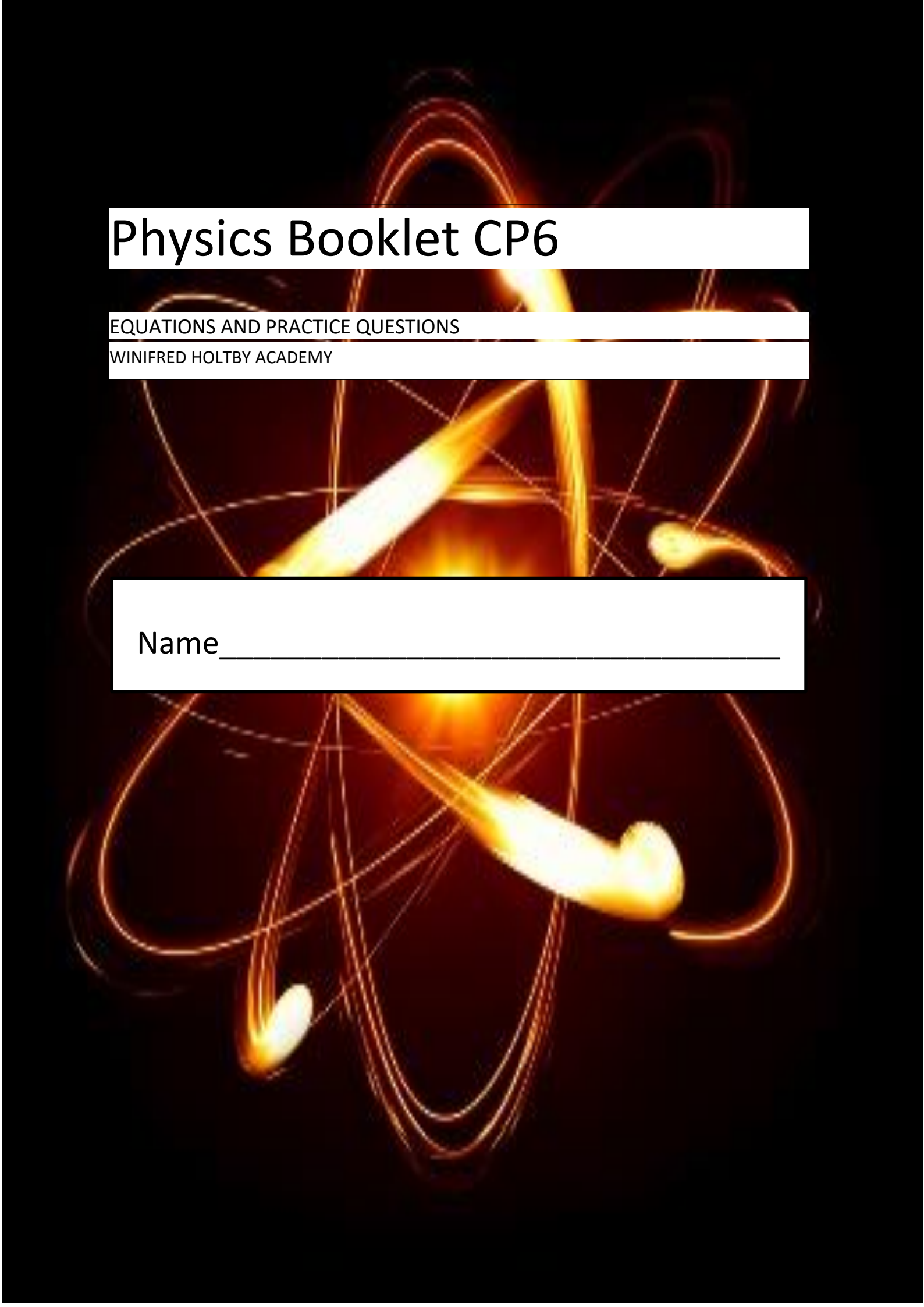


Physics Booklet CP6

EQUATIONS AND PRACTICE QUESTIONS

WINIFRED HOLTBY ACADEMY

Name_____

Write as many of the equations as you can remember in this box. Correct them in green pen using the equations sheet on the back.

CP6b.2

You will need a copy of the periodic table to help you answer these questions.

