

BTEC Diploma and Extended Diploma in Applied Science

Name:

Units	Unit size (GLH)	Details	Units	Unit size (GLH)	Details
1. Principles and Applications of Science 1.	90	3 exams – one biology, one chemistry and one physics	9. Human Regulation and Reproduction	60	Assignments
2. Practical Scientific Procedures and Techniques	90	Assignments	12 Diseases and Infections (Triple)	60	Assignments
3. Science Investigation Skills	120	3 exams based around a pre-released experiment.	14. Applications of organic chemistry (Triple)	60	Assignments
4. Lab techniques and their Application	90	Assignments based on practicals	15. Electric Circuits and their Application	60	Assignments
5. Principles and Applications of Science 2	120	3 exams – one biology, one chemistry and one physics	21. Medical Physics Applications (Triple)	60	Assignments
6. Investigative project	90	One large project assignment	23 Forensic Evidence, Collection and Analysis (Triple)	60	Assignments
7. Contemporary issues in Science (Triple)	120	Exam based on scientific articles			

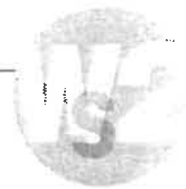
Diploma in Applied Science – 720 GLH

Extended Diploma in Applied Science – 1080 GLH

BTEC Science Summer Work

BTEC Biology Summer Work

1 Well, what do you know?



Read the following passage

The poet who wrote 'Sugar and spice and all things nice, that's what little girls are made of' was lying. Any biologist can tell you that little girls, and their brothers, are made of protein, carbohydrates, lipids, nucleic acids, some inorganic ions and a lot of water.

Now Walter de la Mare was telling the truth when he wrote: 'It's a very odd thing, as odd as can be, that whatever Miss T eats turns into Miss T'. Whatever the associated delights of food may be, we eat for two reasons: to get energy and to acquire the raw materials for growth and metabolism.

Any organic material is food for something; it's all a matter of taste. Dung beetles find nourishment in what sheep leave behind, and sheep can gain from grass all the materials for making meat and wool. The macromolecules that make up our own cells are all derived from the macromolecules we consume. Whether we are omnivores or herbivores, the carbohydrates, proteins, lipids (fats and oils) and nucleic acids that we digest and absorb become the components of human cells.

Cells are mostly water, but if all the water is driven off by heating we are left with the organic content of the cells and some inorganic ions. The organic compounds are mostly polymers, particularly protein and, if we are talking of plant cells, cellulose.

The cytoplasm contains thousands of different soluble proteins known as enzymes, which play an important role in all metabolic processes. Proteins also have an important structural function because they form part of all cell membranes. The other major components of cell membranes are lipids. These are a heterogeneous group of substances, but one thing they all have in common is that they are insoluble in water. A cell surface membrane is more than just a bag holding everything in; it also exerts control over what enters and leaves the cell.

A cell wall is completely different from a cell surface membrane. A plant cell synthesises the cell wall on the outer surface of the cell surface membrane by linking together molecules of glucose to make cellulose. This polysaccharide is never found in animal cells, although glucose is.

Glucose is a carbohydrate and is the most commonly occurring monosaccharide. For almost all cells it is the starting-point in respiration. Remember that food not only provides the materials to make cells, it also provides the energy to make cells work. Energy is released when glucose is broken down chemically inside cells in the process called respiration.

Cells are involved in all kinds of work. Watch a time-lapse film of animal cells and you can see how much they move. Under the microscope you can watch chloroplasts streaming around the cells of Canadian pond weed. Movement is only one of the energy-requiring activities of cells; making bigger molecules from smaller ones is another and so is the control of some substances entering or leaving through the cell surface membrane.

Respiration is one of the characteristics of living organisms. Plants are living organisms, so plants carry out respiration. But plants get their energy from sunlight, so why do they respire? For one thing, only the green parts of a plant photosynthesise, and all cells, green or not, require energy. Even the green cells respire, and this takes place all the time, not only at night. Photosynthesis in the chloroplasts makes glucose, and this travels to other parts of the cell, where it is broken down to release energy for jobs such as building up proteins or cellulose, controlling entry of molecules through the cell surface membrane and cell division.

