Percentage	
Grade	

A Level Physics

Materials

Duration: 1 hour

Total Marks: 57

Information for Candidates:

- Use black or blue ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional paper is used, the question number(s) must be clearly shown
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

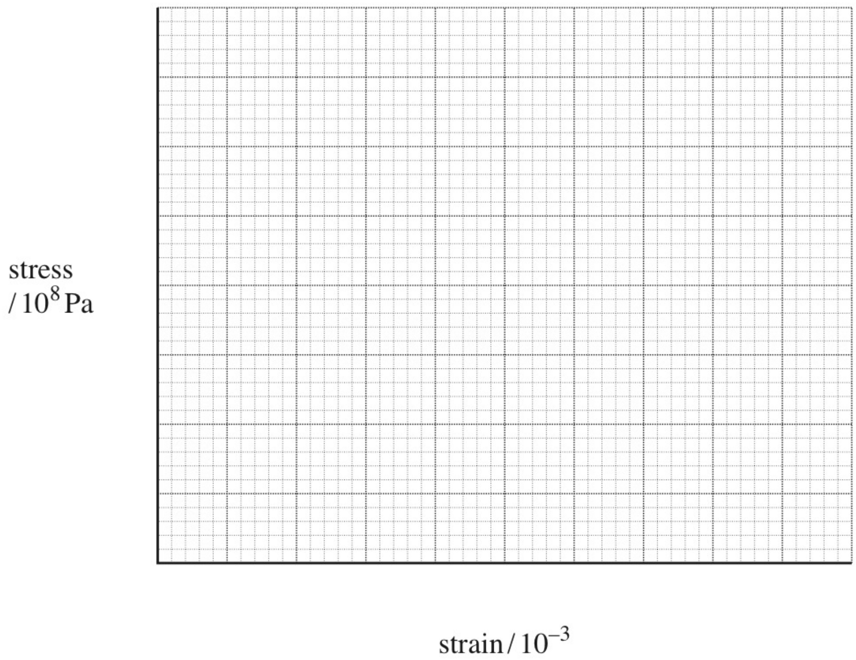
Do not write in this table	
Question	Mark
TOTAL	

6 The table below shows the results of an experiment where a force was applied to a sample of metal.

6 (a) On the axes below, plot a graph of stress against strain using the data in the table.

(3 marks)

strain / 10^{-3}	0	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
stress / 10^{8} Pa	0	0.90	2.15	3.15	3.35	3.20	3.30	3.50	3.60	3.60	3.50



6 (b) Use your graph to find the Young modulus of the metal.

answer = ... Pa

(2 marks)

6 (c) A 3.0 m length of steel rod is going to be used in the construction of a bridge. The tension in the rod will be 10 kN and the rod must extend by no more than 1.0 mm. Calculate the minimum cross-sectional area required for the rod.

Young modulus of steel = 1.90×10^{11} Pa

answer = ... m^2
(3 marks)

8

Turn over for the next question

7 **(a)** Fig. 7.1 shows a length of tape under tension.

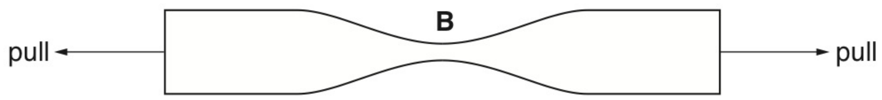


Fig. 7.1

(i) Explain why the tape is most likely to break at point **B**.

....

.... **[1]**

(ii) Explain what is meant by the statement:

'the tape has gone beyond its elastic limit'.

....

....

.... **[1]**

(b) Fig. 7.2 shows one possible method for determining the Young modulus of a metal in the form of a wire.

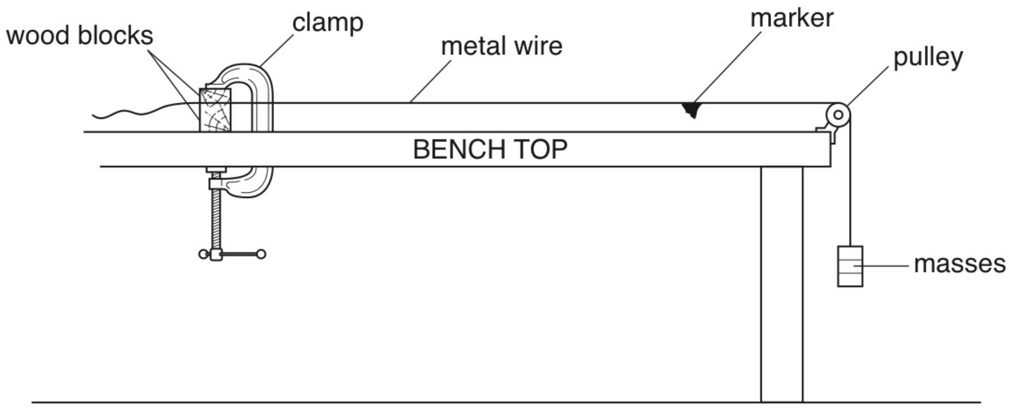


Fig. 7.2

Describe how you can use this apparatus to determine the Young modulus of the metal. The sections below should be helpful when writing your answers.