1 State the **mass number** and **atomic number** of the following elements.

a $^{11}_{5}B$ **b** $^{14}_{7}N$ **c** $^{4}_{2}He$ **d** $^{59}_{27}Co$

e $^{55}_{25}Mn$ **f** $^{48}_{22}Ti$ **g** $^{108}_{47}Ag$ **h** $^{196}_{78}Pt$

2 State the number of **protons** and the number of **neutrons** in one atom of each of these elements.

a $^{11}_{5}B$ **b** $^{14}_{7}N$ **c** $^{4}_{2}He$ **d** $^{59}_{27}Co$

e $^{55}_{25}Mn$ **f** $^{48}_{22}Ti$ **g** $^{108}_{47}Ag$ **h** $^{196}_{78}Pt$

3 Look up the atomic numbers and mass numbers of the following elements in a copy of the periodic table. Represent each element in symbol form.

a lithium (Li) **b** fluorine (F) **c** sulfur (S) **d** krypton (Kr)

e calcium (Ca) **f** iron (Fe) **g** sodium (Na) **h** iodine (I)

4 Oxygen (O) atoms all have eight protons in the nucleus. The most common **isotope** of oxygen is oxygen-16, but atoms of oxygen-17 and oxygen-18 also occur. Write these three isotopes of oxygen in symbol form.

5 Naturally occurring uranium is a mixture of two isotopes. Atoms of one isotope have 146 neutrons, and atoms of the other have 143 neutrons. The atomic number of uranium is 92 and its symbol is U. Write these two isotopes of uranium in symbol form.

6 There are four commonly occurring isotopes of iron. Iron has an atomic number of 26. Write each of the following in symbol form, and state the number of protons and neutrons in one atom of each isotope.

a iron-54 **b** iron-56 **c** iron-57 **d** iron-58

7 Work out the missing number for each of these isotopes without using a periodic table.

a copper-63: $^{??}_{29}Cu$

b tin-?? has 50 protons and 70 neutrons

c xenon-136 has 54 protons: $^{??}_{??}Xe$

d radium-226 has 138 neutrons: $^{??}_{??}Ra$

e chlorine-37: $^{??}_{17}Cl$

f copper-??: $^{65}_{29}Cu$

Answer the questions using the F.R.S.A.U format and a calculator.

CP6b.4 4 I

1 Complete the table below. In the atom column, remember to add the **mass number** and **atomic number** to the chemical symbol.

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{1}_{1}H$					
H		2			
				2	1
Li	3	6			
				4	3
$^{12}_{6}C$					
C		14			
Mg	12	24			
Mg				13	
$^{26}_{12}Mg$					

2 **a** What are **isotopes**? _____

b How many isotopes of magnesium are shown in the table? _____

c What is the same in the isotopes of magnesium? _____

d What is different in the isotopes of magnesium? _____

3 Complete the table using information from the box. You can use each term once, more than once or not at all.

0	1	+1	+2	−1	−2	1/1835	around nucleus	in nucleus

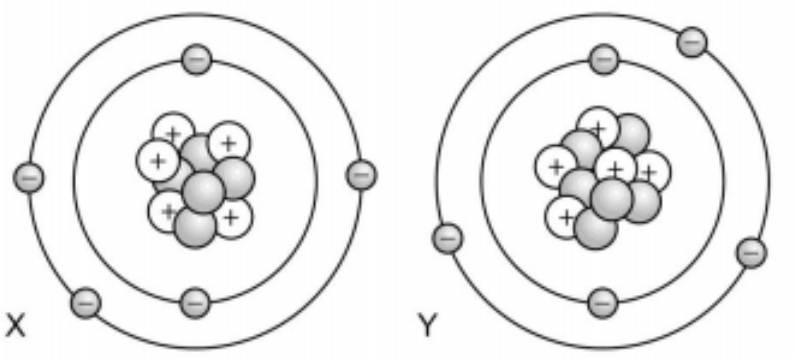
Particle	Location	Relative charge	Relative mass
proton			
electron			
neutron			

4 The diagrams show atoms of boron (B).

a What is the same in the two atoms? _____

b What is different? _____

c Write the symbols for the two atoms. _____



Write as many of the equations as you can remember in this box. Correct them in green pen using the equations sheet on the back.

