We have updated this revision support document to provide information on the modifications that were made to course assessments (coursework and exams) at the start of academic year 2021–22.

Course modifications 2021–22: Higher Physics

Due to the disruption to learning caused by the COVID-19 pandemic, we made modifications at the start of the academic year. This helped reduce the volume of assessment and provide more time for learning and teaching, while maintaining the integrity and credibility of the qualifications.

The type of revision support provided in this document is dependent on the level of modifications that were made to your course assessment at the start of the year. For example, extensive modifications made at the start of academic year 2021–22, such as identifying content that would or would not be assessed, and/or removing parts of an exam paper, limit the amount of additional revision support that can be provided without undermining the integrity and credibility of the qualification. However, for every course the modifications and revision support together provide you with a significant package of help.

The type of modification(s) and revision support for this course are summarised below:

- **Modifications made at start of session:**
  Assignment removed for 2021-22
- **Revision support for exam:**
  Study guide

A summary table that shows the modifications we made to each course, alongside the revision support, is available on SQA's website.

We published more detailed modification documents for schools, colleges and training providers in August 2021. If you have any questions about the modifications for this course please speak to your teacher, lecturer or training provider.

Update to original revision support

There are no further updates to the document originally posted on 08 March 2022.

2022 revision support for learners: Higher Physics

Guidance for the 2022 exam

You can use the following information to help you plan your revision and prepare for the 2022 Higher Physics exam.

‘Calculate’ questions

Most standard ‘calculate’ questions are allocated 3 marks.

You will be awarded 1 mark for selecting and stating the relationship from the Relationships Sheet that you are going to use to answer the question.

You will be awarded 1 mark for substituting the values given in the question or in the Data Sheet.

You will be awarded 1 mark for stating a correct final answer. You must include a unit where it is appropriate.

Don’t include an extra line before the final answer showing all of the figures from your calculator. It’s easy to make a mistake copying all of the numbers and end up with an incorrect answer.

‘Determine’ questions

Determine’ questions will be either:

- a single-stage question that requires you to use a relationship not on the Relationships Sheet

or

- a two-stage question that requires you to use one or more relationships from the Relationships Sheet

‘Determine’ questions may also ask you to work out something from a graph, or a table, or data, such as stating the colour of light by referring to a wavelength on the Data Sheet.

Relationships with a squared term

If the relationship you have selected has a squared term, you must remember to include the squared symbol when you do the substitution. If you don't, your answer is wrong at this point, and you can only be awarded the mark for the correct relationship.

For example, if a question asks:

Calculate the kinetic energy of a mass of 3.0 kg moving at 2.0 m s^{-1}.

And a learner responds:

$E_k = \frac{1}{2}mv^2$	The learner is awarded 1 mark for selecting an appropriate relationship.
$E_k = 0.5 \times 3.0 \times 2.0$	The learner has missed out the squared sign, so no further marks can be awarded even though the correct answer is given.
$E_k = 6.0$ J	

Using physical constants

The values of any physical constants you may need are given either in the Data Sheet on page 2 of the exam or in the stem of individual questions.

It is important that you use the value given. Using a value other than the one given will be treated as an incorrect substitution.

For example, if a question asks:

A helium-neon laser produces monochromatic red light. Calculate the frequency of this red light.

And a learner responds:

$v = f\lambda$	The learner is awarded 1 mark for selecting an appropriate relationship.
$3.00 \times 10^8 = f \times 656 \times 10^{-9}$	The learner has substituted 656×10^{-9} for the wavelength of red light from a helium-neon laser. The value given in the Data Sheet is 633×10^{-9}, so no further marks can be awarded.
$f = 4.57 \times 10^{14}$ Hz	

SI units and prefixes

You should be familiar with the SI units and prefixes used in Higher Physics.

For example, if a question asks:

A 2.0 kΩ resistor is connected to a 1.5 V battery. Calculate the current in the resistor.

And a learner responds:

$V = IR$	The learner is awarded 1 mark for selecting an appropriate relationship.
$1.5 = I \times 2.0$	The learner is awarded 1 mark for substituting the values into the relationship. ($1.5 = I \times 2.0 \times 10^{3}$ would also have been awarded the mark for substitution.)
$I = 0.75$ A	The learner is not awarded the mark for the final answer, since the answer stated is incorrect. A correct final answer could be either 0.75 mA or 7.5×10^{-4} A.

Significant figures

In a numerical question, you should give your final answer to the same number of significant figures as the data with the fewest significant figures given in the question.

Including too many or too few significant figures in your final answer may be treated as incorrect.

For example, if a question asks:

A student takes 18 seconds to run a distance of 120 metres. Calculate the average speed of the student.

