Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

Question Number	Answer	Mark
(a)(i)	The increase in extension is constant for a fixed increase in mass **Or** mass is proportional to extension **Or** extension is proportional to mass **Or** graph is a rising/increasing straight line (1) The wire obeys Hooke's law (1)	2
(a)(ii)	Use of area under the graph **Or** use of ½ $F\Delta x$ (with m or F) (1) Identify that the limit of proportionality is at 2.6 ± 0.1 kg (1) Elastic potential energy = 0.5 J (1) (accept 0.40 J to 0.50 J) Example of calculation Area under the graph = ½ × 3.5×10^{-2} m × 2.6 kg = 0.046 kg m Area × g = 0.046 kg m × 9.81 N kg^{-1} Elastic potential energy = 0.45 J	3
(a)(iii)	The wire will experience a large (increase in) extension/strain for a small (increase in applied) force/stress/mass (1) The wire will not return to its original length/shape (once the force is removed) **Or** the wire will be permanently deformed **Or** the wire will exhibit plastic deformation/behaviour (1)	2

(b)(i)	Thinner wire **Or** smaller CSA/ diameter/radius **Or** longer wire **Or** wire with a lower stiffness/*k*/spring constant **Or** wire that is more ductile **Or** wire with a lower Young modulus (1) (comments must be comparative)	1
(b)(ii)	**Max 2** Use a pointer on the wire/masses (1) Sensible suggestion to reduce parallax e.g. read at eye level **Or** place the rule as near as possible to the mass/wire (1) Use a set square to ensure rule is vertical (1) Wait for the extension to finish (1) Add masses gently (1)	2
	Total for question	**10**

Q2.

Question Number	Acceptable Answers	Additional Guidance	Mark
	• use of mass = density × volume **(1)** • use of upthrust = weight of fluid displaced = $m \times g$ **(1)** • upthrust = 8.3×10^{-4} N **(1)**	Example of calculation: mass of liquid displaced = 1300 kg $m^{-3} \times 6.5 \times 10^{-8}$ m^3 mass of liquid displaced = 8.45×10^{-5} kg upthrust = 8.45×10^{-5} kg × 9.81 m s^{-1}	3
	• viscous force = weight – upthrust **(1)** • use of $F = 6\pi\eta rv$ **(1)** • viscosity = 18 (kg m^{-1} s^{-1}) **(1)**	Example of calculation: viscous force = $W - U$ = 4.8×10^{-3} N - 8.3×10^{-4} N = 3.97×10^{-3} N $\eta = 3.97 \times 10^{-3}$ N / ($6 \times 3.14 \times 4.6 \times 10^{-3}$ m $s^{-1} \times 2.5 \times 10^{-3}$) η = 18 kg m^{-1} s^{-1}	3

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of $\rho = m/V$ **(1)** • Use of relationship upthrust = weight of liquid **(1)** • Use of $F = 6\pi\eta rv$ **(1)** • $\eta = 3.97 \times 10^{-2}$ (Pa s) so it is sunflower oil	<u>Example of calculation</u> mass of oil displaced $= 9.20 \times 10^{2}$ kg m^{-3} $\times$ 1.41×10^{-8} m^{3} $= 1.30 \times 10^{-5}$ kg upthrust = 1.30×10^{-5} kg $\times$ 9.81 m s^{-2} $= 1.27 \times 10^{-4}$ N weight of sphere = 1.10×10^{-4} kg $\times$ 9.81 m s^{-2} $= 1.08 \times 10^{-3}$ N weight = upthrust + drag 1.08×10^{-3} N = ($6\pi \times \eta \times 1.5 \times 10^{-3}$ m $\times$ 0.849 m s^{-1}) + 1.27×10^{-4} N $\eta = 3.97 \times 10^{-2}$ Pa s	**4**