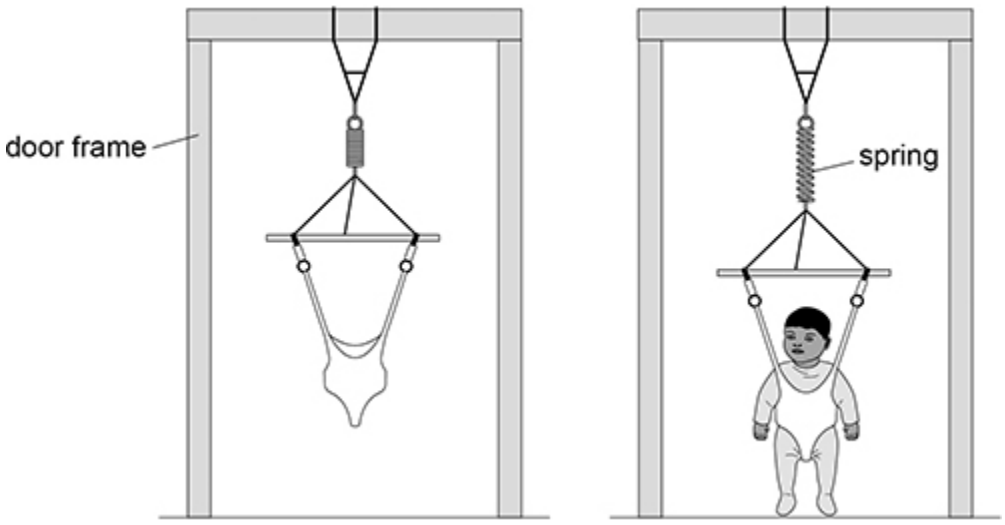
A-Level Physics

Materials
(Multiple Choice)

Question Paper

Time available: 20 minutes
Marks available: 20 marks

1. A baby bouncer consists of an inextensible harness attached to a spring.



The stiffness of the spring is in the range:

A 1–10 N m^{-1} ⬭

B 10–100 N m^{-1} ⬭

C 100–1000 N m^{-1} ⬭

D 1000–10 000 N m^{-1} ⬭

(Total 1 mark)

2. A wire is made from a material of Young modulus E.
The wire obeys Hooke's law.
The wire has an unstretched length L and a cross-sectional area A.
When a force is applied to the wire, the extension of the wire is e.

What is the elastic strain energy stored in the wire?

A $\frac{AEe^2}{2L}$ ⬭

B $\frac{L}{2Ae}$ ⬭

C $\frac{Ae^2}{2EL}$ ⬭

D $\frac{AEL}{2e}$ ⬭

(Total 1 mark)

3. Which two quantities have the base unit $\mathrm{kg\ m^2\ s^{-2}}$?

A kinetic energy and momentum ⬭

B kinetic energy and Young modulus ⬭

C work done and the moment of a couple ⬭

D work done and pressure ⬭

(Total 1 mark)

4. A mass M is suspended from a spring. When the mass is at rest at the equilibrium position, the elastic potential energy stored is E.
An extra mass of $2M$ is added to the spring and the spring extends while still obeying Hooke's law.

What is the total elastic energy stored when the system is at rest at the new equilibrium position?

A $2E$ ⬭

B $3E$ ⬭

C $4E$ ⬭

D $9E$ ⬭

(Total 1 mark)

5. Two wires P and Q are made of the same material and have the same cross-sectional area.
P has an original length L and is subject to a tensile force F. P extends a distance x.
Q has an original length $2L$ and is subject to a tensile force $2F$.

Which statement is correct?

A The stress in P and the stress in Q are the same. ⬭

B The extension of Q is $2x$. ⬭

C The strain of Q is double the strain of P. ⬭

D The value of $\frac{\text{stress}}{\text{strain}}$ for P is half that of Q. ⬭

(Total 1 mark)

6. A mass m is added to a vertical spring that is initially unextended, as shown in **Diagram 1**.

The mass is then lowered until it hangs stationary on the spring, as shown in **Diagram 2**.

The extension of the spring is now ΔL.

