AS and A-level Biology

Key skills and knowledge booster

Dr Harjit K Singh

Contents

GCSE Biology Checker Tasks

1	Vocabulary	7
2	Plant and Animal Cell Structure	9
3	Biological Molecules	10
4	Photosynthesis and Respiration	11
5	Health and Disease	12
6	Transport in Plants	14
7	The Scientific Method	15

Basic Skills for the AS and A-level Biologist

8	Examination Terminology	16
9	Units and Abbreviations	18
10	Powers and Logs	21
11	Orders of Magnitude	23
12	Calculation Skills	24
13	Graph Plotting Skills	27
14	Equation of a Straight Line	31
15	Formulae, Structures and Equations	33
16	Calculating Surface Areas and Volumes	36

Investigation Skills for the AS and A-level Biologist

17	Preparing Solutions of Different Dilution	38
18	Biochemical Tests for Molecules	40
19	Formulating Hypotheses and Investigation Plans	42
20	Correlation and Causal Relationships	44
21	Data Interpretation and Evaluation	47
22	Statistical Tests	52
23	Sampling Techniques	61

Topic Builders

24	Microscopes	66
25	Prokaryotic Cells	70
26	Eukaryotic Cells	72
27	Cell Organelles	74
28	Structure of the Cell Membrane	78
29	Movement Into and Out of Cells	81
30	Structure and Function of Carbohydrates	86
31	Structure and Function of Lipids	91
32	Structure and Function of Proteins	95
33	Enzyme Structure and Mode of Action	98
34	Factors Affecting Enzyme Activity	102
35	Structure and Function of Nucleic Acids	106
36	Replication of DNA	111
37	Structure and Function of Mammalian Lungs	114
38	Heart Structure and the Cardiac Cycle	118
39	Blood Vessels and Blood Cells	122
40	Tissue Fluid and Lymph	126
41	Cell Cycle and Mitosis	130
42	Meiosis and Genetic Variation	134
43	Calculating Surface Area to Volume Ratios	139
44	Gas Exchange Surfaces	142
45	Transport of Water and Minerals in Plants	147
46	Measuring Biodiversity	151
47	Conservation	156

Biology and its Applications

48	Use of Enzymes in Industry	159
49	Infectious Diseases – Causes, Transmission and Prevention	160
50	Lifestyles and Diseases	161
51	Human Impact on the Environment	162
52	Therapeutic Uses of Stem Cells	163
53	Genetic Engineering	164

Introduction – from the authors

About the Key Skills and Knowledge Booster Series

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Students often find this transition very difficult and can easily become overwhelmed by the new subject knowledge they meet, which is often abstract, and the level of understanding required. It is not uncommon for students to find themselves in the unenviable position of failing early exams or gaining grades that lead to them to become despondent with the subject or reconsider their subject choices.

The tasks outlined in this series aim to cover areas of common misconceptions in the main science AS and A-levels of biology, chemistry and physics, and to aid teachers in their delivery of underpinning concepts, such as general maths skills or practical skills, needed for each subject. The newly updated A-level science curricula place a far greater emphasis on these underpinning skills and, for this reason, each of the books in the Key Skills and Knowledge Booster series has had extra tasks added to ensure that teachers can provide as much support as possible to students with these skills.

Due to the wide number of GCSE specifications covered by students, it is impossible for all students to begin their A-levels with identical background knowledge, and there will always be huge variability in the grades students have achieved in their GCSE exams. Both of these factors can have an impact on the delivery of the A-level syllabus and, ultimately, on the success of students. At the time of writing, the new GCSE science curriculum was in the process of being finalised. This curriculum also places an emphasis on underpinning skills, including maths, and has introduced new topics within each of the three subjects. Extra tasks have been added so that teachers can check students' understanding of these areas. This will be of particular importance when teaching students who have moved from the old GCSE specifications, as it will highlight areas that were not covered but which are expected to be commonplace as students progress through their science studies.

The Key Skills and Knowledge Booster Series has been developed to complement your existing teaching. It has not been written to meet any particular A-level specification, rather to cover general areas within each subject that we have found anecdotally to give rise to problems for students. These tasks are not intended to replace your existing text books or to act as a stand-alone teaching guide.

