Stress, Strain and the Young modulus

Question Paper

Level	A Level
Subject	Physics
Exam Board	Edexcel
Topic	Materials
Sub Topic	Stress, Strain and the Young modulus
Booklet	Question Paper
Paper Type	Multiple Choice

Time Allowed: **34 minutes**

Score: **/28**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Select the row of the table which correctly describes the properties of glass.

	Brittle	Tough	Malleable
☒ **A**	No	No	No
☒ **B**	Yes	No	No
☒ **C**	Yes	No	Yes
☒ **D**	Yes	Yes	No

(Total for Question = 1 mark)

2 Concrete pillars may be used to support heavy roofs.

Concrete is used because it has a

☒ **A** high compressive strength.

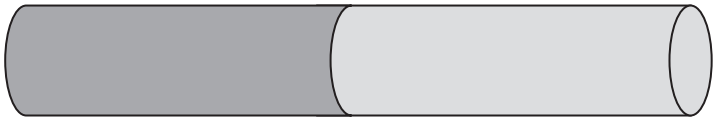
☒ **B** high tensile strength.

☒ **c** low stiffness.

☒ **D** low Young modulus.

(t otal for Question = 1 mark)

3 A steel wire and a brass wire, with identical cross sectional areas and lengths, are fused together. The Young modulus for steel is approximately twice that of brass.



steel brass

The combined wire is stretched.

The ratio $\frac{\text{extension of steel wire}}{\text{extension of brass wire}}$ is approximately

☒ **A** 2.0

☒ **B** 1.0

☒ **c** 0.50

☒ **D** 0.25

(t otal for Question = 1 mark)

4 In the manufacture of cars, mild steel sheets are formed into panels of an appropriate shape.

Mild steel can be shaped in this way because it is

☒ **A** brittle.

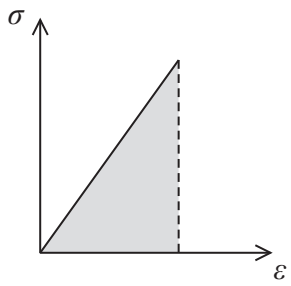
☒ **B** hard.

☒ **C** malleable.

☒ **D** strong.

(Total for Question = 1 mark)

5 A force was applied across the ends of an iron bar. The following stress-strain graph was obtained.



The shaded area represents

☒ **A** $\frac{\text{work done}}{2 \times \text{volume}}$

☒ **B** $\frac{\text{work done}}{\text{volume}}$

☒ **C** $\frac{2 \times \text{work done}}{\text{volume}}$

☒ **D** work done

(Total for Question = 1 mark)

6 A spring with a spring constant 140 N m^{-1} is extended. The elastic potential energy stored is 1.6 J.

The extension of the wire is found using

☒ **A** $\frac{1.6}{140}$

☒ **B** $\frac{2 \times 1.6}{140}$

☒ **C** $\sqrt{\frac{1.6}{140}}$

☒ **D** $\sqrt{\frac{2 \times 1.6}{140}}$

(Total for Question = 1 mark)

7 Which of the following is a derived SI quantity?

☒ **A** force

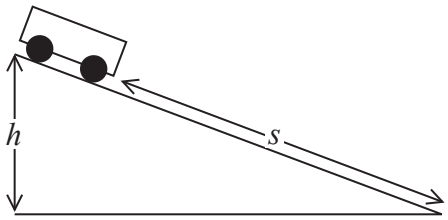
☒ **B** length

☒ **c** second

☒ **D** watt

(t otal for Question = 1 mark)

8 A trolley rolls down a slope from rest. The trolley moves through a vertical height h while rolling a distance s along the slope.



