1 When an object moves relative to a fluid, the fluid exerts a retarding force on the object. This drag force F is due to the viscosity of the fluid. Under non-turbulent conditions, the drag force on a sphere moving in a tube of fluid is given by

$$F = 6\pi\eta r v$$

where r is the radius of the sphere, η is the viscosity of the fluid and v is the velocity of the sphere.

(a) Show that the base units of viscosity η are kg m^{-1} s^{-1}.

[1]

(b) A sphere of diameter (2.0 ± 0.1) cm falls under non-turbulent conditions through a fluid of viscosity (0.13 ± 0.02) kg m^{-1} s^{-1}. Using a ruler and a stopwatch, a student measured the velocity through the liquid to be 2.7 ms^{-1} and estimates that the percentage uncertainty in this measurement to be 5%.

(i) Determine the drag force F acting on the sphere. State your answer with its uncertainty.

F = ... ± ..... N [3]

(ii) In order to improve the accuracy of F, explain which one of the measurements should be improved.

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..... [1]