Topic: Forces and Motion

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Issues tackled:

1. **Misconceptions – Balanced and unbalanced forces on moving objects.**
2. **Practical work - Demonstrations and experiments to measure speed and acceleration.**
3. **Applications, relevance and cross-curricular issues – Using and manipulating quantitative relationships.**

Issue 1: Misconceptions – Balanced and unbalanced forces on moving objects.

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Question a group of 6th Form students (or Year 11 pupils if topic has already been covered) on the role of balanced and unbalanced forces that act on a skydiver at different points during a parachute jump. Analyse the results and identify principle misconceptions.
2. Construct a PowerPoint presentation to explain the motion of a skydiver at different points during a parachute jump.

Possible activities during tutorial:

1. Describe the correct version of the forces that act on a skydiver. Describe the principle misconceptions and how they may have arisen.
2. Show presentation while mentor asks questions and introduces possible pupil misconceptions.

AST Input:

- Go through Newton's laws of motion.
- Discuss the idea that Newton's laws of motion conflict with everyday experiences, e.g. a stationary object has no force acting on it, a constant force means a constant speed, hammer and feather will fall at the same velocity on the moon.
- Play devil's advocate in further discussions of balanced/unbalanced forces in everyday situations e.g. cruise control on a car, dolphin swimming, penalty kick, trampolinist.

Reading:

Subject knowledge and understanding

Most KS4 Textbooks and Revision Guides.

Subject pedagogy

Jerram, A., (1999), **Teaching Physics to KS4,** Hodder, Arnold, H and S, London. Page 69.

Driver, R., **Childrens Ideas In Science** (1985), Open University.

Useful websites and applications

http://solarviews.com/raw/apo/apo15g.mov - hammer and feather falling on the moon.

CD ROMs as available in school. A useful one is M**ultimedia Motion** produced by Anglia.

There are some good simulations to look at on the **Advancing Physics CD ROM** , produced by the IOP to support OCR AS Physics specification B. Look for the Modellus

examples in Chapter 8.

Resources:

Task 1
Worksheet or exam question about a parachute jump/skydiver.

Task 2
Access to computer and PowerPoint.

Issue 2: Practical work - Demonstrations and experiments to measure speed and acceleration.

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Design and trial a demonstration or class experiment to measure the speed or acceleration of a moving object. Be prepared to demonstrate at the tutorial.
2. Find out how to use the school light gates and/or motion sensor with software and make notes on how they might be used in a demonstration about measuring motion.

Possible activities during tutorial:

1. Demonstrate the experiment planned. The mentor could take the role of pupils.
2. Assemble a set of equipment making use of a light gate or motion sensor. Show what measurements can be obtained and discuss how they may be manipulated.

AST Input:

- Discuss key measurements, calculations, sources of inaccuracy and possible pitfalls with the tasks selected.
- Introduce other experimental designs/ simulations to measure speed or acceleration and discuss their merits for use with various groups.

Reading:

Subject knowledge and understanding

Johnson, K. and Ryan, L. (2004) **Physics for You**, Nelson Thornes, Cheltenham.

Physics Revision Guide, CGP, Cumbria**.**

Subject pedagogy

Practical Science with Microcomputers, NCET. – This is dated but has some useful experimental design.

Other work cards or resource packs for using sensors in lessons may have useful ideas eg produced by Philip Harris, Griffin etc..

Frost, R Chapter 3.8 - Use of ICT in Ratcliffe, M. (Ed.) **The ASE Guide to Secondary Science Education**, London.

Useful websites and applications

Suggestions for experimental design at www.practicalphysics.org – follow links to **forces and motion** then **time, dist and speed.**

Resources:

Task 1
Depends on school equipment but will probably include trolley and runway, stop clock, metre rule, ticker tape timer?!!

Task 2
Light gates and suitable timer, sensors and interfaces/ PC and software.

Tutorial
Selection of apparatus described for tasks 1 and 2.

Issue 3: Applications, relevance and cross-curricular issues – Using and manipulating quantitative relationships.

Trainees have already covered:

Possible tasks:

Preparation for tutorial:

1. Discuss with a member of the maths department their approach in teaching the use and manipulation of quantitative relationships (e.g. Force= Mass x Acceleration) for pupils of different ability levels. Bring notes of the discussion and any resources used by/recommended by the maths department.
2. Research past GCSE exam questions which use quantitative relationships, and look at the mark schemes where possible.

Possible activities during tutorial:

1. Present findings from discussion and use one particular approach to introduce a relationship to the mentor posing as a pupil.
2. Show one foundation and one higher tier question and describe a model answer that would obtain full marks.

AST Input:

- Discuss the different approaches, such as using words, symbols and units in equations as appropriate to the ability level of the pupils; e.g. formula triangles.
- Provide list of equations that are used in this topic.

Reading:

Subject knowledge and understanding

Johnson, K. and Ryan, L. (2004) **Physics for You**, Nelson Thornes, Cheltenham.

Physics Revision Guide, CGP, Cumbria**.**

Subject pedagogy

Jerram, A., (1999), **Teaching Physics to KS4,** Hodder, Arnold, H and S, London. Pages 64-65.

Useful websites and applications

Centre for Innovation in Maths Teaching, www.ex.ac.uk/cimt, look for suggestions on **manipulation.**

http://www.bbc.co.uk/schools/gcsebitesize/maths/algebrafi/0algebraicmanipulationrev1.shtml for Bitesize revision of basic algebra.

Resources:

Task 2

Access to past papers and mark schemes.
Exam Board Websites for Past Papers, specimen papers and mark schemes.
www.ocr.org.uk
www.edexcel.org.uk
www.aqa.org.uk