WJEC (Eduqas) Physics A Level

SP1.2a - Measurement of g by Freefall

Practical Flashcards

What is meant by free-fall?

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An object is said to be falling in free-fall if the only force acting on it is its own weight under gravity. This means that negligible resistive forces are acting (small enough that they can be considered to be effectively zero).

What is ‘g’?

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Gravitational Field Strength (in our case, on the surface of Earth)

Why can the SUVAT equations be used in this experiment?

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The SUVAT equations can be used since the object will fall with uniform acceleration. This is because the force of gravity is approximately constant at the Earth's surface.

When plotting a graph of t^2 against h, how is ‘g’ determined?

When plotting a graph of t^2 against h, how is 'g' determined?

The gradient of the graph will be t^2/h. Consequently, the acceleration ('g') will be equal to 2/gradient. This comes from the equation $s = ut + \frac{1}{2} at^2$, where s=h, a=g and u=0.

When plotting a graph of v^2 against h, how is ‘g’ determined?

When plotting a graph of v^2 against h, how is 'g' determined?

The gradient of the graph will be v^2/h. Consequently, the acceleration ('g') will be equal to half the gradient. This comes from the equation $v^2 = u^2 - 2as$, where s=h, a=g and u=0.

Describe how an electromagnet system can be used to determine ‘g’.

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A magnetic ball bearing can be released by an electromagnet clamped at a known height. The timing system starts when the electromagnet is switched off, and the timer is stopped when the ball lands on the finish pad.

When using a clamp stand in this experiment, what safety precaution should be taken?

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The clamp stand should have a counterweight or G-clamp attached to its base to provide a moment to prevent it from toppling over.

What safety precaution should be taken when using an electromagnet?

What safety precaution should be taken when using an electromagnet?

Electromagnets heat up over time. To reduce this heating effect, you should switch it off when not in use.

Why is it advantageous to use a small ball-bearing over a larger ball?

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The effect of air resistance is lesser on a smaller ball-bearing. Therefore, our assumption that the effects of air resistance are negligible is more valid if a smaller ball-bearing is used.

Explain why this experiment would not be valid if the air resistance acting on the ball wasn't negligible.

Explain why this experiment would not be valid if the air resistance acting on the ball wasn't negligible.

The ball wouldn't be in free-fall since the acceleration would not be purely due to the force of gravity. The acceleration would also be variable since air resistance increases with speed, and so the uniform acceleration equations couldn't be used.

Suggest why your obtained value of ‘g’ may not be the same as the accepted value.

Suggest why your obtained value of ‘g’ may not be the same as the accepted value.

- Delays in the timing equipment (if using a stop clock, this will be human reaction time)
- Resistive forces are acting
- Errors in height measurements, such as measuring from different positions on the ball each time

What is the advantage of using an electronic system over a stop-clock in this experiment?

What is the advantage of using an electronic system over a stop-clock in this experiment?

Using light-gates should result in a lower uncertainty in your time measurements. Using a stop-clock would involve human reaction times and would thus create additional uncertainty in timing accuracy.

How could your results be improved?

How could your results be improved?

You should take repeat readings at each height and then calculate the mean time taken, from all non-anomalous results.

You should also ensure that height measurements are taken from the same point on the ball every time.

How should you calculate the uncertainty in your time readings?

How should you calculate the uncertainty in your time readings?

The uncertainty in time can be considered to be equal to half the range of your time readings, measured for each height. This can then be converted into a percentage uncertainty.

How do you determine the percentage uncertainty in t^2?

How do you determine the percentage uncertainty in t^2?

To calculate the percentage uncertainty for a variable that is squared, you should double the percentage uncertainty of the variable itself. In this case the percentage uncertainty in t^2 is double the percentage uncertainty in t.

When plotting a graph how should you determine the scales for the axes?

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The scales should be chosen so that the graph fills at least half the available space. Using numbers that split easily into the squares on page (such as multiples of 5) will also make plotting simpler.

What is the minimum number of repeat readings you should take in this experiment?

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You should take at least 3 repeat readings at each height. This allows for anomalous results to be more easily identified.

What is the equation used to convert an uncertainty into a percentage uncertainty?

What is the equation used to convert an uncertainty into a percentage uncertainty?

Percentage Uncertainty = (Uncertainty/Mean Value) x 100%

How can the percentage difference between your value of ‘g’ and the accepted value be calculated?

How can the percentage difference between your value of ‘g’ and the accepted value be calculated?

$$[(\text{Your Value} - 9.81)/9.81] \times 100\%$$

Would you expect your value of ‘g’ to be greater or lower than the accepted value?

Would you expect your value of ‘g’ to be greater or lower than the accepted value?

You will most likely obtain a value that is lower than the accepted value, due to air resistance reducing the downwards resultant force acting on the object.

How could you use your value for ‘g’ to estimate the mass of the Earth?

How could you use your value for ‘g’ to estimate the mass of the Earth?

Newton’s law of gravitation can be equated with the weight equation at the surface of Earth to give:

$$M = gR^2/G$$