Deformation of Solids

Question paper 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Deformation of Solids
Sub Topic	
Paper Type	Theory
Booklet	Question paper 3

Time Allowed: **64 minutes**

Score: **/53**

Percentage: **/100**

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

1 **(a)** Define

(i) *stress*,

.....

.....[1]

(ii) *strain*.

.....

.....[1]

(b) Explain the term *elastic limit*.

.....

.....[1]

(c) Explain the term *ultimate tensile stress*.

.....

.....

.....[2]

(d) **(i)** A **ductile** material in the form of a wire is stretched up to its breaking point. On Fig. 3.1, sketch the variation with extension *x* of the stretching force *F*.

Fig. 3.1

[2]

(ii) On Fig. 3.2, sketch the variation with x of F for a **brittle** material up to its breaking point.

Fig. 3.2

[1]

(e) **(i)** Explain the features of the graphs in **(d)** that show the characteristics of ductile and brittle materials.

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.....

.....[2]

(ii) The force F is removed from the materials in **(d)** just before the breaking point is reached. Describe the subsequent change in the extension for

1. the ductile material,

.....

.....[1]

2. the brittle material.

.....

.....[1]

2 **(a)** Define the terms

(i) *power*,

.....[1]

(ii) the *Young modulus*.

.....

.....

.....[1]

(b) A crane is used to lift heavy objects, as shown in Fig. 3.1.

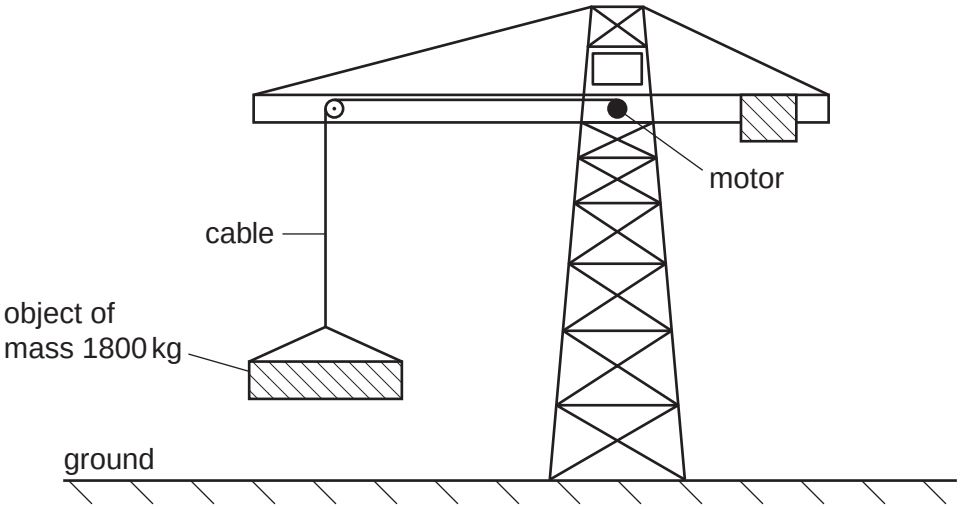

Fig. 3.1

The motor in the crane lifts a total mass of 1800 kg from rest on the ground. The cable supporting the mass is made of steel of Young modulus 2.4×10^{11} Pa. The cross-sectional area of the cable is 1.3×10^{-4} m^2. As the mass leaves the ground, the strain in the cable is 0.0010. Assume the weight of the cable to be negligible.

(i) **1.** Use the Young Modulus of the steel to show that the tension in the cable is 3.1×10^4 N.

[2]

2. Calculate the acceleration of the mass as it is lifted from the ground.

acceleration = ... m s^{-2} [3]

(ii) The motor now lifts the mass through a height of 15 m at a constant speed.

