

International Advanced Level

Subject: Physics

The need for Transferable Skills

Sources: Cognitive/Intrapersonal and Interpersonal skills adapted and taken from the NRC framework

In recent years, higher education institutions and employers have consistently highlighted the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work. The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning'.

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, the team identified the National Research Council's (NRC) framework as the most evidence-based and robust skills framework, and have used this as a basis for our adapted skills framework.

The framework includes cognitive, intrapersonal skills and interpersonal skills. These skills have been interpreted to ensure they are appropriate for this subject. All of the skills listed are evident or accessible in the teaching, learning and/or assessment of the qualification.

Identifying and highlighting these skills in International Advanced Level qualifications ensures that it is not only the academic and cognitive skills that are developed, but those broader elements that universities highlight as being essential for success. Skills such as self-directed study, independent research, self-awareness of own strengths and weaknesses and time-management are skills that students cannot learn from a textbook but have to be developed through the teaching and learning experience that can be provided through an international curriculum.

In the tables below, we have taken the NRC framework skills and provided definitions of how each skill can be interpreted for this subject. This will enable teachers and learners to understand examples of how they can develop each skill through an International Advanced Level qualification.

NRC framework skill	Skill interpretation in this subject	Where the skill is covered in content	Where the skill is explicitly assessed in examination	Opportunity for the skill to be developed through teaching and learning approach
Cognitive skills				
Cognitive Processes and Strategies				
Critical thinking	Using more than one area of Physics concepts to link ideas and synthesise knowledge when solving a problem.	Topics 5.6 and 4.3	Paper 5 Qu 20 AO1: 4 marks and AO2a: 2 marks and AO2b : 4 marks	The motion of satellites combines both Newton's law of gravitation and circular motion. Students can use equations to predict the relationship between the radius of the orbit and the time period.
Problem solving	Applying knowledge and understanding to familiar and unfamiliar contexts to produce a reasoned explanation or calculate a value.	All topics	Paper 1 Qu 16 is an example of a familiar context whilst Qu 18 is likely to be unfamiliar. Qu 16 AO1: 6 marks Qu 18 AO1: 5 marks and AO2a: 3 marks and AO2b: 4 marks	One introduction to mathematical problem solving is to apply the appropriate equations for accelerated motion in one dimension to a variety of examples. Give several examples using different combinations of u , v , s , a and t .
Analysis	Considering data from an experiment and using a graph to test for correlations or causal relationships. Developing the ability to solve physics problems, including those of a mathematical nature.	3.5 and 6.5	Paper 6 Qu 5 (d) AO3: 11 marks	The core practicals can be used to collect data. In most cases a graphical method can be used to establish the mathematical relationship between two variables. In practical 7 most experiments will use different lengths of wire and corresponding resistance to graphically determine resistivity. One variation is to use the same length of different cross-sections of wire - if available. Solve a variety of problems in physics e.g. mechanics.

Cognitive Processes and Strategies				
Reasoning/ argumentation	Drawing a valid conclusion from a practical, using reasoned arguments.	3.5 and 6.5	Paper 6 Qu 4 (b) AO3: 3 marks	Use the core practicals to explore the more common mathematical relationships between variables. E.g. Investigate and graphically test the differences between inversely proportional and exponential decay.
Interpretation	Recognising that information can be presented in different forms.	4.3: 83 4.4	Paper 4 Qu 13 AO1: 1 mark and AO2a: 1 mark and AO2b 6 marks	Information can be presented as a drawing, text, a list of numerical values, graphically or tabulated. Problems concerning momentum in two dimensions will benefit from a well-drawn diagram.
Decision making	Selecting suitable apparatus and an appropriate method for an experiment.	3.3 and 6.3	Paper 6 Qu 3 (a) AO3: 5 marks	The core practicals can be used to generate class discussion about suitable apparatus and an appropriate method which will generate the data required.
Adaptive learning	Responding to a novel context and using knowledge and understanding to identify the key physics concepts under discussion.	All topics	Paper 2 Qu 15 AO1: 2 marks and AO2a: 4 marks	Students should know and understand what is meant by interference of waves and the associated vocabulary. There are then many applications that teachers can present e.g. CD players, astronomical interferometry which students can apply their knowledge to explain.
Executive function	Working to appropriate time scales when planning and conducting practical work.	Core practicals		A range of experiments are suggested within the specification.
Creativity				
Creativity	Identifying possible sources of uncertainty when planning a practical. Explaining how these may be reduced or eliminated.	3.3	Paper 3 Qu 1(b) AO3: 3 marks	The core practicals provide opportunities for class discussion. In core practical 5 discuss how the tension in a wire can be varied and measured.
Innovation	Commenting on how an experiment may be improved, possibly by using additional apparatus.	3.4 and 6.4	Paper 3 Qu 5 (b) AO3: 3 marks	The core practicals provide opportunities for class discussion. In core practical 7 discuss what effect, if any, the width of the connections might have on the length of wire. This may lead to a systematic error which would be evidenced on a suitable graph.