5 Do enzymes play a part in both anabolism and catabolism? Which line tells you the answer?

.....

6 What is cellulose used for in cells?

.....

7 What is cellulose made from?

.....

8 Which of the following words describe cellulose? Underline your answers.

carbohydrate macromolecule polymer polysaccharide protein

9 Dietary fibre is mainly cellulose. Suggest an explanation of how 'dung beetles find nourishment in what sheep leave behind' (lines 7–8).

.....

.....

10 The passage refers to cell membranes and cell surface membranes. Suggest a distinction between these two terms.

.....

.....

11 Which substances are found in:

(a) Plant cell walls?

(b) Cell membranes?

1 Well, what do you know?

Name:

This is a questionnaire about your GCSE biology knowledge

- 1 Tick the compounds you heard about at GCSE, saying whether you heard about them as being components of the diet or as components of cells.

Compounds	Components of diet	Components of cells	Haven't heard of them
Carbohydrates			
Fats and oils			
Lipids			
Nucleic acids			
Proteins			

- 2 Which description best fits your understanding of the term respiration? Circle the letter.

- A Breathing in and out
- B Exchange of oxygen and carbon dioxide in the lungs
- C Breakdown of food molecules to release energy
- D Don't understand the term

- 3 For each statement about enzymes, underline the word that agrees with your own understanding. If you're not sure, underline 'Don't know'.

(a) All enzymes are made of protein.

True False Don't know

(b) All enzymes are found in the digestive system.

True False Don't know

(c) Enzymes are found inside cells.

True False Don't know

(d) All enzymes break down large molecules into smaller ones.

True False Don't know

- 4 Here are some statements about cells. Tick the box if you agree with the statement.

- ☐ The outer covering of an animal cell is called the cell membrane.
- ☐ The outer covering of a plant cell is called the cell wall.
- ☐ Animal cells do not have a cell wall.
- ☐ Plant cells do not have a cell membrane.

1

Well, what do you know?

CONTINUED

5 Here are some statements about plants. Tick the box if you agree with the statement.

- ☐ Plants are alive.
- ☐ Green leaves photosynthesise in the light.
- ☐ Green leaves photosynthesise in the dark.
- ☐ Green leaves respire in the daytime.
- ☐ Green leaves respire at night.
- ☐ Non-green parts of plants respire in the daytime.
- ☐ Non-green parts of plants respire at night.

BTEC
Chemistry
Summer Work

Activity 5 Converting data

Re-write the following.

1. 0.1 metres in millimetres
2. 1 centimetre in millimetres
3. 104 micrograms in grams
4. 1.1202 kilometres in metres
5. 70 decilitres in millilitres
6. 70 decilitres in litres
7. 10 cm^3 in litres
8. 2140 pascals in kilopascals

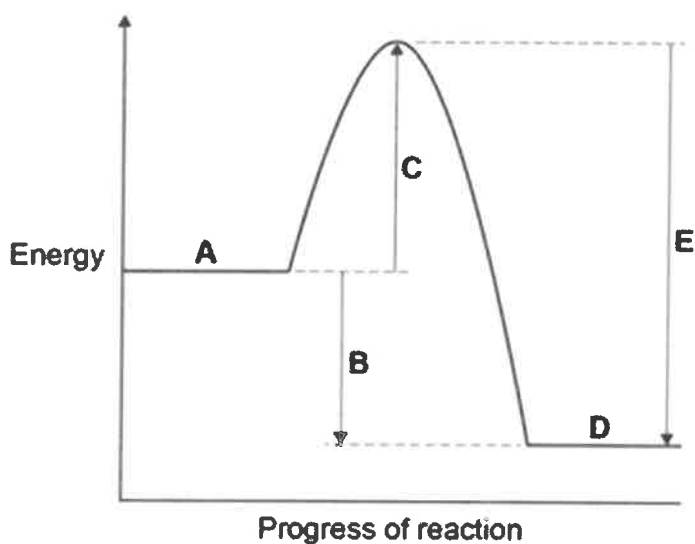
The delta symbol (Δ)

The delta symbol (Δ) is used to mean 'change in'. You might not have seen this symbol before in your GCSE Chemistry course, although it is used in some equations in GCSE Physics.