The **measurements** to be taken:

In your answer, you should use appropriate technical terms, spelled correctly.

The **equipment** used to take the measurements:

In your answer, you should use appropriate technical terms, spelled correctly.

How you would **determine** Young modulus from your measurements:

[8]

[Total: 10]

END OF QUESTION PAPER

7 **(a)** Fig. 7.1 shows stress against strain graphs for materials **X**, **Y** and **Z** up to their breaking points.

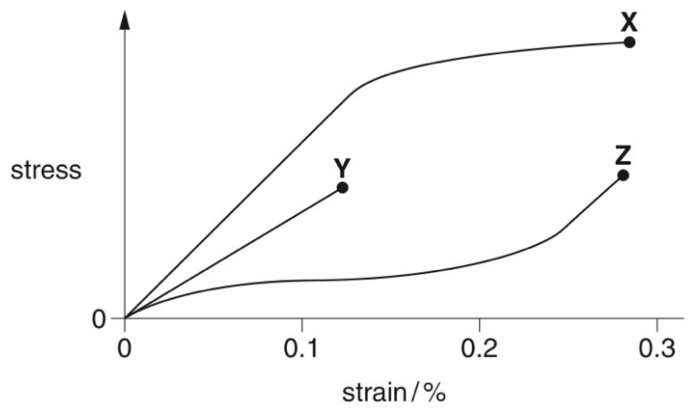


Fig. 7.1

(i) State which of these three materials is brittle.

.... **[1]**

(ii) State one similarity between the properties of materials **X** and **Y** for strains less than 0.05%.

....

.... **[1]**

(iii) State and explain which material has the greatest value for the Young modulus.

....

....

.... **[2]**

(b) Engineers are testing a new material to be used as support cables for a bridge. In a laboratory test, the breaking force for a sample of the material of diameter 0.50 mm is 240 N. Estimate the breaking force for a cable of diameter 15 mm made from the same material.

breaking force = ... N **[2]**

[Total: 6]

Please turnover for Question 8.

2 **(a)** Define *density*.

....

.... **[1]**

(b) Fig. 2.1 shows the variation of density of the Earth with **depth** from the surface.

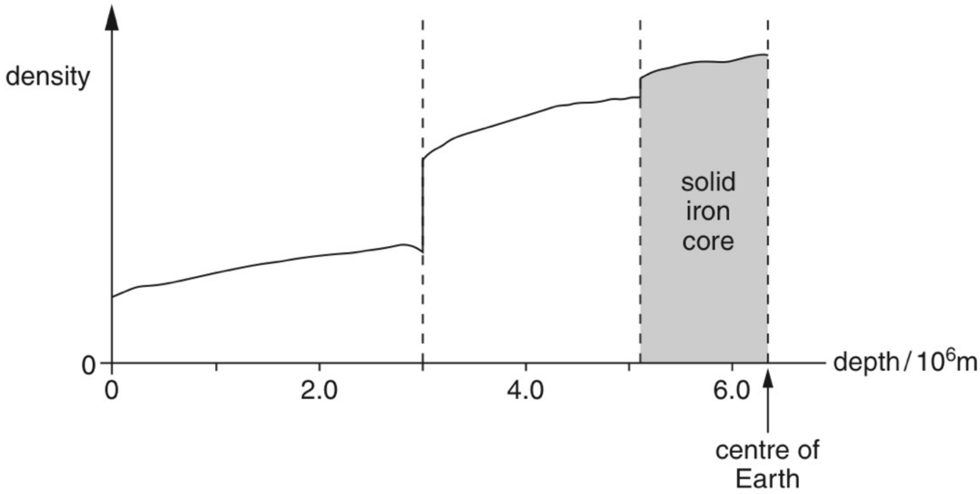


Fig. 2.1

(i) Suggest how Fig. 2.1 shows that the Earth consists of a number of distinct layers.

....

