PEARSON EDEXCEL INTERNATIONAL GCSE (9-1) Physics

Understanding Assessment and Improving Delivery

First teaching in 2017, first assessment in 2019.

Aims and Objectives

Understanding assessment and improving delivery in International GCSE Physics

During the day you will:

- Be introduced to the idea of assessment objectives: what they are and why they are used when writing examination papers.
- Analyse recent question papers and learn which types of question match the different assessment objectives.
- Investigate different assessment objectives, considering how questions in these areas have been answered by looking at feedback from previous exam series.
- Discuss strategies for teaching to try and make sure students can access questions targeting different assessment objectives.
- Review the support Pearson offers for the qualification.
- Network, discuss best practice and share ideas with other teachers.

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Course Agenda

10.00 – 10.10	Introductions
10.10 – 11.10	Session 1: Explanation of the Assessment Objectives
11.10 – 11.30	BREAK
11.30 – 12.45	Session 2: AO1
12.45 – 13.45	LUNCH
13.45 – 15.00	Session 3: AO2
15.00 – 15.30	Session 4: AO3
15.30 – 16.00	Any questions / feedback / depart

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Session 1
Explanation of assessment objectives

Session 1 Explanation of the Assessment Objectives

- What are the Assessment Objectives (AOs)?
- Why they are used
- Balance of AOs in the papers
- Exercise: identifying AOs in questions

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The Assessment Objectives

AO1	Knowledge and understanding of physics
AO2	Application of knowledge and understanding, analysis and evaluation of physics
AO3	Experimental skills, analysis and evaluation of data and methods in physics

All assessment objectives are assessed in both Paper 1 and Paper 2.

Each paper targets the same distribution of these assessment objectives.

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AO1

This assessment objective covers all areas of physics that students should have routinely covered as part of studying the content of the specification. It covers the recall of formulae and units through to understanding standard identified contexts, such as explaining how a loudspeaker works.

Examples of AO1 questions

- State the formula linking average speed, distance moved and time taken
- State the name of component X
- Describe the uses of three different radiations in the electromagnetic spectrum
- Describe how the average kinetic energy of a gas particle changes when the temperature of the gas increases
- Sketch a graph to show what is meant by a.c.
- Give an example of a longitudinal wave

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AO2

Questions targeting this assessment objective will require students to apply their knowledge and understanding to a context that may not be familiar to them. Questions requiring a calculation also target AO2. The most demanding AO2 questions may require the use of a calculation to make a suitable evaluation about an unfamiliar context.

Examples of AO2 questions

- Calculate the average speed of the ball
- Explain how the sound heard from a buzzer changes when the buzzer is thrown towards a student
- Explain why hydrogen must be heated to a high temperature for fusion to take place
- Explain what information the two spectra give about the movement of the galaxy

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AO3

Students are expected to have completed the 12 practical investigations outlined in the specification. Ideally, they will also have completed many other practical investigations. Questions targeting AO3 assess students' knowledge and understanding of designing, performing, presenting and concluding an experimental investigation.

Examples of AO3 questions

- Draw a voltmeter on the circuit diagram to measure the voltage of component X
- State two control variables for this investigation
- Plot the student's results on the grid
- Explain which type of graph is appropriate for this investigation
- Describe how the power output of a wind turbine varies with wind speed using data from the graph

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Why assessment objectives are used

- A range of skills are assessed in every paper
- Consistency between the two papers in terms of accessibility and level of demand
- Similar difficulty of assessment achieved across all examination series over time
- Same assessment objectives and distribution of assessment objectives used across all sciences in the International GCSE suite of qualifications

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Balance of AOs on the papers

		%
AO1	Knowledge and understanding of physics	38–42
AO2	Application of knowledge and understanding, analysis and evaluation of physics	38–42
AO3	Experimental skills, analysis and evaluation of data and methods in physics	19–21

This distribution of assessment objectives is identical in Paper 1 and Paper 2.

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Activity 1 – Identifying AOs

Look at the 4PH1 1P paper in your delegate pack. This paper was sat by candidates in May 2019 and was the first assessment for the 9-1 specification.

Task 1

Look at Q3. Which assessment objective is this question targeting? What features does this question have that links it to this assessment objective?

Task 2

Look at Q6. Which assessment objectives is this question targeting? What features does this question have that links it to these assessment objectives?

Task 3

Look at Q7. Determine which assessment objectives are being targeted in each part of this question.

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Activity 1 feedback

Task 1

Q3 targets AO2.

Students were expected to apply their knowledge and understanding of the penetration powers of alpha and gamma and the difference between irradiation and contamination.

Task 2

Q6(a) targets AO3.

Students were expected to use their experimental skills to answer this question.

Q6(b) targets AO1 (Q6(b)(i) and Q6(b)(iii)) and AO2 (Q6(b)(ii)).

