Heles Year 12 Induction booklet
OCR A – A Level Physics
Foundations of A Level Physics
1.1-2.2

Name:

Bring this workbook to every lesson

Note – You will need to create a quizlet account with your Heles School email address if you don't already have one

Retrieval Questions – Available as Quizlet sets on classroom (scan QR code for direct access)

You are to screen shot your scores for each of these as they are checked

1 Prefixes

What is the value of the prefix T (tera)	10^{12}
What is the value of the prefix G (giga)	10^{9}
What is the value of the prefix M (mega)	10^{6}
What is the value of the prefix k (kilo)	10^{3}
What is the value of the prefix d (deci)	10^{-1}
What is the value of the prefix c (centi)	10^{-2}
What is the value of the prefix m (milli)	10^{-3}
What is the value of the prefix μ (micro)	10^{-6}
What is the value of the prefix n (nano)	10^{-9}
What is the value of the prefix p (pico)	10^{-12}

2.1-2.2 Quantities, Units and Conversions

What six base units of the SI system are used in A Level Physics?	metre, kilogram, second, Ampere, Kelvin, Mole
What six base quantities of the SI system are used in A Level Physics?	length, mass, time, electric current, absolute temperature, amount of substance.
What is the base unit of mass?	kg
What is the base unit of length?	m
What is the base unit of time?	s
What is the base unit of current?	A
What is the base unit of temperature?	K
What is the SI unit of potential difference?	V
What are the SI units of density?	kgm^{-3}
What is the SI unit of energy?	J
What is the SI unit of power?	W
What is the SI unit of charge?	C
What is $1m^2$ in mm^2?	10^6mm^2
What is $1m^3$ in cm^3?	10^6cm^3
What is $1km^2$ in m^2?	10^6m^2
What is $1cm^3$ in mm^3?	10^3mm^3
There are 10^{24} free charge carriers per m^3 of a material. How many are there per mm^3?	10^{15}
10^6 particles strike each mm^2 of a surface per second. How many strike $1m^2$ of the surface per second?	10^{12}
If there is 1 particle per mm^3, how many are there per m^3?	10^9
Water has a density of $1000kgm^{-3}$. What is this in $kgcm^{-3}$?	10^{-3}
Water has a density of $1000kgm^{-3}$. What is this in gcm^{-3}?	1
What six base units of the SI system are used in A Level Physics?	metre, kilogram, second, Ampere, Kelvin, Mole

Conversion of units/changes of magnitude of units

Key ideas:

A – Converting areas and volumes can be tricky and often leads to mistakes by students. Why is this?

B – Physics deals with objects ranging in size from sub-atomic particles to whole galaxies. Using internet research or the Scale of the Universe website (https://scaleofuniverse.com/en-gb) list two objects that are in the following size ranges:

1pm – 1nm

1. 2.

1nm – 1µm

1. 2.

1µm – 1mm

1. 2.

1mm – 1m

1. 2.

1m – 1km

1. 2.

1km – 1Mm

1. 2.

1Mm – 1Gm

1. 2.

1Gm – 1Tm

1. 2.

1Tm – 1Pm

1. 2.

Exercises

1. Prefixes

Prefix	Symbol	Name	Multiplier
femto	f	quadrillionth	10^{-15}
pico	p	trillionth	10^{-12}
nano	n	billionth	10^{-9}
micro	µ	millionth	10^{-6}
milli	m	thousandth	10^{-3}
centi	c	hundredth	10^{-2}
deci	d	tenth	10^{-1}
deka	da	ten	10^{1}
hecto	h	hundred	10^{2}
kilo	k	thousand	10^{3}
mega	M	million	10^{6}
giga	G	billion	10^{9}
tera	T	trillion	10^{12}
peta	P	quadrillion	10^{15}

When you are given a variable with a prefix you must convert it into its numerical equivalent before you use it in an equation.