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  These could be used as an induction exercise to ascertain students' background knowledge and highlight areas that students will need to revise, or they could be combined to form an induction test.

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These could be used at the beginning of the AS year to bring students up to a basic level in skills such as graph plotting, using calculators or using scientific notation. They can also be given to students if work they are completing throughout the year shows they have weaknesses in certain areas, for example rearranging equations.

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  These could be used when introducing a new practical technique, such as dilution and biochemical tests, the run-up to practical exams or to aid in-depth investigations.

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- **Accompanying CD:** this contains a copy of the entire book plus answers to the tasks. The CD files can be used either to project the tasks onto a whiteboard, or to print off relevant pages for individual students.

The tasks in the first four sections all contain questions or tasks for students to attempt to check their understanding. Answers (contained on the CD) have been provided for self-marking. Where necessary, 'workings out' have been shown to help students check through, and learn from, their answers. Key words and terms have been shown in bold throughout the tasks contained in the books to help students identify words or phrases they should know and be able to define or interpret.

Who is the Key Skills and Knowledge Booster series aimed at?

The tasks have been written predominantly for first-year A-level students, although some of the tasks will be relevant to both AS- and A2-level students. The tasks would be very suitable for students who are finding the transition from GCSE-level science into A-level difficult.

They have been written with students in mind who are achieving grades lower than a C in homework or exams; they are designed to assist these students to fill gaps in their background knowledge or subject-specific knowledge.

Not all students will find all topics difficult, so the tasks can be used as and when required for any student, to help 'top-up' understanding when they meet an area of study they find more difficult.

The series would also be an excellent resource to use with students who miss lessons due to illness or university visits, for example. The tasks would also be an excellent resource to give to students as preparation to be completed prior to, or during, personal tutorials or group seminars.

When do I use the Biology tasks?

The tasks do not need to be used in a sequential order; they can be used as and when they are suitable within your own specification. Nor does each of the tasks need to be used – the book forms a resource bank that can be dipped in and out of.

About the author

Dr Harjit K Singh is an experienced teacher and has taught biology, chemistry and psychology up to A-level as well as BTEC Forensic Science. She has taught AS/A2 Biology and IB Biology and has presented many CPD courses for teachers as well as biology student revision conferences and online web conferences. She has a wealth of experience as an examiner in AS/A2 Biology and IB specifications, and in writing biology resources.

Vocabulary

It is very important that you are able to use scientific vocabulary accurately. There are many biological terms that you will be familiar with from your GCSE science course and it is now essential that you can understand and use them appropriately. Complete the following task and questions, and then compare your results with the Answers. Revise any areas where you have made mistakes.

Task

Use the biological terms below to complete the definitions in the table. Some terms have not been included to provide an extra challenge.

tissue	**enzyme**	**bacteria**
photosynthesis	**active transport**	**nucleus**
cytoplasm	**DNA**	**active site**
living organisms	**diffusion**	**low**
high	**protein**	**dilute**
homeostasis	**identical**	**water**
internal	**similar**	**chain**
concentrated		

Scientific word	Definition
Activation energy	Energy needed to make a reaction take place
……..	Place on the enzyme molecule where the substrate fits
A…….. t……..	Movement of substance against a concentration gradient requiring ……..
……..	A single-celled micro-organism with no nucleus
Cell	Fundamental building block of …….. ……..
Chromosome	Made up from …….., found in the nucleus
C……..	Found in all living cells where chemical reactions take place
Denatured	When the shape of an enzyme molecule changes so it is not able to function
D……..	Net movement of molecules from an area of …….. concentration to one of …….. concentration
E……..	Biological catalyst that …….. the rate of reaction
Food ……..	Feeding relationship between different organisms in an ecosystem
Gene	A part of DNA that codes for a ……..
H……..	Maintaining a constant ……... environment
Mitosis	Cell division in which two …….. daughter cells are produced
N……..	An organelle that contains the genetic material and controls cell activity

(*Continued*)

Vocabulary

Scientific word	Definition
Osmosis	Diffusion of …….. from a …….. to a more …….. solution
P……..	Process carried out by …….. in which light …….. is used to produce glucose
Respiration	Process where g…….. is broken down to provide energy in all cells
T……..	A group of cells that have a …….. structure and function

Questions

1 Where in the cell do the chemical reactions take place?

2 In which process is light energy used to produce glucose?

3 Define the term ‘respiration’.

4 What is a gene?

5 What is the term used to describe the loss of function by enzymes?

6 What is tissue made up of?

Plant and Animal Cell Structure

Cells are the basic building blocks of all living things. There are many similarities and differences between plant and animal cells that you would have studied in your GCSE science course. Complete the following tasks and questions.

