Isaac Physics Teacher CPD:
Question-writing Workshop Session 1

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Isaac Physics Project Physicist and Chair of the British Physics Olympiad

Categories of questions

- Multiple choice
  - Simple factual
  - Deduction
  - Elimination
- Short answer
- Long calculation
- Anecdotal i.e. is it interesting to read about?

Know Your Audience – what and who are your writing for?

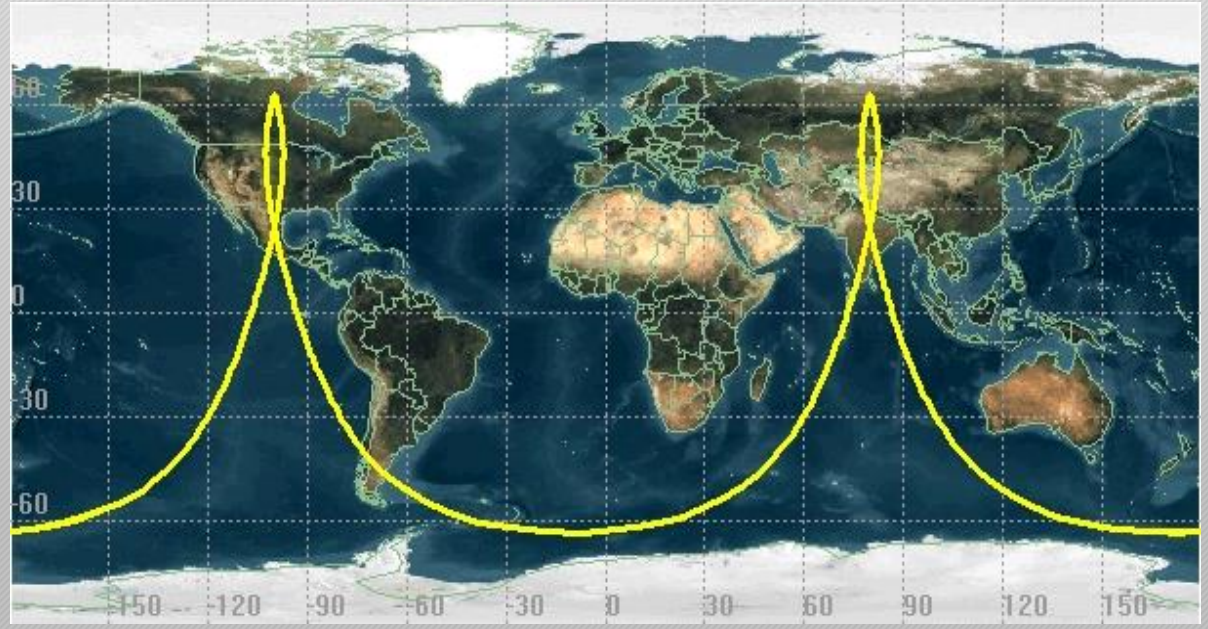
- Do you want them to get the answer?
- Age range
- Level of difficulty
  - Participation
  - Challenge
  - Didactic
  - Discriminating
- Time allocation

Question types and styles

- Explanations
- Diagram
- Computations & calculations
- Estimates
- Technique spotting
- Proofs
- Bookwork
- Data analysis
- Conceptual