Always start by replacing the prefix symbol with its equivalent multiplier.
For example: $0.16\ \mu A = 0.16 \times 10^{-6}\ A$
$10\ ns = 10 \times 10^{-9}\ s$
Replace the prefix with the equivalent multiplier:

e.g. $12.0\ mm = 12.0\mathbf{\underline{x10^{-3}}}\ m = 1.2x10^{-2}\ m$

1. 1.4 kW =

2. 10 µC =

3. 24 cm =

4. 340 MW =

5. 46 pF =

6. 0.03 mA =

Express these with an appropriate prefix (Use of the ENG button on your calculator can help you)

e.g. $5.6x10^{-11}$m = $56x10^{-12}$m = 56pm

7. $6.4x10^{-3}$ W =

8. $82.3x10^{8}$ m =

9. $2.0x10^{-5}$ m =

10. $5.12x10^{8}$ bytes =

11. $1000x10^{-9}$ A =

12. $0.520x10^{4}$ Ω =

Change the prefix to the one required (using the ENG and SHIFT+ENG buttons on your calculator can help you)

13. 0.0063 kA = mA

14. 300 Mms^{-1} = Gms^{-1}

15. $6x10^{3}$ km = Mm

16. 0.0023 THz = MHz

17. 657,000 μm = cm

18. 2,112,000μs = ms

19. 0.0083GBytes = kBytes

2. Powers of 10

Calculate the following using the EXP or x10^x button on your calculator.

1. $8 \times 10^3 \times 9 \times 10^6 =$

2. $5 \times 10^{-3} \times 4 \times 10^{-2} =$

3. $\frac{3.00 \times 10^8}{550 \times 10^{-9}} =$

4. $\frac{5.5 \times 10^3}{4.7 \times 10^6} =$

5. $\frac{(42 \times 10^3)^2}{384 \times 10^6} =$

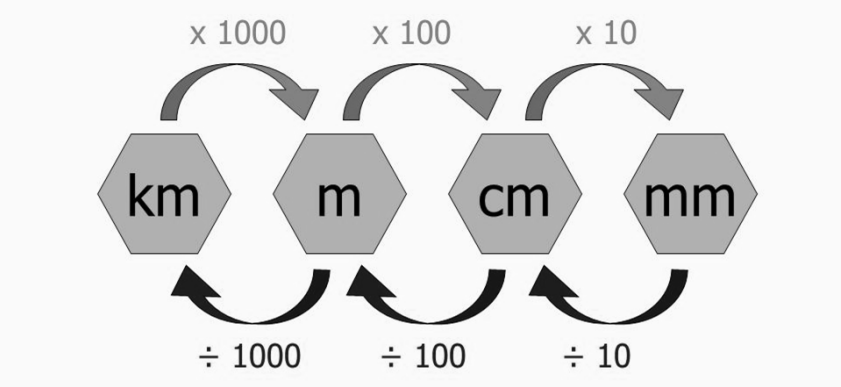
6. $\frac{6.63 \times 10^{-34} \times 3.00 \times 10^8}{720 \times 10^{-9}} =$

7. $\frac{4.92 \times 10^{-7} \times 5000 \times 10^{-3}}{\pi \times (5.00 \times 10^{-5})^2} =$

8. $\frac{196 \times 10^{-3} \times 80 \times 10^{-2}}{\pi \times (5.0 \times 10^{-3})^2 \times 6.0 \times 10^{-3}} =$

3. Conversions

Remember to raise the conversion factor to the same power as the units.



1. $1000cm^2$ = m^2
2. $5mm^2$ = m^2
3. $5550mm^2$ = m^2
4. $15cm^3$ = m^3
5. $7000cm^3$ = m^3
6. $11mm^3$ = m^3
7. $6x10^{-4}\ ^0Cs^{-1}$ = ^0C per day
8. $1000kgm^{-3}$ = $kgcm^{-3}$
9. $2x10^{24}$ per m^3 = per mm^3
10. 2kg per min. = gs^{-1}