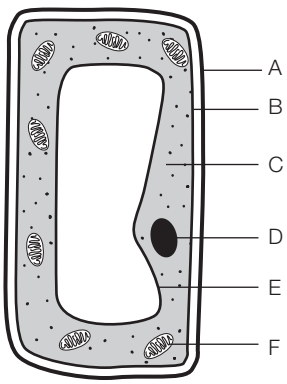
Task 1

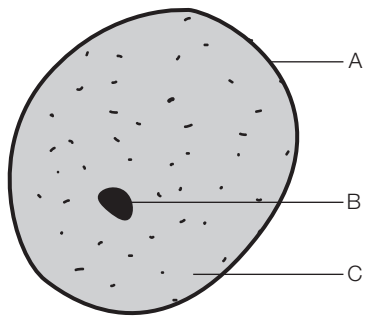
Complete the table below, stating the function of each feature. Tick (✔) which cell type the feature is present in and place a cross (✘) where it does not exist.

Feature	Function	Plant	Animal
Cellulose cell wall			
Cell (plasma) membrane			
Nucleus			
Cytoplasm			
Large permanent vacuole			

Task 2

Label the plant and animal cells below.





Questions

1. What structures are usually present in all cells, whether plant or animal?
2. Which cell structure is responsible for controlling the entry and exit of substances into and out of the cell?
3. What structures are only present in palisade cells?
4. Which process occurs in the chloroplast?
5. State the function of the nucleus.
6. Where in the plant cell would you find cell sap?
7. What is the function of the cellulose cell wall?
8. Where in the cell do most of the chemical reactions take place?

Biological Molecules

Different types of food are needed in correct amounts to maintain a healthy body. The main food groups are **carbohydrates**, **lipids** and **proteins**.

Complete the following task and questions.

Task

Complete the table below by placing a tick (✔) if the statement is correct for each food group or a cross (✘) if incorrect.

Statement	Carbohydrates	Lipids	Proteins
Major component found in the plant cell wall – cellulose			
Provides thermal insulation			
Can be either found as fats (animals) or oils (plants)			
Needed to build up muscles in animals			
Main compound used in respiration			
Amino acids are the building blocks			
Made up of fatty acids and glycerol			
Examples include enzymes, hormones and haemoglobin			
Includes glucose, sucrose and starch			
Denature/break down at high temperature			

Questions

1. Name the compound that is the source of energy in respiration.
2. What are built up from amino acids?
3. Which compound serves as a reserve source of energy in plants and animals?
4. What has a structural role in the plant cell wall?
5. List two functions of lipids.
6. What compound is made up of glycerol and fatty acids?
7. This forms compounds that carry oxygen in the blood.
8. Name the storage molecule found in plant cells.

AS and A-level Chemistry

Key skills and knowledge booster

Victoria Stutt

Contents

GCSE Chemistry Checker Tasks

1	Vocabulary	7
2	The Scientific Method	8
3	Atomic Structure	9
4	The Periodic Table	10
5	Chemical Equations and Reactions	11
6	Chemical Bonding	12
7	Electrolysis	13
8	Endothermic and Exothermic Reactions	14
9	Mini Quiz	15

Basic Skills for the AS and A-level Chemist

10	Chemistry Glossary	17
11	Handling Numbers	18
12	Powers and Logs	21
13	Orders of Magnitude	23
14	Calculating Surface Areas and Volumes	24
15	SI Units	26
16	Calculator Skills	28
17	Line Graphs	30
18	Equation of a Straight Line	32
19	Rearranging Equations	34
20	Chemical Formulae	36
21	Balancing Chemical Equations	38
22	Half and Ionic Equations	40

