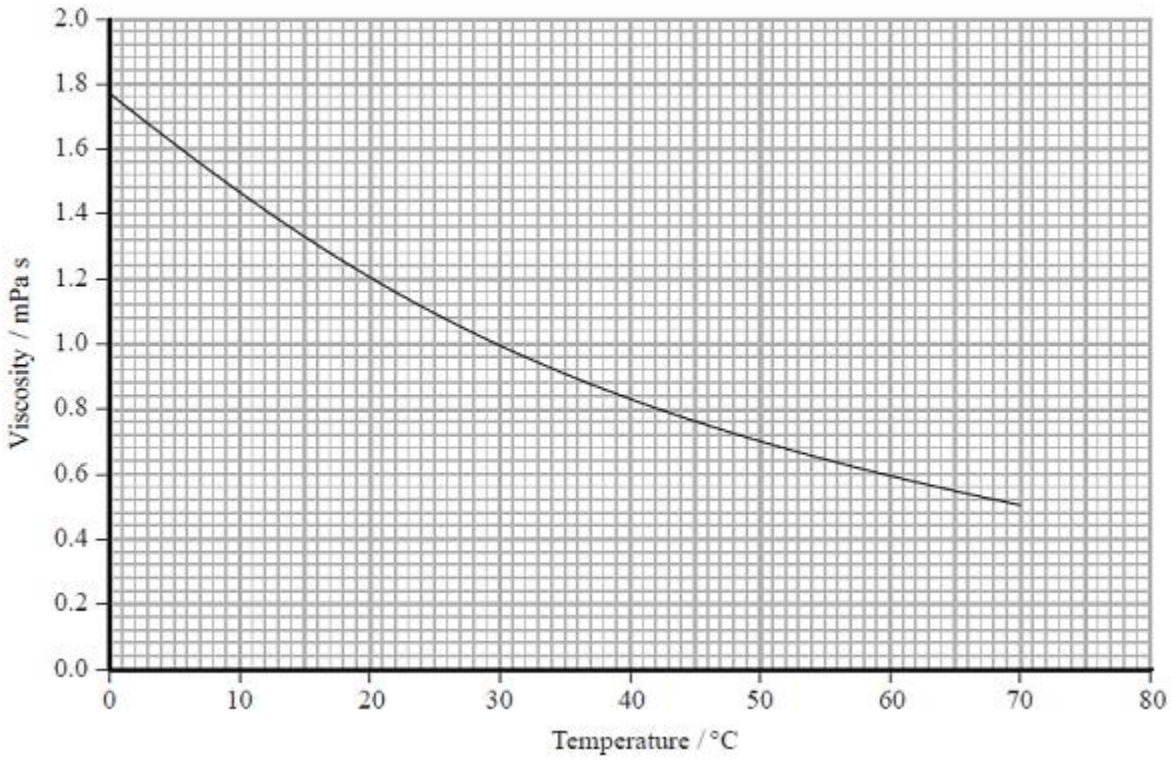
Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

The graph shows how the viscosity of ethanol varies with temperature.



(a) Describe how the viscosity of ethanol varies with temperature.

(2)

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(b) (i) Use Stoke's law to show that the SI unit of viscosity is Pa s.

(2)

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(ii) A small sphere is dropped into a large volume of ethanol at 24 °C.

Show that, if the drag were due to viscous forces alone, the terminal velocity would be about 4 ms^{-1}.

Assume that upthrust is negligible.

radius of sphere = 5.0×10^{-4} m

room temperature = 24 °C

mass of sphere = 4.0×10^{-6} kg

(3)

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*(c) Diesel is used as the fuel in some vehicles. Diesel is not renewable, so alternatives are being researched. Biodiesel is a fuel made from vegetable oil; biodiesel on its own is not suitable for use in vehicles.

The table gives some information about diesel, biodiesel and ethanol.

	Viscosity / mPa s at 0 °C	Viscosity / mPa s at 40 °C	Energy / MJ kg^{-1}	Freezing point / °C
Diesel	4.9	2.6	43	–30
Biodiesel	17.3	4.6	39	–12
Ethanol	1.8	0.9	27	–114

Blends of biodiesel with ethanol are being researched as a renewable alternative to diesel fuels for use in vehicles all year round.

Using the information in the table, suggest why these blends are being researched.

(3)