Activity 6 Using the delta symbol

In exothermic and endothermic reactions there are energy changes.

The diagram below shows the reaction profile for the reaction between zinc and copper sulfate solution.



1. Which letter represents the products of the reaction?
2. Which letter represents the activation energy?
3. Complete the sentence using the words below.

The reaction is _____ and therefore ΔH is _____

endothermic

exothermic

negative

positive

Practical skills

The practical skills you learnt at GCSE will be further developed through the practicals you undertake at A-level. Your teacher will explain in more detail the requirements for practical work in Chemistry.

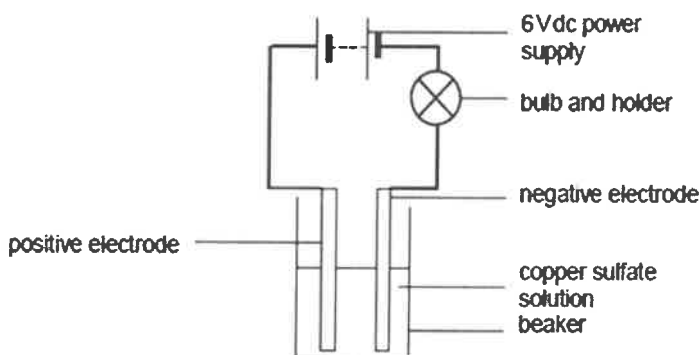
There is a practical handbook for Chemistry, which has lots of very useful information to support you in developing these important skills. You can download a copy [here](#):

Activity 7 Electrolysis

Students were investigating if the time the current flows through an electrolyte affects the amount of copper deposited on the negative electrode.

Equipment:

Measuring cylinder
Balance
Two suitable electrodes eg carbon rods
6V bulb and holder
0.5 moles per dm^3 copper sulfate solution
Stopwatch
Wires
Power supply
100 cm^3 beaker



Method:

1. Measure 50 cm^3 of the copper sulfate solution into the beaker.
 2. Measure and record the mass of the negative electrode.
 3. Set up the circuit, setting the power pack at 6V dc.
 4. Turn on the power supply for the time you have been given, then turn the power pack off.
 5. Remove and carefully dry the negative electrode.
 6. Measure and record the mass of the negative electrode.
-
1. Write a hypothesis for this investigation.
 2. What do you predict will be the result of this investigation?
 3. For this investigation, give
 - a. the independent variable
 - b. the dependent variable
 - c. a control variable.
 4. What is the difference between repeatable and reproducible results?

