Higher Physics



Study Guide

Name: _____

Introduction

This study guide should be used to help Higher Physics students prepare for their exam. When studying, you should use this booklet to help answer questions and track your progress. To be successful in physics you need to study **regularly** following the guidance in this booklet.

Final exam date – 25th of April 2024

Paper 1 – 09:00 – 09:45 (45 minutes) Paper 2 – 10:15 – 12:30 (2 hours 15 minutes)

Exam Format:

Paper 1 – 25 marks of multiple-choice questions. Paper 2 – 130 marks of extended answer questions.

Contents

Topic Checklist	рЗ
How to Study for Physics	.p4
Calculator Help Sheet	.p5
Method for Solving Problems (WAGOLL)	p6
Prefixes and Greek Letters	р7
Command Words	ρ8
Data Sheetp	ว9
Formula Sheet	p10
Past Paper Log	p11

Higher Physics Topics

Unit 1 – Our Dynamic Universe

	Revised?	Revised?	Revised?
Motion – Equations and Graphs			
Forces, Energy and Power			
Gravitation and Projectiles			
Special Relativity			
The Expanding Universe			

Unit 2 – Particles and Waves

	Revised?	Revised?	Revised?
Forces on charged particles			
The Standard Model			
Nuclear Reactions			
The Inverse Square Law (Irradiance)			
Wave-Particle Duality			
Interference			
Spectra			
Refraction			

Unit 3 – Electricity

	Revised ?	Revised ?	Revised ?
Monitoring and Measuring AC			
Voltage, Current, Resistance and Power			
Internal Resistance			
Capacitors			
Semiconductors and p-n Junctions			

How to study for Physics

Pick a topic and follow these steps to effectively study Physics!

1. Review course material

Simply reading through your notes is <u>not enough</u> to help you learn the content. You need to <u>do something</u> with the material to help you understand it.

For example, you could:

- Create a Summary of your own notes highlighting the key points.
- Make flashcards either physical cards or digital ones using tools like Anki and Brainscape.
- Complete a mind-map (templates on your Teams page).
- Write questions that you can swap with classmates to answer.

2. Problem Practice

4

Problem practice is key to success in physics. Regular practice helps reinforce your understanding of the concepts learned.

This should be done in two main ways:

- Tutorial Questions Work through your tutorial questions on your chosen topic.
- Past paper questions using the "Mr= Davie" past paper document on teams work your way through all the questions on your chosen topic. Make sure you check your answers using the marking scheme.

3. Ask for Help

If there are any concepts or questions you are still struggling with you can seek further help in several ways including:

- Asking your teacher bring the specific question or concept you are struggling with!
- Look at the summary notes or textbooks for a different perspective. There are a range of resources on Teams that can be useful for this.
- Work with your classmates to try and understand the concept better.
- Take a break and revisit the material another time sometimes a rest is all that is needed!







Button/	How to get there	What is does
x10 ^x		Puts your answer to the power of 10, use for m, μ , k etc
ENG		Puts your answer to the power of 10 to a value that can be converted to a prefix, keep clicking the Eng to move up powers of 3 or shift Eng to move down
S↔D		Toggles between leaving your answer as a fraction or decimal
DEG		WHAT YOUR CALCULATOR MUST BE IN WHEN DOING PHYSICS USED FOR TRIG
RAD/Grad		DON'T LET YOUR CALCULATOR BE IN EITHER OF THESE
calculate		To work out a sum rather than statistics, the default setting
Input/output	Shift /set up 1	This decides if you want to use the MathIQ (recommended MathI decimalQ) which allows for the fraction button to be used or put in equations in a line format
Angle unit	Shift/set up 2	For checking your calculator is set to DEGREES
Number format	Shift/ set up 3	
Fix	Shift/ set up 3 /1	This fixes the number of decimal places you want to display so will round up. Use this for individual questions only
Sci	Shift/ set up 3 /2	Displays your answer in scientific notation, good when your answer requires this (lots of decimal places or a big number of sig fig etc
Norm	Shift/ set up 3 /3	Cancels the Fix and Sci but you then select the type of input you want (see above)
Norm 1~2		Selects between maths or line
Ab/c or d/c	Shift/ set up 4	Do you want vulgar fractions or full numbers and fractions
Recurring decimal	Shift / set up /down. 3	I RECOMMEND THIS BEING OFF, IT GIVES YOU THE DOT WHICH YOU MIGHT NOT NOTICE
Decimal mark	Shift/ set up / down 4	Should be set to dot, some countries use a comma instead of a dot in a number
pol	Shift +	Shift + number comma number bracket = FOR USE WITH VECTORS RIGHT ANGLED TRIANGLES, CONVERTS A VECTOR AND ANGLE TO X,Y
Rec	Shift -	Shift – number comma number bracket = FOR USE WITH VECTORS RIGHT ANGLED TRIANGLES, Converts an X and Y to resultant and angle (but not a bearing)
ANS		This stores the answer so you can use this for additional parts of the calculation
X ⁻¹		Puts your number/answer over 1 (e.g. in Resistance in parallel)
Sin, cos, tan		Only needs for the angle in vector questions
<i>n</i> 10		Converts between hours, mins and second
C C		Fraction button RECOMMENDED to avoid problems of BODMAS