And a learner responds:

$s = \bar{v}t$	The learner is awarded 1 mark for selecting an appropriate relationship.
$120 = \bar{v} \times 18$	The learner is awarded 1 mark for substituting the values into the relationship.
$\bar{v} = 6.6667$ m s^{-1}	The learner is not awarded the mark for the final answer as they have given the answer to five significant figures. Both distance (120 m) and time (18 s) have two significant figures. The final answer should be given to two significant figures (6.7 m s^{-1}).

Rounding answers in intermediate calculations

Some numerical questions have two stages, where you use the answer to the first stage as data for the second stage to obtain the final answer.

Don't round the answer to the first stage before you use it as data for the second stage. An answer to the first stage that is rounded may lead to an incorrect final answer.

For example, if a question asks:

The band gap between the valence band and the conduction band in a semiconductor LED is 3.03×10^{-19} J.

Calculate the wavelength of light emitted by the LED.

And a learner responds:

$E = hf$

$3.03\times10^{-19} = 6.63\times10^{-34}\times f$

$f = 4.6\times10^{14}$ — 4.6×10^{14} is a rounded value.

$v = f\lambda$

$3.00\times10^{8} = 4.6\times10^{14}\times\lambda$ — Using 4.6×10^{14} leads to an incorrect final answer.

$\lambda = 652\times10^{-9}$ m — The learner is awarded 3 out of 4 marks, as the final answer is incorrect.

The correct answer is:

$E = hf$

$3.03\times10^{-19} = 6.63\times10^{-34}\times f$

$v = f\lambda$

$$3.00\times10^{8} = \frac{3.03\times10^{-19}}{6.63\times10^{-34}}\times\lambda$$

$\lambda = 656\times10^{-9}$ m

Rounding final answers

You should only ever round off when you state your final answer.

If, for example, you want to round your final answer to two significant figures, look at the third significant figure.

If it is less than 5, then round down.

If it is 5 or more, then round up.

Any incorrect rounding, whether it appears in the final answer or at an intermediate stage, is treated as an arithmetic error.

Vulgar fractions

You should always give final answers in decimal notation with the appropriate number of significant figures.

At Higher level, an exception to this would be a final answer expressing the charge on a quark (for example $+\frac{2}{3}e$).

For example, if a question asks:

Calculate the acceleration of a 2.0 kg mass when an unbalanced force of 1.0 N acts on it.

And a learner responds:

$F = ma$	The learner is awarded 1 mark for selecting an appropriate relationship.
$1.0 = 2.0 \times a$	The learner is awarded 1 mark for substituting the values into the relationship.
$a = \frac{1}{2}$ m s^{-2}	The learner is not awarded the final mark as the answer should be written as 0.50 m s^{-2}.

Index notation

It is often a good idea to give your final answer in scientific (index) notation, for example 3.00×10^8 m s^{-1} rather than 300 000 000 m s^{-1}.

For example, if a question asks:

A car travels at a constant speed of 75 m s^{-1}.

Calculate the distance it travels in 240 s.

And a learner responds:

$d = \bar{v}t$	The learner is awarded 1 mark for selecting an appropriate relationship.
$d = 75 \times 240$	The learner is awarded 1 mark for substituting the values into the relationship.
$d = 1.8^4$ m or d = 1.8 10^4 m or d = 1.8 4 m	The learner is not awarded the final mark as the answer should be 1.8×10^4 m .

Superscripts and subscripts

When you're using superscripts (the second '2' in $E_k = \frac{1}{2}mv^2$) or subscripts (the '1' and '2' in $n = \frac{\sin\theta_1}{\sin\theta_2}$), take care not to misalign them. This will be treated as an error.

For example, if a question asks:

A trolley of mass 0.75 kg is moving at 1.6 m s^{-1}.

Calculate the kinetic energy of the trolley.

And a learner responds:

$E_k = \frac{1}{2}mv^2$	The learner is awarded 1 mark for selecting an appropriate relationship.
$E_k = 0.5 \times 0.75 \times 1.6_2$	The substitution is incorrect, as this looks more like 1.62 rather than 1.6^2.
$E_k = 0.96$ J	The learner is awarded 1 mark out of the 3 marks allocated to the question, even though the final answer is correct.

Non-standard symbols

The correct symbol for each quantity appears in the relationships shown in the Relationships Sheet.

When answering questions, you should make sure the symbols in any relationship you state are as they appear in the Relationships Sheet, especially when symbols from the Greek alphabet are involved.

For example, if a question asks:

The potential difference across a parallel plate capacitor is 9.0 V when the charge stored on its plates is 22 μC. Calculate the capacitance of the capacitor.
And a learner responds:

$F = \frac{C}{V}$

The learner is not awarded the mark for selecting an appropriate relationship. The relationship should be $C = \frac{Q}{V}$.
Using C to represent charge is incorrect as C should represent capacitance.

