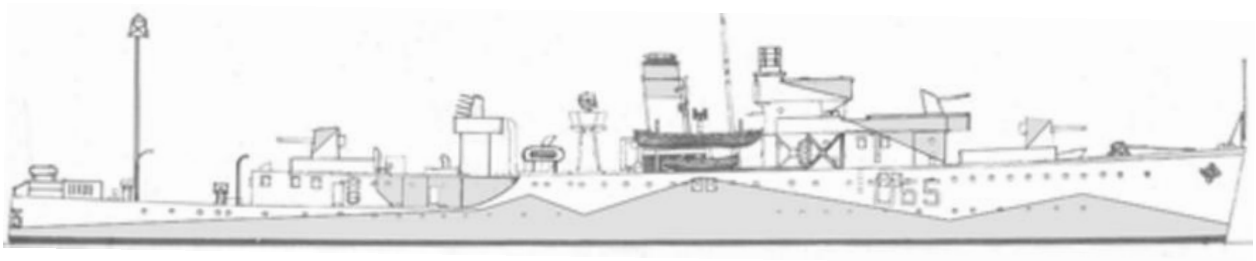
HQS Wellington A level Physics support

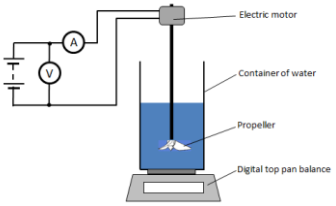


Activities

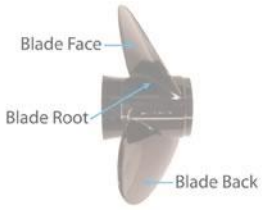
The aim of these activities is to provide opportunities for students you use their Physics skills, knowledge and understanding in marine contexts that they would not normally encounter in the classroom. Most involve some aspect of research using the ship's intranet, some are practically based, some require data analysis and all involve some aspect of problem solving. Relevant equations are provided where necessary.

Currently available:

1. **Investigating the thrust from a propeller**
   This is a practical task. Students measure the force produced by a propeller across a range of potential differences and currents supplied to the motor. The turbulence produced by the propeller at higher speeds produces some additional problems for students to address.



2. **Choosing the right propeller**



   Through some initial research students are introduced to the idea that the pitch of a propeller and well as the rate of rotation affect the speed and that increasing the pitch reduces the rate of rotation. Students are then guided to manipulate and analyse some data to determine the optimum pitch pf propeller for a ship similar to HQS Wellington. Some android tablets are available running Excel to assist with the analysis.

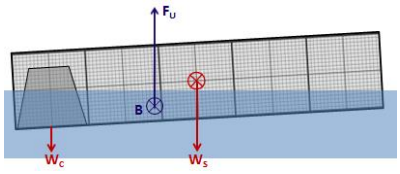
3. **Maximum mass of the ship**
   Students are simply given the task to estimate the maximum safe mass of the ship when fully loaded. There is no correct method stipulated but a reasonable answer can be obtained using the principles of flotation and estimating the volume of water displaced when the ship is floating with the Plimsoll line just visible above the water. With research students can find information on the Plimsoll line and a scale diagram of the ship.

4. **HF/DF**
   High-frequency direction finding, usually known by its abbreviation HF/DF or nickname huff-duff, is the common name for a type of radio direction finder introduced. in World War II. Students use a model HF/DF system (based on a search coil and hidden a.c.-energised electromagnet) to find the location of a hidden submarine. They are expected to consider how best to maximise the reliability of their location of the submarine, state the coordinates of its inferred location and the uncertainty.

5. **Hedgehog bombs**

As well as researching the advantages of hedgehog bombs over depth charges students will use their knowledge and understanding of projectile motion and consider the implications of a misfire.

6. **Forces on a ship and the correct loading of cargo**



A Powerpoint presentation introduces students to the concept of centre of buoyancy and the forces on a floating ship particularly when it is not level. Students then use this together with their existing knowledge and understanding of moments and equilibrium to consider the importance of how cargo is loaded.