W.A.G.O.L.L

Solving Problems in Physics

When solving problems in physics follow the five steps below as shown in the example.

Step 1: Data List - Write the information given in the question in symbol form down the left-hand side to create a data list.

Step 2: Conversion - Convert your data list values into standard units. This may involve changing time into seconds or replacing prefixes where required.

Step 3: Formula - Write down the correct formula from the formula sheet. Look at your data list to help you here.

Step 4: Substitute - Substitute the values from your data list into the formula.

Step 5: Rearrange and Solve - Rearrange your equation if required (change side, change sign) and solve using your calculator. Remember to include units with your final answer.

Example: A school bus takes 20 minutes to travel 15km. What is the buses average speed for this journey?

Other Useful Information

Prefixes

Prefix	Symbol	Multiple	Scientific Not.
Giga	G	X 1,000,000,000	X10 ⁹
Mega	М	X 1,000,000	X10 ⁶
Kilo	k	X 1,000	X10 ³
Milli	m	÷ 1,000	X10 ⁻³
Micro	μ	÷ 1,000,000	X10 ⁻⁶
Nano	n	÷ 1,000,000,000	X10 ⁻⁹

Greek Alphabet



Command Words

Command	How to answer
Describe	You must provide a statement or structure of characteristics/features.
	You must determine a number from given facts, figures or information.
Determine or Calculate	You should use numbers given in the question to work out the answer.
	You should always show your working.
Estimate	You must determine an approximate value for something.
	You must relate cause and effect and/or make relationships between things clear.
Explain	You should make something clear or state the reasons for something happening.
	This means that points in the answer must be linked coherently and logically.
	The answer should not be a simple list of reasons.
Identify Name State or	You need only name or present in brief form.
Cive	Only a short answer is required, not an explanation or a description.
Give	Often it can be answered with a single word, phrase or sentence.
	You must give reasons to support their suggestions or conclusions.
Justify	For example, this might be by identifying an appropriate relationship and the
	effect of changing variables.
Predict	You must suggest what may happen based on available information.
Show that	You must use the appropriate formula to prove something (e.g. a given value)
	All steps, including the stated answer and units, must be shown.
	You must apply your knowledge and understanding of physics to a new
Suggest	situation. A number of responses are acceptable: marks will be awarded for any
	suggestions that are supported by knowledge and understanding of physics.
Use your knowledge of	You must apply your skills, knowledge and understanding to respond
physics	appropriately to the problem/situation presented.
Use the information	The answer must be based on the information given in the question. Unless the
	information given in the question is used, no marks can be given.
	This requires you to describe the similarities and/or differences between things,
	not just write about one.
Compare	If you are asked to 'compare x with y', you need to write down something about
	x compared to y, using comparative words such as 'better, 'more than', 'less
	than', 'quicker', 'more expensive', 'on the other hand.'

DATA SHEET

COMMON PHYSICAL QUANTITIES

Quantity	Symbol	Value	Quantity	Symbol	Value
Speed of light in vacuum	с	$3.00 \times 10^8 \text{ m s}^{-1}$	Planck's constant	h	$6.63 \times 10^{-34} \text{ Js}$
Magnitude of the charge on an electron	е	1.60 × 10 ^{−19} C	Mass of electron	m _e	9.11 × 10 ⁻³¹ kg
Universal Constant of Gravitation	G	$6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$	Mass of neutron	m _n	1.675 × 10 ^{−27} kg
Gravitational acceleration on Earth	g	9.8 m s ⁻²	Mass of proton	m _p	$1.673 \times 10^{-27} \text{ kg}$
Hubble's constant	H ₀	$2.3 \times 10^{-18} s^{-1}$			

REFRACTIVE INDICES

The refractive indices refer to sodium light of wavelength 589 nm and to substances at a temperature of 273 K.

