

# Level 2 Cambridge Technical in Engineering

**05887/05888**

## Unit 2: Application of engineering principles

Sample Assessment Material

### Date – Morning/Afternoon

**Time allowed: 50 minutes**

This test is a computer based test and will be completed using Surpass on OCR Secure Assess portal.

This SAM illustrates the styles and types of questions that make up this test, along with its associated mark scheme.

A practice test will be available on the OCR Secure Assess portal.

There will not be a paper test available for this qualification.

First name

Last name

Centre  
number

Candidate  
number

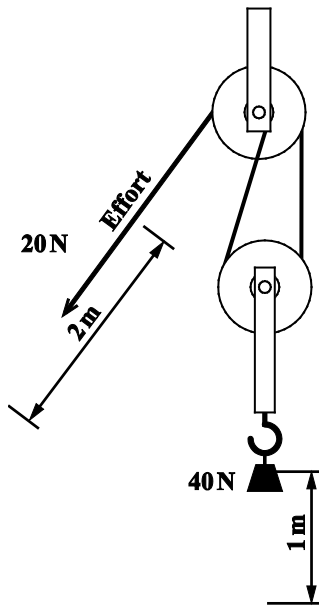
#### INFORMATION FOR CANDIDATES

- The total mark for this paper is **45**.
- The marks for each question are shown in brackets [ ].

Turn over

Answer **all** questions.

1 The diagram below shows a 2:1 pulley system.



(i) Calculate the input work done for this pulley system.  
Use the formula Work done = force x distance.  
Show your workings and include the correct unit in your answer.

[2]

(ii) Calculate the output power for this system. It takes 2 seconds to lift the load.  
Show your workings and include the correct unit in your answer.

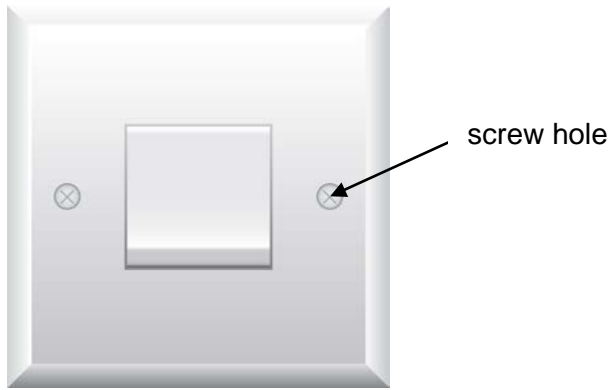
[3]

(iii) Explain **two** factors that can reduce the efficiency of a pulley system.

- 1.....
- .....
- 2.....
- .....

[4]

2 (a) The image below shows an electric light switch front cover which is made from thermosetting plastic.



(i) State **one** property of thermosetting plastic that makes it suitable for the electric light switch front cover.

.....[1]

(ii) State **one** material processing technique that could be used to produce the screw holes in the electric light switch front cover.

.....[1]

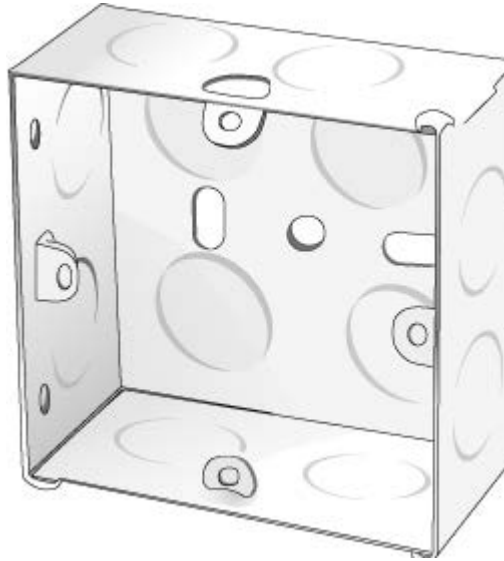
(iii) When deciding to use a thermosetting plastic for the electric light switch front cover the manufacturer would have considered the material properties.

Explain considerations, other than material properties, that affect the choice of material for the electric light switch front cover.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[5]

Turn over

2 (b) The image below shows an electric light switch back box which is made from mild steel.



(i) State why the electric light switch back box is protected with a chemical treatment.

.....[1]

(ii) Describe **one** chemical treatment that could be used on the electric light switch back box.

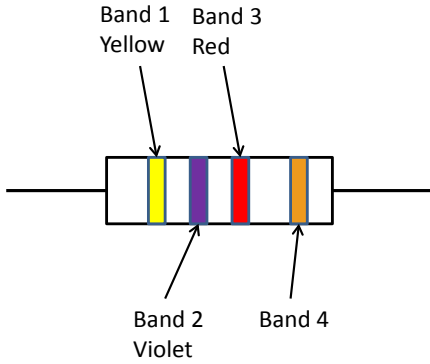
.....  
.....[2]

(iii) State **two** processes that can be used to form the shape of the electric light switch back box.