Investigation Skills for the AS and A-level Chemist

23	Formulating Hypotheses and Investigation Plans	43
24	Weighing	46
25	Making Quantitative and Qualitative Observations	48
26	Filtering	50
27	Chromatography	52
28	Preparing Standard Solutions	55
29	Titration	57
30	Recrystallisation	59
31	Refluxing	60
32	Distillation	62
33	Common Chemical Tests	64
34	Determining the Rate of a Reaction	67
35	Evaluation Skills	70

Topic Builders

36	Learning about the Elements	72
37	Moles	76
38	Empirical and Molecular Formulae	79
39	The Ideal Gas Law	82
40	Electronic Configurations	84
41	More Electronic Configurations	88
42	Periodic and Group Trends	90
43	Ionisation Energy	93
44	How Bonding Influences Structures and Properties	98
45	Intermolecular Bonding	103
46	Acids and Bases	108
47	Functional Groups	112
48	Isomers	116
49	Yield and Atom Economy	120
50	Boltzmann Distribution	124
51	Enthalpy Changes and Hess' Law	127
52	Le Chatelier's Principle	132
53	Oxidation Numbers	137

Chemistry and its Applications

54	Cosmetics	142
55	Medicines	143
56	Nanoparticles	144
57	Explosives	145
58	Global Warming	146
59	Green Fuels	147

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Not all students will find all topics difficult, so the tasks can be used as and when required for any student; to help 'top-up' understanding when they meet an area of study they find more difficult.

The series would also be an excellent resource to use with students who miss lessons due to illness or university visits, for example, along with an excellent resource to give to students as preparation to be completed prior to, or during, personal tutorials or group seminars.

When do I use the Chemistry tasks?

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About the author

Victoria Stutt is an experienced KS3, KS4 and A-level classroom teacher. Victoria is the co-author of the KS3 Level Assessed Homework Tasks and co-author of the GCSE Triple Science Chemistry Tasks.

Vocabulary

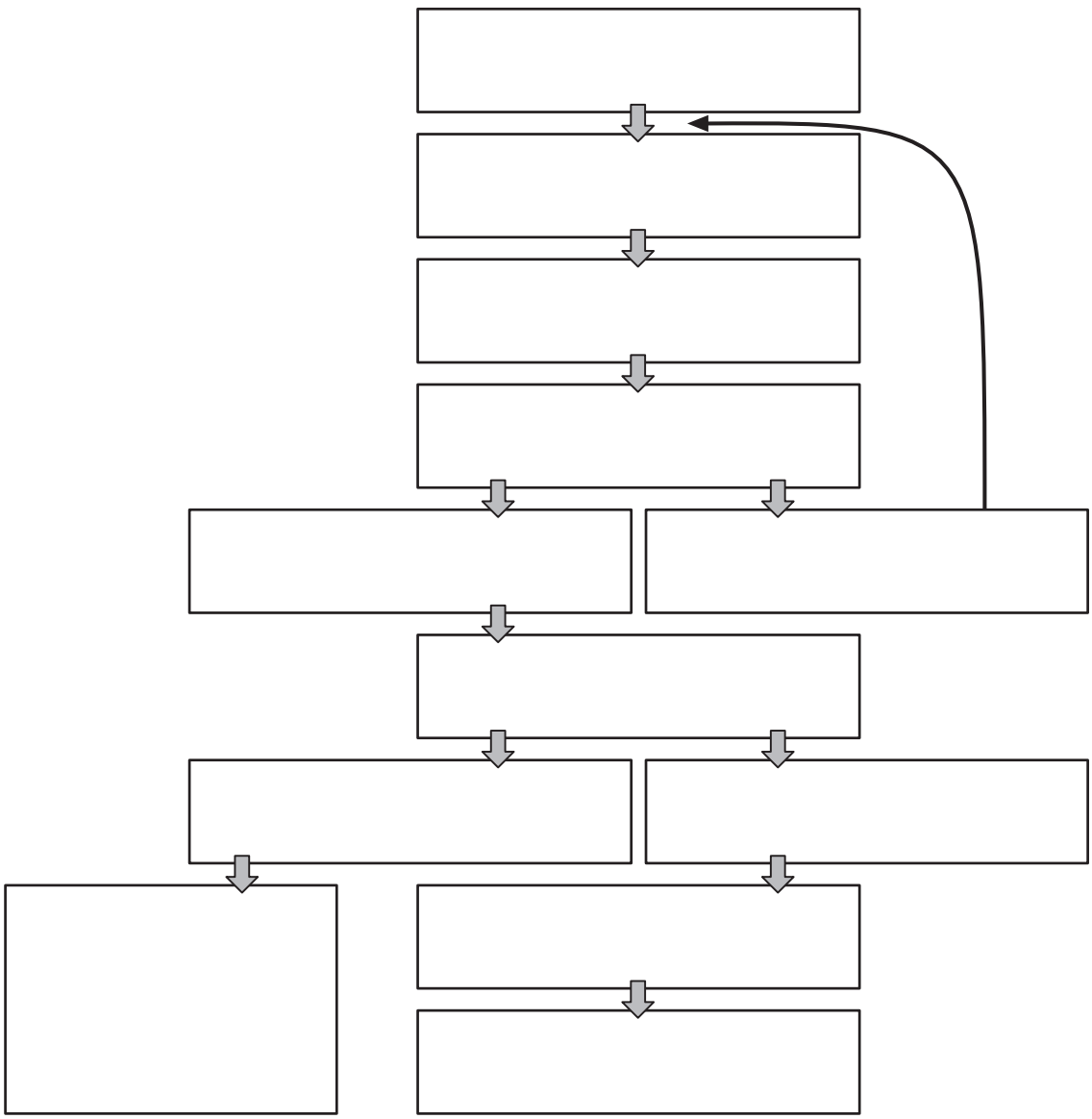
Each of the definitions below is for a common word or term used in chemistry. Identify the correct word or term to go with each definition and write it in the space provided.