5. What would be the most likely resolution of the balance you use in a school lab?

6. How could you make the reading more precise?

7. Random errors cause readings to be spread about the true value.

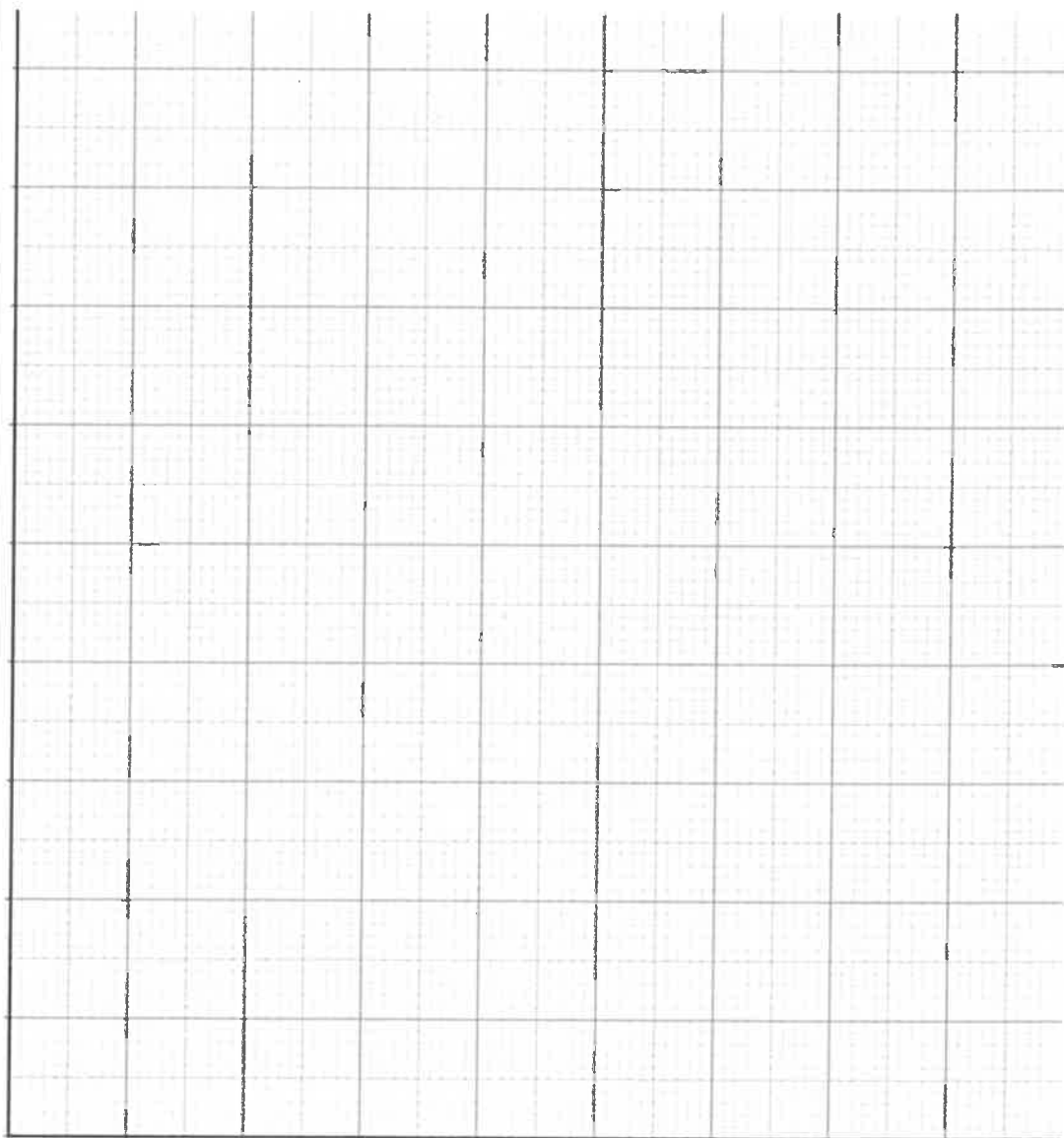
How could you reduce the effect of random errors and make the results more accurate?

8. The results the student recorded are given in the table.

Time / minutes	Increase in mass / g			Mean
2	0.62	0.64	0.45	
4	0.87	0.83	0.86	
6	0.99	1.02	0.97	
8	1.06	1.05	1.08	
10	1.10	1.12	1.10	

Calculate the mean increase in mass for each time measurement.

9. Plot a graph of your results.



Using maths skills

Throughout your A-level Chemistry course you will need to be able to use maths skills you have developed in your GCSE Chemistry and GCSE maths courses, such as using standard form, rounding correctly and quoting your answer to an appropriate number of significant figures.