$F = \frac{2.2 \times 10^{-5}}{9.0}$

The learner cannot access the marks for substitution and final answer.

$F = 2.4$ μF

Surplus answers

In questions that ask for a specific number of answers, it's not a good idea to give more answers than the question specifies. If your additional answers are correct, you will not be awarded any more marks, and if they are incorrect you will not be awarded the full number of marks allocated to the question.

For example, if a question asks:

State the name of the boson associated with the strong force.

And a learner responds:

Gluon and photon.

Gluon is a correct answer, but photon is incorrect.

The learner is awarded 0 marks out of the 1 mark allocated to the question.

Incorrect spelling

It's always a good idea to spell words correctly. An incorrectly spelled word may make your answer unclear or ambiguous.

This is especially true for words that sound similar but have different meanings. Spelling these words incorrectly will make your answer unclear, and you won't be awarded marks.

'Show' questions

In 'show' questions, you are asked to show how a given numerical answer is determined. In a 'show' question you must clearly show **all steps**, including:

1 a statement of the relationship(s) selected from the Relationships Sheet
2 substitution of data into the relationship(s)
3 a statement of the final numerical answer exactly as given in the question

For example, if a question asks:

A photon causes an electron to make a transition between energy levels E_1 and E_3 in an atom.

The energy of E_1 is $-5.42\times10^{-19}\,\text{J}$.

The energy of E_3 is $-1.36\times10^{-19}\,\text{J}$.

Show that the frequency of the photon is 6.12×10^{14} Hz.

And a learner responds:

$-1.36\times10^{-19}-\left(-5.42\times10^{-19}\right)=6.63\times10^{-34}\times f$

The learner's response does not start with an appropriate relationship, so the learner is awarded 0 marks.

$f=6.12\times10^{14}$ Hz

If a learner responds:

$E_2-E_1=hf$

The learner is awarded 1 mark for selecting an appropriate relationship.

$4.06\times10^{-19}=6.63\times10^{-34}\times f$

The learner has not substituted the given data into the relationship. In a 'show' question, you must show all the steps, so the correct substitution would be $-1.36\times10^{-19}-\left(-5.42\times10^{-19}\right)=6.63\times10^{-34}\times f$.

The learner is not awarded the mark for substitution and statement of final answer.

$f=6.12\times10^{14}$ Hz

If a learner responds:

$E_2 - E_1 = hf$	The learner is awarded 1 mark for selecting an appropriate relationship.
$-1.36\times10^{-19} - \left(-5.42\times10^{-19}\right) = 6.63\times10^{-34} \times f$	Although the substitution is correct, the learner has not stated the final answer as given in the question. The learner is not awarded the mark for substitution and statement of final answer.
$f = 6.1\times10^{14}$ Hz	

‘Must justify’ and ‘justify’ questions

In ‘must justify’ questions, you are required to make a statement and justify your statement using directly relevant and correct physics.

The mark for a correct statement depends on the justification being based on relevant and correct physics.

If you don’t give a justification, or your justification is wrong, you will be awarded 0 marks for the question.

For example, if a question asks:

A battery, a lamp and an ammeter are connected in series. A second lamp is now connected in parallel with the original lamp.

State what happens to the reading on the ammeter when the second lamp is connected. You must justify your answer.

If a learner responds:

The reading on the ammeter increases.

There is no justification for the statement, and so 0 marks are awarded.

In questions asking you to ‘justify’ your statement, your answer would be the same as a ‘must justify’ question, but it would be marked differently.

If the example above was an answer to a question that asked you to ‘justify’ rather than ‘must justify’, it would be awarded 1 mark.

‘State what is meant by…’ questions

In ‘state what is meant by …’ questions, you are asked to make a statement demonstrating your knowledge of a specific concept in physics.

In your answer, you must make sure you use terms specific enough to answer the question.

For example, if referring to a cell, a question asks:

State what is meant by *an EMF of 1.5 V*.

And a learner responds:

The EMF of a cell is the energy gained by each coulomb of charge passing through the cell.

Although the statement is correct, it is not sufficient for the mark to be awarded. An acceptable answer would be ‘A cell with EMF 1.5 V would supply 1.5 J of energy to each coulomb of charge passing through the cell.’

Open-ended questions

This type of question is identified by the phrase ‘Use your knowledge …’ and gives you the opportunity to show your **understanding** of the topic in question.

There is not a fixed answer to open-ended questions. You can choose to either concentrate on a small part of the topic in depth or to give a wide-ranging answer covering a larger part of the topic. However, make sure you answer the question you have been asked. If a question asks you to compare things, make sure you make a comparison. If you are asked to comment on something, make sure you comment on the specific situation.