CP6f.2

Particle	Symbol	
alpha	α	$^{4}_{2}He$
beta	β^-	$^{0}_{-1}e$
positron	β^+	$^{0}_{+1}e$
neutron		$^{1}_{0}n$

1 Copy these **nuclear equations** and replace each question mark (?) with the correct number.

a $^{255}_{89}Ac \rightarrow {}^{4}_{2}He + {}^{?}_{?}Fr$

b $^{20}_{9}F \rightarrow {}^{0}_{-1}e + {}^{?}_{?}Ne$

c $^{5}_{2}He \rightarrow {}^{1}_{0}n + {}^{?}_{?}He$

d $^{53}_{26}Fe \rightarrow {}^{0}_{+1}e + {}^{?}_{?}Mn$

e $^{152}_{64}Gd \rightarrow {}^{?}_{?}He + {}^{?}_{62}Sm$

2 Copy and complete these nuclear equations. Use a copy of the periodic table to find the symbol for the new element that forms.

a $^{240}_{91}Pa \rightarrow {}^{0}_{-1}e + ?$

b $^{237}_{93}Np \rightarrow {}^{4}_{2}He + ?$

c $^{8}_{3}Li \rightarrow {}^{0}_{-1}e + ?$

d $^{187}_{78}Pt \rightarrow {}^{0}_{+1}e + ?$

e $^{226}_{88}Ra \rightarrow {}^{4}_{2}He + ?$

f $^{17}_{7}N \rightarrow {}^{1}_{0}n + ?$

g $^{200}_{84}Po \rightarrow + {}^{0}_{+1}e + ?$

3 Copy and complete these nuclear equations to show the particle that was emitted during the reaction. Replace each question mark (?) with the correct number or symbol.

a $^{227}_{88}Ra \rightarrow ? + {}^{227}_{89}Ac$

b $^{185}_{78}Pt \rightarrow ? + {}^{185}_{77}Ir$

c $^{170}_{78}Pt \rightarrow ? + {}^{166}_{76}Os$

d $^{146}_{62}Sm \rightarrow ? + {}^{?}_{?}Nd$

e $^{247}_{95}Am \rightarrow ? + {}^{?}_{96}?$

4 These equations show the results of some nuclear reactions. Copy and complete the equations to show the starting elements.

a $? \rightarrow {}^{0}_{-1}e + {}^{223}_{88}Ra$

b $? \rightarrow {}^{0}_{+1}e + {}^{38}_{18}Ar$

c $? \rightarrow {}^{4}_{2}He + {}^{140}_{58}Ce$

d $? \rightarrow {}^{0}_{-1}e + {}^{24}_{12}Mg$

e $? \rightarrow {}^{0}_{+1}e + {}^{20}_{10}Ne$

Answer the questions using the F.R.S.A.U format and a calculator.

CP6f.5

You will need a copy of the periodic table to help you answer these questions.

1 **a** Describe how α radiation is similar to β^- radiation.

b What are the key differences between α radiation and β^- radiation?

2 Why do we refer to α particles and β particles, but not γ particles?

3 How does γ radiation compare with both α and β radiation in terms of:

a ionising capabilities

b penetration

c mass

d charge?

4 Uranium-238 undergoes α decay. What effect does α radiation have on:

a the proton number (the charge on the nucleus)

b the mass number?

5 Nickel-60 undergoes γ decay. What effect does this have on:

a the proton number

b the mass number?

6 What effect does emitting a neutron $\left({}^{1}_{0}n\right)$ have on:

a the proton number

b the mass number?

7 What effect does β^- decay have on:

a the proton number

b the mass number?

8 What new element forms when uranium-238 emits an alpha particle?

9 What isotope undergoes β^- decay to produce plutonium-244?

10 What kind of decay would cause:

a fermium-258 to decay to californium-254

b thorium-234 to decay to protactinium-234?

11 Write balanced **nuclear equations** to explain what happens when:

a francium-211 $\left({}^{211}_{87}Fr\right)$ decays to astatine-207 $\left({}^{207}_{85}At\right)$

