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

Mark Schemes

Q1.

Question Number	Acceptable Answers	Mark
(a)	As the temperature increases the viscosity decreases **(1)** at a decreasing rate **Or** the rate of decrease is greater at lower temperatures **Or** exponentially **(1)** (do not accept quicker/slower in place of greater/smaller) (a statement that quantities are inversely proportional can score MP1 only)	**2**

Question Number	Acceptable Answers	Mark
(b)(i)	F = N **Or** F = kg m s^{-2} **Or** Pa m^2, r = m and v = ms^{-1} seen **(1)** Pa = N m^{-2} clearly shown **(1)** Example of calculation $\eta = \frac{N}{m \times m\,s^{-1}} = N\,m^{-2}\,s = Pa\,s$	**2**

Question Number	Acceptable Answers	Mark
(b)(ii)	Reading from graph of viscosity: 1.09 to 1.13 ($\times 10^{-3}$)(Pa s) **(1)** Use of $F = mg$ **and** $F = 6\pi r\eta v$ **Or** use of $mg = 6\pi r\eta v$ **(1)** v =3.7 to 3.8 (m s^{-1}) (must be at least 2 sig figs) **(1)** Example of calculation $v = \frac{4.0\times10^{-6}\ \text{kg}\times9.81\ \text{N kg}^{-1}}{6\times\pi\times5.0\times10^{-4}\ \text{m}\times1.11\times10^{-3}\ \text{Pa s}}$ v = 3.75 (m s^{-1})	**3**

Question Number	Acceptable Answers	Mark
***(c)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** **Max 3** Viscosity of biodiesel is high **Or** viscosity of biodiesel higher than diesel **Or** viscosity of biodiesel needs reducing **(1)** Freezing point of biodiesel is high **Or** freezing point of biodiesel is higher than diesel **(1)** Adding ethanol/blending reduces η/freezing point **Or** adding ethanol/blending makes η/freezing point closer to that for diesel **(1)** Ethanol/ alcohol alone has too low an energy content **(1)**	**3**
	Total for question	**10**

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to: • Stress caused by component of F **(1)** • Parallel to surface **(1)** • = F sin α **(1)** • As α increases, sin α increases **(1)**		**4**

Q3.

Question Number	Answer		Mark
(a)	Property of material Linked evidence from graph Brittle Breaks with no/little plastic deformation **Or** breaks soon after elastic limit **Or** breaks soon after limit of proportionality **Or** Large Young modulus **Or** stiff Gradient of stress/strain graph is high **Or** large stress for a small deformation /strain **Or** Strong Large breaking stress **Or** Obeys Hooke's law Straight line graph through the origin **Or** Stress is directly proportional to strain	(1) (1)	2
(b)(i)	Compressive would shorten the bone **and** tensile would stretch the bone	(1)	1
(b)(ii)	Gradient of the linear section of the graph **Or** stress divided by (the corresponding) strain in the linear part of the graph (accept alternative references to the linear section of the graph such as "where the graph obeys Hooke's law" **Or** "where the stress is proportional to the strain")	(1)	1
(b)(iii)	Use of Stress = Force / Area Answer (62900 N) Use of weight = mg Divide by weight = 71 times (allow 4 marks for arriving at a ratio $\frac{\text{maximum breaking stress}}{\text{stress of person's weight on the bone}} = 71$) (**max 3** for any reverse show that e.g. 170 MPa × 3.76×10^{-4} m^2 = 62900 N is approx equal to 883 N x 70 = 61 810 N **Or** 883N x 70 /3.76×10^{-4} m^2 = 167 (MPa) ≈ 170 (MPa)) (ratio= 68.3 comes from misreading graph and scores 3 marks) Example of calculation Force = stress × area Force = 170 MPa × 3.76×10^{-4} m^2 = 62900 N Weight = mg = 90 kg × 9.81 m s^{-2} = 883 N Force / weight = 62900 N / 883 N = 71	(1) (1) (1) (1)	4
(b)(iv)	Part is trabecular Which is weaker **Or** has a lower maximum (compressive) stress **Or** lower breaking stress **Or** The effective area of cortical bone is less (than in (iii)) So the force is less (Reverse arguments may be given)	(1) (1) (1) (1)	2