BTEC Human Biology

BARNWELL SCHOOL MIDDLE & UPPER

Achieving Excellence Together

BTEC Level 3 National Extended Certificate in Applied Human Biology

Transition Induction Pack

Table of Contents

Course Structure *3*

Unit 1 – Principles of Applied Human Biology 3

Unit 2 – Practical Microbiology and Infectious Diseases 3

Unit 3 – Human Biology & Health Issues 3

Unit 4 – Functional Physiology 3

Assessment in the course *4*

Unit 1 – Principles of Applied Human Biology – External Written Exam 4

Unit 2 – Practical Microbiology and Infectious Diseases – Internal Assessment 4

Unit 3 – Human Biology & Health Issues – Externally set, report and analysis task. 5

Unit 4 – Functional Physiology – Internal Assessment 5

Post-18 Progression *6*

University 6

Degree Apprenticeships & Employability 6

Command words *7*

Biological Molecules 9

Cellular Ultrastructure 12

Nervous system 14

Circulatory system 16

Digestive system 19

Mathematical skills in BTEC Human Biology 22

Practical skills biology **26**

Course Structure

The BTEC level 3 national extended certificate in applied human biology is equivalent to one A-Level. The course is made up for four units:

BTEC Human Biology Specification

Unit 1 – Principles of Applied Human Biology

In this unit, you will study how the human body functions at a genetic, cellular and tissue level. You will gain understanding of how human biology and lifestyle factors interact to affect the health of individuals and populations. This unit will give you a foundation for biological study, as you will gain theoretical knowledge of human body functioning, an insight into the factors and risks affecting health and knowledge of how biology is applied to make a positive impact on all our lives.

Unit 2 – Practical Microbiology and Infectious Diseases

In this unit, you will carry out your own investigation into the effect of antimicrobial agents on the growth of microorganisms and will recognise the importance of disease management to modern human society. To carry out your investigation, you will explore a variety of tests and techniques using essential laboratory practice. In order carry out this investigation, you will first develop an understanding of the significance of microorganisms in their role as pathogens. You will link your understanding of cell and tissue adaptation, function of biological molecules and the relationship between the structure, function, and processes of key body systems with your knowledge of the immune response to understand how diseases develop.

Unit 3 – Human Biology & Health Issues

In this unit, you will interpret, analyse, and evaluate scientific information related to health issues and initiatives and explore the presentation of this information for a defined purpose and audience. You will further your knowledge of human biology from Unit 1: Principles of Applied Human Biology and Unit 2: Practical Microbiology and Infectious Disease; to explore the impact of health issues on the world we live in, further developing your skills of analysis and interpretation. You will consider a range of health issues and associated initiatives from developments in food nutrition and healthy diets to advances in medical treatments, including stem cell therapy and genetic engineering.

Unit 4 – Functional Physiology

In this unit, you will have the opportunity to explore growth and development of four body systems and homeostasis and its role in the body. There will be opportunity to research common disorders, their causes in relation to these systems and the impact they have on a person's life. The unit provides a strong foundation for human biology study, it gives you theoretical knowledge of the structure, function, and role of the muscular, skeletal, nervous and endocrine systems.

Assessment in the course

A summary of the course assessment is found below:

Pearson BTEC Level 3 National Extended Certificate in Applied Human Biology				
Unit number	**Unit title**	**GLH**	**Type**	**How assessed**
	Mandatory units – learners complete and achieve all units			
1	Principles of Applied Human Biology	**90**	**Mandatory**	External
2	Practical Microbiology and Infectious Diseases	**90**	**Mandatory**	Internal
3	Human Biology and Health Issues	**120**	**Mandatory and Synoptic**	External
4	Functional Physiology	**60**	**Optional**	Internal

This QR code and link will take you to the 'course materials' webpage.

Here you can find past papers and example work for all units.

BTEC Human Biology Course Materials

Unit 1 – Principles of Applied Human Biology – External Written Exam

Assessment objectives

AO1 Demonstrate knowledge of human biology, health and disease facts, terms, definitions.

AO2 Demonstrate understanding of human biology, health and disease concepts, procedures, processes and techniques and their application.

AO3 Analyse, interpret and evaluate information and data relating to human biology, health and disease to make judgements and reach conclusions.

AO4 Make connections, use, and integrate different areas of knowledge and understanding of human biology, health and disease concepts, procedures, processes or techniques.

Unit 2 – Practical Microbiology and Infectious Diseases – Internal Assessment

Learning Aims

A Understand the classification and nature of microorganisms.

B Examine the transmission and treatments of infectious diseases.

C Explore the application of techniques to culture and identify microorganisms.

D Investigate the effects of antimicrobial agents on the growth of microorganisms.

Unit 3 – Human Biology & Health Issues – Externally set, report and analysis task.

This unit will be assessed under supervised conditions. The supervised assessment task will assess learners' ability to understand a health issue covered in a scientific article.

The supervised assessment task must be completed in a single session of 3 hours, on a day timetabled by Pearson. During the supervised assessment session, learners will be given stimulus in the form of a scientific article. Learners will analyse and interpret this article in the context of how the health issue is being reported. Pearson sets and marks the task. The number of marks for the unit is 60.

Assessment outcomes

AO1 Demonstrate knowledge and understanding of health issues and associated initiatives and reporting.

AO2 Apply understanding of health issues and associated initiatives and reporting.

AO3 Be able to interpret, analyse and evaluate different sources of scientific information.