Task 3

Q7 targets a mixture of AO1 and AO2.

There are some standard definitions, formulae and ray diagrams (AO1).

The calculations target AO2.

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Break

Session 2
AO1

Why do we ask AO1?

- A physicist should develop their knowledge and understanding of different physical processes and theories as their education develops.
- The purpose of AO1 is to assess students' knowledge and understanding of these processes and theories.
- AO1 questions are often (but not always) targeted at the lower and middle grade ranges (Grades 1-3 and Grades 4-6 respectively).
- AO1 is not limited to questions where students have to simply recall something from their knowledge. However, such recall questions would always be considered as targeting AO1.
- AO1 questions may be interpreted or referred to as 'standard' questions by teachers and students.

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Identifying AO1 questions in assessments

The command word used in a question is often a very strong indicator as to which assessment objective that question is targeting.

Command words linked to AO1 questions may include:

- Add / label
- Describe
- Discuss
- Draw
- Give / state / name
- State what is meant by
- What / why / which (only used in multiple-choice questions)

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4PH1 1PR Q2

This question linked nuclear fission and nuclear fusion to the generation of electricity.

(a) A nuclear fission power station generates electricity.

(i) State the role of the moderator in a nuclear fission power station.

(1)

(iii) The daughter nuclei can cause contamination and irradiation.

Describe the difference between contamination and irradiation.

(2)

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4PH1 1PR Q2

Mark scheme

Question number	Answer	Notes	Marks
2 (a) (i)	reduce the kinetic energy of neutrons;	allow 'slow down' neutrons	1
(ii)	to absorb (high energy) neutrons;	allow absorb / reduce strength of neutron radiation condone "stop neutrons escaping"	
	use of (concrete / lead) shielding;	allow "concrete walls"	
(iii)	idea that contamination is when a non-radioactive object comes into contact with a radioactive material; idea that irradiation is when radiation is present;	Condone idea of exposure for 1 mark if no other mark scored	2

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4PH1 1PR Q2

This question linked nuclear fission and nuclear fusion to the generation of electricity.

(b) Nuclear fusion is another process that could be used to generate electricity.

(i) Describe the process of nuclear fusion.

(2)

(ii) State where nuclear fusion occurs naturally.

(1)

(iii) Generating electricity from nuclear fusion is very difficult as the conditions needed are hard to achieve and maintain.

Explain the conditions required for nuclear fusion.

(3)

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4PH1 1PR Q2

Mark scheme

(b)	(i)	any two from: MP1. creation of a (large) nucleus from small nuclei; MP2. resulting in a loss of mass; MP3. and the release of energy;	 condone "fusing of two nuclei" accept reference to $E=mc^2$ condone "converted to energy"	2
	(ii)	(in) star(s);	allow named star e.g. The Sun	1
	(iii)	any three from: MP1. high temperature required; MP2. to increase kinetic energy of nuclei; MP3. high pressure required; MP4. (because) nuclei need to be close enough to collide; MP5. (since) nuclei repel each other;	 allow to make nuclei move faster allow particles or atoms for this MP allow higher level answers in terms of short range strong nuclear force	3

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4PH1 1PR Q9

This question assessed students' knowledge and understanding of refraction.

(a) A light ray travels from air into water.

Diagram 1 shows the direction of the light ray and the wavefronts in air.

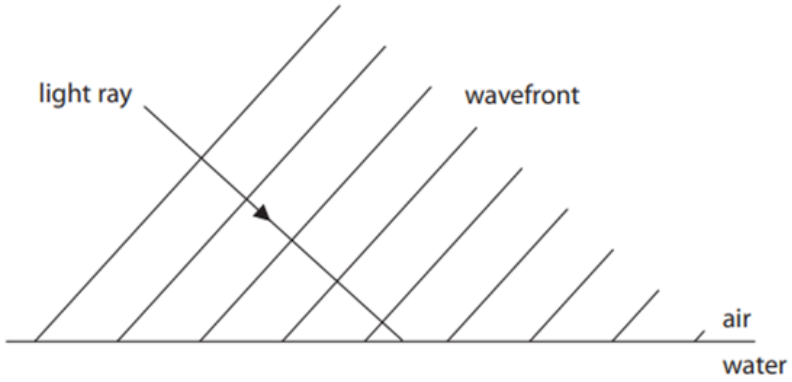

Diagram 1

The refractive index of water is greater than the refractive index of air.

(i) Complete diagram 1 by showing

- the wavefronts in the water
- the path of the light ray in the water

(3)

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4PH1 1PR Q9

Mark scheme

Question number	Answer	Notes	Marks
9 (a) (i)	light ray refracting and bending in the correct direction; wavefronts in water drawn closer together by eye; wavefronts drawn in water join up with wavefronts in air;	ignore any response in the air e.g. reflected wavefronts or direction of travel of reflected ray allow wherever seen in diagram	3

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4PH1 1PR Q9

This question assessed students' knowledge and understanding of refraction.

