1 A crane supports a load of 950 N with a steel cable. If the breaking stress of steel is 500 MPa, calculate the smallest diameter cable that can be used.

(3)

2 The Olympic flame for the 2012 Games held in London consisted of 204 separate copper petals supported by steel stems.

Each petal was made using a thin copper sheet wrapped around a shaped piece of wood.

(a) Explain why copper was a suitable material from which to make the petals.

(2)

(b) Explain why steel was a suitable material from which to make the stems.

(2)

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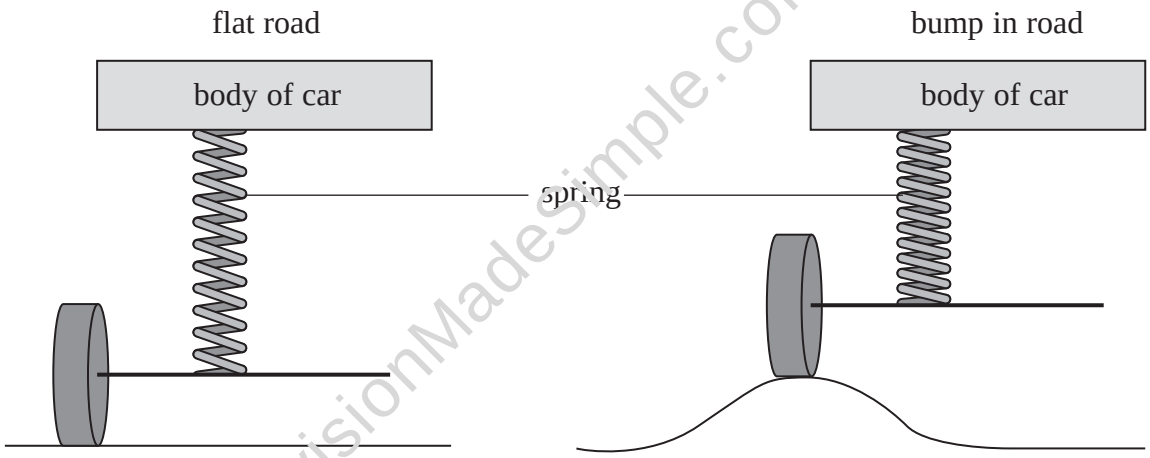
3 Cars have a suspension system which includes springs that are compressed by the weight of the car. This is necessary to keep the body of the car at approximately the same level, when the surface of a road is uneven.

The diagrams show a simplified suspension system for one wheel when on a flat road and when on a bump in the road.



(a) The surface of a racing track is much smoother than the surface of a road. Racing cars are therefore able to use springs with a greater stiffness constant *k*.

(i) Suggest what the effect would be of using springs with a greater value *k* when driving on a bumpy road.

(2)

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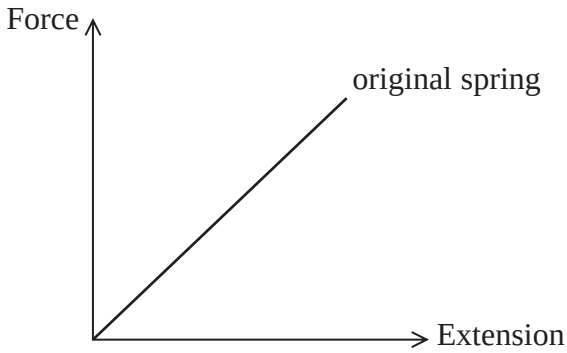
(ii) Add an appropriate line to the force-extension graph for the new spring with a higher value of *k*.

(1)



(b) A spring used in the front suspension of a car has an initial length of 0.316 m and a new length of 0.205 m when under a load of 4.07 kN.

Calculate the spring constant of the spring.