Definition	Word/Term
The smallest particle of an element	
Positive nuclei held together by delocalised electrons	
Different physical structures of atoms of the same element	
The rate of change in concentration of a reactant or product over time	
Chemically combined elements in a fixed ratio	
Able to dissolve in a particular solvent	
Breaking a substance apart using an electrical current	
A reaction in which a substance is burned in oxygen	
A substance able to speed up a chemical reaction but which remains unchanged after the reaction is complete	
A bond formed by the sharing of a pair of electrons	
Negatively charged particle found within atoms	
The loss of electrons	
The reaction between an acid and a base to produce water and a solution of pH 7	
A bond formed by the exchange of electrons and resulting attraction between ions	
Positively charged particle found within atoms	
A type of reaction that gives out heat and causes a rise in temperature	
Centre of an atom, containing protons and neutrons	
Gain of electrons	
Particle with no charge found within atoms	
The amount of a dissolved substance in a given volume of solvent	
A type of reaction that takes in heat and causes a decrease in temperature	
An atom or molecule with an overall charge	
A more reactive element taking the place of a less reactive element	

Task

Place the processes below into the flow chart to illustrate the typical order of the 'scientific method'.

- Carry out experiments that test the hypothesis
- Results do not support hypothesis
- Follow advice given by the expert reviewers
- Propose a hypothesis
- Submit results (scientific paper) for review by qualified, expert scientists
- Ask questions/carry out simple tests
- Findings are not accepted by other scientists
- Draw a conclusion from experimental results
- Findings may be continually accepted and become a 'theory' or eventually a 'law'
- Findings are accepted by other scientists
- Results support hypothesis
- Scientific paper is published



Atomic Structure

Every substance around you is made from atoms. But what is an atom and what does an atom contain?

In the space below produce a drawing that shows what makes up an atom. You should label your diagram fully and give explanations where necessary.

Once you are happy that you have included everything, compare it with the completed diagram in the Answers to check you have all the essential points.