4. Change of subject / Rearranging Equations

Formula	Rearrangements		
$\rho = \frac{m}{V}$	$V =$	$m =$	
$F = kx$	$k =$	$x =$	
$\varepsilon = \frac{x}{l}$	$l =$	$x =$	
$E = \frac{\sigma}{\varepsilon}$	$\varepsilon =$	$\sigma =$	
$G = \frac{\sigma A}{l}$	$A =$	$\sigma =$	$l =$
$R = \frac{\rho L}{A}$	$A =$	$\rho =$	$l =$
$\rho = \frac{1}{\sigma}$	$\sigma =$		
$v = u + at$	$u =$	$a =$	$t =$
$hf = \phi + E_k$	$f =$	$\phi =$	$E_k =$
$E_s = \frac{1}{2} k \Delta l^2$	$\Delta l =$	$k =$	
$v^2 = u^2 + 2as$	$u =$	$a =$	$s =$

Express the following quantities in terms of their base units:

7. Force, F in Newtons(N), given that F = ma

8. Work done, W in Joules(J), given that $W = F \times s$

9. Power, P in Watts(W), given that $P = \frac{W}{t}$

10. Momentum, p, given that $F = \frac{p}{t}$

11. Density, ρ, given that $\rho = \frac{m}{V}$

12. Angular frequency, ω, given that $\omega = \frac{2\pi}{T}$

13. The gravitational constant G, given that $g = \frac{GM}{r^2}$

7. Density Calculations

1. A block of aluminium is 160kg and has a volume of 0.06 m^3. What is the density of aluminium?

…….kgm^{-3}

2. A block of material has a volume of 32,000 cm^3 and a density of $11x10^3$ kgm^{-3}. What is the mass of the block?

……..…….kg

3. The density of gold is 19300kgm^{-3}. The largest gold bar in the world measures 0.45cm by 170mm by 170mm, what is it's mass?

…….kg

4. What is the side length of a block of steel of mass 60kg and density 7.7 $x10^3kgm^{-3}$.

……..m

5. Mercury is a liquid metal with a density of 13.6gcm^{-3}. What is the mass of 200cm^3 of mercury?

……kg

6. The volume of the Earth $1.1x10^{21}m^3$. Its mass is 6.0 x 10^{24} kg. What is its average density?

…….kgm^{-3}

7. The hydrogen nucleus consists of a proton of mass $1.7x10^{-27}$ kg and a radius of 1fm. What is the density of the hydrogen nucleus?

……..kgm^{-3}

8. A rectangular cuboid sample of brass(of density 8200kg/m^3) has a mass of 492g. It is 100mm long by 2cm wide. What is its height?

……m

9. The density of iron is 7800 kgm^{-3}. Calculate the mass of an iron wire of length 2.5m and cross sectional area 0.82 mm^2