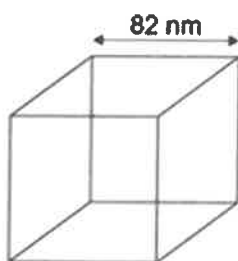
Activity 8 Using maths skills

1. Write the following numbers in standard form:

- a. 4000
- b. 1 000 000

2. Zinc oxide can be produced as nanoparticles.

A nanoparticle of zinc oxide is a cube of side 82nm.



Calculate the surface area of a nanoparticle of zinc oxide. Give your answer in standard form

3. Express the following numbers to 3 significant figures:

- a. 57 658
- b. 0.045346

4. Toothpaste may contain sodium fluoride (NaF).

The concentration of sodium fluoride can be expressed in parts per million (ppm). 1 ppm represents a concentration of 1 mg in every 1 kg of toothpaste.

A 1.00 g sample of toothpaste was found to contain 2.88×10^{-5} mol of sodium fluoride.

Calculate the concentration of sodium fluoride, in ppm, for the sample of toothpaste.

Give your answer to 3 significant figures.

Use the following information to help you

To convert moles to grams use $g = \text{moles} \times \text{relative formula mass}$

Relative formula mass of NaF = 42

Using the periodic table

During your course you will need to become familiar with the periodic table of the elements, and be able to use information from the table to answer questions.

There is a copy of the periodic table that you will be given to use in your exams on the next page.

The Periodic Table of the Elements

1	2	3	4	5	6	7	0
					</		

* 58 – 71 Lanthanides

† 90 – 103 Actinides

Activity 9 Atoms

1. Give the atomic number of:
 - a. Osmium
 - b. Lead
 - c. Sodium
 - d. Chlorine

2. Give the relative atomic mass (A_r) of:
 - a. Helium
 - b. Francium
 - c. Barium
 - d. Oxygen

3. What is the number of neutrons in each of the following elements?
 - a. Fluorine
 - b. Beryllium
 - c. Gold

Activity 10 Formulae of common compounds

State the formulae of the following compounds:

1. Methane
2. Sulfuric acid
3. Potassium manganate (VII)
4. Water

Activity 11 Ions and ionic compounds

The table below lists the formulae of some common ions.

Positive ions		Negative ions	
Name	Formula	Name	Formula
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Iodide	I^-
Hydrogen	H^+	Hydroxide	OH^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lead	Pb^{2+}	Sulfate	SO_4^{2-}
Lithium	Li^+	Sulfide	S^{2-}
Magnesium	Mg^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

Use the table to state the formulae for the following ionic compounds.

1. Magnesium bromide
2. Barium oxide
3. Zinc chloride
4. Ammonium chloride
5. Ammonium carbonate
6. Aluminium bromide
7. Calcium nitrate
8. Iron (II) sulfate
9. Iron (III) sulfate

Activity 12 Empirical formula

Use the periodic table on page 21 to help you answer these questions.

1. The smell of a pineapple is caused by ethyl butanoate.
A sample is known to contain:

0.360 g of carbon
0.060 g of hydrogen
0.160 g of oxygen.

What is the empirical formula of ethyl butyrate?

2. What is the empirical formula of a compound containing:

0.479 g of titanium
0.180 g of carbon
0.730 g of oxygen

3. A 300g sample of a substance is analysed and found to contain only carbon, hydrogen and oxygen.
The sample contains 145.9 g of carbon and 24.32 g of hydrogen.

What is the empirical formula of the compound?

4. Another 300 g sample is known to contain only carbon, hydrogen and oxygen.
The percentage of carbon is found to be exactly the same as the percentage of oxygen.
The percentage of hydrogen is known to be 5.99%.

What is the empirical formula of the compound?

Activity 13 Balancing equations

1. Write balanced symbol equations for the following reactions.

You'll need to use the information on the previous pages to work out the formulae of the compounds.

Remember some of the elements may be diatomic molecules.