The maximum possible speed is given by

☒ **A** $2gs$

☒ **B** $2gh$

☒ **c** $\sqrt{(2gs)}$

☒ **D** $\sqrt{(2gh)}$

(t otal for Question = 1 mark)

9 A wire of length x is stretched by a force F. The extension is Δx.

A second wire of the same material and cross-sectional area is stretched by the same force. If it has twice the length of the first wire its extension will be

☒ **A** 1/2 Ÿx

☒ **B** Ÿx

☒ **C** $2\Delta x$

☒ **D** ŒDŸ

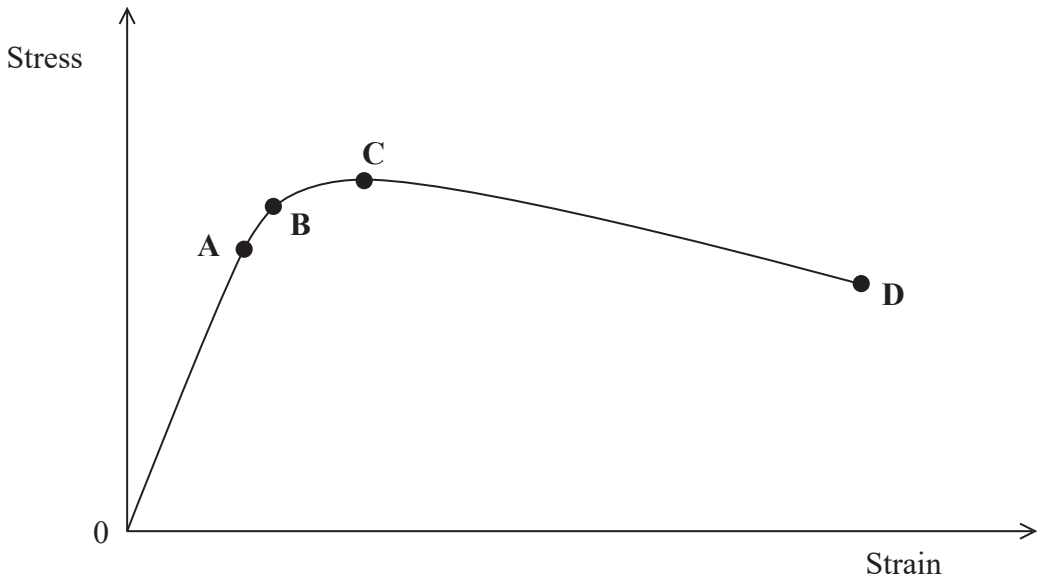
(Total for Question = 1 mark)

10 A material which can be drawn into a wire is described as being

- ☒ **A** brittle.
- ☒ **B** ductile.
- ☒ **C** hard.
- ☒ **D** soft.

(Total for Question = 1 mark)

11 The graph shows the stress-strain graph for a wire.



Which point would give the value for maximum tensile stress?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question = 1 mark)

12 All ductile materials are also

☒ **A** brittle

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question = 1 mark)

13 A material is described as 'not easy to scratch or indent'.

The material is best described as

☒ **A** hard

☒ **B** plastic

☒ **C** stiff

☒ **D** tough

(Total for Question = 1 mark)

14 Select the row of the table that correctly matches the property of a material to the type of deformation it can experience.

	Property	Elastic deformation	Plastic deformation
☒ **A**	brittle	no	yes
☒ **B**	brittle	yes	little or no
☒ **C**	malleable	no	yes
☒ **D**	malleable	yes	little or no

(Total for Question = 1 mark)

15 A material that is able to undergo plastic deformation under compression is said to be

☒ **A** brittle.

☒ **B** ductile.

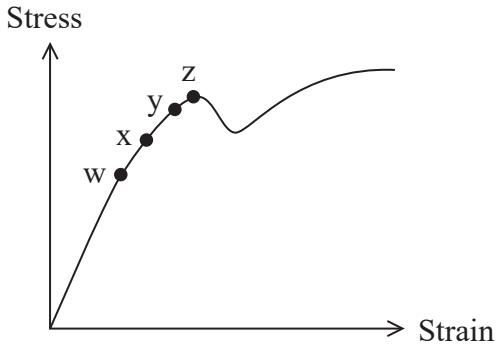
☒ **C** hard.

☒ **D** malleable.

(Total for Question = 1 mark)

16 A thin wire of uniform cross-sectional area is stretched by an increasing force.

The corresponding stress-strain graph is shown.



Points w, x, y and z are shown on the graph.

