Edexcel Physics IAL

CP01 - Determining the Acceleration of a Freely-Falling Object

Flashcards

What is meant by free-fall?

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What is meant by free-fall?

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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What is ‘g’?

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?

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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 a light gate system can be used to determine ‘g’.

Describe how a light gate system can be used to determine ‘g’.

A small ball or piece of dowel can be released down a vertical tube of known height with a light gate at either end. The timing system starts when the first gate is passed through, and stopped when the second gate is passed.

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

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

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

Suggest how light-gates could be positioned to ensure that the ball or dowel falls directly through them.

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A plumb line could be used to demonstrate the expected path of the object. This allows the light-gates to be positioned in appropriate places, so that the ball will fall through them.

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

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

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.

Why should there be a gap between the release position and the first light-gate?

Why should there be a gap between the release position and the first light-gate?

There should be a gap to ensure that the time over which the ball is passing through the light gate is negligible (the ball is moving sufficiently quickly at the light gate).

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 light-gates over a stop-clock in this experiment?

What is the advantage of using light-gates 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?

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

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?

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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?

[(Your Value - 9.81)/9.81] x 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.