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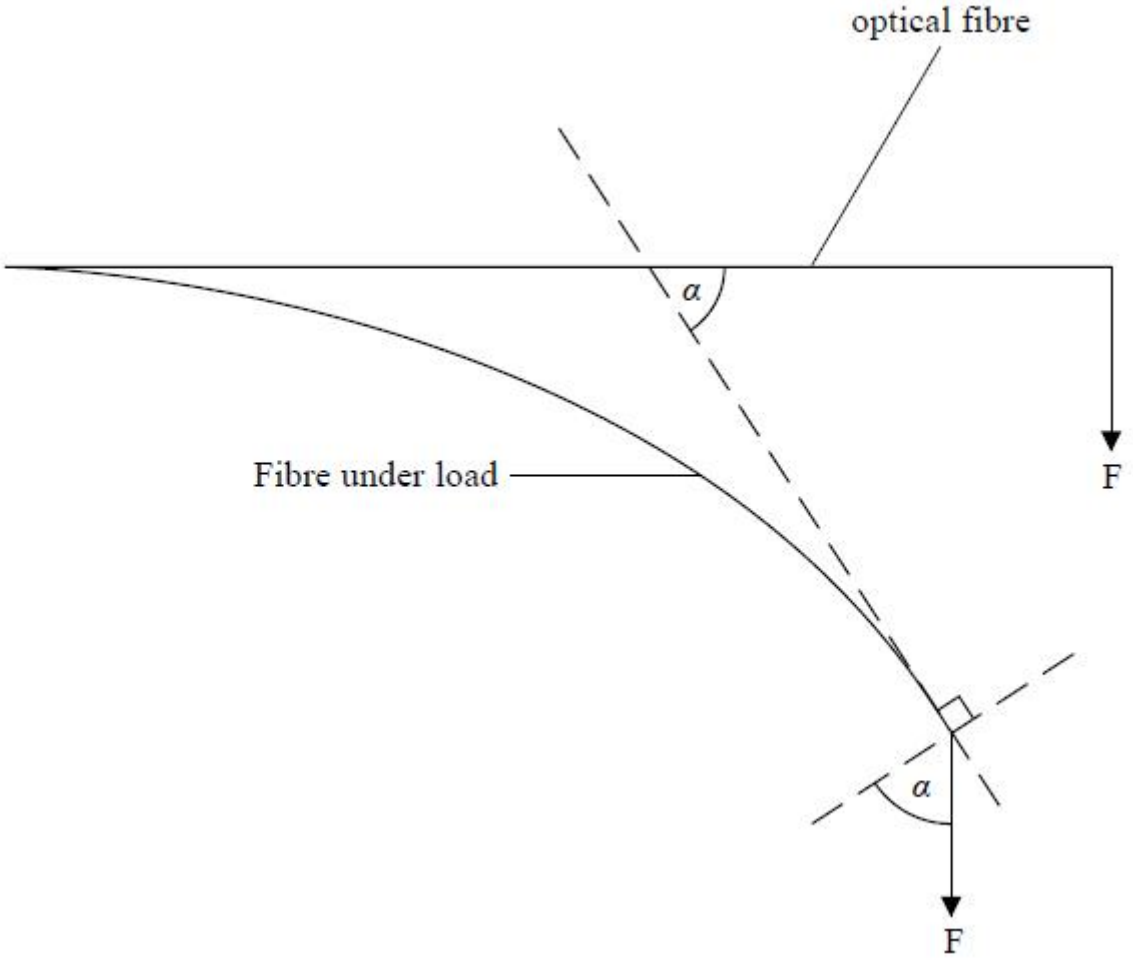
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(Total for Question = 10 marks)

Q2.

The diagram shows an optical fibre. A small force F is applied to the end of the optical fibre causing it to bend through an angle α.



Explain why the stress parallel to the surface of the fibre increases as the fibre bends.

(4)

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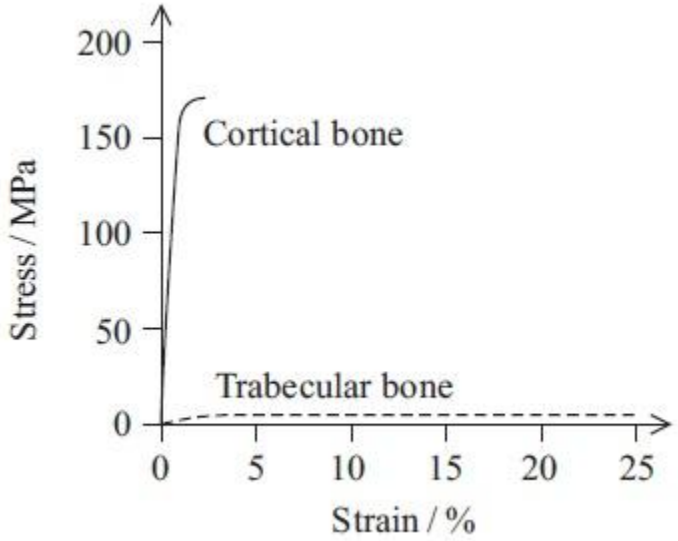
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(Total for question = 4 marks)

Q3.

The graph shows the stress-strain curve for two types of human bone under compression.



(a) Use the graph to identify and describe **one** property of cortical bone.

(2)

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(b) The table gives the following information for the two types of bone.

Material	Young modulus / GPa	Maximum compressive stress / MPa	Maximum tensile stress / MPa
Cortical bone	17.9	170	120
Trabecular bone	0.076	2.2	

(i) State the difference between compressive stress and tensile stress.

(1)

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(ii) State how the graph could be used to confirm the value of the Young modulus for cortical bone.

(1)

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(iii) A person of mass 90 kg stands on one foot. Show that the maximum weight which can be supported is about 70 times this person's weight. Assume all the weight is supported by the femur (thigh bone) and that it is made of cortical bone.

cross-sectional area of femur = 3.7×10^{-4} m^2

(4)

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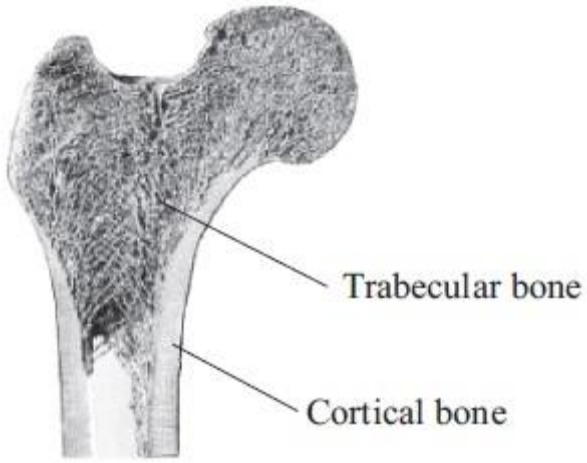
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(iv) It is stated in a text book that a femur can support about 30 times a person's weight.



Explain how the structure shown in the diagram would account for the difference from the calculated value.

(2)

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(Total for question = 10 marks)

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