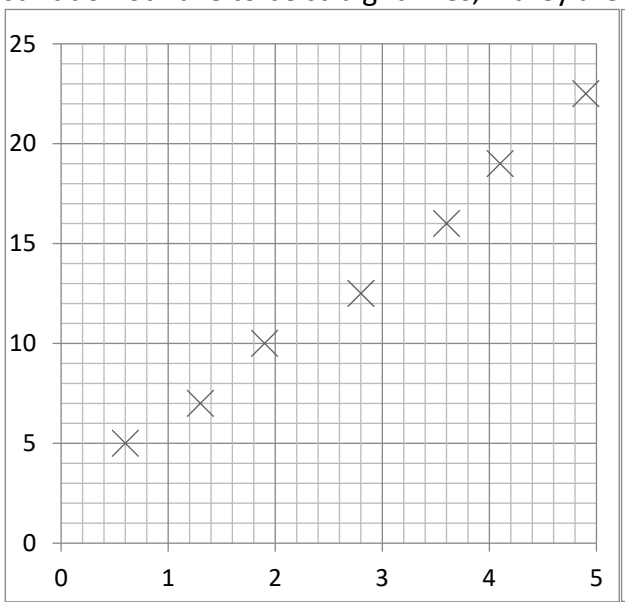
…….kg

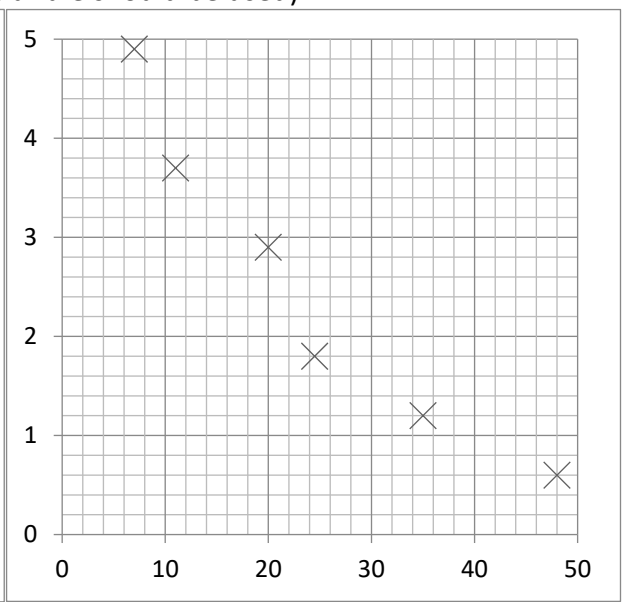
10. 50 cm^3 of a material weighs 43g. Calculate the density of the material in kgm^{-3}.

