Cambridge Assessment International Education

Cambridge IGCSE™

DESIGN AND TECHNOLOGY **0445/41**

Paper 4 Systems and Control **May/June 2020**

MARK SCHEME

Maximum Mark: 50

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

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

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

[Turn over

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).

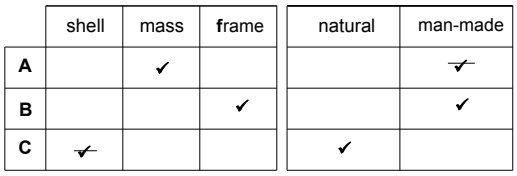
GENERIC MARKING PRINCIPLE 6:

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
1	**A** – Do not place electrical item in general waste. **B** – Double insulated, no earth connection.	**2**

Question	Answer	Marks
2(a)	Reasons could include: • No special tools needed, manufacturer could want to restrict access • Slot can easily be deformed • Screwdriver can slip causing injury	**1**
2(b)	Benefits could be: • Will not slip easily • Positive fixing in screw • Special tool is needed to undo screw • Difficult access for untrained people. 2 × 1 mark	**2**

Question	Answer	Marks
3	 1 mark for each correct 4 × 1.	**4**

Question	Answer	Marks
4	A static load is any load that is applied to a structure but does not move or change in force or direction.	**1**

Question	Answer	Marks
5	Valid example of a second order lever, 1 mark. 1 mark each for fulcrum load and effort correctly indicated. 4 × 1 mark	**4**

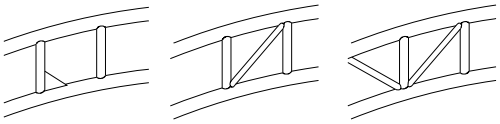
Question	Answer	Marks
6	Drawing to show three spur gears, the centre one an idler gear. 1 mark for idler gear used, 1 mark for correct positioning of all three gears. 2 × 1	**2**

Question	Answer	Marks
7(a)	Lubrication, 1 mark	**1**
7(b)	Reciprocating motion, 1 mark	**1**

Question	Answer	Marks
8	lowest value | 19 μV | 0.7 V | 800 mV | 120kV | 1.9 MV | highest value Lowest and highest correct, 1 mark each Any two in correct ascending order, 1 mark Four or five correct 4 marks.	**4**

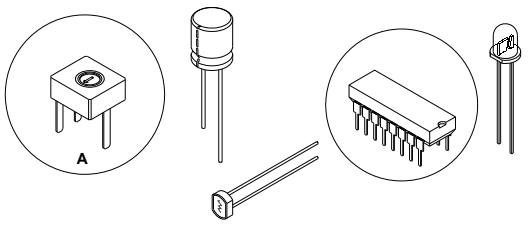
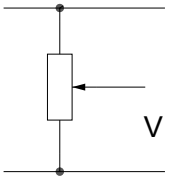
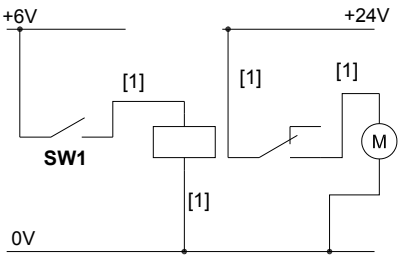
Question	Answer	Marks
9	**D** = electrolytic capacitor, 1 mark **E** = fuse, 1 mark **F** = variable resistor, 1 mark	**3**

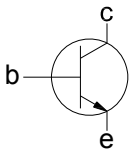
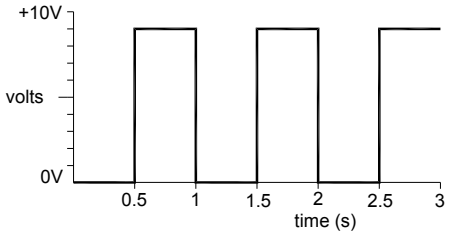
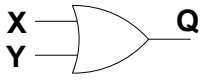
Section B

Question	Answer	Marks
10(a)(i)	A moment is force [1] × distance [1]	**2**
10(a)(ii)	Newton metre (Nm)	**1**
10(b)	LH moment is 0.75 × 320 = 240 Nm, 1 mark RH moment is 1.0 × 250 = 250 Nm, 1 mark The effect will be to rotate slowly clockwise, 1 mark	**3**
10(c)	A strut will resist compression A tie will resist tension. Sketches to show both 2 × 1 mark indication of forces resisted, 1 mark.	**3**
10(d)(i)	**A** Steel box section is • Light • Resist twisting, tension and compression **B** Available in long lengths • Resists compression well • Will not bend easily **C** Resistant to tension and compression • Can be cast in situ • Does not corrode easily 1 mark for a valid benefit for each.	**3**
10(d)(ii)	Explanation to include: Beams are placed on their narrow edge to increase resistance to bending, 1 mark and increase the load carrying capacity of the beam 1 mark.	**2**
10(d)(iii)	Concrete is naturally weak in tension, 1 mark The lower part of the beam will be in tension, 1 mark Steel is strong in tension and will help to resist cracking/failure of the beam, 1 mark	**3**
10(e)(i)	Welding, 1 mark	**1**
10(e)(ii)	 Use of gusset plate, 1 mark Suitable position, 1 mark Use of strut,1 mark Suitable position, 1 mark	**4**
10(e)(iii)	Factor of Safety will be considered for the benefit of those who will use the bridge as it is difficult to predict exactly how many people / what traffic will be on the bridge at one time. Dynamic (moving) loads can be un-predictable e.g. high winds, snow. The bridge will be designed to carry a greater load than it is likely to encounter, this is the factor of safety.	**3**