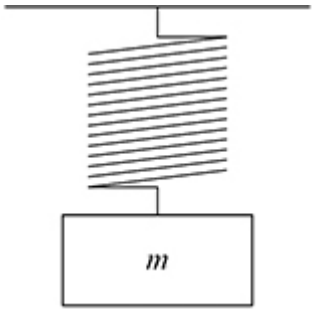


Diagram 1

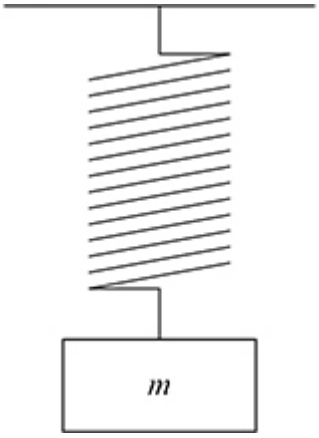


Diagram 2

How much energy is transferred from the mass–spring system?

A $\frac{mg\Delta L}{2}$ ⬭

B $mg\Delta L$ ⬭

C $\frac{3mg\Delta L}{2}$ ⬭

D $2mg\Delta L$ ⬭

(Total 1 mark)

7. A wire is made from a material of density ρ.
The wire has a mass m and an initial length L.
When the tensile force in the wire is F the extension of the wire is ΔL.

What is the Young modulus of the material?

A $\frac{F\rho L^2}{m\Delta L}$ ⬭

B $\frac{FL^2}{m\rho\Delta L}$ ⬭

C $\frac{F\rho}{m\Delta L}$ ⬭

D $\frac{FmL^2}{\rho\Delta L}$ ⬭

(Total 1 mark)

8. Two wires **X** and **Y** have the same extension for the same load.
X has a diameter d and is made of a metal of density ρ and Young modulus E.
Y has the same mass and length as **X** but its diameter is $2d$.

What are the density and the Young modulus of the metal from which **Y** is made?

	Density	Young modulus	
A	$\frac{\rho}{2}$	$\frac{E}{4}$	⬭
B	$\frac{\rho}{2}$	$4E$	⬭
C	$\frac{\rho}{4}$	$\frac{E}{4}$	⬭
D	$\frac{\rho}{4}$	$4E$	⬭

(Total 1 mark)

9. A tensile force F_1 causes a wire to stretch to length x_1.

When the tensile force is increased to F_2 the length of the wire is x_2.

The wire obeys Hooke's Law.

What is the additional energy stored in the wire as the length increases from x_1 to x_2 ?

A $\frac{F_1 + F_2}{2} \times \frac{x_2 - x_1}{2}$ ⬭

B $\frac{F_1 + F_2}{2} \times \frac{x_2 + x_1}{2}$ ⬭

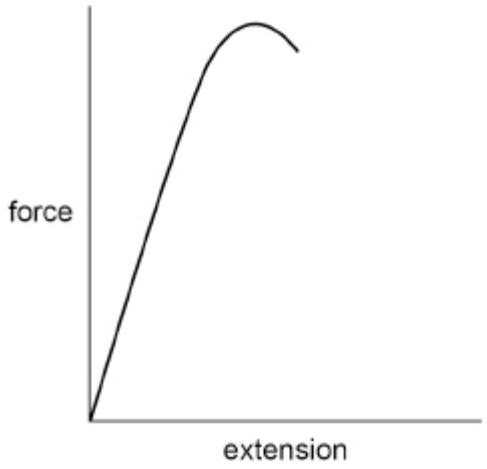
C $\frac{F_1 + F_2}{2} \times (x_2 - x_1)$ ⬭

D $\frac{F_1 + F_2}{2} \times (x_2 + x_1)$ ⬭

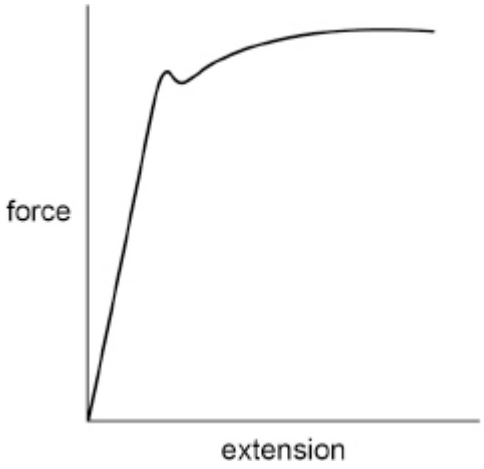
(Total 1 mark)