1.....  
2.....

[2]

3 (a) The diagram below shows a resistor and a resistor colour code table.



Band 1	Band 2	Band 3	Band 4
Black 0	Black 0	Black 0	Brown 0.01
Brown 1	Brown 1	Brown 1	Red 0.02
Red 2	Red 2	Red 2	Gold 0.05
Orange 3	Orange 3	Orange 3	
Yellow 4	Yellow 4	Yellow 4	
Green 5	Green 5	Green 5	
Blue 6	Blue 6	Blue 6	
Violet 7	Violet 7		
Grey 8	Grey 8		
White 9	White 9		

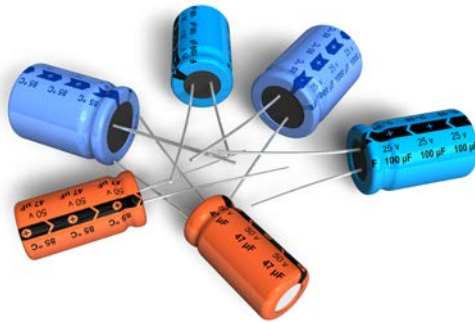
(i) Determine the value of the resistor using the resistor colour code table. Include the correct unit in your answer.

.....  
 .....[2]

(ii) State what is indicated by band 4.

.....[1]

(b) The image below shows capacitors.



(i) State the type of capacitors shown.

.....[1]

Turn over

(ii) Explain the purpose of a voltage rating on a capacitor.

.....

.....

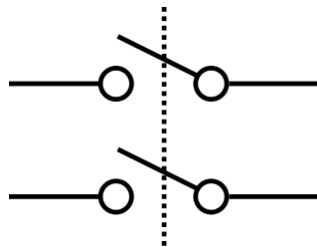
.....

.....[2]

(iii) State the meaning of the term 'tolerance' in relation to capacitors and resistors.

.....[1]

(c) A circuit symbol for a switch is shown below.



(i) Name the type of switch shown.

.....[1]

(ii) State the number of independent circuits this type of switch can operate.

.....[1]

(d) (i) Continuity can be tested using a multimeter and selecting the correct range.

Place a tick (✓) in the table below to select the correct range.

Range	Tick (✓)
Current	
Resistance	
Voltage	

[1]

(i) Explain **one** precaution that should be taken when using a multimeter to test continuity.

.....

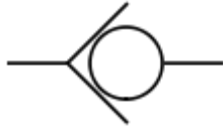
.....

.....

.....[2]

Turn over

4 (a) A symbol for a check valve is shown below.



(i) Explain in detail the operation of the check valve.

.....  
.....  
.....  
.....  
.....  
.....

[3]

(ii) Give **one** application of a check valve.

.....

[1]

(b) (i) Explain the operation of a positive displacement pump including how fluid flow can be increased.

.....  
.....  
.....  
.....  
.....  
.....

[3]

(ii) Give **two** applications of a positive displacement pump.

1.....  
2.....

[2]



(c) Give **one** example of a linear single acting hydraulic actuator.

.....[1]

(d) Explain the difference in operation between a poppet valve and a spool valve.

.....  
.....  
.....  
.....[2]

**END OF QUESTION PAPER**

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**Sample Assessment Material**

**CAMBRIDGE TECHNICAL ENGINEERING LEVEL 2**

**Unit 2: Application of engineering principles**

**MARK SCHEME**

**Duration: 50 minutes**

**MAXIMUM MARK 45**

**SPECIMEN**

**Version: 2 Date: May 2017**

**This document consists of 6 pages**

Question			Answer	Marks	Guidance
1	(a)	(i)	$20 \times 2 = 40$ Nm or J	1 1	<b>No</b> marks for stating the formula: Work done = force x distance as this is given in the question.
		(ii)	$P = \text{force} \times \text{distance} / \text{time}$  $(40 \times 1) / 2 = 20$  W or watts	1  1  1	
		(iii)	<ul style="list-style-type: none"> <li>Losses in efficiency due to friction – thermal, noise, vibration, wear</li> <li>Losses in efficiency due to imbalances – friction, vibration, noise</li> </ul> <p>e.g.</p> <p>There may be losses due to friction (1) between the rope and pulleys which could cause wear or vibration (1).</p> <p>There could also be losses due to imbalances (1) in the pulley wheels leading to friction (1) in the bearings.</p>	4	1 mark for each correct factor, maximum 2 marks 1 mark for each factor explained, maximum 2 marks

Question			Answer	Marks	Guidance
2	(a)	(i)	One from: <ul style="list-style-type: none"> <li>• toughness</li> <li>• hardness</li> <li>• low conductivity of electricity.</li> </ul>	1	Accept any suitable alternative answer.
		(ii)	One from: <ul style="list-style-type: none"> <li>• drilling</li> <li>• turning</li> <li>• milling.</li> </ul>	1	Accept any suitable alternative answer.
		(iii)	Considerations e.g.: <ul style="list-style-type: none"> <li>• Relative cost</li> <li>• Relative availability</li> <li>• Safety in manufacture e.g. ease of use</li> <li>• Safety in use</li> <li>• Form of supply e.g. granular</li> <li>• Environmental considerations e.g. sustainability, energy use to manufacture, product life cycle, DFMA.</li> </ul>	5	1-2 marks – one consideration with limited explanation or two considerations with no attempt to explain.  Up to 3 marks - at least one consideration which is explained in detail.  4-5 marks – at least two considerations explained in detail.  No more than two marks for considerations listed but not explained.
2	(b)	(i)	e.g. to stop rusting	1	Accept any suitable alternative answer.
		(ii)	Up to 2 marks for a description. <ul style="list-style-type: none"> <li>• galvanising</li> <li>• painting</li> <li>• electroplating.</li> </ul> <p>e.g. Galvanising (1) is electrically coating with zinc. (1)</p>	2	

Question		Answer	Marks	Guidance
	(iii)	Two from: <ul style="list-style-type: none"> <li>• folding</li> <li>• bending.</li> </ul>	2	Accept other valid answers for: <ul style="list-style-type: none"> <li>• cutting</li> <li>• riveting</li> <li>• soldering</li> <li>• welding</li> <li>• adhesive bonding</li> </ul>
3	(a)	(i)	4700 / 4.7 ohms / k $\Omega$	1 1 1 mark for value 1 mark for correct unit
		(ii)	Tolerance	1
	(b)	(i)	polarised	1 Do <b>not</b> accept capacitor on its own as this is given in the question.
		(ii)	Up to 2 marks for an explanation e.g. The purpose of a voltage rating is to ensure the capacitor used at least matches the voltage of the circuit (1) so that the capacitor and/or circuit are not damaged (1).	2
		(iii)	Tolerance is the operating range of values or upper and lower limits.	1
	(c)	(i)	Double-pole single-throw/DPST	1
		(ii)	2 (independent circuits)	1

Question			Answer	Marks	Guidance								
	(d)	(i)	Tick against Resistance <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Range</th> <th>Tick</th> </tr> </thead> <tbody> <tr> <td>Current</td> <td></td> </tr> <tr> <td>Resistance</td> <td>✓</td> </tr> <tr> <td>Voltage</td> <td></td> </tr> </tbody> </table>	Range	Tick	Current		Resistance	✓	Voltage		1	
Range	Tick												
Current													
Resistance	✓												
Voltage													
	(d)	(ii)	Up to 2 marks e.g. <ul style="list-style-type: none"> <li>• Check that multimeter and test leads are not damaged (1) before use to avoid incorrect readings or damage to the meter (1).</li> <li>• Be careful not to create a short circuit (1) when connecting probes to circuit to take a measurement to avoid incorrect readings (1).</li> <li>• Do not connect multimeter to voltage source when on ohms range (1) (circuit should be disconnected from power source) to avoid damage to the meter, circuit or self (1).</li> </ul>	2	1 mark for identifying a precaution and one mark for a justification.								
4	(a)	(i)	Up to 3 marks for an explanation e.g.: Allows flow in one direction only. (1) Automatically resists flow in other direction. (1) This is usually achieved by the valve being held against the seat by spring pressure. (1)	3									

Question		Answer	Marks	Guidance
	(ii)	One from: <ul style="list-style-type: none"> <li>• pumps</li> <li>• fluid feed systems</li> <li>• fluid mixing systems</li> <li>• heating system</li> <li>• irrigation system.</li> </ul>	1	Accept any suitable alternative answer.
(b)	(i)	Up to 3 marks from: <ul style="list-style-type: none"> <li>• Operates on series of working cycles</li> <li>• Each cycle moves a certain amount of fluid mechanically through the pump</li> <li>• This happens with little influence from the back pressure on the pump</li> <li>• To increase the amount of fluid flow it is necessary to increase the size of the pump</li> <li>• or to increase the speed of operation</li> </ul>	3	
(b)	(ii)	Two from e.g.: <ul style="list-style-type: none"> <li>• Pumping water from wells</li> <li>• Car industry for water cooling and fuel injection</li> <li>• Energy industry for pumping oil and natural gas</li> <li>• Filtering in aquariums and ponds</li> <li>• Pumping process for artificial hearts</li> </ul>	2	Accept any suitable alternative answers.
(c)	(i)	One from: <ul style="list-style-type: none"> <li>• car hoist</li> <li>• car jack.</li> </ul>	1	Accept any suitable alternative answer.
(d)		Up to 2 marks for an explanation e.g. Poppet valve lifts from seat to uncover valve port, whereas (1) spool valve slides over seat to uncover valve port (1).	2	1 mark for each point