

**OCR**

Oxford Cambridge and RSA

# Level 3 Cambridge Technical in Engineering

## 05822/05823/05824/05825

### Unit 2: Science for engineering

## Thursday 19<sup>th</sup> May 2016 – Morning

### Time allowed: 1 hour 30 minutes

**You must have:**

- the formula booklet for Level 3 Cambridge Technical in Engineering (inserted)
- a ruler (cm/mm)
- a protractor
- a scientific calculator

<b>First Name</b>						<b>Last Name</b>					
<b>Centre Number</b>						<b>Candidate Number</b>					
<b>Date of Birth</b>											

**INSTRUCTIONS**

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

**INFORMATION**

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [ ].
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- An answer may receive no marks unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER USE ONLY	
Question No	Mark
1	/10
2	/10
3	/10
4	/10
5	/10
6	/10
<b>Total</b>	<b>/60</b>

Answer **all** questions.

- 1 (a)** The table below refers to the International System of units (SI units).

Complete the table.

The first row has been completed for you.

Quantity	Unit
Length	metre
Mass	
	henry
	kelvin
Time	

[4]

- (b)** In an electronics circuit a voltmeter is indicating a value of 11.7 V when the true value is known to be 12 V.

Determine:

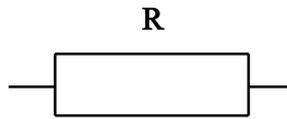
- (i)** the absolute correction

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

- (ii)** the relative correction.

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

(c) Fig. 1 shows a single resistor R.



**Fig. 1**

Using the diagram in Fig.1, draw a labelled circuit diagram to show how the resistance of the resistor R can be measured using one instrument.

[2]

2 (a) Give a practical example of:

(i) a scalar quantity

..... [1]

(ii) a vector quantity.

..... [1]

(b) (i) A force of 3 N and a force of 4 N act at a point and are inclined at  $60^\circ$  to one another.  
Draw, to scale, a force diagram.

[2]

Using your force diagram in 2 (b) (i), determine by measurement:

(ii) the magnitude of the resultant force

..... [1]

(iii) the angle between the resultant and the 4 N force.

..... [1]

(c) The velocity of a vehicle changes uniformly from 20 metres per second to 40 metres per second in 10 seconds.

(i) Use the grid in Fig. 2 to draw a velocity-time graph.

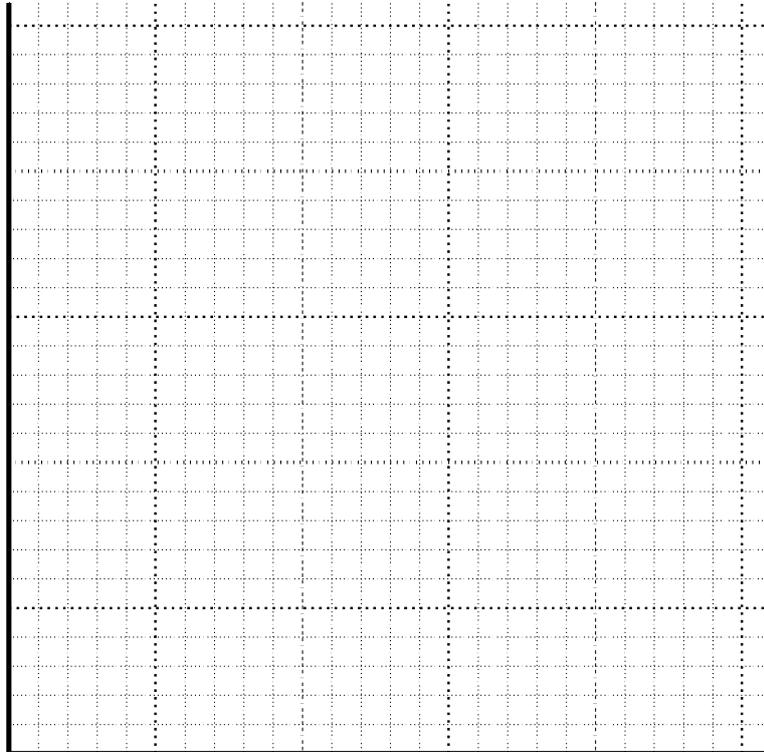


Fig.2

[2]

(ii) Using your graph in Fig.2, calculate the acceleration during the 10 second time period.

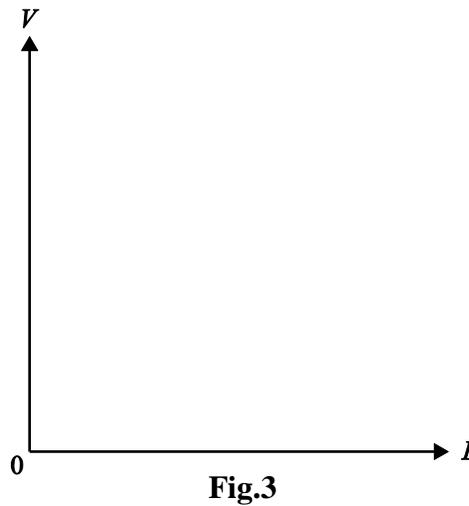
.....

..... [2]

- 3 (a) Explain what is meant by the term 'electrical resistance'.

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

- (b) Using Fig. 3, sketch a graph to show the relationship between potential difference across and current flowing through a metallic conductor at constant temperature.