(b) Diagram 2 shows what can happen when a light ray travelling in glass meets the boundary with air.

The wavefronts are not shown in this diagram.

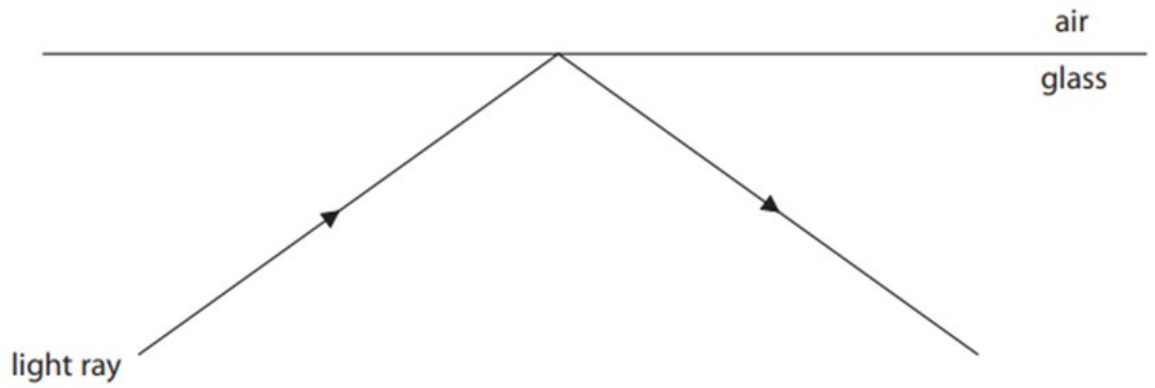

Diagram 2

(i) Add the normal to diagram 2.

(1)

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4PH1 1PR Q9

Mark scheme

(b)	(i)	normal drawn at right angles where light ray meets boundary;	judge by eye	1

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Activity 2 – Marking exercise

Look at the Activity 2 booklet in your delegate pack.

This activity shows some real student responses to parts of Q2 and Q9 from the 4PH1 1PR sat in May 2019.

Using the mark schemes, mark the students' responses.

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Activity 3 – Facilitating achievement in AO1 questions

As teachers, what strategies can we use to help students succeed when attempting AO1 questions?

Discuss, with other delegates on your table, teaching and revision strategies that may improve students' performance in AO1 questions.

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Activity 3 – some suggestions

- Using a spiral curriculum – teaching a little of each of the 8 topics in each year of study to allow frequent opportunities to revise and revisit challenging concepts and theories.
- Whiteboard starter activities / mini plenaries – assess students' retention of key concepts at the beginning of a lesson and at relevant points throughout the lesson.
- Revision flashcards – these can be bought or made (even better for students to make their own) to revise definitions, formulae and units that need to be recalled.
- Topic checklists – edit the specification to turn it into a list of questions for students to answer.

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Lunch

Session 3
AO2

Why do we ask AO2?

- A physicist should be able to apply what they have learned to solve problems.
- A physicist should also be able to apply their knowledge and understanding in unfamiliar contexts.
- The most able physicists should be able to extend their knowledge and understanding into linked areas of study.
- AO2 questions are targeted at assessing these skills.

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Identifying AO2 questions in assessments

All calculations (unless they are linked to experimental skills) target AO2.

Students are assessed on their ability to use a suitable formula and their mathematical skills to solve a quantitative problem.

Marks are given for:

- Substituting values correctly into a formula
- Rearranging a formula
- Changing units into standard units (where relevant)
- Evaluating a mathematical expression to give an answer in decimal or standard form
- Giving an answer to a given number of significant figures (when requested)

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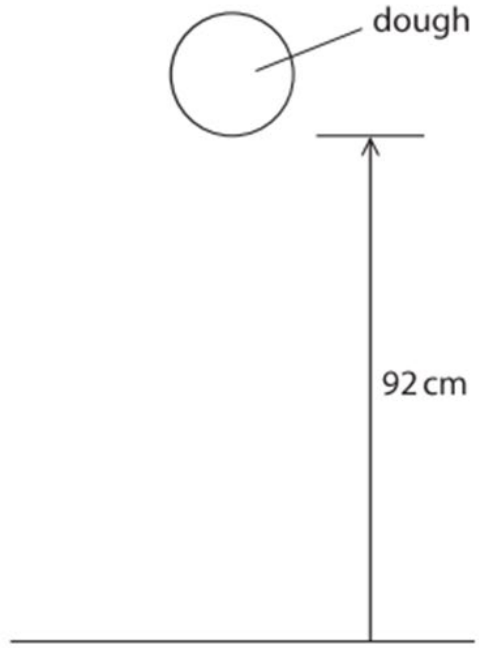
Example calculation question 4PH1 1P Q12(a)

12 (a) The diagram shows a ball of dough, of mass 580 g, held at a height of 92 cm above the floor.