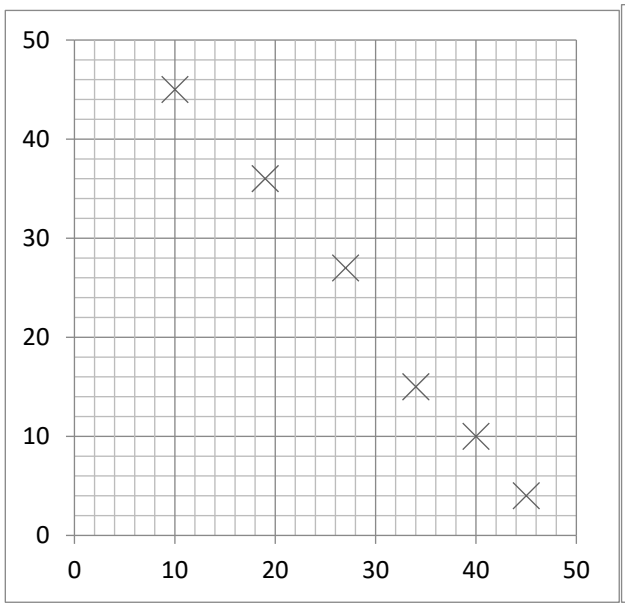
……..kgm^{-3}

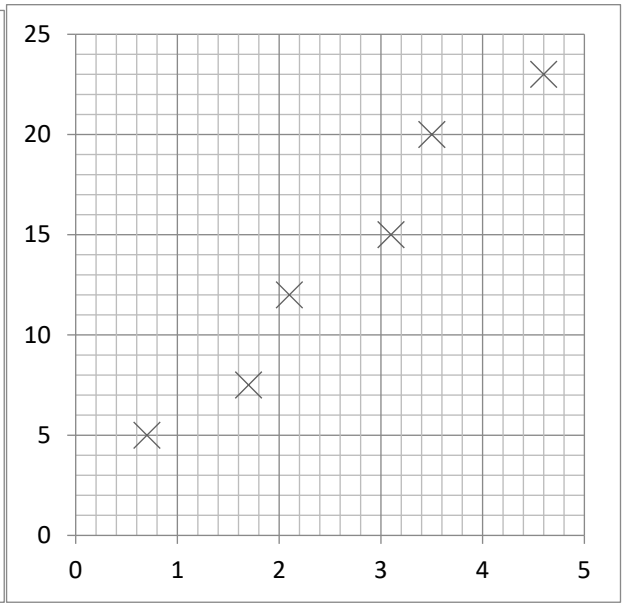
9. Graph Skills

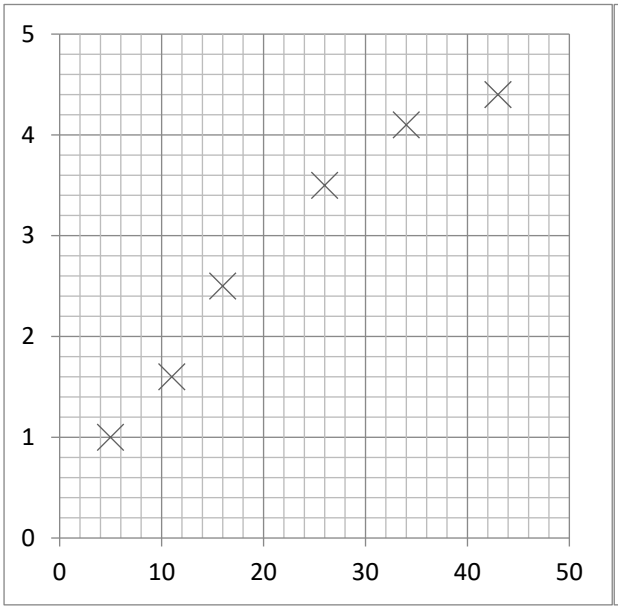
1. draw a line of best fit on each of these graphs (think about the shape the data implies- lines of best fit do not have to be straight lines, if they are a rule should be used).

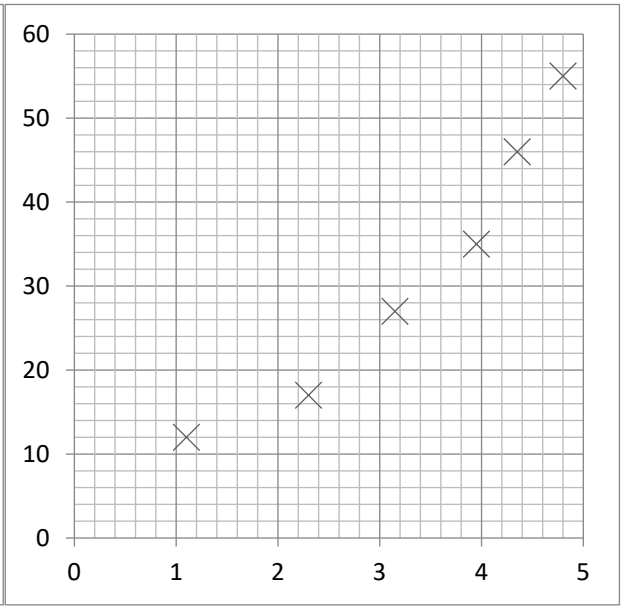












2. Complete the table identifying the quantities from the equation of a straight line, as in the example)

Equation	Graph	Rearranged Equation	Gradient	Intercept
$y = mx + c$	y plotted on the y axis x plotted on the x axis	$y = mx + c$	*m*	*c*
$V = IR$	y axis = *V* x axis = *I*	$V = RI$	*R*	0
$I = \frac{Q}{t}$	y axis = *t* x axis = *Q*			
$\rho = \frac{RA}{l}$	y axis = *l* x axis = *R*			
$\varepsilon = V + Ir$	y axis = *V* x axis = *I*			
$E = VIt$	y axis = *E/t* x axis = *V*			
$hf = \phi + E_K$	y axis = E_K x axis = *f*			

$\lambda = \frac{h}{mv}$	y axis = $1/v$			
	x axis = m			
$E_P = mgh$	y axis = mg			
	x axis = E_P			
$E = \frac{1}{2}Fe$	y axis = e			
	x axis = $1/F$			
$c = f\lambda$	y axis = $1/\lambda$			
	x axis = f			
$v = u + at$	y axis = a			
	x axis = $1/t$			
$v^2 = u^2 + 2as$	y axis = v^2			
	x axis = s			
$s = \frac{(u+v)}{2}t$	y axis = v			
	x axis = s			
$w = \frac{\lambda D}{s}$	y axis = λ			
	x axis = w			