

# What do physics students know?

A view from Scotland

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- The physics curriculum in Scotland
- Embedded knowledge and skills
- Changes post 2012

# The shape of the Scottish post-16 curriculum

**18**

Advanced Higher Physics

**17**

Higher Physics

**16**

Intermediate 2 Physics

Standard Grade Physics

Intermediate 1 Physics

## **Advanced Higher Physics**

Mechanics (40)  
Electrical phenomena (40)  
Wave phenomena (20)  
Investigation (20)

## **Higher Physics**

Mechanics and properties of matter (40)  
Electricity and electronics (40)  
Radiation and matter (40)

## **Standard Grade Physics**

Telecommunications (40)  
Using Electricity (40)  
Health Physics (40)  
Electronics (40)  
Transport (40)  
Energy matters (40)  
Space Physics (40)

## **Intermediate 2 Physics**

Mechanics and heat (40)  
Electricity and electronics (40)  
Waves and optics (20)  
Radioactivity (20)

## **Intermediate 1 Physics**

Telecommunications (20)  
Practical electricity (20)  
Radiations (20)  
Sound and music (20)  
Movement (20)  
Electronics (20)

## **1. Demonstrating knowledge and understanding.**

1a. Use quantities and units correctly

1b. Use relationships and mathematical techniques

1c. Apply principles correctly

1d. Describe and use models

## **2. Problem solving.**

2a. Select and present relevant information

2b. Accurately process information using calculations where appropriate

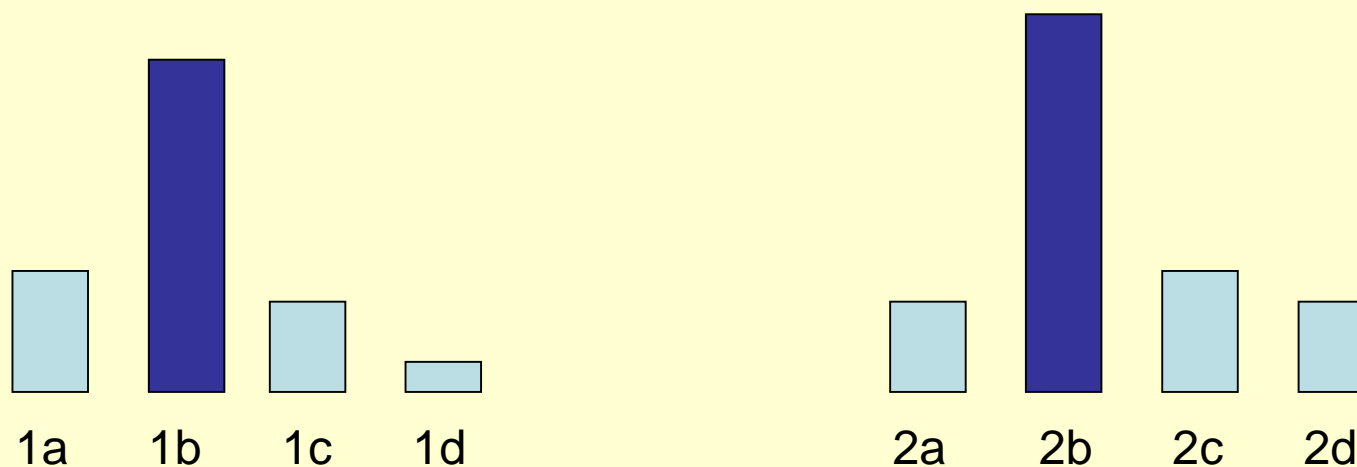
2c. Draw conclusions and support explanations using evidence

2d. Plan design and evaluate experimental procedures.

## **3. Practical procedures.**

Typical breakdown of marks allocated to  
each element of performance.

Advanced Higher physics.



## **1. Demonstrating knowledge and understanding.**

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1c. Apply principles correctly

1d. Describe and use models

## **2. Problem solving.**

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2c. Draw conclusions and support explanations using evidence

2d. Plan design and evaluate experimental procedures.

## **3. Practical procedures.**

# The two mark question

$$\text{Pressure} = \text{force} / \text{area}$$

$\frac{1}{2}$  for the relation

$$= 180 \text{ N} / 3 \text{ m}^2$$

$\frac{1}{2}$  for the substitution

$$= \underline{60 \text{ Pa}}$$

$\frac{1}{2}$  for the correct unit

$\frac{1}{2}$  for the correct computation

**Total 2 marks.**

## 2 + 1 mark question.

$$\text{Weight of the block} = mg = 20 \times 9.8 = 196 \text{ N}$$

1/2 for relationship, 1/2 for substitution.

$$\begin{aligned}\text{Stress} &= \text{force} / \text{area} \\ &= 196 \text{ N} / 3 \text{ m}^2 \\ &= 65.3 \text{ Pa}\end{aligned}$$

Two marks as before

**3 marks (Problem solving.)**

Let's consider two questions from the  
2006 Advanced Higher paper.

(see handout)

2. a. i. Torque =  $F \times d = 10 \times 20 \times 10^{-3} = \underline{\underline{0.20 \text{ Nm}}}$

ii.  $\frac{\Delta \omega}{\Delta t} = \frac{7.5}{3} = \underline{\underline{2.5 \text{ rad s}^{-2}}}$

iii. Torque =  $I \alpha \quad \therefore I = \frac{T}{\alpha} = \frac{0.20}{2.5} = \underline{\underline{0.08 \text{ kg m}^2}}$

b. i.  $I = \frac{1}{2} m r^2 = \frac{1}{2} \times 3.2 \times (0.12)^2 = \underline{\underline{0.023 \text{ kg m}^2}}$

ii. Angular momentum remains constant so...

$$I_1 \omega_1 = (I_1 + I_2) \omega_2$$

$$0.08 \times 7.5 = (0.08 + 0.023) \omega_2$$

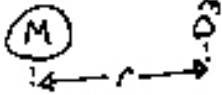
$$\omega_2 = \frac{0.6}{0.103}$$

$$= \underline{\underline{5.8 \text{ rad s}^{-1}}}$$

c.  $I$  for the new disc is greater (mass is distributed further from centre.)