.... **[1]**

(ii) Geophysicists believe that the central core of the Earth is solid iron. This central core is surrounded by a layer of molten metal. The central core starts at a **depth** of 5.1×10^6 m. The solid iron core accounts for 18% of the mass of the Earth. The mass of the Earth is 6.0×10^{24} kg and its radius is 6.4×10^6 m. Calculate the mean density of the central core of the Earth.

volume of a sphere $= \frac{4}{3}\pi r^3$

density = ... kg m^{-3} **[3]**

[Total: 5]

8 A sample of wire is tested in the laboratory. Fig. 8.1 shows the force, F against extension, x graph for this wire.

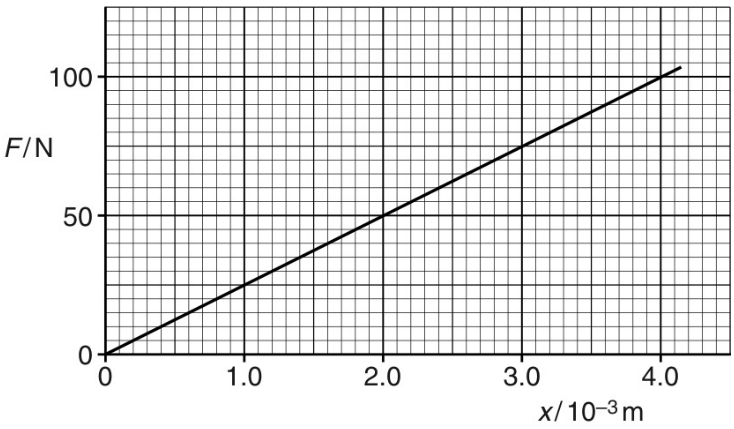


Fig. 8.1

(a) Explain how the graph shows that the wire obeys Hooke's law.

In your answer, you should use appropriate technical terms, spelled correctly.

....

.... **[1]**

(b) State what the gradient of the graph represents.

.... **[1]**

(c) The initial length of the wire is 1.60 m. The radius of the wire is 2.8×10^{-4} m. Use the graph and this information to determine the Young modulus of the material of the wire.

Young modulus = ... Pa **[3]**

(d) The test is repeated for another wire made from the same material, having the same length but **half** the diameter. Explain how the force against extension graph for this wire will differ from the graph of Fig. 8.1.

....

....

....

....

.... **[2]**

(e) It is very dangerous if the wire under stress suddenly breaks. The elastic potential energy of the strained wire is converted into kinetic energy. Show that the 'whiplash' speed v of the wire is directly proportional to the extension x of the wire.

....

....

.... **[2]**

[Total: 9]

END OF QUESTION PAPER

8 **(a)** Fig. 8.1 shows the stress against strain graph obtained from a test on a sample of wire of a ductile material.