Calculate the increase in gravitational potential energy (GPE) stored in the ball of dough when it is above the floor.

(3)

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Example calculation question 4PH1 1P Q12(a)

Question number	Answer	Notes	Marks
12 (a)	substitution into GPE = mass × *g* × height; at least one quantity correctly converted to SI units; correct evaluation; e.g. GPE = 0.580 × 10 × 0.92 mass = 0.580 (kg) OR height = 0.92 (m) (GPE =) 5.3 (J)	allow substitution with no unit conversions allow *g* = 9.8, 9.81 allow 5.2, 5.34, 5.336, 5.23...	3

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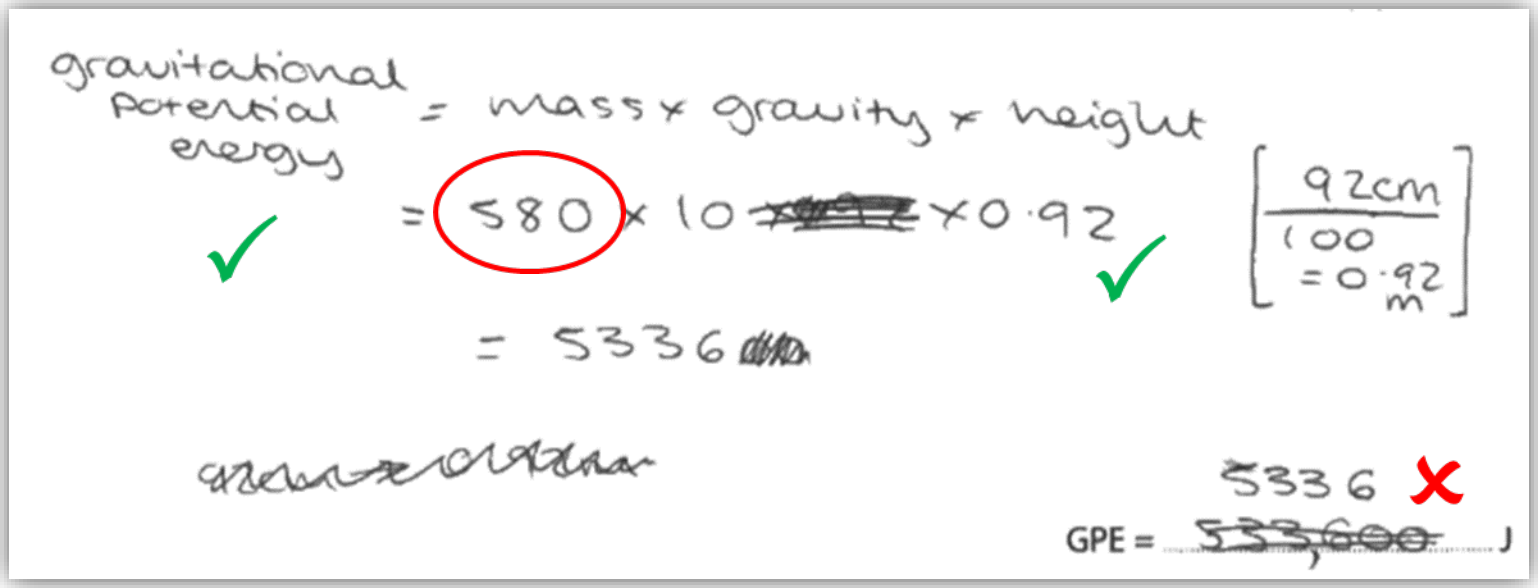
Example calculation question 4PH1 1P Q12(a)



2 marks awarded

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Example calculation question 4PH1 1P Q12(a)

Calculate the increase in gravitational potential energy (GPE) stored in the ball of dough when it is above the floor.

(3)

gpe = mass (kg) × gravity (9) × height (m)

$= \frac{580}{1000} \times 10 \times \frac{92}{100}$ ✓ ✓

$= 0.58 \times 10 \times 0.92$

$= 5.336$

GPE = 5.336 ✓ J

3 marks awarded

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Identifying AO2 questions in assessments

The command word used in a question is often a very strong indicator as to which assessment objective that question is targeting.

Command words linked to AO2 questions may include:

- Calculate
- Deduce
- Determine
- Evaluate
- Explain
- Justify
- Show that
- Suggest

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Example AO2 question
4PH1 1P Q8(a)(ii)

8 Schiaparelli is a spacecraft that was sent to Mars in 2016.

(a) Schiaparelli slowed down as it fell vertically through the atmosphere of Mars.

(ii) Schiaparelli then opened a parachute to slow down.

Explain how the spacecraft reached a low terminal velocity after opening its parachute.

Use ideas about forces in your answer.

(4)

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Example AO2 question
4PH1 1P Q8(a)(ii)

(ii)	any four from:	allow "drag" for air resistance throughout condone "gravity" for weight throughout	4
	MP1. air resistance increases (greatly) when parachute is opened;	allow "upwards force" for air resistance	
	MP2. idea that air resistance is greater than weight;	allow upward force is bigger than downward force	
	MP3. (therefore) resultant force is upwards;	allow deceleration / upwards acceleration ignore "it slows down"	
	MP4. idea that as speed decreases, air resistance decreases;		
	MP5. resultant force (eventually) becomes zero;	allow forces are balanced/equal air resistance = weight	
	MP6. constant speed achieved;	allow idea that there is no acceleration	

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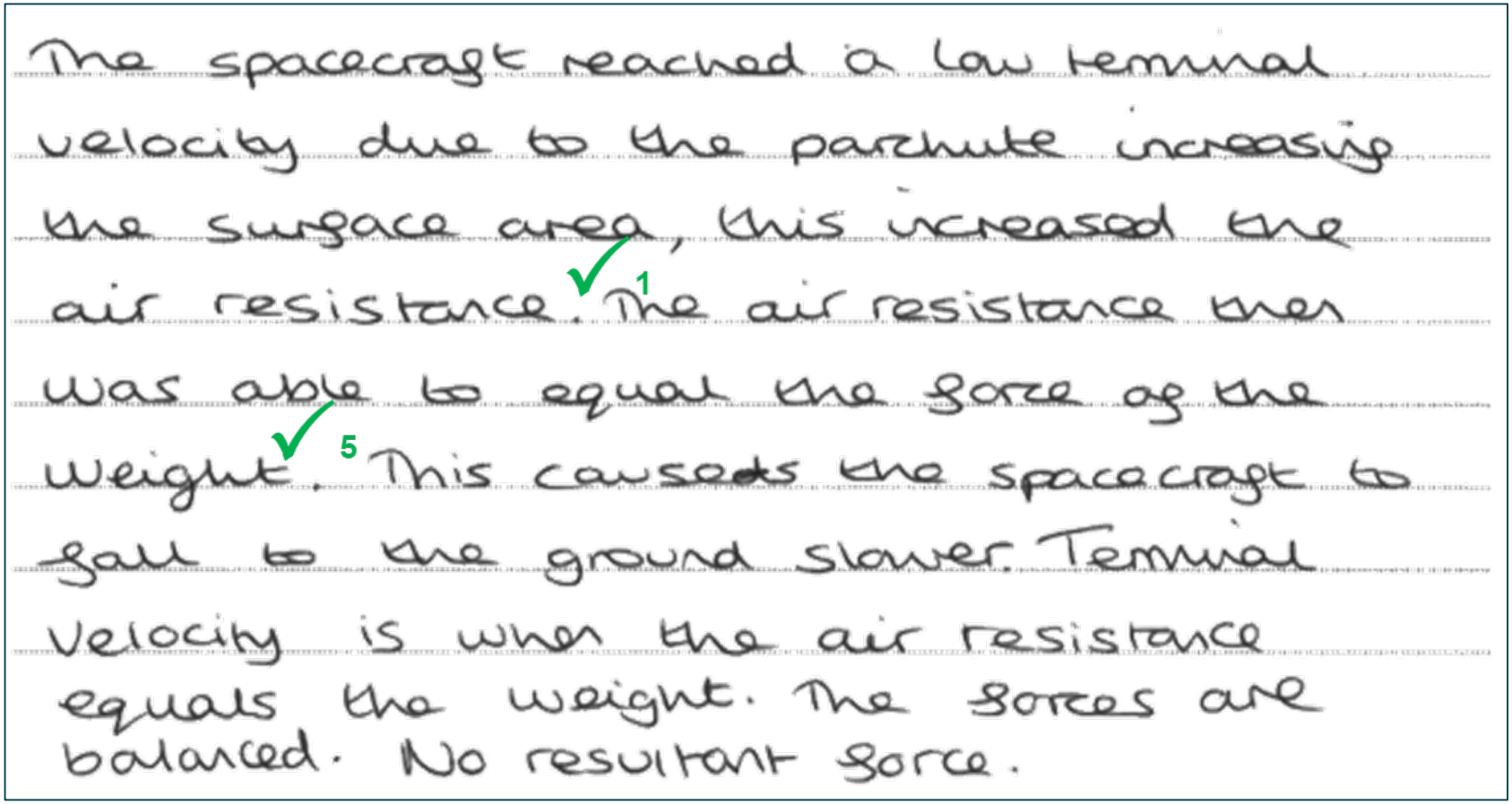
Example AO2 question
4PH1 1P Q8(a)(ii)


The spacecraft reached a low terminal velocity due to the parchute increasig the surface area, this increased the air resistance. ✓1 The air resistance then was able to equal the force of the weight. ✓5 This caused the spacecraft to fall to the ground slower. Terminal velocity is when the air resistance equals the weight. The forces are balanced. No resultant force.

2 marks awarded

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Example AO2 question
4PH1 1P Q8(a)(ii)

The parachute opening increased the surface area of the spacecraft, causing the ~~resc~~ air resistance to increase ✓1 and the resultant force to act upwards. ✓3 This caused the spacecraft to decelerate. Once this happened, the air resistance decreased due to the space craft ~~lower~~ lower velocity, ✓4 while the weight stayed constant. Eventually, the air resistance and the weight of the aircraft were ~~equ~~ equal, ✓5 and a new terminal velocity (lower) was reached (resultant force = 0).

4 marks awarded

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Example AO2 question
4PH1 1P Q8(c)

(c) Suggest why Mars has a lower gravitational field strength than Earth.

(1)

(c)	any one from: MP1. Mars has a smaller mass; MP2. Mars has a lower density; MP3. Mars has a smaller (iron rich) core;	allow RA allow Mars is less massive	1

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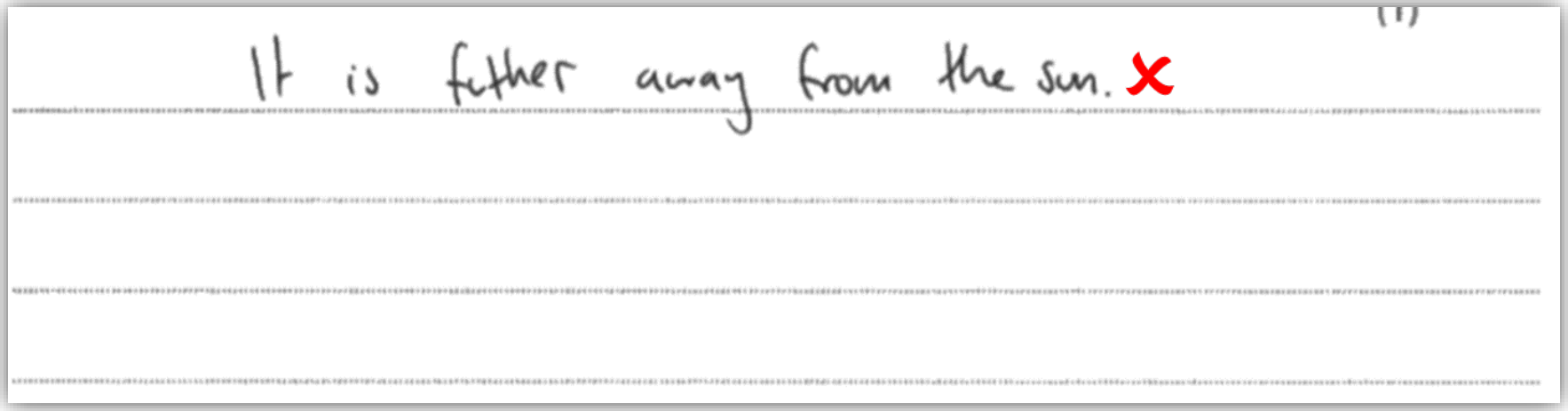
Example AO2 question
4PH1 1P Q8(c)



0 marks awarded

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Example AO2 question
4PH1 1P Q8(c)

Mars has a lower gravitational field strength then mars due to it having less mass. ✓

1 mark awarded

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Raising achievement in AO2 questions

Many students find AO2 questions more challenging than AO1 questions.

Students who have difficulty rearranging formulae find calculations very difficult. The following suggestions may improve achievement:

- Substitute data into a formula **before** rearranging it as this is usually worth 1 mark.
- Try rearranging formula after substituting data – this makes the problem more similar to a maths exercise and some students find they can solve a problem this way.
- Practise as many calculations with as many different formulae as possible, especially with more demanding formulae such as $v^2 = u^2 + 2as$.

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Raising achievement in AO2 questions

Many students find AO2 questions more challenging than AO1 questions.

Students found Q8(a)(ii) (previous terminal velocity question) very difficult because the context was similar to a standard ‘why does a falling object reach terminal velocity?’ question.

However, students still received marks for writing valid statements from their knowledge that were relevant, e.g. forces (eventually) becoming balanced.

Students will never lose marks unless their statements directly contradict each other. Therefore, trying to include as much of their relevant knowledge in their answer as possible is recommended.

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Raising achievement in AO2 questions

Many students find AO2 questions more challenging than AO1 questions.

The command word '***suggest***' is used when students are being asked to extend their knowledge and understanding to a completely unfamiliar context.