b beryllium-13 $\left({}^{13}_{9}Be\right)$ emits a neutron

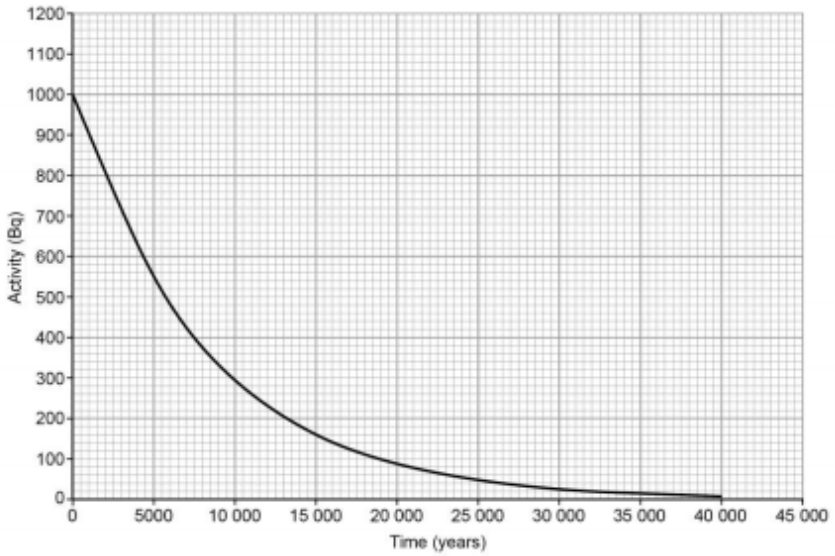
c iron-59 $\left({}^{59}_{26}Fe\right)$ undergoes β^- decay.

Write as many of the equations as you can remember in this box. Correct them in green pen using the equations sheet on the back.

CP6g.2

You do not need to remember all the details on this sheet for your exam, but you could be asked to apply your knowledge to unfamiliar situations.

Carbon contains an isotope, carbon-14, which is radioactive. The graph on the right shows the **activity** of a sample of carbon.



1 **a** The activity of the carbon sample is measured in **becquerels**. What is a becquerel?

b What happens to the activity of the carbon sample over one **half-life**?

c Work out the half-life of carbon-14 from the graph.

If we measure how much carbon-14 is left in a dead organism, we can find out how long it has been dead.

Peat bog man

An ancient human has been found in a peat bog in Ireland. You are given a 10 g sample from the body, which has an activity of 2 counts per minute from the carbon-14 in it. A 10 g sample when living would have had a count rate of 8 counts per minute.

2 **a** What has happened to some of the carbon-14 nuclei in the sample from the body?

b What is the activity of the sample from the body as a fraction of the activity of a living sample?

c What fraction of the original carbon-14 is left?

d How many half-lives does your answer in part **c** correspond to?

e Using this value and the value you calculated in question **1c**, how long ago did the man from the bog die?

Desert skeleton

A skeleton of a man has been found in the desert in Australia. You are sent a 10 g sample to date the skeleton. When living, this sample would have had an activity of 8 counts per minute from the carbon-14 in it.

When you test it, the reading for your sample is 1 count per minute.

3 **a** What is the activity of the sample from the skeleton as a fraction of the activity of a living sample?

b What fraction or percentage of the original carbon-14 is left?

c Using this value and the value you calculated in question **1c**, how long is it since the man was alive?

	distance travelled = average speed × time	
	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{(v-u)}{t}$
	force = mass × acceleration	$F = m \times a$
	weight = mass × gravitational field strength	$W = m \times g$
	efficiency = $\frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}}$	
HT	**momentum = mass × velocity**	$p = m \times v$
	wave speed = frequency × wavelength	$v = f \times \lambda$
	wave speed = distance ÷ time	$v = \frac{x}{t}$
	density = mass ÷ volume	$\rho = \frac{m}{V}$
	work done = force × distance moved in direction of force	$E = F \times d$
	change in gravitational potential energy = mass × gravitational field strength × change in vertical height	$\Delta GPE = m \times g \times \Delta h$
	kinetic energy = ½ × mass × (speed)²	$KE = ½ \times m \times v^2$
	power = work done ÷ time taken	$P = \frac{E}{t}$
	energy transferred = charge moved × potential difference	$E = Q \times V$
	charge = current × time	$Q = I \times t$
	potential difference = current × resistance	$V = I \times R$
	power = energy transferred ÷ time taken	$P = \frac{E}{t}$
	electrical power = current × potential difference	$P = I \times V$
	electrical power = current squared × resistance	$P = I^2 \times R$
	force exerted on a spring = spring constant × extension	$F = k \times x$

GCSE (9–1) Physics, you also need to learn these extra equations:

	moment of a force = force × distance normal to the direction of the force	
	pressure = force normal to surface ÷ area of that surface	$P = \frac{F}{A}$