Demonstrating a good level of understanding is awarded 3 marks, a reasonable level of understanding, 2 marks, a limited level of understanding, 1 mark, and no understanding, 0 marks.

The marker won’t award 1 mark for each point you make. They will read your answer as a whole and judge the level of **understanding** you have shown.

Graph-drawing questions

If you are asked to draw a graph in a question, you should draw a scatter graph. In a physics exam you will never be asked to draw a bar chart, a histogram, or a line graph.

When drawing a scatter graph, you must:

1 label each axis clearly with the name of the variable (or a recognised abbreviation or symbol) and a unit, where appropriate
2 show a scale on each axis that is linear over the range of the data
3 plot all data points accurately
4 draw a line of best fit (this may be a single straight line or a single smooth curve) that covers the range of the data

A linear scale is one that goes up in equal amounts. You must make sure you have a linear scale on both axes within the range of your data.

Many graphs will include the origin (0,0), but sometimes it may be more appropriate to start a scale at a non-zero value.

When you're drawing a line of best fit, you should first decide whether it is a straight line or a single smooth curve. If the line of best fit is straight, use a ruler and a sharp pencil. If the line of best fit is a single smooth curve, use a sharp pencil and avoid showing a double line by drawing the curve in a single sweeping action. Don't draw straight lines between each of the plotted points (join the dots) to produce a jagged line.

Lines of best fit don't always pass through the origin. You should avoid forcing your line of best fit to pass through the origin when it wouldn't be appropriate to do so.

Joining the first and last data points with a line is unlikely to produce an acceptable line of best fit.

Multiple-choice questions

Where possible, you should work out what your answer is before you look at the options listed. For some multiple-choice questions it is not possible to do this, and you have to evaluate each option. Make sure you select an answer for each question and don't leave any blank.

Tips

‘Calculate’ questions

Make sure you include a unit in your answer, where appropriate. Take care not to add an ‘s’ to the unit symbol to make your final answer plural. There is no ‘secs’ in physics.

‘Determine’ questions

In multi-stage calculations, make sure you state each relationship you use and make sure you show the substitution in each relationship. Don’t round any figures until the final answer.

Relationships with a squared term

If the relationship you’ve selected has a squared term (or a term raised to another power), check your substitution line carefully in case you’ve missed showing the ‘square’ (or ‘power’).

Using physical constants

Even if you think you can remember the value of some physical constants, it’s a good idea to check the value in the Data Sheet to make sure you are using the correct value.

SI units and prefixes

As well as knowing the SI prefixes for Higher Physics, read the question carefully to check that you haven’t missed or misunderstood a prefix.

Significant figures

When you have your final answer in your calculator, think about how many significant figures you should include in your answer.

Rounding answers in intermediate calculations

In two-stage calculations, make sure you don’t round the answer to the first stage. Using a rounded value may lead to an incorrect final answer.

Rounding final answers

Never use a recurrence dot ($4.6\dot{6}$) or an ellipsis ($4.66...$) in your final answer as these indicate an infinite number of significant figures and you would not be awarded the mark for the final answer.

Vulgar fractions

Make sure that your calculator is in decimal mode and not fraction mode when you’re doing calculations.

Index notation

Make sure you are familiar with how your calculator represents numbers in scientific notation.

Superscripts and subscripts

Once you've completed a question, read through your answer to check that any superscripts or subscripts are clear and in the correct place.

Non-standard symbols

If you're not sure which symbols to use in the relationship you've selected, check out the relationship on the Relationships Sheet. Take special care with symbols from the Greek alphabet, such as λ.

Surplus answers

In questions that ask for a specific number of answers, make sure you give only the number of answers asked for and don't include extra answers.

Incorrect spelling

Make sure you can spell 'reflection', 'refraction', 'diffraction', 'fission', and 'fusion' correctly.

'Show' questions

If you are going to use the value you are asked to show in a later part of a question, use the value exactly as it is given in the question. Make sure you clear any non-rounded value from your calculator.

'Must justify' questions

In a 'must justify' question make sure you include a justification in your answer otherwise you can't be awarded any marks.

'State what is meant by…' questions

Make sure you've learned the definitions you may need for Higher Physics.

Open-ended questions

As well as reading the question, it is a good idea to look closely at any pictures or diagrams given in the question. These often include things you can discuss as part of your answer.

Graph-drawing questions

It's a good idea to plot your points with a small diagonal cross, made with a sharp pencil.

Multiple-choice questions

Where possible, try to work out the correct answer before looking at the list of options.

Remember to look out for *Your Exams*. This guide contains essential information and rules that you need to know about SQA exams.