Substance	Refractive index	Substance	Refractive index
Diamond	2.42	Water	1.33
Crown glass	1.50	Air	1.00

SPECTRAL LINES

Element	Wavelength (nm)	Colour	Element	Wavelength (nm)	Colour
Hydrogen	656	Red	Cadmium	644	Red
	486	Blue-green		509	Green
	434	Blue-violet		480	Blue
	410	Violet		Lasors	1
	397	Ultraviolet		Lasers	
	389	Ultraviolet	Element	Wavelength (nm)	Colour
			Carbon dioxide	9550 7	Infrared
Sodium	589	Yellow		10 590 🖌	
			Helium-neon	633	Red

PROPERTIES OF SELECTED MATERIALS

Substance	Density (kg m ⁻³)	Melting point (K)	Boiling point (K)
Aluminium	2.70 × 10 ³	933	2623
Copper	8.96 × 10 ³	1357	2853
Ice	9.20 × 10 ²	273	
Sea Water	1.02×10^{3}	264	377
Water	1.00×10^{3}	273	373
Air	1.29		
Hydrogen	9.0 × 10 ⁻²	14	20

The gas densities refer to a temperature of 273 K and a pressure of 1.01×10^5 Pa.

$d = \overline{v}t$	W = QV	$V_{rms} = \frac{V_{peak}}{\overline{\Sigma}}$
$s = \overline{v}t$	$E = mc^2$	√2 -
v = u + at	$I = \frac{P}{I}$	$I_{rms} = \frac{I_{peak}}{\sqrt{2}}$
$s = ut + \frac{1}{2}at^2$	A	$T = \frac{1}{2}$
$v^2 = u^2 + 2as$	$I = \frac{k}{d^2}$	$I = \frac{1}{f}$
$s = \frac{1}{2}(u+v)t$	$I_1 d_1^2 = I_2 d_2^2$	V = IR
F = ma	E = hf	$P = IV = I^2 R = \frac{V^2}{R}$
W = mg	$E_k = hf - hf_0$	$R_T = R_1 + R_2 + \dots$
$E_w = Fd$, or $W = Fd$	$v = f\lambda$	1_1,1,
$E_p = mgh$	$E_2 - E_1 = hf$	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
$E_k = \frac{1}{2}mv^2$	$d\sin\theta = m\lambda$	$V_1 = \left(\frac{R_1}{R_1 + R_2}\right) V_S$
$P = \frac{E}{t}$	$n = \frac{\sin \theta_1}{2}$	$\left(R_{1}+R_{2}\right)$
<i>r</i>	$\sin \theta_2$	$\frac{V_1}{V_2} = \frac{R_1}{R_2}$
p - mv Et = mv - mu	$\frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$	E = V + Ir
n n	. 1	0
$F = G \frac{m_1 m_2}{r^2}$	$\sin\theta_c = -\frac{1}{n}$	$C = \frac{Q}{V}$
$t' = -\frac{t}{t}$		Q = It
$\sqrt{1-\left(\frac{v}{c}\right)^2}$		$E = \frac{1}{2}QV = \frac{1}{2}CV^{2} = \frac{1}{2}\frac{Q^{2}}{C}$
$l' = l_1 \left(\frac{v}{1 - \left(\frac{v}{v} \right)^2} \right)^2$		
V (c)	path difference = $m\lambda$ or $(m+s)$	$\frac{1}{2}\lambda$ where $m = 0, 1, 2$
$f_o = f_s \left(\frac{v}{v + v} \right)$	may use	
1 1	random uncertainty = $\frac{max.value}{number}$	er of values
$z = \frac{\lambda_{observed} - \lambda_{rest}}{\lambda_{rest}}$	or	
$z = \frac{v}{c}$	$\Delta R = \frac{R_{\max} - R_{\min}}{n}$	
$v = H_0 d$		

Higher Physics - Past Paper Log

Name:

iper 1	Questions Wrong	Q3,4,12,14,15,19,20,22,23,24,25										
Pa	Percentage	56%										
	Mark (/25)	14										
	Marked	1										
	Completed	>										
	Year	example	2022	2020	2019	2018	2017	2016	2015	2014	SQA Mock	

Paper 2	Questions Wrong	Q2a + b, Q4, Q5, Q6b, Q9a, Q11, Q12a									
	Percentage	65%									
	Mark (/130)	84									
	Marked	1									
	Completed	~									
	Year	example	2022	2020	2019	2018	2017	2016	2015	2014	SQA Mock

Notes: