Edexcel Physics A-level
CP04 - Determine the Viscosity of a Liquid

Practical Flashcards

What safety precautions should be taken when carrying out this experiment?

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If any spillages occur, they must be cleaned up immediately. Washing-up liquid is very slippery and so spillages lead to a risk of slipping and injury.

Why is this experiment invalid if the diameter of the tube is too small?

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Stokes' law is only valid for laminar flow. If the tube is too narrow, the flow may not be laminar throughout, rendering Stokes' law invalid.

Suggest why light-gates shouldn't be used when carrying out this experiment.

Light-gates rely on a clear breakage of the beam. This will not occur in this experiment since it is unlikely that the ball will cut the beam. The line of the beam may also be disturbed by the coloured liquid.

Explain why the flow may become non-laminar if the ball approaches the tube's wall as it sinks.

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If the ball approaches the wall, the surrounding liquid will accelerate upwards around it due to Bernoulli's principle. Faster fluid flow means a lower pressure, which would further guide the ball towards the wall. As a result the streamlines would be non-symmetrical, and so would be non-laminar.

What forces act on a ball as it sinks down a tube of liquid?

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The downwards force of weight, and two upwards forces: drag and upthrust.

How can the uncertainty of r² be determined from the uncertainty in r?

The uncertainty in a squared variable is equal to twice the uncertainty in the variable itself. This means that the uncertainty in r² is double the uncertainty in r.

How can the radius of a small ball be measured?

How can the radius of a small ball be measured?

A screw gauge micrometer can be used to measure the diameter of the ball. This can then be halved to give the radius.

Describe the forces on the ball when it reaches terminal velocity.

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At terminal velocity, the downwards forces on the ball equal the upwards forces.

Weight = Upthrust + Drag

Describe how you should take time readings in this experiment.

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Time readings should be taken at eye level to rubber bands, wrapped around the measuring cylinder at set values. The lap function should be used to record the time at each band.

How can you ensure that the time readings are accurate?

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The same person should record the time readings throughout. They should measure at eye level to the rubber bands and must ensure they stop the timer at the same relative position between the ball and the band each time.

Suggest why it may be advantageous to use a steel ball bearing in this experiment.

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Steel ball bearings are magnetic. This means that a magnet can be used to easily lift the ball from the bottom of the liquid after each run.

What must be the case when positioning the highest rubber band on the tube?

What must be the case when positioning the highest rubber band on the tube?

The ball should be travelling at terminal velocity by the time it reaches this first band. This means it needs to be positioned sufficiently low enough for this to be the case.

If the ball has reached terminal velocity by the time it reaches the first band, what should be true about the two speeds calculated?

If the ball has reached terminal velocity by the time it reaches the first band, what should be true about the two speeds calculated?

The two speeds should be the same since the ball will not accelerate beyond its terminal velocity.

How should the lower two bands be positioned on the tube?

The lower two bands should be positioned sufficiently far apart so that the time intervals between each are easily observable and measurable.

What equation is used to calculate the liquid's viscosity?

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$$\eta = \frac{2r^2 g(\rho - \sigma)}{9v}$$

How can the density of each ball be determined?

How can the density of each ball be determined?

The diameter can be measured using a micrometer, and from this the volume of the sphere can be calculated. The mass of the ball can be measured using a mass balance. Dividing the mass by the volume gives the ball's density.

What is the unit of viscosity?

What is the unit of viscosity?

Pascal-Seconds

Pa · s