ADVANCED CONNECTIONS | CYSYLLTIADAU PELLACH

SESSION PLAN

Physics Tutorial 6: Being a Physicist

Aim

To bring together the skills learned in these tutorials in an experiment.

Learning Objectives

By the end of this session, the mentees will be able to...

- Reflect on their progress by returning to Fermi problems from Tutorial 1
- Perform an experiment to investigate the terminal velocity of a cupcake case

Prepare in Advance

- There shouldn't be anything to prepare in advance, just have a read through the answers and make sure you understand and can explain them!

Scaffolding

If a mentee finishes early:

- Get them to try the optional extras (if they haven't already)
- Have some extra exam questions on hand (use the WJEC question bank tool on the bright ideas page)
  - You could also encourage them to use the question bank themselves!

If a mentee is struggling:

- Exam technique is a difficult skill to learn, and it takes time and practice. Be mindful that mentees may struggle with this quite a bit and use your own exam experiences to encourage and guide them
- Get them to break it down into smaller steps if needed

Session Flow

Time	Activity
5 min	**Introduction** • Run through the aim and LOs • Recap the ground rules if needed
25 min	**Self-study Recap** • Go through the self-study materials and any solutions (on next page) • Answer any questions the mentees may have about the materials
15 min	**Continuing Exam Practice** • Work with the mentees to answer some further exam questions and practice their exam technique • Pass on any exam tips you have!
10 min	**Revision Techniques** • Discuss different revision techniques, and encourage mentees to try out different ones until they find what works for them • Again, use your own experiences to pass on any advice/techniques
5 min	**Plenary** • Allow some time for mentees to ask questions and discuss today's topic

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MENTOR GUIDANCE

SESSION 6: BEING A PHYSICIST

PART 1: SELF-STUDY RECAP

This first half of this tutorial is going through the self-study materials to ensure that mentees understand the progress they have made since their first session.

TASK 1: FERMI PROBLEMS REVISITED

This is more of a discussion than something with “right” and “wrong” answers. Encourage the mentees to **reflect** on the skills and confidence they’ve gained, and how this will help them solve real-world problems. You can use the mentor guidance from **Tutorial 1** to remind yourself of the Fermi problems.

TASK 2: TERMINAL VELOCITY EXPERIMENT

The mentees should have performed this experiment during their pre-tutorial work.

- Allow each mentee a few minutes to **describe** their experiment set-up, and **show** their graph to the group
- Once everyone has contributed, encourage a **discussion** between the mentees. Some prompts:
  - What were the biggest **challenges** of this experiment?
  - How could it be **improved?**
  - What was **similar/different** between everyone’s experiments and results?
  - Is there anything you’d do **differently** after seeing the others’ experiments?

OPTIONAL EXTRAS

FERMI PROBLEMS

A How many blades of grass are there on a football pitch?

B How many times do you blink in a year?

Discuss the steps that your mentees have taken to complete these calculations. It’s not about guessing, but making educated guesses. Highlight if you spot any point where a mentee has taken too much of a leap and help them to break it down into smaller steps.

Examples of assumptions might be:

A

- We have ignored different types of grass
- All blades of grass are the same size/volume
- The size of a football pitch
- We have ignored goal posts taking up grass space

B

- Everyone blinks at the same rate
- Everyone blinks for the same amount of time every day
- Everyone sleeps for the same amount of time every day

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OPTIONAL EXTRAS

EXAM PRACTICE

Mentees might find it useful for you to explain where the marks are coming from/the mark scheme

2 (a)(i)

(in their exam booklets)

Vertical force upwards $= 4.0 \times 10^{-4}$ N

Vertical force downwards $= 6.0 \times 10^{-4}$ N

Horizontal force $= 5.0 \times 10^{-4}$ N

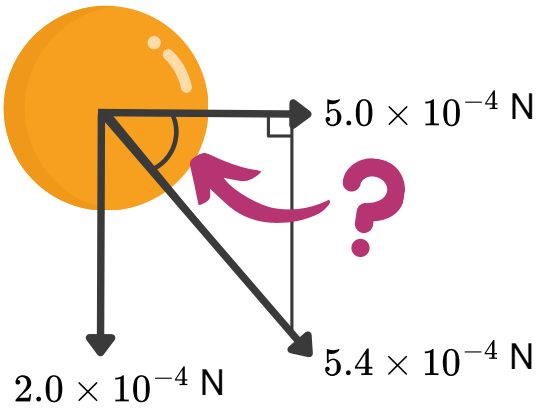
Total vertical force $= 2.0 \times 10^{-4}$ N **1 mark**

Use Pythagoras to calculate overall magnitude:

$$F_{overall}{}^2 = \left(2.0 \times 10^{-4}\right)^2 + \left(5.0 \times 10^{-4}\right)^2 \quad \text{so} \quad F_{overall} = 5.4 \times 10^{-4}\ \text{N}$$ **1 mark**

(5.38 or 5.39 is accepted)

Now to find the direction!