AS and A-level Physics

Key skills and knowledge booster

Spencer Senior

Contents

GCSE Physics Checker Tasks

1	Electricity	7
2	Forces	9
3	Motion	10
4	Space and Radioactivity	11
5	Energy and Waves	13
6	The Scientific Method	15

Basic Skills for the AS and A-level Physicist

7	The Study of Physics; Physical Quantities and their Symbols	16
8	Large and Small Numbers and Standard Form	18
9	Units in Physics	20
10	Prefixes for Units	22
11	Using your Calculator	25
12	Rearranging Equations	27
13	Using Equations in Physics	31

Investigation Skills for the AS and A-level Physicist

14	Calculating Volumes and Surface Areas	34
15	Powers and Logs	36
16	Orders of Magnitude	38
17	Formulating Hypotheses and Investigation Plans	39
18	Measurements and Errors	41
19	Results Tables	45
20	Analysing Results	47
21	Graphs	50
22	Equation of a Straight Line	52

Topic Builders

23	Atoms and Nuclei	54
24	Subatomic Particles	58
25	Conservations Laws and Feynman Diagrams	62
26	Electrical Circuits: Charge, Current and Voltage	66
27	Electrical Circuits: Resistance	70
28	Vectors and Scalars	75
29	Mass and Weight	80
30	Forces in Equilibrium	83
31	Moments	86
32	Motion Graphs	89
33	Equations of Motion	93
34	Forces and Motion	96
35	Energy and Power	99
36	Kinetic Energy and Gravitational Potential Energy	102
37	Momentum	105
38	Waves	109
39	The Photon	112
40	The Photoelectric Effect	116
41	Wave–particle Duality	119
42	Energy Levels	122
43	The Young Modulus	126

Physics and its Applications

44	Superconductors	129
45	Particle Accelerators	130
46	Neutron Stars and Black Holes	131
47	Dark Energy and Dark Matter	132
48	Exoplanets	133
49	Metamaterials	134

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The tasks outlined in this series aim to cover areas of common misconceptions in the main science AS and A-levels of biology, chemistry and physics, and to aid teachers in their delivery of underpinning concepts, such as general maths skills or practical skills, needed for each subject. The newly updated AS and A-level science curricula place a far greater emphasis on these underpinning skills and, for this reason, each of the books in the Key Skills and Knowledge Booster series has had extra tasks added to ensure that teachers can provide as much support as possible to help students develop these skills.

Due to the wide number of GCSE specifications covered by students, it is impossible for all students to begin their AS and A-levels with identical background knowledge, and there will always be huge variability in the grades students have achieved in their GCSE exams. Both of these factors can have an impact on the delivery of the AS and A-level syllabus and, ultimately, on the success of students. At the time of writing, the new GCSE science curriculum was in the process of being finalised. This curriculum also places an emphasis on underpinning skills, including maths, and has introduced new topics within each of the three subjects. Extra tasks have been added so that teachers can check students' understanding of these areas. This will be of particular importance when teaching students who have moved from the old GCSE specifications, as it will highlight areas that were not covered but which are expected to be commonplace as students progress through their science studies.

The Key Skills and Knowledge Booster Series has been developed to complement your existing teaching. It has not been written to meet any particular AS and A-level specification, rather to cover general areas within each subject that we have found anecdotally to give rise to problems for students. These tasks are not intended to replace your existing text books or to act as a stand-alone teaching guide.

What the Key Skills and Knowledge Boosters series contains

A separate book has been produced for biology, chemistry and physics. Each title is broken down into the following sections. Ideas on how you may wish to use each type of task within your own teaching have been shown in italics.

- **GCSE Checker Tasks:** these tasks can be used to get an overview of GCSE knowledge that students have.

  These could be used as an induction exercise to ascertain students' background knowledge and highlight areas that students will need to revise or they could be combined to form an induction test.

- **Basic Skills for the AS and A-level Student:** these tasks give instructions and guidance to students on skills they will need throughout AS and A-levels, such as essential maths skills. We have found that maths skills, or confidence in particular, is often an area that causes many problems, especially if students are not following AS and A-level courses in maths. These tasks aim to cover some of the gaps in knowledge that students may have.

These could be used at the beginning of the AS year to bring students up to a basic level in skills such as graph plotting, using calculators or using scientific notation. They can also be given to students if work they are completing throughout the year shows they have weaknesses in certain areas: for example, rearranging equations.