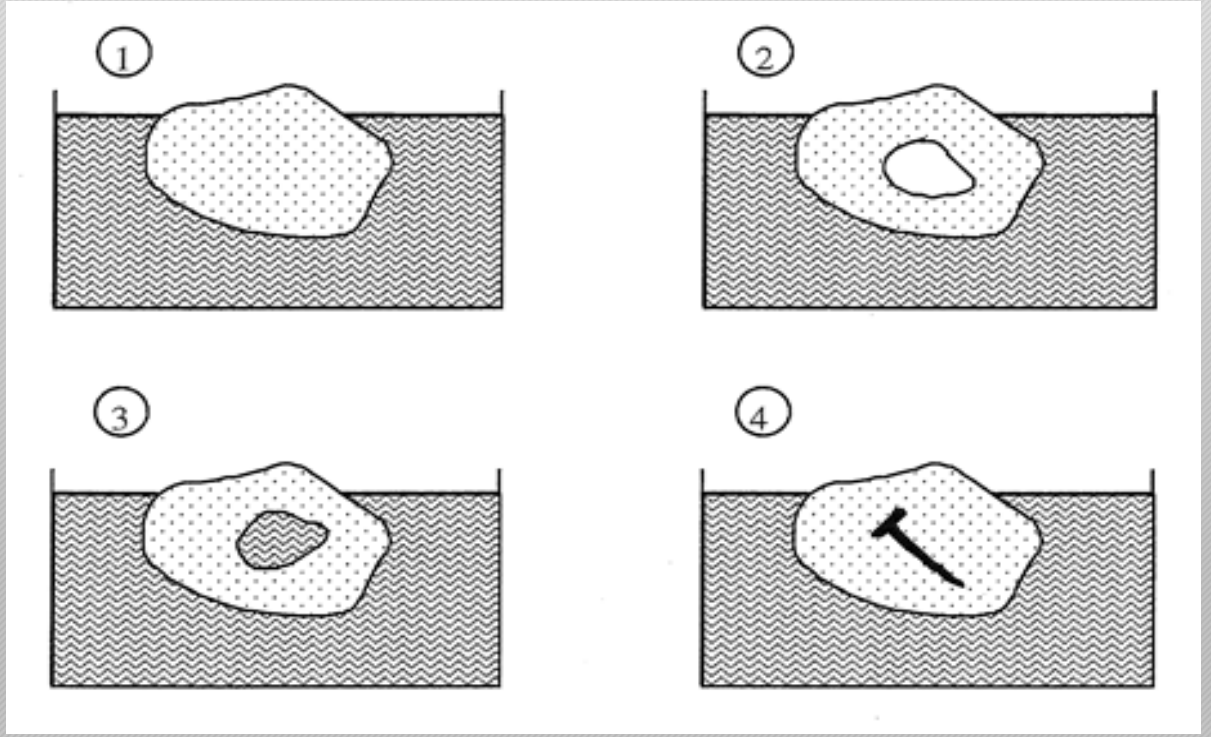
Explanations

Ground path of a satellite



Diagram

What happens to the water level when the ice melts?



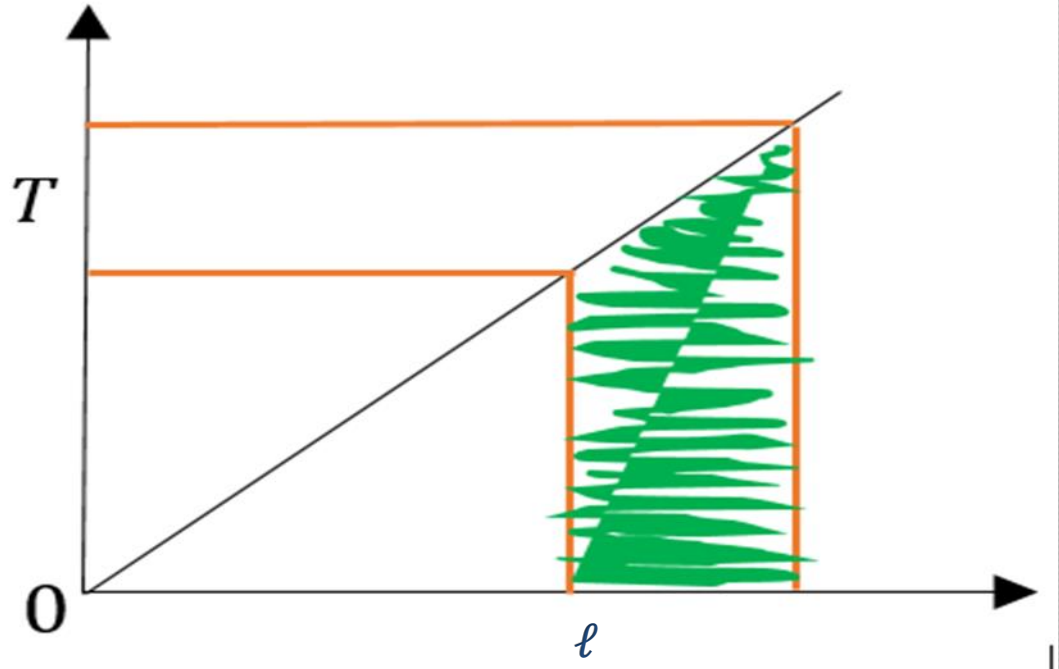
Computations & calculations

Q: Energy in a Wire

A wire that obeys Hooke's Law is of length l_1 when it is in equilibrium under a tension T_1, and its length becomes l_2 when the tension is increased to T_2.

