of the chain • Keep water away from moving parts • Increase efficiency of the mechanism.	**2**	Allow any other valid reason. Full explanation of a single point, 2 marks. Explanation that includes two points, 2 marks. One point mentioned 1 mark.
11(b)(ii)	Grease would be too thick to get through to the inner sections of rollers.	**1**	
11(c)(i)	The rubber seals will: • Keep oil in place in the bearing • Keep dust / grit / water away from the bearing surfaces	**1**	
11(c)(ii)	The grooves act as a reservoir for the oil. They also allow grit / abrasive material to collect without damaging the bearing surface.	**1**	Allow mark for reference to oiling.
11(c)(iii)	Benefit of type **S**: 1 mark • Simple design • Low cost • Easily replaced Benefit of type **T**: 1 mark • Reduced friction • Will take both axial and radial load • No maintenance required	**2**	Allow any other valid benefits. Do not allow the same benefit for both bearings. For **T** allow, 'withstand force'.
11(d)(i)	**Rack** and **pinion,** 1 mark for each	**2**	
11(d)(ii)	**Rotary** motion to **linear** motion, 1 mark for each	**2**	Allow 'circular' for 'rotary'

Question	Answer	Marks	Guidance
11(d)(iii)	Energy losses can be through friction in bearings, sound, heat. 2 × 1 marks	2	
11(d)(iv)	Energy loss can be reduced by: • Use of efficient bearings to reduce friction • Lubrication • Reducing weight of any moving parts • Switching machine off when not in use.	2	Allow any other valid method of reducing energy loss.
11(d)(v)	Factors will include: • Cams allow for quick adjustment • Limited movement needed • Positive locking action is possible • No tools required	2	Allow any other valid reason. Full explanation of a single point, 2 marks. Explanation that includes two points, 2 marks. One point mentioned 1 mark.
11(e)(i)	Mechanical advantage of the compound pulley is 8/1 = **8**	1	
11(e)(ii)	1.5 kN = 1500N / 8 [1] = **187.5 N**, [1] **0.1875 kN**	2	

Question	Answer	Marks	Guidance
12(a)	• Leads from multimeter connected to terminals of switch [1] With switch not pressed [1] • Reading of close to zero will indicate a PTB switch • Reading of '1' will indicate a PTM switch With switch pressed [1] • Reading of close to zero will indicate a PTM switch • Reading of '1' will indicate a PTB switch	3	Allow 1 mark for understanding of process.
12(b)(i)	The most suitable is 7 / 0.2 equipment wire	1	

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Question	Answer	Marks	Guidance
12(b)(ii)	This wire is insulated [1] and is flexible enough to allow some movement when the switch is positioned [1].	1	Allow mark for another type if good reason given.
12(b)(iii)	Stages in soldering could include: • Wire stripping • Twisting strands • Fitting to terminal • Cleaning tip / tinning soldering iron • Tinning the wire / switch terminal • Positioning soldering iron to touch both terminal and wire • Waiting for joint to heat. • Feed solder into joint • Allow to cool • Cut off surplus wire	4	4 marks for clear description of the process. Stages must be directly related to the soldering process.
12(c)	Advantages will include: • Pins are easier to fit into circuit board than individual wires • Can be rapidly connected / disconnected • There is a notch on socket for correct orientation • No danger of individual wires breaking. 2 × 1 marks	2	
12(d)(i)	Use of forward voltage in calculation 12 – 3.4 = 8.6 V, 1 mark. Correct use of ohms law formula R = V / I = 8.6 / 0.04, 1 mark **215 Ω**, 1 mark	3	Dividing voltage by current = 1 mark Allow 3 marks for correct answer with no working shown.
12(d)(ii)	Explanation to include: • Resistors connected in series • Voltage is divided in proportion to the value of resistors	2	Both points must be included for 2 marks.

Question	Answer	Marks	Guidance
12(d)(iii)	Description of voltage comparator to include the following: If non-inverting input > inverting input the output will be high (close to supply) [1] If inverting input > non-inverting input the output will be low (close to 0V) [1] One input is reference voltage and does not change the varying input comes from the LDR potential divider. [1]	3	Allow mark for understanding shown
12(d)(iv)	Sensitivity of the circuit can be changed by: • Changing value of R1 • Altering the reference voltage at inverting input using VR2 • Altering the voltage at the LDR potential divider using VR1. 2 × 1 marks	2	
12(d)(v)	 Transistor and resistor symbols correct, with connections correct 1 mark Emitter to 0V connection, 1 mark Collector to relay / diode, 1 mark	3	
12(d)(vi)	Reasons for relay use could include: • Different voltages for control circuit and relay output • Isolation of the two circuits • High current draw from the motor.	1	