3 Fig. 3.1 shows a picture suspended from a hook on a wall using a wire of negligible mass.

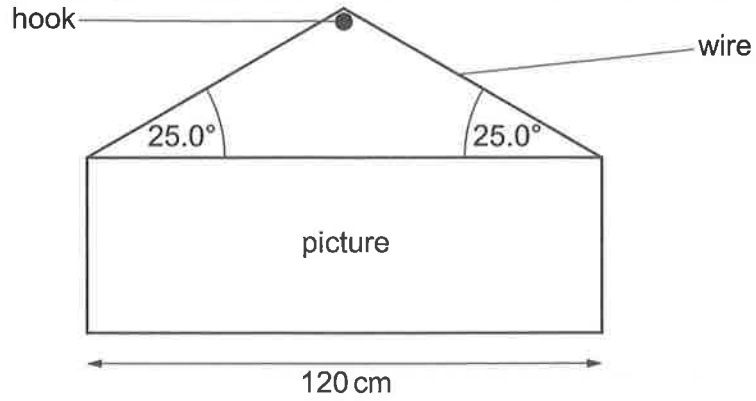

Fig. 3.1

(a) The weight of the picture is 42.0 N.

Explain what is meant by weight.

.....

.....

..... [2]

(b) Explain how Newton's first law of motion applies to this picture.

.....

.....

.....

..... [3]

(c) Show that the tension in the wire is approximately 50 N.

[2]

(d) The picture is suspended using an alternative wire.

The wire is attached to the picture only at the two top corners.

Table 3.1 shows the properties of four different wires.

Wires cannot be joined to make a longer length.

Breaking tension is the tension which causes the wire to break.

Table 3.1

wire	breaking tension / N	length / cm	diameter / mm
A	20.0	110	0.90
B	40.0	145	1.20
C	50.0	130	1.45
D	60.0	125	1.56

(i) Wire A is not suitable for suspending the picture.

Explain which, if any, of the other wires are suitable for suspending the picture.

You will need to carry out some calculations.

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..... [4]

(ii) By considering the breaking tension explain whether the picture could be suspended using a longer length of wire A.

.....

.....

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..... [3]

(e) A quantity called stress can be calculated for all wires using the relationship:

$$\text{stress} = \frac{\text{tension}}{\text{cross-sectional area}}$$

This allows comparisons of wires of different materials as the breaking stress is constant for all wires made of the same material.

Breaking stress is the stress which causes the wire to break.

Table 3.2 shows breaking stress data for the same wires shown in Table 3.1.

Table 3.2

wire	breaking tension / N	length / cm	diameter / mm	breaking stress / 10^7 N m^{-2}
A	20.0	110	0.90	3.14
B	40.0	145	1.20	3.54
C	50.0	130	1.45	3.03
D	60.0	125	1.56	

(i) Calculate the breaking stress in wire D.

breaking stress = ... N m^{-2} [2]

(ii) Explain which two wires are made of the same material.

.....

.....

..... [1]

(f) The uncertainty in the diameter of wire D is ±0.01 mm.

(i) Calculate the percentage uncertainty in the diameter of wire D.

uncertainty in diameter = ...% [1]

(ii) Calculate the uncertainty in the cross-sectional area of wire D.

uncertainty in cross-sectional area = ... m^2 [2]

[Total: 20]