Answer Now | Hint 1 | Hint 2 | Hint 3 | Hint 4 | Hint 5

What is the extra energy stored in the wire as a result of this process?

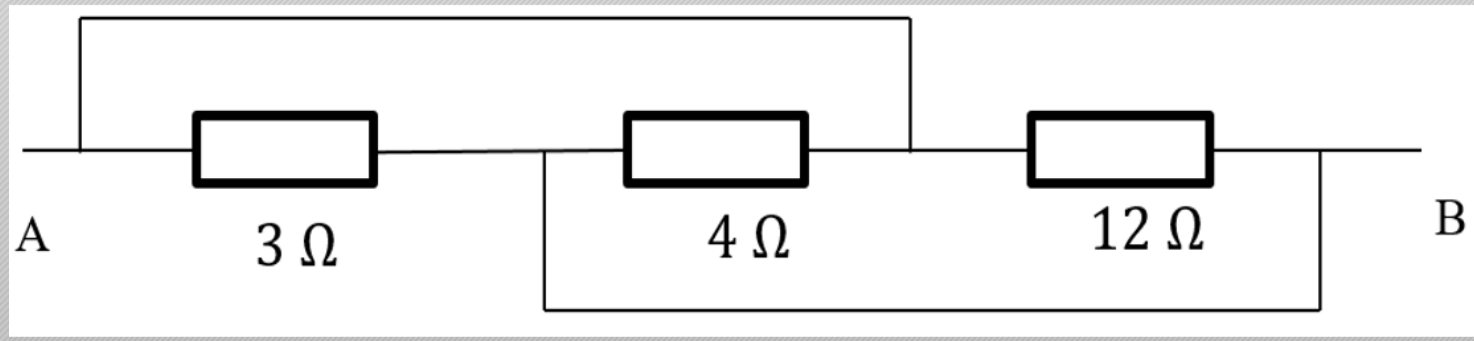


Estimations

Which is smoother: a squash ball or the Earth?

