

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.

.....
.....
.....
.....
..... [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.

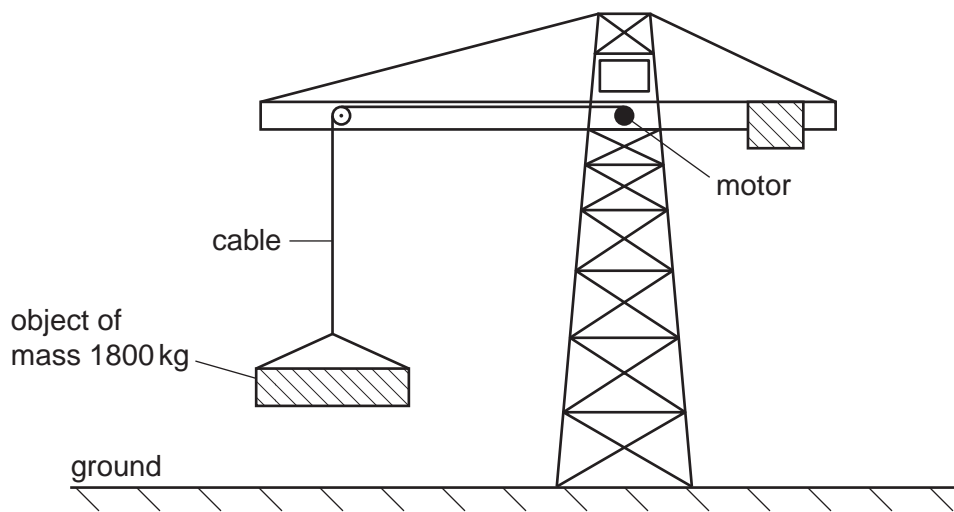


Fig. 3.1

The motor in the crane lifts a total mass of 1800kg 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} m². 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 = ms⁻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 1.70m hangs vertically from a fixed point, as shown in Fig. 4.1.

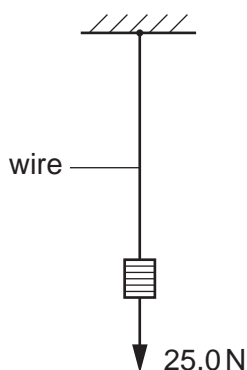


Fig. 4.1

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

.....

 [3]

5 (a) State Hooke's Law.

.....
..... [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.

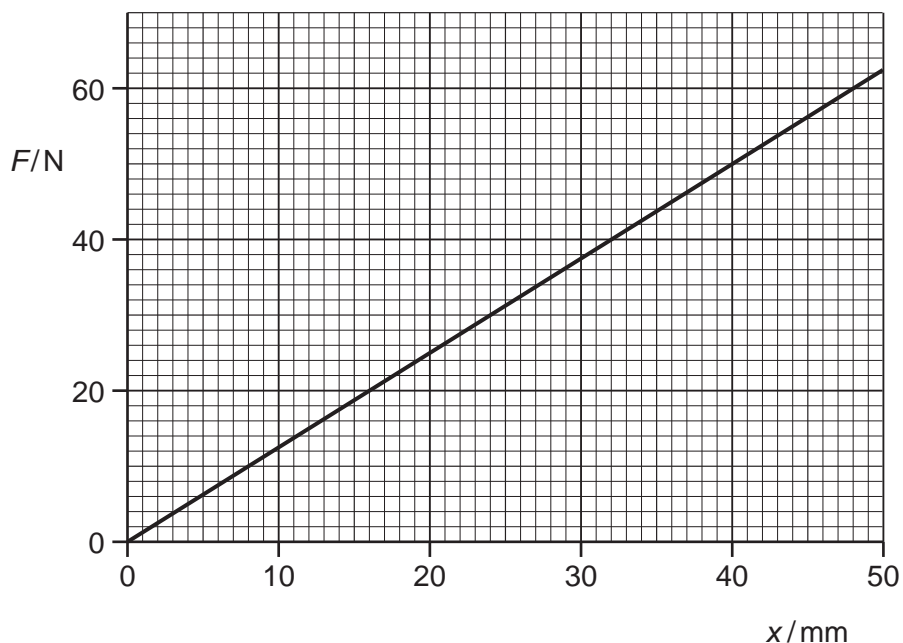


Fig. 4.1

(i) Calculate the spring constant.

spring constant = Nm^{-1} [1]

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

[2]