Calculate

1. the tension in the lifting cable,

tension = ... N [1]

2. the gain in potential energy of the mass.

gain in potential energy = ... J [2]

(iii) The motor of the crane is 30% efficient. Calculate the input power to the motor required to lift the mass at a constant speed of 0.55 m s^{-1}.

input power = ... W [3]

3 **(a)** Define, for a wire,

(i) *stress*,

.....

..... [1]

(ii) *strain*.

.....

..... [1]

(b) A wire of length 1.70 m hangs vertically from a fixed point, as shown in Fig. 4.1.

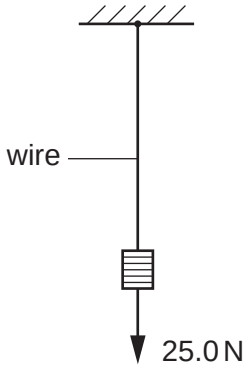

Fig. 4.1

The wire has cross-sectional area $5.74 \times 10^{-8}\,m^2$ and is made of a material that has a Young modulus of 1.60×10^{11} Pa. A load of 25.0 N is hung from the wire.

(i) Calculate the extension of the wire.

extension = ... m [3]

(ii) The same load is hung from a second wire of the same material. This wire is twice the length but the **same volume** as the first wire. State and explain how the extension of the second wire compares with that of the first wire.

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..... [3]

4 A student measures the Young modulus of a metal in the form of a wire.

(a) Describe, with the aid of a diagram, the apparatus that could be used.

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..... [2]

(b) Describe the method used to obtain the required measurements.

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..... [4]

(c) Describe how the measurements taken can be used to determine the Young modulus.

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..... [4]

5 **(a)** State Hooke's Law.

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..... [1]

(b) A spring is compressed by applying a force. The variation with compression x of the force F is shown in Fig. 4.1.

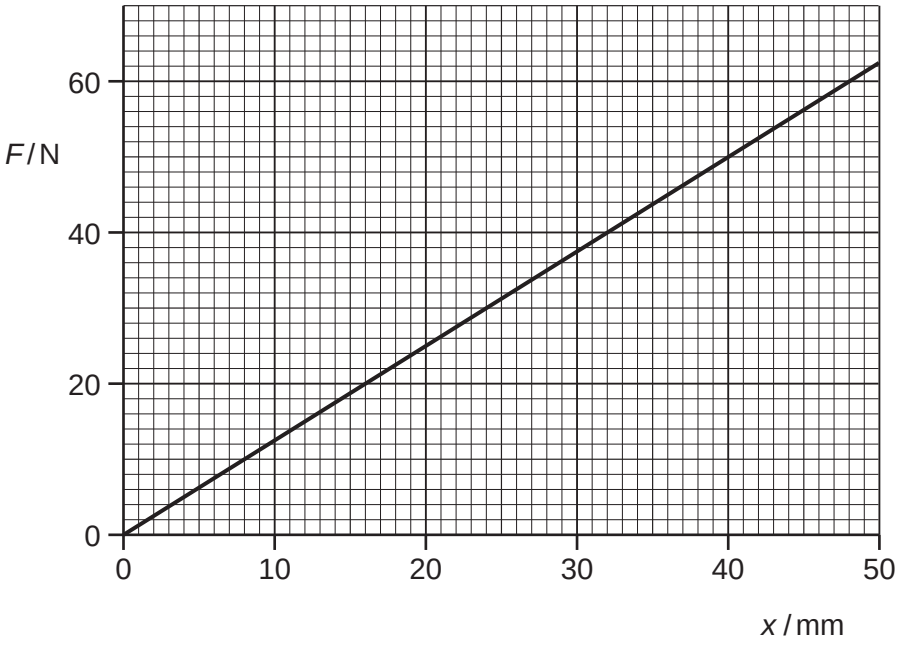

Fig. 4.1

(i) Calculate the spring constant.

spring constant = ... $N\,m^{-1}$ [1]

(ii) Show that the work done in compressing the spring by 36 mm is 0.81 J.

[2]