Name: …….

Physics – Summer work

A Level Physics is a difficult but rewarding subject for the dedicated student. This booklet is designed to prepare you for A-Level Physics. It covers many areas of physics with which **you must be competent** before starting an A-level physics course. Some tasks require the use of **knowledge and understanding from GCSE** and others require some **research** in order to find the answers.

This booklet **must be completed and handed in** to one of your physics teachers during the **first week** of the Year 1 Physics course in September.

The SI system

In order for a physical quantity to be measured it must be compared to a standard for that quantity. The creation of the metric system led to the manufacture of two standard measures held in the Archives de la Republiqué in France. These represented the metre and the kilogram. There are now seven base units which you should learn and many derived units. Each unit has an agreed symbol and you should always check whether upper or lower case is used.

Draw arrows to match the quantity to its name and symbol, also complete the gaps.

Physical base quantity		**Name of base unit**		**Symbol for the base unit**
length		second		K
		mole		cd
				kg
electric current		candela		
temperature		kilogram		
luminous intensity				s
amount of a substance		Ampere		m

The definitions of the base units are now quite complex but due to standard measures and the standard definitions there is greater repeatability in measurements across the world. You do not need to learn the standard definitions; this activity is merely designed to give you a feel for how precise they are.

Match the unit to the correct definition.

Base Unit		Definition
Mole		This is the length of the path travelled by light in a vacuum during a time interval of 1/299792458 of a second.
Kelvin		This is the duration of 9192631770 periods of the radiation corresponding to the transition between two hyperfine levels of the ground state of the caesium –133 atom.
Metre		This is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012kg of carbon 12.
Candela		This is the constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 metre apart in a vacuum, would produce between these conductors a force equal to 2×10^{-7} Newtons per metre of length.
Second		This is equal to the mass of the international prototype of this standard.
Kilogram		This is the luminous intensity, in a given direction, of a source that emits monochromic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 Watt per radian.
Ampere		This is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

Standard Form

Standard form is used to express very large or very small numbers in a more concise way. You will have studied how to convert numbers into standard form in KS4 maths so if you are unsure of how to do the following exercise, please research 'standard form' on GCSE bitesize (maths).

Convert these numbers to their standard form.

8654000000		568150.00	
0.000000896		4563000	
0.00056		0.0234	

Transfer these from the standard form to their decimal equivalent.

2.45×10^{3}		3.18×10^{8}	
4.23×10^{-3}		1.21×10^{-5}	
6.23×10^{4}		7.21×10^{2}	

Significant figures

Standard form is used to express very large or very small numbers in a more concise way. You will have studied how to convert numbers into standard form in KS4 maths so if you are unsure of how to do the following exercise, please research 'significant figures' on GCSE bitesize (maths).

For each state how many significant figures have been used.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.07	
2.0		82.42		2.483×10^4		69324.8	
2.00		750000		2.483		0.0063	
0.136		310		5906.4291		9.81×10^4	
0.34		3.10×10^2		200000		6717	
54.1		3.1×10^2		12.711		0.91	

Add the values below then write the answer to the appropriate number of significant figures. The correct number of significant figures is the same as the lowest number of those added together.

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4 (3s.f.)	1.67 (3s.f)	3.240 (4s.f.)	56.310	56.3 or 56.3 (3 sf)
7146	–32.54	12.8		
20.8	18.72	0.851		
1.4693	10.18	–1.062		
9.07	0.56	3.14		
739762	26017	2.058		
8.15	0.002	106		
132.303	4.123	53800		
152	0.8	0.55		
0.1142	4922388	132000		

For each set of values calculate the mean.
Please use appropriate significant figures.

1	2	3	4	5	Mean
140	220	90	180	140	
56300	41200	58600	48300	53800	
0.186	0.341	0.276	0.216	0.314	
1.427	0.235	0.488	1.922	1.620	
34	62	46	12	39	
326.19	360.22	314.20	352.22	400.18	
1.4	5.3	2.7	3.9	2.6	

Rearranging Equations

We often need to use an equation in a different format to the way it appears in a data book or the way we have learned it, so it is important to be able to change the subject of an equation. Rearrange these equations so that the variable in bold is the subject:

1 $f = \frac{1}{\mathbf{T}}$

2 $F = B\mathbf{I}L$

3 $P = \mathbf{I}^2R$

4 $V = -\frac{k\mathbf{Q}}{R}$

5 $s = ut + \frac{1}{2}\mathbf{a}t^2$

6 $T = 2\pi\sqrt{\frac{m}{k}}$ Make m the subject

7 $T = 2\pi\sqrt{\frac{l}{g}}$ Make g the subject

8 $\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$ Make f the subject

How to write Units at A- Level

At GCSE you will have expressed certain units using a "/" (divide) symbol to represent the word "per", for example "m/s" (metres per second) for velocity. However, at KS5 we express these units more concisely. Any unit that is after the "/" symbol is expressed to a negative power ($1/x = x^{-1}$). If the unit is squared, then you express it to the power of $^{-2}$ etc.

For example: Velocity = Distance / Time = m/s = ms^{-1}.

Identify the quantity and convert the units to the more concise format.

Quantity	Units	Concise Units
	N/kg	
	kgm/s	
	m/s^2	
	kg/m^3	

Multiple Choice Questions – cross the correct answer. Research any you are unsure of using your GCSE revision guide or the internet.

1 A student is asked to determine the output of a motor as it lifts an object. He measures the height through which the object is raised, the time taken and the weight of the object.

To find the power he must calculate

☒ **A** height × weight × time

☒ **B** $\frac{\text{height} \times \text{weight}}{\text{time}}$

☒ **C** $\frac{\text{time} \times \text{weight}}{\text{height}}$

☒ **D** $\frac{\text{weight}}{\text{height} \times \text{time}}$

2 Which table is correct for scalar and vector quantities?

☐ **A**

	has magnitude	has a direction
scalar	✓	✓
vector	✗	✓

☐ **B**

	has magnitude	has a direction
scalar	✗	✓
vector	✓	✓

☐ **C**

	has magnitude	has a direction
scalar	✓	✗
vector	✓	✓

☐ **D**

	has magnitude	has a direction
scalar	✓	✓
vector	✓	✗

3 A pigeon of mass 0.45 kg is flying with kinetic energy 58 J.
Its speed is

- ☒ **A** 8.0 m s^{-1}
- ☒ **B** 11 m s^{-1}
- ☒ **C** 16 m s^{-1}
- ☒ **D** 22 m s^{-1}

4 Which of the following is a scalar quantity?

- ☒ **A** displacement
- ☒ **B** force
- ☒ **C** time
- ☒ **D** velocity

5 Which of the following is not a SI base quantity?

- ☒ **A** force
- ☒ **B** length
- ☒ **C** mass
- ☒ **D** time

6 A spring extends by 9 cm when a force of 6 N is applied. The limit of proportionality is not exceeded.

Another identical spring is joined end to end with this spring and a force of 4 N is applied.

The extension for the pair of springs is

- ☒ **A** 3 cm
- ☒ **B** 6 cm
- ☒ **C** 12 cm
- ☒ **D** 18 cm

A car of mass 1400 kg is travelling at 25 m s^{-1}.

7 The kinetic energy of the car is

- ☒ **A** 17.5 kJ
- ☒ **B** 35.0 kJ
- ☒ **C** 438 kJ
- ☒ **D** 875 kJ