Technique spotting

- *What is the resistance between A and B?*

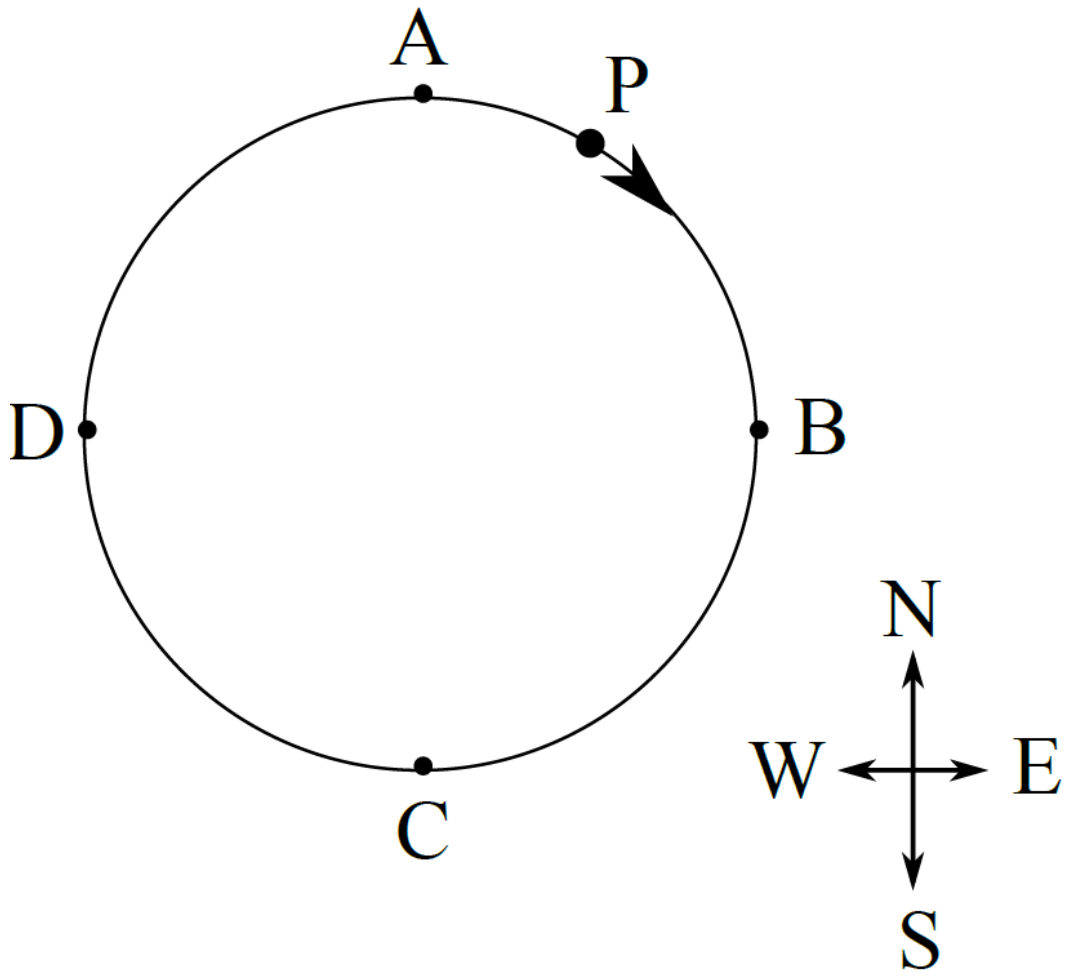


Bookwork

- *A question about velocity as opposed to speed*

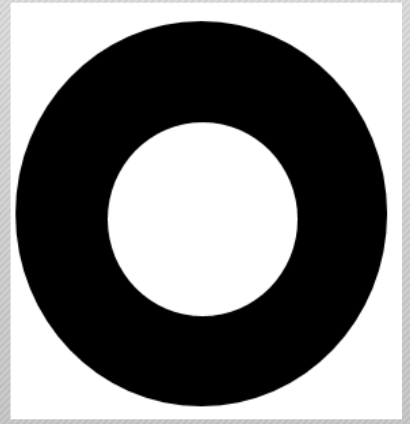
Point P moving in a circle of radius 4m at a constant speed. T=2.0 s.

What is its average velocity?



Conceptual

- *A metal disc has a hole cut in the middle. The disk is heated. What happens to the size of the hole?*



Have a go!!!

- Think of an idea first and not a question.
- Form an idea round it.
- Doodling can help.

Andrea Chlebikova,

Isaac Physics Project Chemist

Please see recording for session content

Anton Machacek,

Isaac Physics Associate Director

Practice & confidence-building questions

- Choose an equation your students need practice with

- Write 6-10 practice questions involving this equation.
  - First questions just involve 'plugging numbers'
  - Later ones involve more complex re-arrangement
  - One or two can involve a challenge
  - Make the contexts of some questions relevant to applications
  - Make a question or two have visual impact
  - Ensure it is easy to mark!

- GCSE: $E = qV$

- Write 6-10 practice questions involving this equation.
  - How much energy is given to a 0.002C charge by a 9V battery?
  - Calculate the potential difference needed to give 50J to 0.25C of charge.
  - How much energy does a 240V supply give to 9nC?
  - Calculate the kinetic energy of an electron accelerated across 10kV in an X-ray machine.
  - A cat stands on a carpet and rubs itself against a sofa gaining 5μJ of electrostatically stored energy and 10nC of charge. What is its potential difference?

Nicki Humphry-Baker,

Isaac Physics Assistant Director

Please see recording for session content

Ingrid Murray,

Isaac Physics Teacher Support Manager

Embedding diversity and inclusion in question-writing

- Who writes the questions?
- Who reads the questions?
- What do questions teach us about physics?
- What do questions teach us about society?

- **Increasing the diversity of teachers who feel confident to write questions will enrich our perspective on physics and make students and teachers feel more welcome in the physics community.**

1 Discuss, in terms of quantitative relationships where possible, the factors that determine the acceleration of a skier on a ski slope. [8 *marks*]

A small sphere is released from rest and, after falling a vertical distance of 0·5 m, bounces on a smooth plane which is inclined at 10° to the horizontal. If the sphere loses no energy during the impact, why do its directions of motion immediately before and immediately after the impact make equal angles with the normal to the plane? [4 *marks*]

Find the distance, measured down the plane, between this impact and the next. [8 *marks*]

https://www.cambridgeassessment.org.uk/Images/1974j-physics-alevel-questionpaper.pdf

Two skaters are standing, at rest, opposite each other on an ice rink.

Skater **A** has a mass of 40 kg and skater **B** has a mass of 50 kg.

A 40 kg **B** 50 kg

Skater **A** pushes against skater **B** with a force of 30 N.

(a) (i) What does Newton's third law tell us about the force that skater **A** experiences from skater **B**?

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