Using trigonometry again:

$\theta = 21.8°$

Mentees may use sin, cos or tan depending on the forces they choose to use

1 mark (allow 112, 22, as long as they are clearly stated or shown on diagrams)

2 (a)(ii)

Mentees could say any of the following for the mark: **1 mark**

- Air resistance and force due to gravity (or weight) are equal
- Air resistance is now equal to 6.0×10^{-4} N, so there is no resultant force
- Forced are balanced / cancel / no acceleration

2 (b)(i)

Subtract 0.05 (from the readings of time / the time delay / it) **1 mark**

2 (b)(ii)

Drop height, h/m	0.40	0.80	1.20	1.60	2.00
Corrected time, t/s	0.27	0.41	0.48	0.58	0.64
Corrected time squared, t^2/s^2	0.07(3)	0.17	0.23	0.34	0.41

All values calculated correctly (regardless of sig figs) **1 mark**

All to 2 sig figs (allow 1 sig fig on first answer) **1 mark**

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PART 2: SKILLS PRACTICE

The second half of this tutorial gives students an opportunity to practice their skills and ask any questions.

CONTINUING EXAM PRACTICE

15 MINS

Exam technique is a difficult skill to learn that takes time and practice (and it **is** a skill; you're not just naturally good at answering exam questions!!).

For this activity, you will be continuing the question from the Optional Extras in the pre--tutorial materials. There are two ways you can run the activity:

- Share your screen, and get the mentees to lead you through the answer to each question whilst you write what they suggest on your screen. You can then go through the mark scheme and see how you did together.
- Get mentees to work in pairs/threes in the sub-breakout rooms to answer the questions, then go through the mark scheme together afterwards.

2 (b)(iii)

The following relationship is used to find a value for g: $g = \frac{2h}{t^2}$

Show how this relationship is obtained from an appropriate equation of accelerated motion. [2]

(in their exam booklets)

Mentees will need to choose a suvat equation: $x = ut + \frac{1}{2}at^2$ **1 mark**

$x = h$
$u = 0$
$a = g$

We know that the height is the distance, the starting position is zero, and acceleration is gravity. **1 mark**

No algebra is required to get the 2 marks, but if mentees would like it step by step:

$h = \frac{1}{2}gt^2$ re-arrange to get $g = \frac{2h}{t^2}$

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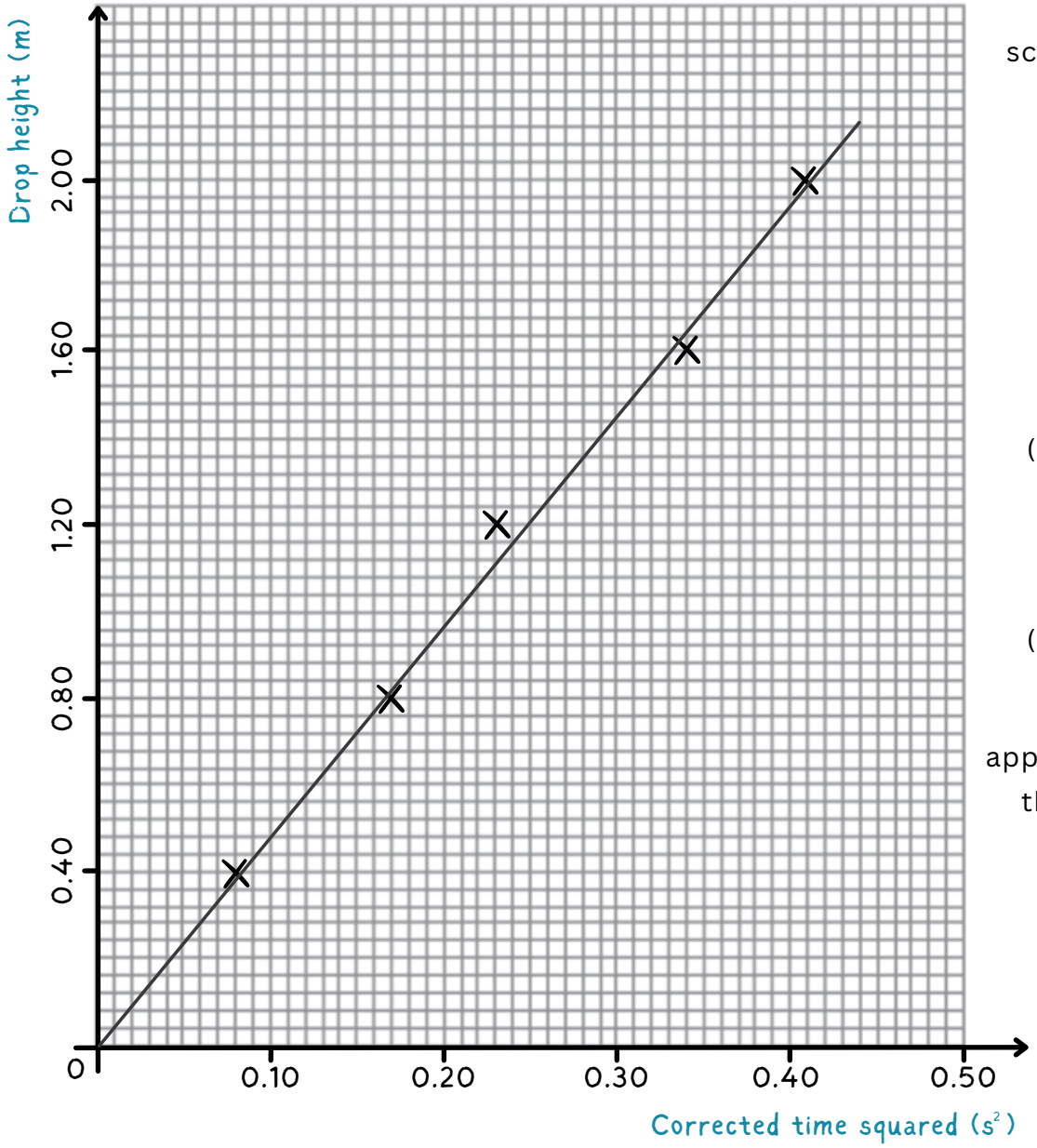
CONTINUING EXAM PRACTICE

15 MINS

2 (b)(iv) On the grid below, plot a graph of h (vertical axis) against t^2 (horizontal axis) and draw a line of best fit. [4]



choose suitable axes scales, labelled correctly
1 mark

all 5 points plotted correctly (within 0.5 squares)
2 marks

up to 4 points plotted correctly (within 0.5 squares)
1 mark

up to 3 points plotted correctly (within 0.5 squares)
0 marks

appropriate line of best fit that goes through origin
1 mark

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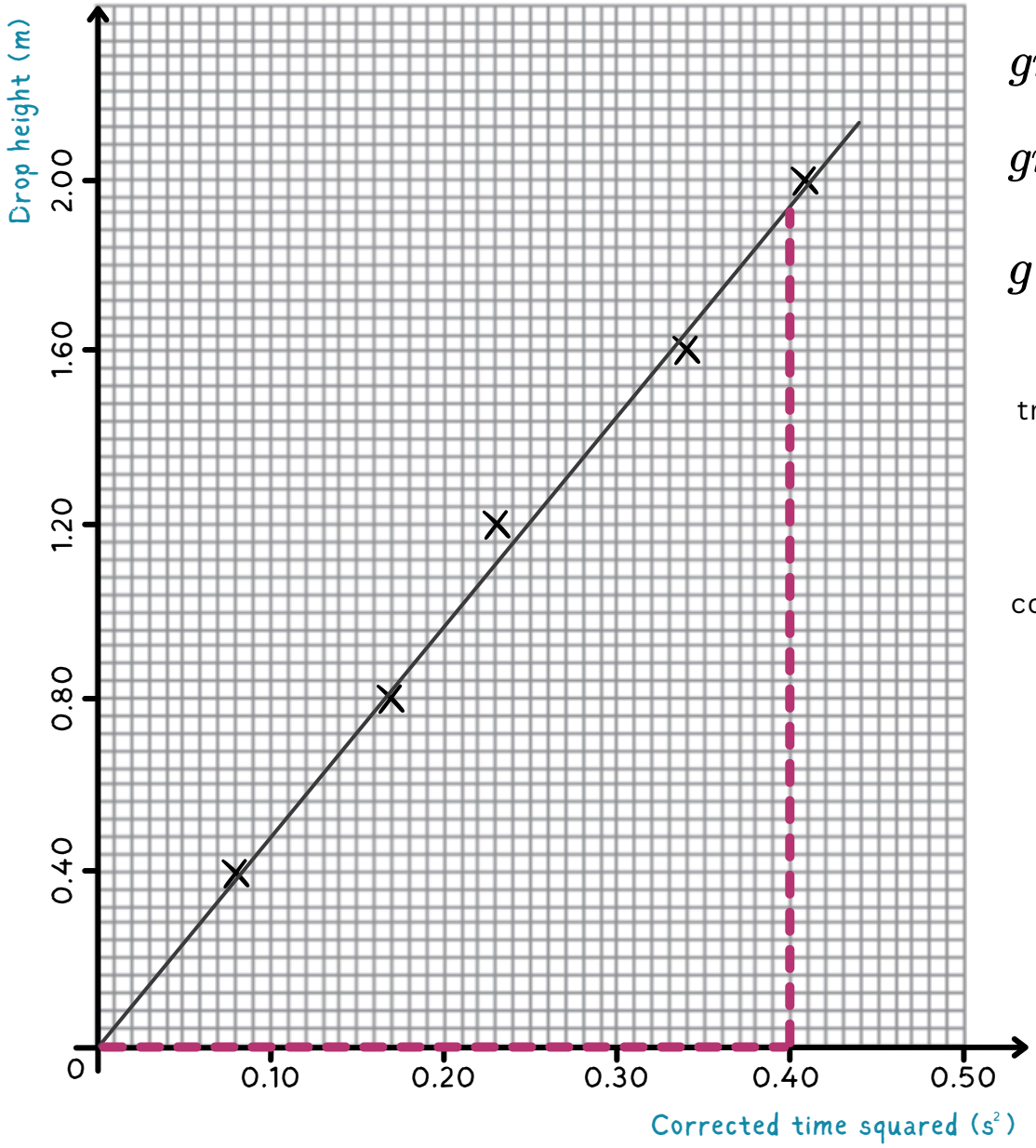
CONTINUING EXAM PRACTICE