$\therefore$  the new total  $I$  will be greater and hence final angular velocity will reduce.

3. a. i, The magnitude of the grav force on a unit mass.

ii, A Universal law: Force =  $\frac{Mm}{r^2} G$  

$$\text{Field, } g_1 = \frac{F}{m} = \frac{GM}{r^2}$$

$$\therefore \underline{\underline{M = \frac{gr^2}{G}}}$$

B Substituting into the equation above:

$$M = \frac{3.7 \times (3.4 \times 10^6)^2}{6.67 \times 10^{-11}} = \underline{\underline{6.4 \times 10^{23} \text{ kg}}}$$

b, i, Force on craft =  $F = \frac{GMm}{d^2}$

$$m = 100 \text{ kg}$$
$$d = 3.7 \times 10^3 \text{ km}$$

$$= \frac{6.67 \times 10^{-11} \times 6.4 \times 10^{23} \times 100}{(3.7 \times 10^6)^2}$$

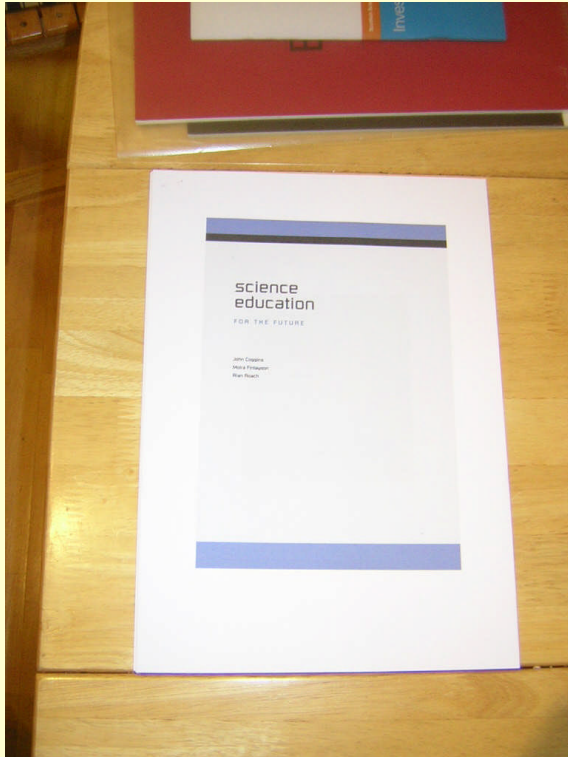
$$= \underline{\underline{3.1 \times 10^2 \text{ N}}}$$

ii, Force (centrif) =  $\frac{mv^2}{r}$   $\therefore v = \sqrt{\frac{r}{m} \times 3.1 \times 10^2} = \underline{\underline{3.4 \times 10^3 \text{ m/s}}}$

‘The study of Higher Physics should also foster an interest in current developments in, and applications of, physics, the willingness to make critical and evaluative comment and the acceptance that physics is a changing subject.

Positive attitudes, such as being open minded and willing to recognise alternative points of view, are promoted.’

SQA Physics Higher arrangements.



‘We can assert that our project participants would not object to changes to assessment that substantially reduce the burden imposed and led to much less detail-orientated examination papers. Nor would they be upset if not all corners of the topic curriculum were always addressed.’

*Science Curriculum for the Future (2004)*

Coggins, Finlayson and Roach

**What to expect post 2012**

# Evolution not revolution.

## Higher Physics

Mechanics and properties of matter (40)

Electricity and electronics (40)

Radiation and matter (40)

## New Higher Physics??

Big physics (astrophysics)

Wee physics (particle physics)

Dynamic Physics

Waves

Electrons at work

Topical investigation

Web based research

Planning an investigation

Carrying out an investigation

Taking part in a presentation

Maintaining a record of work

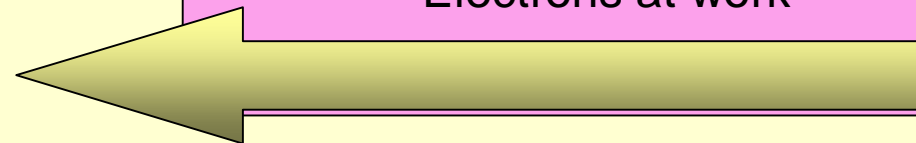
or

## New Higher Physics??

Our Dynamic universe

Particles and Waves

Electrons at work



# And then...more morphing

## **Advanced Higher Physics**

Mechanics (40)

Electrical phenomena (40)

Wave phenomena (20)

Investigation (20)

## **New Advanced Higher Physics??**

Mechanics and waves  
repackaged

Electrical phenomena

Investigation

Environmental physics

Astrophysics

# Assessment

## Question 4

A book describing a medieval battle includes the following description of the flight of an arrow.

“The arrow drew its curve in the sky, then fell fast, plunging, and losing its momentum.”

Using physics principles, comment on the way the author has described the flight of the arrow.

3 marks

- 1 In a book in which he describes his childhood experiences, an author describes how he used to drop peanuts down the stairwell of a department store. This would annoy the shop owner “*who would come flying up the stairs at about the speed that the peanut had gone down, giving you less than five seconds to scramble away to freedom*”.

Using physics principles, comment on the way the author has compared the speed of the peanut and the shop owner.

3 marks