Select the row of the table that correctly identifies the yield point, the limit of proportionality and the elastic limit.

	Yield point	Limit of proportionality	Elastic limit
☒ **A**	y	w	x
☒ **B**	z	w	y
☒ **C**	y	x	w
☒ **D**	z	x	y

(Total for Question = 1 mark

17 A force of 15 N is applied to a wire of cross-sectional area 3.0×10^{-6} m^2. The wire extends by 1% of the original length.

The Young modulus of the wire, in N m^{-2}, can be found from

☒ **A** $\dfrac{15}{1 \times 3.0 \times 10^{-6}}$

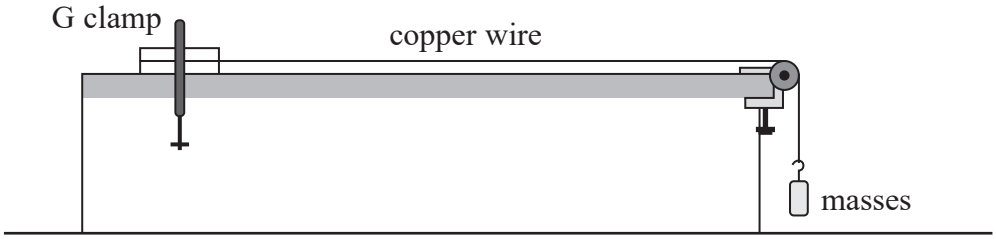
☒ **B** $\dfrac{15}{(0.01)(3.0 \times 10^{-6})}$

☒ **C** $\dfrac{(1)(3.0 \times 10^{-6})}{15}$

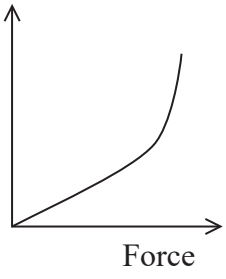
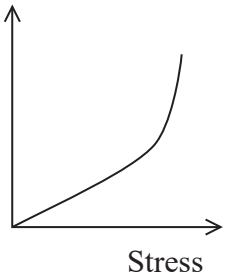
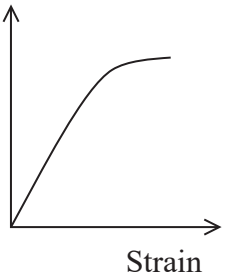
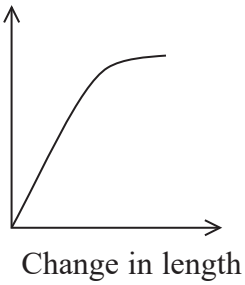
☒ **D** $\dfrac{(15)(0.01)}{(3.0 \times 10^{-6})}$

(Total for Question = 1 mark)

18 Some masses are added to a piece of copper wire as shown. Measurements are taken of the length of the wire as the force on the wire is increased.



The work done in stretching the wire is given by the area under which graph?

☒ A	☒ B	☒ C	☒ D
Change in length  Force	Strain  Stress	Stress  Strain	Force  Change in length

(Total for Question = 1 mark)

19 A wire of cross-sectional area A and length x is stretched by a force F. The Young modulus of the material of the wire is E.

The extension Δx is given by

☒ **A** AE/Fx

☒ **B** Ex/FA

☒ **C** FA/Ex

☒ **D** Fx/AE

(Total for Question = 1 mark)

20 A physics book gives this definition:

A material which shows a large plastic deformation under compression.

This is the definition for

☒ **A** ductile

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question = 1 mark)