15 MINS

2 (b)(v) Use your graph to determine a value for g. [3]



$$gradient = \frac{1.92}{0.4}$$

$$gradient = 4.8$$

$$g = 2 \times 4.8 = 9.6$$

choose a suitable triangle within the points (must be height > 1)

1 mark

gradient calculated correctly (accept 4.6-5.0)

1 mark

g is 2 x gradient (allow error carried forward)

1 mark

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REVISION TECHNIQUES

10 MINS

Mentees should be spending **lots of time revising,** especially as they will be taking their A-level exams this summer. You will be discussing what **effective revision** looks like, and how mentees can work independently.

HOW WE REVISE

Ask the mentees the following questions and discuss:

- **What revision strategies do you currently use?**
- **How do you plan your revision time?**

Mentees will likely have tried lots of different techniques, with different amounts of success. Reassure them that revision will be covered in a lot more detail in **Mentoring Session 7.**

Emphasise how useful **practicing past exam papers** can be! If mentees are struggling with exam technique, they can start by going through a past paper with the mark scheme next to them so they can see how to answer questions. Then try another paper without the mark scheme available and build from there. In order to get the most from exam papers:

- Do them **regularly** but with space in between – **not all in one day**
- Make sure to **mark** them using the mark scheme
- The questions you **can't** answer are much **more important** than the ones you can easily do - these are the ones you need to practice more often
- Be **tough** when marking yourself - "I know what I meant" **won't get you a mark** in the exam if it's not on the mark scheme!

PROBLEM AREAS

Allow time for mentees to ask about any **specific areas they are struggling with** when revising. You can always **take note** of these areas for your co-mentor to use when planning their revision session for Mentoring Session 7!

As always, **you are an expert** when it comes to revising and independent study. Share your experiences, tips, and advice with the mentees.

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PHYSICS TUTORIAL 6: BEING A PHYSICIST

BRIGHT IDEAS!

This page contains ideas for alternative sessions, changes/additions, extra activities, etc. Feel free to use as you wish!

Physics Everywhere

Now that mentees have improved their science capital, challenge them to think of out-of-the-box areas where physics can be applied (in either careers or hobbies). Some examples:

- Baking: the physics of heat transfer in an oven
- Fashion: properties of different materials and how they can be manipulated

Physics Skills

If you think the mentees are struggling to link the topic to wider skill applications, you can run an activity where they list the skills they use to solve the problems, and then discuss where they use those skills in physics.

Exam Practice

You can use **WJEC's question bank** (https://questionbank.wjec.co.uk/) to find more exam questions with mark schemes that you can go through with mentees to practice exam technique. Make sure you search for "Physics" in subjects and "GCE A/AS" in levels! You can also use the tags search to find questions about specific topics.

Experiment Time!

You could design an experiment to demonstrate to the mentees. You could also design a simple experiment that they can conduct during the session.

Please be mindful that the mentees will be at home, so there will be a variation in what they can access during the session.