NRC framework skill	Skill interpretation in this subject	Where the skill is covered in content	Where the skill is explicitly assessed in examination	Opportunity for the skill to be developed through teaching and learning approach
Intrapersonal skills				
Intellectual openness				
Adaptability	Reflecting on a method and the apparatus used when carrying out practical work and considering what improvements could be made.	3.4 and 6.4	Paper 6 Qu 3 (b) AO3: 2 marks	Use class practicals and discussion to consider improvements that could be made.
Personal and social responsibility	Discussing areas of the specification e.g. big bang theory of the universe and how it is based on factual scientific evidence.	5.6: 171	Paper 5 Qu 21 (b)(i) AO2b: 4 marks	There are opportunities e.g. in topic 5.6 to discuss ideas within physics that some students may find challenging for cultural or religious reasons. Discuss the fact that conclusions reached within science are based on evidence.
Continuous learning	Consolidating the AS topics within Physics as many of the A2 topics are related.	4.3: 83 depends on 1.3: 13 and 1.3: 14	Paper 5 Q18(b) AO2b: 3 marks	The treatment of momentum in topic 4.3 depends on and revisits earlier work covered in topic 1.3. This emphasises the nature of the subject as one in which deeper levels of understanding are achieved incrementally.
Intellectual interest and curiosity	Undertaking a research project such as the extended project.	Appendix 4 within the specification gives further details and examples about the extended project.		See appendix 4 in the specification.
Work ethic/conscientiousness				
Initiative	Showing a willingness to study and read beyond that routinely suggested by the teacher.			Use group or individual presentations to assess whether students have been prepared to research beyond the obvious.
Self-direction	Planning and carrying out individual lines of enquiry.			Set students the task to write their own learning plan for a particular topic.
Responsibility	Taking responsibility to manage one's own learning and creating a plan to improve. Managing practical work safely.			Review the plan with the student, encourage them to be reflective and honest. Taking responsibility for carrying out practical work in a safe manner, following all safety requirements.
Perseverance	Recognising areas of weakness and prioritising these as a way to improve.			Follow up the learning plan and encourage the student to consider whether they have completed it fully.

Productivity	Developing a succinct written style to answer questions directly and fluently.			This can be encouraged by asking students to exchange written answers to problems. Ask them to be critical about the effectiveness of the level of communication.
Self-regulation (metacognition, forethought, reflection)	Developing strategies over time, including self-assessment and critical review, for reflecting on the success or otherwise of the work.			Follow up learning plans and encourage the student to reflect and consider a new set of actions and goals.
Ethics	Engaging in discussions and arguing from an appropriate standpoint whilst being considerate to other views and positions.			Learners could consider the ethics of spending a large amount of money on the space programme, or ethical issues relating to the impact of physics on the environment.
Integrity	Employing working methods which are honest and appropriate.	Core practicals		Records practical results with integrity, including anomalous results.
Positive Core Self Evaluation				
Self-monitoring/self-evaluation/self-reinforcement	Developing the ability to reflect both positively and negatively about one's understanding of the concepts being covered.			Students can be encouraged to reflect on their progress and consider actions which will improve their overall level of achievement.
NRC framework skill	Skill interpretation in this subject	Where the skill is covered in content	Where the skill is explicitly assessed in examination	Opportunity for the skill to be developed through teaching and learning approach
Interpersonal skills				
Teamwork and collaboration				
Communication	Developing an ability to form an argument using verbal and written, linguistic and/or mathematical, expression.		Paper 2 Qu 16 b (ii)	Use scenarios to encourage students to write a paragraph explanation using physics principles or work through a mathematical solution which involves multiple steps. Presenting practical results in a standard scientific format; presenting problems to solutions in a clear and coherent fashion.
Collaboration	Sharing ideas when discussing approaches to class practical work.	Core practicals		Use a class practical to discuss apparatus, appropriate methods and data analysis.
Teamwork	Working with others to develop an understanding of a key concept.			Use groups to research different scenarios within a given topic and then feedback their findings to the rest of the class. E.g. give each group a different application of electromagnetic induction.
Co-operation	Listening, discussing and criticising respective answers/presentations from groups of students to a problem solving activity.			Encourage each group to be considerate yet usefully critical of group presentations.
Interpersonal skills	Using verbal and non-verbal skills in presenting, or listening to, a reasoned			Use opportunities within class to allow students to present an

	argument.			explanation to a physics scenario or problem.
Empathy/perspective taking	Being considerate of the position of others during class discussions.			Encourage each group to be equally interested in the work of others as they are of their own when participating in group presentations.
Negotiation	Learning to agree to someone else's position or using the art of persuasion to reach a common understanding of a particular scenario or problem.			This can be developed by asking groups to work on a solution to the same problem. There may be different approaches but students will learn the art of recognising when another point of view is valid.
Leadership				
Leadership	Taking a leading role during discussions, shared problem solving sessions and practical work whilst ensuring other students are able to contribute appropriately.			Leadership can be developed by encouraging a particular student to take the lead in a discussion or problem solving session. Consequently encourage the student to ask for the opinions or help from other students in the class.
Responsibility	Considering others when participating in class discussions.			Leadership can be developed by encouraging students to be considerate of other points of view and, consequently earning the respect of other students.
Assertive communication	Learning to address conflicting viewpoints, using persuasive techniques effectively to convince a point of view which leads to a singular conclusion or answer.			There will be times when a number of points of view are prevalent, use this to encourage students to weigh up the different arguments for themselves and reach a conclusion.
Self-presentation	Developing a reflective attitude to one's behaviour during classroom discussions, shared problem solving sessions and practical work.			Encourage students to reflectively consider their approach to classroom activity on a regular basis.