Question	Answer	Marks
11(a)(i)	Reasons for using each type of belt will include: • **R** toothed belt will not slip, pulleys are kept in the sae relative position to each other • **S** Vee belt will transmit torque better than other types • As belt moves down in the vee torque is transmitted through the sides of the belt • Standard sizes readily available. • **T** The flat belt is relatively low cost. • It can be twisted for reverse drive • A range of belt widths can be used on the same pulleys. 3×1 mark	**3**
11(a)(ii)	Functional method of tensioning, 1 mark Adjustment possible, 1 mark Clear description / sketches used to communicate idea.	**3**
11(b)(i)	Two factors from: • Largest chainring, 1 mark • Largest sprocket, 1 mark. • Length of derailleur cage • Length of chain stay. 2×1 mark	**2**
11(b)(ii)	Plain bearing.	**1**
11(b)(iii)	Points in explanation could be: • If cycle is used in wet weather or snow lubrication can be washed off • Dry dusty weather will cause a build-up of dirt on the chain. This can be abrasive and cause wear in the chain and the sprockets. • The chain can rust if no lubrication is applied • Operating the gears with the chain at extremes e.g. large chainring, large sprocket can cause wear on chain	**3**
11(b)(iv)	The gearing means that the rear wheel will rotate three times for each revolution of the crank, 51/17 = 3, 1 mark Circumference of wheel = $2 \times \pi \times 350 = 2199$ mm, 1 mark Distance travelled = 2199×3 = **6597.34 mm**, 1 mark.	**3**
11(b)(v)	Friction in moving parts will reduce efficiency. Additional movement due to wear in bearings will reduce efficiency, 1 mark.	**1**
11(c)(i)	**X** is a worm gear / worm and wheel, 1 mark **Y** is a ratchet and pawl, 1 mark	**2**
11(c)(ii)	**Worm wheel:** Notes to show that a movement of the spur gear against the worm will cause a sideways movement of the worm, 1 mark, putting thrust on the side of the worm gear and not allowing any rotational movement, 1 mark. **Ratchet and pawl:** Notes to show that the pawl is held in place by a spring against the rachet, 1 mark, locking it in position to prevent reverse rotation, 1 mark.	**4**

Question	Answer	Marks
11(d)(i)	Component **Z** is a crankshaft, 1 mark.	**1**
11(d)(ii)	Reciprocation motion in the piston is converted to rotary motion in the crankshaft, 2 marks.	**2**

Question	Answer	Marks
12(a)(i)	Reasons for wide tracks could be: Less chance of accidental damage / breakage Carry higher current Not easily damaged when drilling	**1**
12(a)(ii)	 1 mark for each correct circle.	**2**
12(a)(iii)	 Each end of potentiometer connected to power rails, 1 mark Centre contact / wiper providing the divided voltage, 1 mark.	**2**
12(a)(iv)	Benefits will include • Less strain on connecting wires • Connections are not permanent / can be easily replaced • No danger of heat damage from soldering, 2 × 1 mark.	**2**
12(b)(i)	 1 mark for each connection as shown.	**4**
12(b)(ii)	Voltage taken from Fig. 12.4, 24 V, 1 mark 24 × 1.75, 1 mark = **42 W**, 1 mark	**3**

Question	Answer	Marks
12(b)(iii)	Features to be considered are: • Coil voltage • Current rating of switched outputs • Number of poles / throws in switch • Physical size of relay • Price 2 × 1 mark	**2**
12(c)	 Shape of symbol correct, 1 mark. labels correct, 1 mark	**2**
12(d)	 Frequency of 1Hz, 1 mark. Peak voltage +9 V, 1 mark	**2**
12(e)(i)	• Explanation may include the following: • NC terminals are joined, NO terminals are joined. • With switches in position shown the lamp is on, changing either switch will cause it to go off. • A further change to either switch will result in the lamp being on again. • The common terminal connected to SW1 provides the positive connection • The common terminal connected to SW2 is the return path through the lamp.	**3**
12(e)(ii)	 **X** **Y** **Q** 0 0 0 0 1 1 1 0 1 1 1 1 OR gate drawn correctly, 1 mark. Truth table correct, 1 mark.	**2**