7. **Forces on a turning vessel**

Using the same Powerpoint presentation as for 'Forces on a ship and the correct loading of cargo' students apply their knowledge and understanding of centripetal force, moments and equilibrium to find out why ships tilt when they turn. They can also go on to consider the factors determining the radius of turn and maximum safe speed, and particular issues concerning cruise ships.

8. **Using a sextant**

The main task in this activity is to follow instructions in order to use a sextant to measure the height of a nearby landmark (usually The Shard). Reading of angle scales with Vernier are involved as is some use of basic trigonometry.

The second task is to find the focal lengths of the 2 lenses in the sextant telescope by estimating the magnification and distance between the lenses.

9. **QF Mark IX guns**

This task investigates the logistical considerations when using the ship's main guns. Initially students are guided to research data about the guns. They then use this data and their knowledge and understanding of forces, motion, projectiles and momentum to explore issues such as how firing the guns affects the rest if the ship and how the amount of propellant used affects the range.

Soon to be added:

10. **Oscillations of a floating object**

The practical part of this task involves investigating the vertical oscillations of a floating object and determining whether or not it is SHM. Students then consider the implications of resonance and how it might occur. Finally students consider whether or not they can suggest a value for the natural frequency for the vertical oscillations of a ship and whether resonance is a potential problem.

See more over page

11. **Acceleration of a model ship**
    This is a practical task where students take measurements from videos showing the motion of a model ship in various control conditions. They will then use their measurements to make inferences about the factors affecting the motion.

The next pages shows the match between the tasks and the practical skills assessed by the A level Physics examinations. **See below**

Skills assessed by endorsed practicals	1	2	3	4	5	6	7	8	9	10	11
	Propeller thrust	Choosing the right propeller	Max mass of ship	HF/DF	Hedgehog bombs	Forces & Correctly Loading Cargo	Forces on a turning vessel	Using a Sextant	QF Mark IX guns	Oscillations of a floating object	Acceleration of a model ship
a) use appropriate analogue apparatus to record a range of measurements and to interpolate between scale markings.	✓					✓	✓	✓		✓	✓
b) use appropriate digital instruments, including electrical multimeters, to obtain a range of measurements.	✓			✓							✓
c) use methods to increase accuracy of measurements, such as timing over multiple oscillations, or use of fiduciary marker, set square or plumb line.	✓			✓				✓		✓	
d) use stopwatch or light gates for timing.										✓	
e) use calipers and micrometers for small distances, using digital or vernier scales.								✓			
f) correctly construct circuits from circuit diagrams using DC power supplies, cells, and a range of circuit components, including those where polarity is important.	✓										
g) design, construct and check circuits using DC power supplies, cells, and a range of circuit components.											
k) use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.	✓	✓								✓	✓

Skill assessed in examinations	1	2	3	4	5	6	7	8	9	10	11
	Propeller thrust	Choosing the right propeller	Max mass of ship	HF/DF	Hedgehog bombs	Forces & Correctly Loading Cargo	Forces on a turning vessel	Using a Sextant	QF Mark IX guns	Oscillations of a floating object	Acceleration of a model ship
1.1 Solve problems set in practical contexts	✓		✓	✓				✓		✓	✓
1.2 Apply scientific knowledge to practical contexts	✓		✓	✓				✓		✓	✓
2.1 Comment on experimental design and evaluate scientific methods	✓		✓							✓	✓
2.2 Present data in appropriate ways	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.3 Evaluate results and draw conclusions with reference to measurement uncertainties and errors	✓	✓	✓	✓		✓	✓	✓		✓	✓
2.4 Identify variables including those that must be controlled	✓								✓	✓	✓
3.1 Plot and interpret graphs	✓	✓								✓	✓
3.2 Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
3.3 Consider margins of error, accuracy and precision of data	✓	✓	✓	✓		✓	✓	✓		✓	✓
4.1 Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification	✓			✓				✓		✓	