- **Investigation Skills for the AS and A-level Student:** these tasks outline key skills or techniques that students will need in order to access their specific AS and A-level syllabus; they form an excellent bank of resources that students could refer to in order to remind themselves of practical techniques, or skills that they may need to use time and time again. These will complement the teaching around any investigations or assessed practical activities that students may need to complete.

  These could be used when introducing practical skills and results analysis, in the run-up to practical exams, or to aid in-depth investigations.

- **Topic Builders:** these tasks lead students through the topics that, in our experience, students find the most difficult to comprehend. They have been written in as simple a manner as possible to try and support students through topics and to steer them away from forming misconceptions. Where possible, simple analogies have been included to help students overcome the abstract nature of some of the topics. These tasks include a 'Taking it Further' section that allows students to consolidate what they have covered and to go on and extend their understanding, once they have grasped the essential points and are feeling more confident with the topic.

  These can be given to students who are struggling with specific concepts. They could be used as individual self-study exercises, homework, material to work through in tutorials or within small group settings.

- **Physics and its Applications:** these tasks are open ended and research based. They encourage students to consider how the subject they are studying impacts on everyday life, industry or perhaps the world of academic research. Students can become so focused on what they need to know for exams that they lose sight of what the subject they are studying is all about; these tasks allow students to become enthused on topics and may (hopefully) lead to interest in studying the subject further.

  These could be used throughout the year, perhaps as homework, research tasks or extension work.

- **Accompanying CD:** this contains a copy of the entire book plus answers to the tasks. The CD files can be used either to project the tasks onto a whiteboard, or to print off relevant pages for individual students.

The tasks in the first four sections all contain questions or tasks for students to attempt to check their understanding. Answers (contained on the CD) have been provided for self-marking. Where necessary, 'workings out' have been shown to help students check through, and learn from, their answers. Key words and terms have been shown in bold throughout the tasks contained in the books to help students identify words or phrases they should know and be able to define or interpret.

Who is the Key Skills and Knowledge Booster series aimed at?

The tasks have been written predominantly for first-year AS and A-level students, although some of the tasks will be relevant to both AS- and A2-level students. The tasks would be very suitable for students who are finding the transition from GCSE-level science into AS and A-level difficult.

They have been written with students in mind who are achieving grades lower than a C in homework or exams; they are designed to assist these students to fill gaps in their background knowledge or subject-specific knowledge.

Not all students will find all topics difficult, so the tasks can be used as and when required for any student; to help 'top-up' understanding when they meet an area of study they find more difficult.

The series would also be an excellent resource to use with students who miss lessons due to illness or university visits, for example. The tasks would also be an excellent resource to give to students as preparation to be completed prior to, or during, personal tutorials or group seminars.

When do I use the Physics tasks?

The tasks do not need to be used in a sequential order; they can be used as and when they are suitable within your own specification. Nor does each of the tasks need to be used – the book forms a resource bank that can be dipped in and out of.

About the author

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Electricity

The questions below are intended to test your knowledge of key ideas covered in most GCSE specifications. Answers with brief explanations follow. You should revise any areas which you find difficult or do not score well on.

Conductors and insulators

1 Name three good electrical conductors, including one non-metal.

2 Name three electrical insulators.

3 What name is given to the property of a material that gives a measure of how easy it is for electrical current to flow through it?

4 Why does a circuit stop working when a switch is open?

Circuit symbols

5 Copy the table and complete the missing circuit symbols and their names.

symbol	name
	cell
	
	resistor
	
	bulb

Circuits

6 Draw a simple circuit containing a cell, bulb, ammeter and voltmeter.

7 Label the positive and negative sides of the cell symbol.

8 Copy and complete: An ammeter measures ..... flowing in a circuit and is always placed in ..... with components in the circuit.

9 Copy and complete: A voltmeter measures .... across a component and is always placed in ..... with components in the circuit.