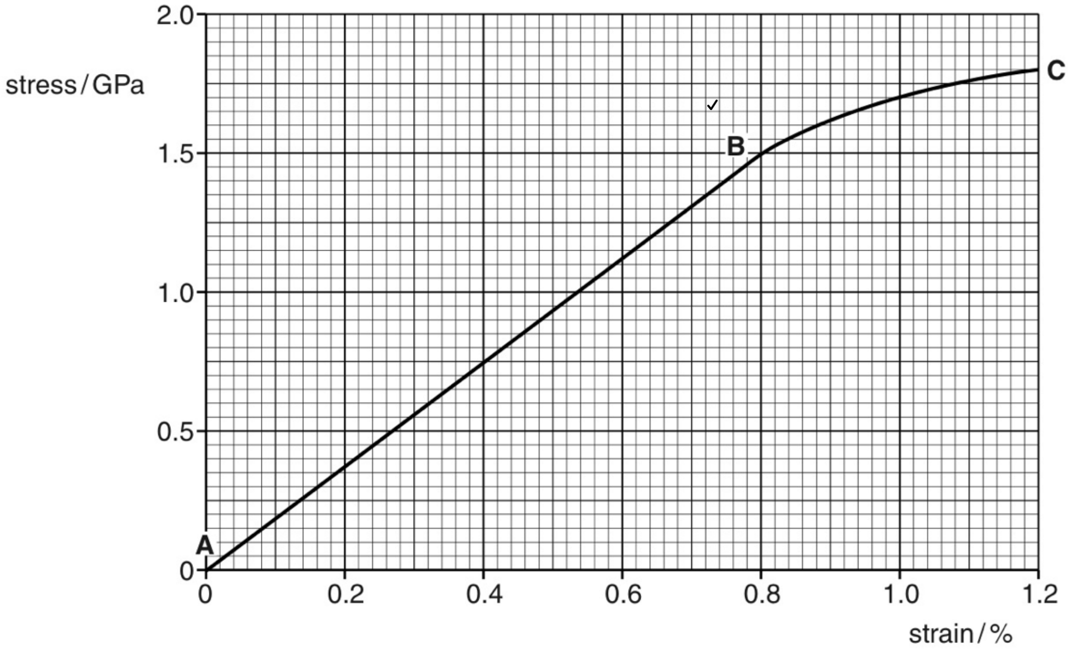


Fig. 8.1

(i) Use Fig. 8.1 to determine the Young modulus of the material.

Young modulus = ... Pa **[3]**

(ii) Use Fig. 8.1 to describe the behaviour of the material

1 in section **AB**

....

.... **[1]**

2 in section **BC**.

....

.... **[1]**

(iii) State and explain the effect on the linear section **AB** of the graph when a sample of the same wire, but of twice the original length is used.

....

....

.... **[2]**

(b) Fig. 8.2 shows a force against extension graph for an elastic material. The work done on this material during loading (upward arrow) is equal to the energy returned by the material when the load is removed (downward arrow).

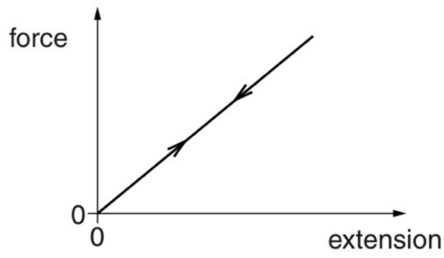


Fig. 8.2

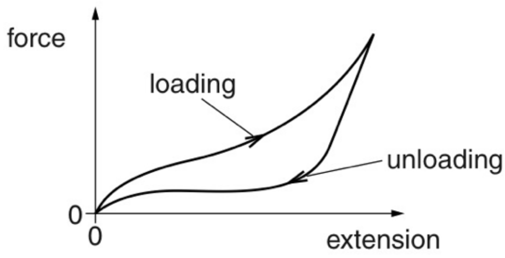


Fig. 8.3

Fig. 8.3 shows the force against extension graph for a material used to make aeroplane tyres. Aeroplane tyres experience sudden impact forces during landing.

Identify the type of material from Fig. 8.3. Describe the properties of this material and suggest why this material is suitable for aeroplane tyres.

In your answer, you should use appropriate technical terms, spelled correctly.

....

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.... **[3]**

[Total: 10]

END OF QUESTION PAPER

8 **(a)** Fig. 8.1 shows a graph of stress against strain for rubber.

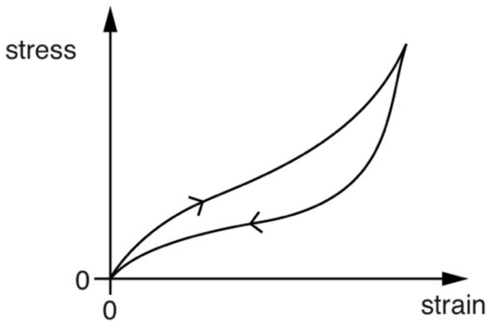

Fig. 8.1

Use Fig. 8.1 to describe the main physical properties of this material.

In your answer, you should use appropriate technical terms, spelled correctly.

....

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.... **[3]**

(b) Fig. 8.2 shows a metal strip pulled from its ends until it breaks.

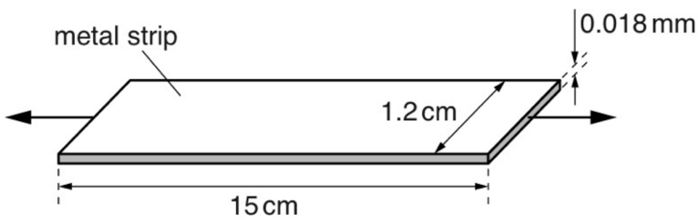

Fig. 8.2

The strip is 15 cm long, 1.2 cm wide and 0.018 mm thick. The breaking force for this strip is 16 N. The Young modulus of the metal is 7.1×10^{10} Pa.

(i) Calculate the extension of the metal strip when it breaks. State one assumption made in your calculation.

extension = ... m **[3]**

assumption: ....

.... **[1]**

(ii) Calculate the breaking force of a rod of radius 0.60 cm made from the same metal.

breaking force = ... N **[2]**

END OF QUESTION PAPER