- Aluminium + oxygen \rightarrow aluminium oxide
- Methane + oxygen \rightarrow carbon dioxide + water
- Calcium carbonate + hydrochloric acid \rightarrow calcium chloride + water + carbon dioxide

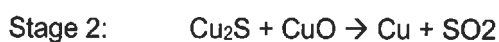
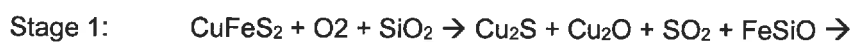
2. Chalcopryite is a sulfide mineral with formula CuFeS_2 .

Chalcopryite is the most important copper ore. It is a sulfide mineral, a member of iron (2+) sulfides and a copper sulfide.

Copper can be produced from rock that contains CuFeS_2 in two stages.

Balance the equations for the two stages in this process.

Hint: remember that sometimes fractions have to be used to balance equations.



Activity 14 Moles

The amount of a substance is measured in moles (the SI unit). The mass of one mole of a substance in grams is numerically equal to the relative formula mass of the substance. One mole of a substance contains the same number of the stated particles, atoms or ions as one mole of any other substance. The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is

6.02×10^{23} per mole.

Complete the table. Use the periodic table on page 21 to help you.

Substance	Mass of substance in grams	Amount in moles	Number of particles
Helium			18.12×10^{23}
Chlorine (Cl)	14.2		
Methane		4	
Sulfuric acid	4.905		

Activity 15 Isotopes and calculating relative atomic mass

1. What is the relative atomic mass of bromine if the two isotopes ^{79}Br and ^{81}Br exist in equal amounts?
2. A sample of neon is made up of three isotopes:

^{20}Ne accounts for 90.9%

^{21}Ne accounts for 0.3%

^{22}Ne accounts for 8.8%.

What is the relative atomic mass of neon?

Give your answer to 4 significant figures.

3. Copper's isotopes are ^{63}Cu and ^{65}Cu .

If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

BTEC Physics Summer Work

You will need to go to the following website if you need help

<https://www.bbc.co.uk/bitesize/guides/z32f4qt/revision/1>

Test 5: Waves and the Electromagnetic Spectrum

There are 11 questions in this test. Give yourself 10 minutes to answer them all.

- Which of these processes does **not** produce a type of electromagnetic radiation?
 A Oscillations in electrical circuits
 B Changes in atoms and nuclei
 C Vibrations of air particles
 [1]
- What units are used for wave speed?
 A Metres, m.
 B Metres per second, m/s.
 C Hertz, Hz.
 [1]
- What is the 'normal' on a ray diagram?
 A The length of a full cycle of a wave.
 B A line drawn perpendicular to a surface at the point of incidence.
 C The dull side of a mirror.
 [1]
- Waves can change direction as they cross a boundary between two different substances. What is this called?
 A Absorption
 B Reflection
 C Refraction
 [1]
- True or False? "The angle of incidence is equal to the angle of reflection."
 A True
 B False
 [1]
- What is the distance from the centre of a lens to the principal focus called?
 A Convex length
 B Focal length
 C Principal length
 [1]
- True or False? "All objects emit and absorb radiation."
 A True
 B False
 [1]
- What colour will a blue object appear when viewed through a red filter?
 A Blue
 B Red
 C Black
 [1]

9. The diagram below shows the different regions of the electromagnetic spectrum and their wavelengths, λ . Name the regions labelled **A** and **D** in the diagram below.

Region	Radio waves	A	B	Visible light	C	D	Gamma rays
λ (m)	$1 - 10^4$	10^{-2}	10^{-5}	10^{-7}	10^{-8}	10^{-10}	10^{-15}

A: D: [2]

10. Name one type of electromagnetic radiation that can cause harm. State a potential harmful effect of this radiation.

Type of radiation:
 Harmful effect: [1]

11. Describe one way of measuring the velocity of sound in air. You may draw a diagram to show any apparatus required.

.....

 [4]

Test 6: Waves and the Electromagnetic Spectrum

There are 11 questions in this test. Give yourself 10 minutes to answer them all.