(3)

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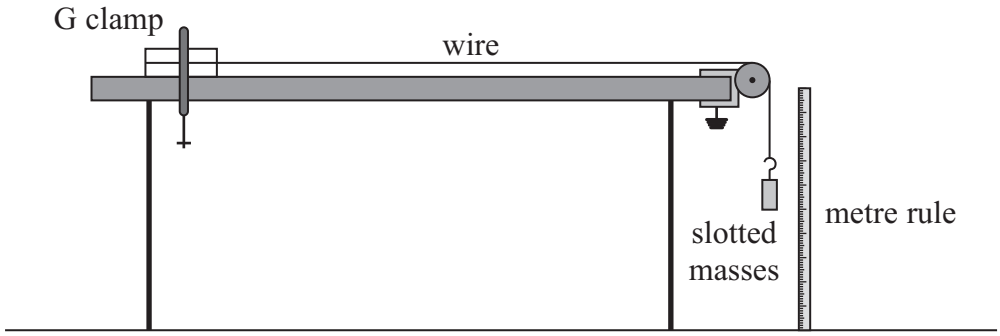
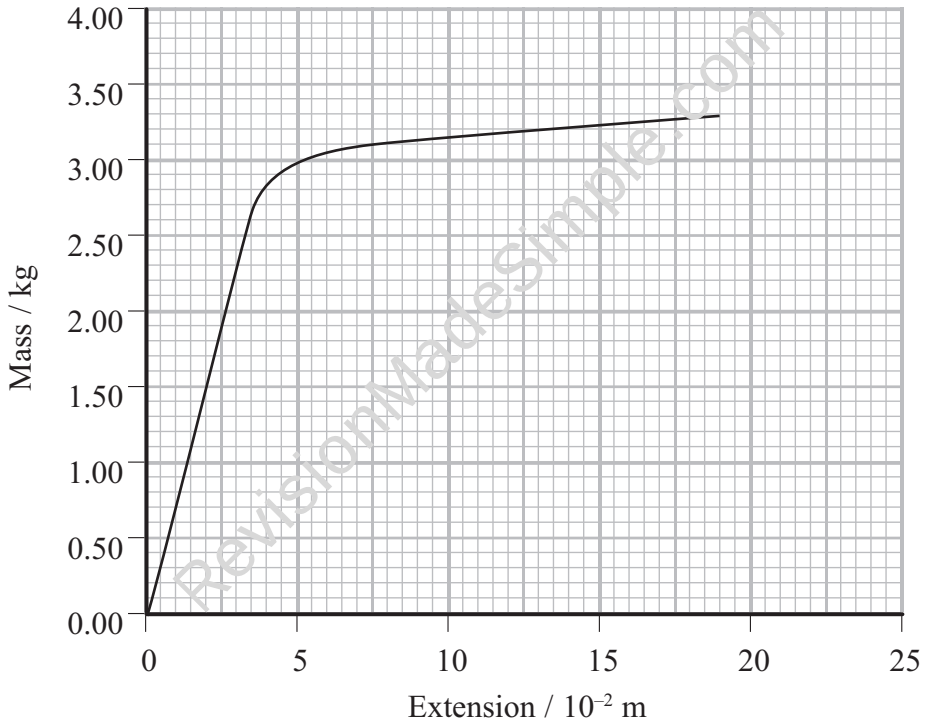
Spring constant = ...

4 The diagram shows the equipment a student used to investigate the behaviour of a material in the form of a wire under an increasing tension.



Masses were added up to a maximum of 3.30 kg. Each time a mass was added the extension of the wire was calculated.

(a) The following mass-extension graph was obtained.



(i) Initially the extension increased linearly.

State what is meant by 'increased linearly' in relation to this graph and what can be concluded about the wire from this observation.

(2)

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(ii) Use the graph to calculate the maximum energy that the wire could store while behaving linearly.

(3)

Maximum energy = ...

(iii) Describe the behaviour of the wire when the added mass was greater than 2.9 kg.

(2)

(b) The student modifies the investigation.

(i) Suggest **one** modification that would produce a greater extension for a given mass.

(1)

(ii) Suggest **two** measuring techniques that could be used to ensure the accuracy of the measured extensions.

(2)