10. Which is a force–extension graph for a brittle material?

A



B



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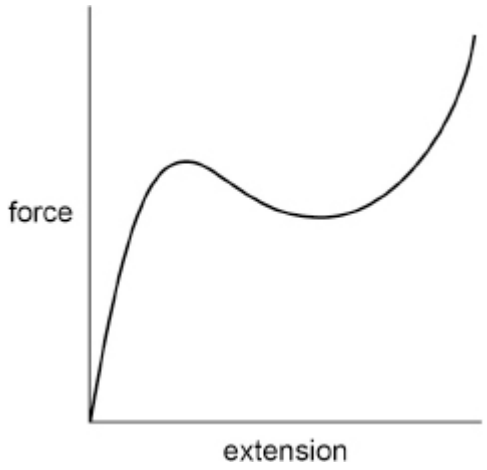
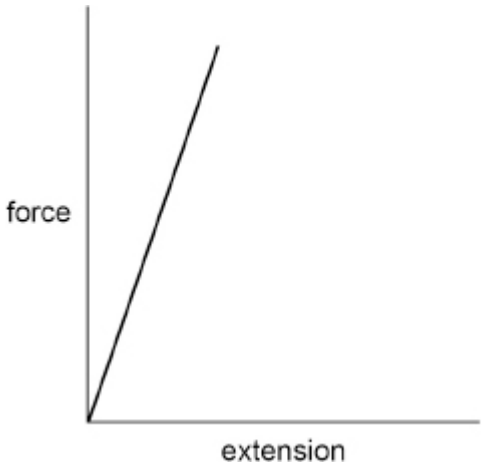


D



A ⬭

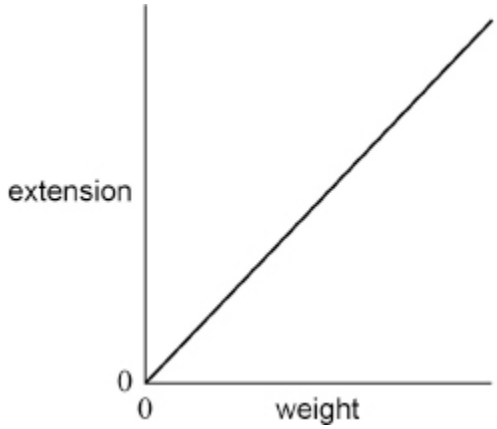
B ⬭

C ⬭

D ⬭

(Total 1 mark)

11. An experiment is carried out to determine the Young modulus E of steel using a vertical wire of initial length L and cross-sectional area A. Various weights are suspended from the wire. A graph of extension against weight is plotted.



What does the gradient of the graph represent?

A E ⬭

B $\frac{1}{E}$ ⬭

C $\frac{EA}{L}$ ⬭

D $\frac{L}{EA}$ ⬭

(Total 1 mark)

12. A tensile force produces an extension ΔL in a steel wire of initial length L and diameter d.

The same steel is used to make a second wire of initial length $2L$ and diameter $\frac{d}{2}$

What is the extension when the same force is applied to the second wire?

A $\frac{\Delta L}{2}$ ⬭

B 2ΔL ⬭

C 4ΔL ⬭

D 8ΔL ⬭

(Total 1 mark)

13. A load of 50 N is suspended from a wire that has an area of cross-section of 1 mm^2.

The stress in the wire, in Pa, is between

A 10^0 and 10^3 ⬭

B 10^3 and 10^6 ⬭

C 10^6 and 10^9 ⬭

D 10^9 and 10^{12} ⬭

(Total 1 mark)

14. Which combination of properties would produce the smallest extension of a wire when the same tensile force is applied to the wire?