1. Which of the following is a use of radio waves?
 A Disinfecting water
 B Airport security scanners
 C Television broadcasts [1]
2. True or False? "Waves are only refracted if they're travelling along the normal to the boundary they are crossing."
 A True
 B False [1]
3. Total internal reflection can only happen when light travels through one material and hits a boundary with another material that has...
 A ...a lower optical density.
 B ...a higher optical density. [1]
 C ...the same optical density. [1]
4. Which of the following statements about electromagnetic (EM) waves is correct?
 A All EM waves travel through a vacuum at the same speed.
 B The higher the frequency of an EM wave, the faster it travels through a vacuum.
 C The higher the frequency of an EM wave, the slower it travels through a vacuum. [1]
5. True or False? "Waves transfer matter."
 A True
 B False [1]
6. Which of these is an example of a longitudinal wave?
 A Ripples on the surface of water
 B Sound waves [1]
 C X-rays [1]
7. True or False? "A converging lens always produces a real image."
 A True
 B False [1]
8. What happens to the intensity of the radiation emitted by an object as its temperature increases?
 A It increases
 B It stays the same [1]
 C It decreases [1]

9. A student is investigating how light reflects from different surfaces. He shines a beam of light onto a flat sheet of rough card and then onto a plane mirror, using the same angle of incidence each time. Describe how the light will reflect differently from the card and from the mirror.

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..... [2]

10. Describe how ultrasound is used to produce an image of the inside of a human body.

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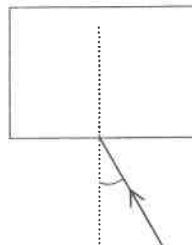
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..... [3]

11. A light ray enters the block below at an angle to the normal. The block has a higher optical density than air. Sketch a light ray on the ray diagram below to show how the light ray may refract when it enters the block. Sketch a second light ray on the diagram to show the light ray leaving the block.



[2]



Test 7: Waves and the Electromagnetic Spectrum

There are 11 questions in this test. Give yourself 10 minutes to answer them all.

- The different types of electromagnetic waves...
 A ... all have the same wavelength.
 B ... all have the same frequency.
 C ... form a continuous spectrum. [1]
- In a longitudinal wave, the vibrations are...
 A ... parallel to the direction of energy transfer.
 B ... perpendicular to the direction of energy transfer. [1]
- Which of these is a use of gamma radiation?
 A Cooking food
 B Communications
 C Cancer treatment [1]
- True or False? "The frequency of a sound wave changes when it passes from one medium into another medium."
 A True
 B False [1]
- Refraction is the process in which light...
 A ... bounces back as it hits a new medium.
 B ... changes direction as it enters a new medium.
 C ... transfers its energy to the medium as it enters that new medium. [1]
- An object is absorbing radiation at a faster rate than it is emitting radiation. What is happening to its temperature?
 A It is decreasing
 B It is remaining constant
 C It is increasing [1]
- Infrasound is the name given to sound with a frequency...
 A ... below 20 Hz.
 B ... between 20 Hz and 20 000 Hz.
 C ... above 20 000 Hz. [1]

- Explain why a green Wellington boot appears green when white light is shone on it.
 Explain why the boot appears black when viewed through a red colour filter.

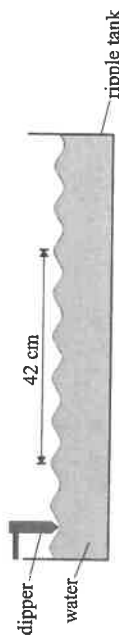
 [3]

- A student drops a small rubber duck into a tank of water. They observe that ripples form on, and move across, the water's surface. State a second observation they could make that would provide evidence that it is the wave and not the water that is moving.

 [1]

- A student uses a dipper to set up water waves in a ripple tank. She measures the distance shown in the diagram to be 42 cm. The time taken for the peak of one wave to travel this distance is 3.2 s.

 [1]



Calculate the speed of the waves. Give your answer to 2 significant figures.

Wave speed = m/s [3]