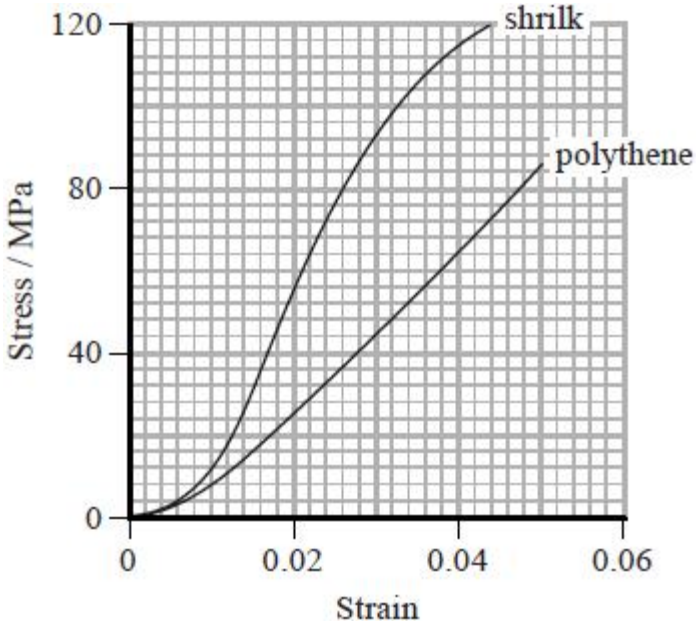
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

Shrilk is a new material made from discarded shrimp shells. It is biodegradable and is easily moulded into different shapes. Shrilk is an alternative to polythene and could be used to make waste bags in the future.

The graph shows a stress-strain curve for a 25.0 cm length of shrilk and for a similar length of polythene, up to breaking point.



(a) (i) Calculate the force applied to the shrilk at a strain of 0.02

cross-sectional area = 1.2×10^{-6} m^2

(3)

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Force = ...

(ii) Determine the extension of the shrilk at a strain of 0.04

(2)

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Extension = ...

(b) Deduce whether shrilk or polythene is better for making waste bags.

(3)

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(Total for question = 8 marks)

Q2.

Weather stations monitor the position of storm clouds.

(i) A raindrop is falling vertically through the air.

The free-body force diagram shows the forces acting on the raindrop.

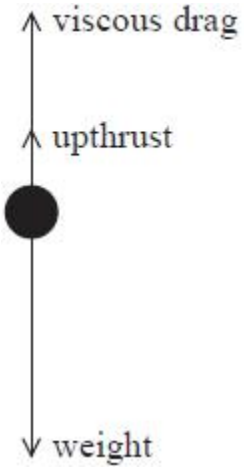


Diagram **NOT** drawn to scale

The raindrop is travelling at terminal velocity. The raindrop is spherical with a radius of 0.10 mm and a weight of 4.1×10^{-8} N .

Calculate the magnitude of the terminal velocity.

viscosity of air = 1.3×10^{-5} Pa s density of air = 1.2 kg m^{-3}

(4)

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Magnitude of terminal velocity = ...

(ii) The value of terminal velocity calculated using the data in (i) is greater than the actual terminal velocity of the raindrop.

Explain why the calculation in (i) may not be valid.

(2)

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(Total for question = 6 marks)

Q3.

In 2010, Andre Geim and Konstantin Novoselov were awarded the Nobel Prize in Physics for producing, identifying and studying graphene.

Graphene is a form of carbon which exists only as a single atomic layer of graphite. It has a breaking stress of 130 GPa compared to 0.5 GPa for steel. Some scientists claim that graphene is the strongest material ever measured.

(a) Explain why graphene, despite its greater strength, is unlikely to replace steel in many applications.

(2)

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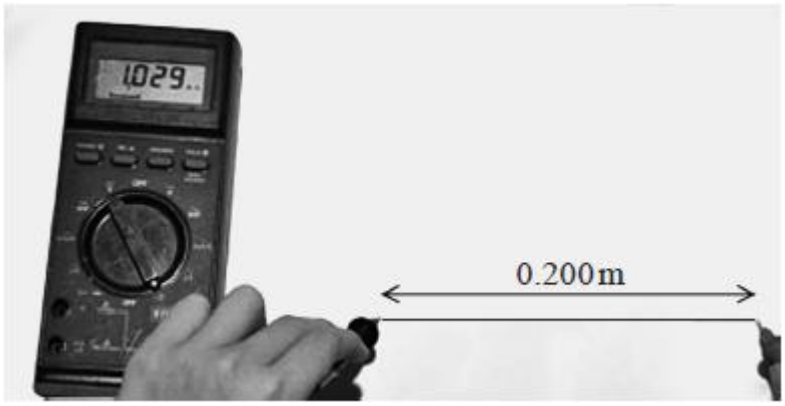
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(b) Graphite used in pencils consists of many layers of carbon. It can be assumed that a pencil deposits approximately 100 layers of carbon atoms when drawn across a piece of paper.

A student carried out an experiment to determine the resistivity of the graphite in a pencil.
A line of length 0.200m and width 0.50mm was drawn on a piece of paper. An ohmmeter was then used to measure the resistance of the graphite line.

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Calculate the resistivity of graphite.
resistance = 1.029×10^{6} Ω
diameter of carbon atom = 1.4×10^{-10} m

(4)

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Resistivity of graphite = ...

(c) Photocells traditionally use silicon to generate electricity using visible light. Research demonstrates that unlike silicon, graphene is able to respond at all wavelengths and releases multiple electrons as it absorbs one photon.

Deduce why it would be an advantage to use graphene in photocells to generate electricity.

(3)

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(Total for question = 9 marks)

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