21 A substance which can undergo a large plastic deformation without cracking can be described as

☒ **A** brittle

☒ **B** hard

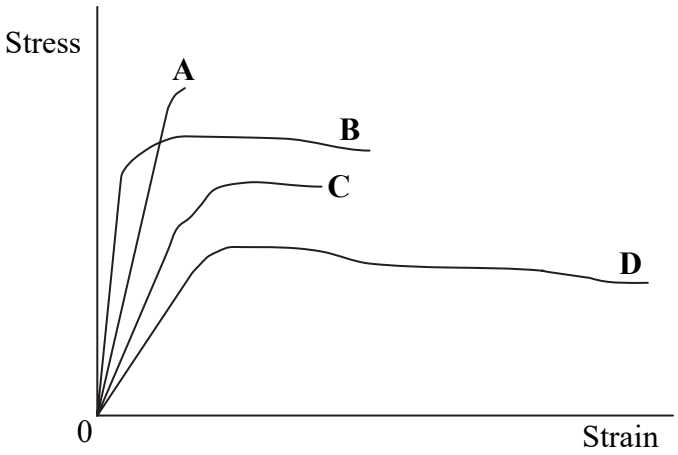
☒ **C** malleable

☒ **D** stiff

(Total for Question = 1 mark)

Use the graph below for questions 22 and 23.

The graph shows stress–strain curves for samples of four different materials.



22 Which material has the greatest strength?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

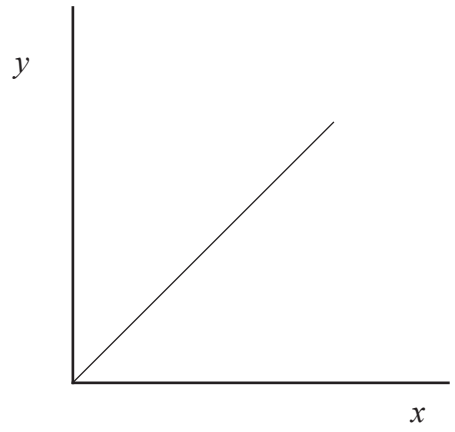
(Total for Question = 1 mark)

23 Which material has the greatest value for the Young modulus?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question = 1 mark)

24 The diagram shows a graph plotted using the results from an experiment in which a metal wire was stretched.



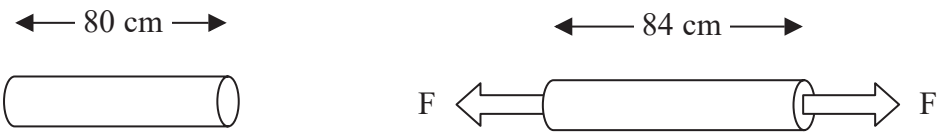
The gradient of the graph equals the Young modulus of the metal.

Which row gives the correct labels for the axis?

		y	*x*
☒	**A**	extension	force
☒	**B**	force	extension
☒	**C**	strain	stress
☒	**D**	stress	strain

(Total for Question = 1 mark)

25 A wire of length 80 cm has a force F applied. The new length of the wire is 84 cm.



The strain is given by

☒ **A** $\frac{4}{84}$

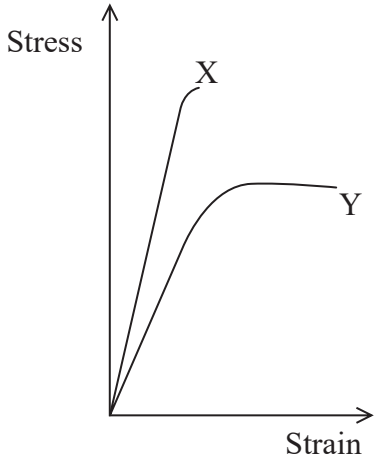
☒ **B** $\frac{4}{80}$

☒ **C** $\frac{80}{84}$

☒ **D** $\frac{84}{80}$

(Total for Question = 1 mark)

26 The graph shows stress against strain up to the breaking point for two materials X and Y.



Which row in the table correctly identifies the behaviour of each material?

	X	Y
☒ **A**	brittle	ductile
☒ **B**	ductile	brittle
☒ **C**	ductile	hard
☒ **D**	brittle	hard

(Total for Question = 1 mark)

27 Which of the following descriptions of a material implies that it undergoes significant plastic deformation?

☒ **A** brittle

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question = 1 mark)

28 New buildings in earthquake zones are often designed to be earthquake resistant. Such buildings incorporate mechanisms to reduce the transfer of kinetic energy from the ground to the building.

Which of the following would be the most important property of a material used in such a mechanism?

☒ **A** density

☒ **B** ductility

☒ **C** stiffness

☒ **D** strength

(Total for Question 4 = 1 mark)