Students should be encouraged to think carefully before answering such questions.

Teachers should refer to such questions as being about something the students haven't been taught before, but that can be answered using their existing knowledge and understanding.

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Activity 4 – Raising achievement in AO2 questions

Students need opportunities to practise applying their knowledge and understanding in unfamiliar contexts.

Exam wizard and past papers allow teachers to provide students (free of charge) with past examination questions.

Teachers may also wish to write their own questions and worksheets to give their students opportunities to practise applying their knowledge and understanding of a particular area of the syllabus.

Refer to the Activity 4 booklet in your delegate pack. Using the given context, write two questions (with accompanying mark schemes) that will allow students to practise applying their knowledge and understanding of physics.

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Session 4
AO3

Why do we ask AO3?

A student pursuing an education or career in physics must be able to plan and carry out experiments to test a scientific theory.

The specification outlines 12 compulsory experiments to enable students to develop their experimental skills.

Questions targeting AO3 assess these experimental skills.

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Identifying AO3 questions in assessments

AO3 questions can be whole questions or parts of questions.

Command words commonly used in AO3 questions are:

- Analyse the data / graph to explain
- Design
- Draw
- Give / state / name
- Plot
- Predict

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4PH1 1PR Q5(a)(i)

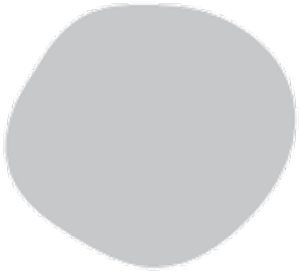
5 A student is given a type of putty that conducts electricity.

He rolls the putty into cylinders of different cross-sectional area.

The photograph shows the cylinders.

The student investigates how the electrical resistance of the putty is affected by its cross-sectional area.

(a) The diagram shows the cross-sectional area of one of the cylinders of putty.



drawn to scale

(i) Use the diagram to determine the mean diameter of the cylinder of putty.

(2)

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4PH1 1PR Q5(a)(i)

Question number	Answer	Notes	Marks
5 (a) (i)	diameter measured within range 3.5-4.0 cm; evidence of finding a mean of the diameter;		2

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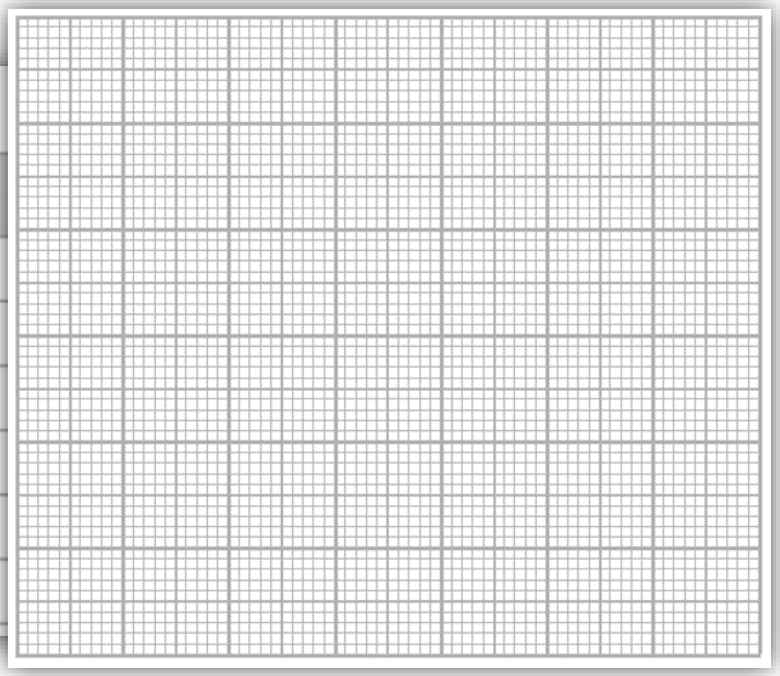
4PH1 1PR Q5(c)(ii)-(iii)

The table shows some of his results.

Cross-sectional area in cm^2	Voltage in V	Current in A	Resistance in Ω
4.5	4.56	0.049	91.2
6.2	4.56	0.059	77.3
9.1	4.56	0.068	67.1
13.9	4.56	0.085	53.6
18.1	4.56	0.094	48.5
24.6	4.56	0.107	



(ii) Plot a graph of resistance on the y-axis and cross-sectional area on the x-axis.

(3)

(iii) Draw the curve of best fit.