	Cross-sectional area	Length	Young modulus of material	
A	X	$3L$	E	⬭
B	$2X$	L	E	⬭
C	X	$3L$	$4E$	⬭
D	$2X$	L	$4E$	⬭

(Total 1 mark)

15. The table contains information on four wires. It shows the stiffness of each wire and the maximum strain energy stored in the wire when extended to the breaking point.

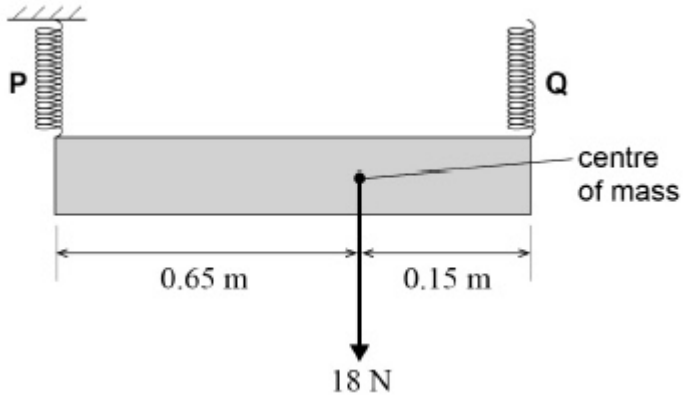
Assume each wire has the same initial dimensions and obeys Hooke's law.

Which wire extends the least before reaching the breaking point?

	Stiffness / N m^{-1}	Maximum strain energy / J	
A	4.0	1	⬭
B	9.0	1	⬭
C	16	3	⬭
D	25	3	⬭

(Total 1 mark)

16. A non-uniform sign is 0.80 m long and has a weight of 18 N
It is suspended from two vertical springs **P** and **Q**. The springs obey Hooke's law and the spring constant of each spring is 240 N m^{-1}



The top end of spring **P** is fixed and the top end of spring **Q** is adjusted until the sign is horizontal and in equilibrium.

What is the extension of spring **Q**?

A 0.014 m ⬭

B 0.038 m ⬭

C 0.049 m ⬭

D 0.061 m ⬭

(Total 1 mark)

17. A steel wire **W** has a length l and a circular cross-section of radius r. When **W** hangs vertically and a load is attached to the bottom end, it extends by e.
Another wire **X** made from the same material has the same load attached to it.

Which length and radius for **X** will produce an extension of $\frac{e}{4}$?

	Length of X	Radius of X	
A	$0.5l$	$2r$	⬭
B	l	$4r$	⬭
C	$2l$	$2r$	⬭
D	$4l$	$4r$	⬭

(Total 1 mark)

18. What is the name given to a material that breaks without deformation when a force is applied to it?

A Plastic ⬭

B Brittle ⬭

C Stiff ⬭

D Elastic ⬭

(Total 1 mark)

19. What **cannot** be used as a unit for the Young modulus?

A $N\ m^{-2}$ ⬭

B Pa ⬭

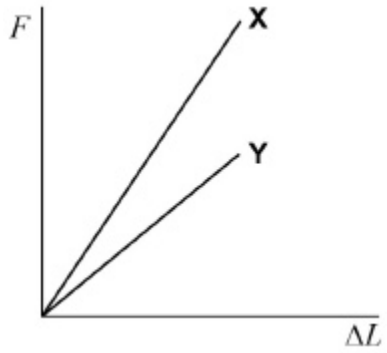
C $kg\ m^{-2}\ s^{-2}$ ⬭

D $kg\ m^{-1}\ s^{-2}$ ⬭

(Total 1 mark)

20. Two separate wires **X** and **Y** have the same original length and cross-sectional area.

The graph shows the extension ΔL produced in **X** and **Y** when the tensile force F applied to the wires is increased up to the point where they break.



Which statement is **incorrect**?

A For a given extension more energy is stored in **X** than in **Y**. ⬭

B The Young modulus of the material of wire **Y** is greater than that of wire **X**. ⬭

C Both wire **X** and wire **Y** obey Hooke's law. ⬭

D Wire **X** has a greater breaking stress than wire **Y**. ⬭

(Total 1 mark)