[2]

- (c) Two resistors connected in series give a total resistance of  $900\ \Omega$ . If one resistor is of value  $680\ \Omega$  calculate the value of the other resistor.

.....  
 .....  
 ..... [3]

- (d) Calculate the current taken by an electric drill rated at  $400\ \text{W}$  used on a  $230\ \text{V}$  supply.

.....  
 .....  
 ..... [3]

4 (a) State Hooke's law with reference to materials.

.....

.....

..... [2]

(b) Fig. 4 shows a graph of force-extension for a material.

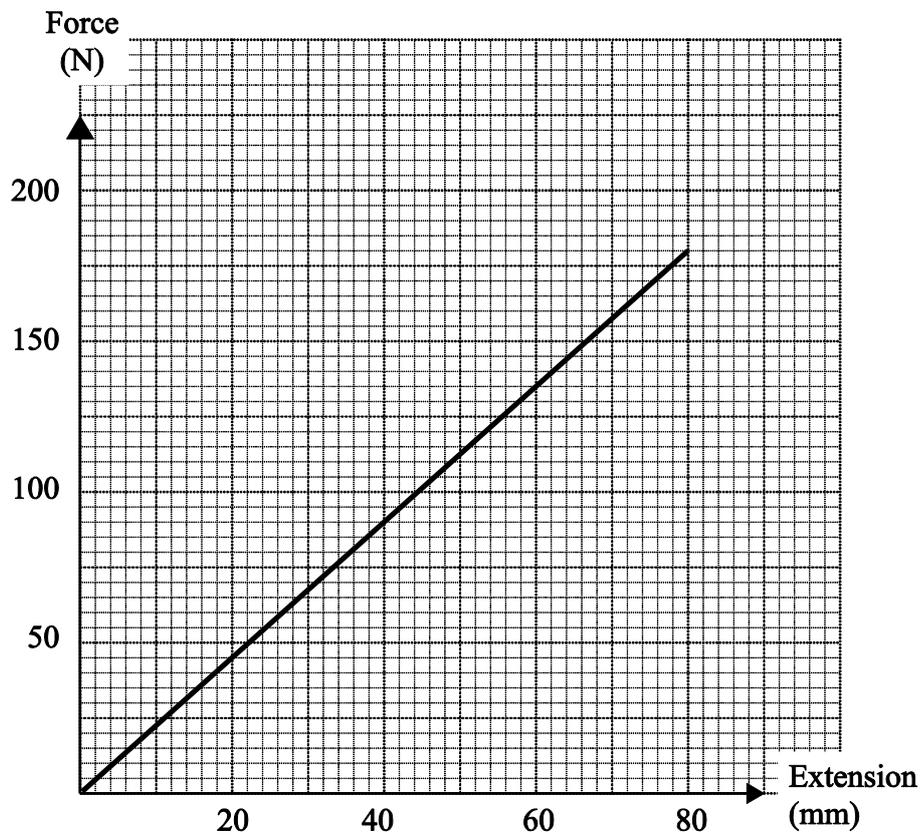


Fig.4

Calculate the strain energy by using data taken from the graph in Fig.4

.....

..... [2]

(c) Choose the correct material property from the following list for each of the definitions shown in the table below.

- Brittleness
- Ductility
- Endurance
- Hardness
- Stiffness
- Toughness

Definition	Property of material
The ability of a material to deform, generally by stretching along its length.	
The ability of a material to resist wear, scratching and indentation.	
The ability of a material to withstand blows or sudden shocks without breaking.	

[3]

(d) State what is meant by the term 'ultimate tensile stress'.

.....

.....

..... [2]

(e) Explain why you would use a 'non-destructive test' on a material.

.....

.....

..... [1]

5 (a) Explain what is meant by 'turbulent flow' in a fluid.

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

(b) Given that atmospheric pressure = absolute gas pressure – gauge pressure.

Calculate the absolute gas pressure when the gauge pressure is  $350 \text{ kN m}^{-2}$  and the atmospheric pressure is  $100 \text{ kN m}^{-2}$ .

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

(c) A force of 120 N is acting on a surface area of  $2.5 \text{ m}^2$ .

Calculate the pressure acting on the surface.

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

(d) Explain what is meant by the term 'viscosity'.

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

(e) State what happens to the kinematic viscosity of:

(i) a liquid when its temperature rises

..... [1]

(ii) a gas when its temperature rises.

..... [1]

- 6 (a) A mass of gas has a volume of  $0.05 \text{ m}^3$  at a temperature of  $80^\circ\text{C}$ .

Calculate the temperature for the same mass of gas when its volume is  $0.1 \text{ m}^3$ .

.....  
.....  
.....  
..... [3]

- (b) A mass of gas has a pressure of  $250 \text{ kN m}^{-2}$  when occupying a volume of  $0.004 \text{ m}^3$ .

Calculate the volume that the same mass of gas will occupy when its pressure is  $500 \text{ kN m}^{-2}$  if there is no change in temperature.

.....  
.....  
.....  
..... [3]

- (c) Explain what is meant by the term 'latent heat'.

.....  
..... [1]

- (d) A mass of  $0.5 \text{ kg}$  of water is heated from  $10^\circ\text{C}$  to  $70^\circ\text{C}$ .

Calculate the sensible heat generated if the specific heat capacity of water is taken as  $4000 \text{ J kg}^{-1} \text{ K}^{-1}$ .

.....  
.....  
..... [3]

**END OF QUESTION PAPER**