(1)

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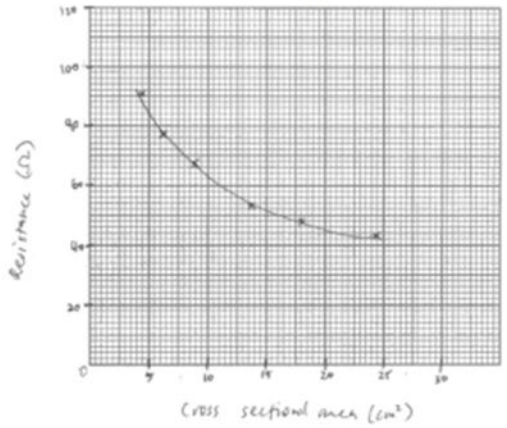
4PH1 1PR Q5(a)(i)

(ii)	suitable linear scale chosen (>50% of grid used); axes labelled with quantities and units; plotting correct to nearest half square;	orientation needs to be correct all points must be correct ignore plotting of final point	3
(iii)	line (curve) of best fit acceptable;	allow ECF from plotting i.e. smooth curve with points evenly distributed about it	1

Cross-sectional area in cm^2	Voltage in V	Current in A	Resistance in Ω
4.5	4.56	0.049	91.2
6.2	4.56	0.059	77.3
9.1	4.56	0.068	67.1
13.9	4.56	0.085	53.6
18.1	4.56	0.094	48.5
24.6	4.56	0.107	



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4PH1 1PR Q7(a)

7 A student investigates how the surface material of a ramp affects the average speed of a block sliding down the ramp.

(a) Design a suitable method for the student's investigation.

Your answer should include

- the measuring equipment needed
- details of the independent, dependent and control variables
- how the average speed will be determined

You may include a diagram to help your answer.

(6)

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4PH1 1PR Q7(a)

Question number	Answer	Notes	Marks
7 (a)	**measuring equipment:**	allow if clearly included in diagram	6
	MP1. ruler / tape measure;		
	MP2. stopclock / stopwatch;	condone 'timer'	
		accept use of light gates if connected to timing device e.g. computer/datalogger	
		accept 'camera' if subsequent method describes 'freeze-frame'/timestamp technique	
	variables:		
	MP3. surface material is the independent variable;		
	MP4. (average) speed is the dependent variable;	allow time as the dependent variable	
	MP5. any one control variable from;	allow 'keep constant' for 'control variable'	
	• size / mass / material / area /weight of block		
	• height/angle/gradient of ramp		
	• initial force given to block	allow 'push' given to block allow **initial** speed or velocity	
	• distance travelled down the ramp	allow same starting point and finishing point	
	determining average speed:		
	MP6. use of (average) speed = distance travelled / time	accept use of light gate if description includes length of card/block and time of transit	

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Raising achievement in AO3 questions

In recent examination series, students commonly lost marks for…

- Confusing the independent, dependent and control variables in an experiment.
- Not being aware of which type of graph is appropriate for a particular experiment.
- Not understanding the meaning of the terms *accuracy*, *precision*, *reliability* and *validity*.
- Designing methods that do not focus on the scaffolding bullet points used in the question.

Teachers should aim to provide as many opportunities for practical work as are realistic in the teaching timeframe.

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Support and resources

Support overview for International GCSE in Physics

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ResultsPlus

- Free online results analysis tool for teachers.
- Provides a detailed breakdown of student performance in Pearson Edexcel exams.
- Identify topics and questions where the student could benefit from further learning and inform teaching strategies and approaches.
- Benchmark your school's performance against other Pearson Edexcel schools in your country.
- Not just a post-results tool: Mock exam results can also be fed into the system to produce analysis.
- Find student results analysis from their previous Pearson Edexcel school.
- ResultsPlus Direct gives your students access to their final grades and performance breakdown, wherever they are.
- Schools can sign up for free ResultsPlus account in just a few quick and easy steps: https://qualifications.pearson.com/en/support/Services/ResultsPlus.html

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examWizard

- A free tool for teachers which helps you make quick homework assignments, topic tests and mock exams.
- Questions tagged against unit, topic and assessment objective or simply choose a whole past paper.
- Use existing mark schemes for accurate marking.
- Use examiner report for insight.
- Most recent exam content available sooner.
- Use the results to understand where students need more support, informing teaching strategies.

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New Access to Script (ATS) Online Portal

Access to Scripts (ATS) is a free online portal which allows teachers to immediately access electronically marked exam papers

Provides enhanced transparency and

- Offers transparent approach to marking process
- Provides better understanding of marking before requests for enquiries about results are made
- Provides excellent aid for teaching and preparing other cohorts for examinations by helping you to evaluate a student's performance on particular questions in relation to what they have been taught.

Available instantly from results day for all our examination series, for a defined window, you can view and download scripts which have been marked online free of charge from our Self-Service Portal.

For more information on ATS, and the post results windows, visit our post-results pages.

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Pearson International Schools Community

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- Read topical news and articles and share yours
- Advertise jobs at your school or find job opportunities
- Download free resources
- Sign up for events.

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ALWAYS LEARNING