10 What changes and what remains the same as you move round a series circuit?

Electricity

Safety

11 What are the colours of the mains wires in a plug?

12 Name what each wire is.

13 Explain how a fuse works.

14 If someone is electrocuted what is the first thing you should do?

Calculations

15 What is the total resistance when a 470 Ω resistor is placed in series with a 500 Ω resistor?

16 What is the voltage across a 24 Ω resistor if a current of 0.78 A flows through it? (Use $V = IR$)

17 What is the voltage across an 11 kΩ resistor if a current of 0.055 A flows through it? (Use $V = IR$)

18 Rearrange $V = IR$ so that current is the subject instead of voltage.

19 Calculate the resistance of a circuit if 1.2 A flows around it when the voltage of the supply is 12 V.

20 Calculate the resistance of a resistor if 0.22 A flows through it when the voltage across it is 230 V.

Forces

The questions below are intended to test your knowledge of key ideas covered in most GCSE specifications. Answers with brief explanations follow. You should revise any areas which you find difficult or do not score well on.

Examples of forces

1 What name is given to the force of gravity on an object?

2 What is the name of the force that makes raindrops and bubbles round?

3 What force between tyres and the surface of a road enables a car to corner?

4 What force causes some objects to float in water?

5 What name is given to the force acting along a rope that is pulled taut?

6 What name is given to the force on the wings of an aeroplane during flight?

7 Draw the forces acting on

a. a book on a table

b. a ball on the floor

c. a ball falling towards the ground

d. a boat on a still lake

Balanced and unbalanced forces

8 What is the name given to the force put on an object by the surface it rests on?

9 What is the same, and what is different, about a pair of forces if they are balanced with each other?

10 What does it mean to say a body is in equilibrium?

11 What does an unbalanced force do to an object's motion?

Newton's Laws of Motion

12 State Newton's First Law of Motion.

13 Write the formula for Newton's Second Law of Motion.

14 What 'saying' is a version of Newton's Third Law of Motion?

Pressure

15 a. State the equation for pressure in a liquid and name all the variables and their units.
b. Describe a situation where pressure is exerted on one object by another.

16 State the density of water.

17 a. Explain how pressure varies with varying depth and density in a liquid.
b. State the equation that shows the relationship between pressure, depth and density.

18 Calculate the pressure at a depth of 0.1 m in water.

19 Calculate the pressure in air of average density 0.6 kg m^{-3} at a depth of 18 km.

20 Calculate the pressure at a depth of 253 m in seawater with a density of 1030 kg m^{-3}.

Motion

The questions below are intended to test your knowledge of key ideas covered in most GCSE specifications. Answers with brief explanations follow. You should revise any areas which you find difficult or do not score well on.

Speed

1 Speed is a measure of how far an object travels in a given time. Write an equation that relates speed, distance and time.

2 What is the metric unit for speed?

3 What is the average speed of a sprinter, if they travel 200 metres in 19.2 seconds?

4 Calculate the average speed of a snail covering 1.6 metres in 26 minutes.

5 How far does sound travel in 10 seconds, if its speed in air is 330 ms^{-1}?

6 How long does it take a car travelling at 24 ms^{-1} to cover a distance of 1.2 km?

Acceleration

7 Acceleration is the change in speed in a given time. The change in speed is the final speed minus the initial speed, so when the initial speed is zero (that is, when an object starts at rest), the change in speed is the same thing as the final speed. Write an equation that relates acceleration, speed and time.

8 Write the metric unit for acceleration.

9 If a cyclist reaches a speed of 5 ms^{-1}, after starting from rest, in 3 seconds, what is their acceleration?

10 A sprinter achieved a speed of 12 ms^{-1}, 1.4 seconds after the starter's gun was fired. What was their acceleration?

11 If an object starting at rest falls with an acceleration of 10 ms^{-2}, what is its speed at 8 seconds?

12 How long does it take for a rocket travelling at 100 ms^{-1} to increase its speed to 150 ms^{-1}, if the rocket motor can produce an acceleration of 25 ms^{-2} ?

Force and motion

13 Explain the difference between stopping distance, thinking distance and braking distance for vehicles on the road.

14 Give three factors that affect thinking distance.

15 Give three factors that affect braking distance.

16 Name two safety features modern cars have that are designed to reduce the size of forces on occupants during an impact.

17 Engine thrust acts forwards when a car is travelling on a road. This is opposed by drag (friction and air resistance) acting in the opposite direction to motion. What happens to these forces:

a. when the car accelerates?

b. when the car brakes?