AO4 Be able to synthesise different sources of scientific information.

Unit 4 – Functional Physiology – Internal Assessment

Leaning Aims

A Examine the structure, function, and disorders of the muscular and skeletal systems.

B Understand the structure, function, and disorders of the endocrine and nervous systems

C Understand the role of homeostasis in controlling and coordinating the body systems.

Post-18 Progression

University

Grade	UCAS Points
D*	56
D	48
M	32
P	16

The qualification carries UCAS points and is recognised by higher education providers as contributing to admission requirements of many relevant applied human biology/health science courses. When combined with other strong A Levels and BTEC/CTEC qualifications students can expect a good opportunity to step forward into higher education. All BTEC Nationals provide transferable knowledge and skills that prepare learners for progression to university. The transferable skills that universities value include:

- the ability to learn independently.
- the ability to research actively and methodically.
- the ability to give presentations and be active group members.

BTEC learners can also benefit from opportunities for deep learning where they are able to make connections among units and select areas of interest for detailed study. BTEC Nationals provide a vocational context in which learners can develop the knowledge and skills required for degree courses, including:

- reading technical texts
- analytical skills
- preparation for assessment methods used in degrees.

Degree Apprenticeships & Employability

In the BTEC National units, there are opportunities during the teaching and learning phase to give learners practice in developing employability skills. Where employability skills are referred to in this specification, we are generally referring to skills in the following three main categories:

- Cognitive and problem-solving skills: using critical thinking, approaching non-routine problems applying expert and creative solutions, using systems and technology.
- Interpersonal skills: communicating, working collaboratively, negotiating, and influencing, self-presentation.
- Intrapersonal skills: self-management, adaptability and resilience, self-monitoring, and development.

Students of BTEC Applied Human Biology regularly progress to apprenticeships and careers in:

- Health and social care
- Sport science
- Nursing
- Midwifery
- Occupational Health

Command words

The following table shows the key words that will be used consistently by Pearson in our assessments to ensure learners are rewarded for demonstrating the necessary skills.
Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Heavily featured in unit 1	
Calculate	Obtain a numerical answer, showing relevant working. If the answer has a unit, this must be included. This can include using an equation to calculate a numerical answer.
Compare	Looking for the similarities and/or differences of two (or more) things. Should not require the drawing of a conclusion. Answer must relate to both (or all) things mentioned in the question.
Complete	Requires the completion of a table/diagram.
Describe	Give an account, or details, of 'something' or give an account of a 'process' (in sequence where required). Statements in the response need to be developed as they are often linked but do not need to include a justification or reason.
Discuss	Consider the different aspects in detail of an issue, situation, problem or argument and how they interrelate.
Evaluate	Consider various aspects of a subject's qualities in relation to its context such as: strengths or weaknesses, advantages or disadvantages, pros or cons. Come to a judgement supported by evidence which will often be in the form of a conclusion.
Explain	Requires identification of a point and linked justification / exemplification of that point. The answer must contain some linked reasoning.
Give/Name/State	All of these command words are really synonyms. They generally all require recall of one or more pieces of information, or, provide examples, justifications and/or reasons to a context.
Heavily featured in unit 3	
Bias	Inclination or prejudice in a way considered to be unfair.
Discuss	Consider the different aspects in detail of an issue, situation, problem or argument and how they interrelate.
Economic issue	Related to the best use of limited, or scarce, resources.
Ethical issue	Ethically related aspects that may have affected how research was carried out.

Explain	Requires identification of a point and linked justification / exemplification of that point. The answer must contain some linked reasoning.
Health initiative	Identified in the article and related to the impact it has in the health issue.
Health issue	Issue or problem that has been identified, which is often open ended and has multiple potential solutions.
Implication	Effects or consequences of an action or decision that may happen although not explicitly stated.
Influence	The capacity or power to have an effect on the development, actions, behaviours or opinions.
Issue	May be used on its own to describe the subject that the article is describing.
Media	The means of mass communication through reporting medium.
Primary research	Research compiled directly from the original source, which may not have been compiled before.
Qualitative data	Descriptive data, such as data drawn from open-ended questions in questionnaires.
Quantitative data	Data in numerical form, which can be categorised and used to construct graphs or tables of raw data, such as data drawn from results of experiments.
Referencing	Acknowledgement of sources of information used within an article.
Reliability	The extent to which an experiment, test or measuring procedure yields the same results on repeated trials.
Research methods	Refers to how the research described in the article was carried out, for example through quantitative methods such as analysis of numerical data or qualitative-based observations.
Secondary sources/research	Published research reports and data, likely to be based on analysis of primary research.
Social issue	An issue that influences and is opposed by a considerable number of individuals in society.
Suggest	Use your knowledge to propose a likely solution to a problem.
Target audience	A specific group at which the article is aimed.
Technical language	Specific terminology directly relating to the subject matter presented in the article.

Biological Molecules

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Questions

1) **Structure of Carbohydrates**

a. Describe the structure of a monomer.

b. Describe the structure of a polymer.

c. State the elements that make up a carbohydrate.

d. Sugars are water-soluble. Describe what this means.

e. Describe the term and give an example of a monosaccharide.

f. Describe the term and give an example of a disaccharide.

g. Describe the term and give an example of a polysaccharide.

h. Describe the role of condensation reactions in this context.

i. Explain the role of monosaccharides in biology.

j. Explain the role of polysaccharides in biology.

2) Structure of Proteins

a. State the monomer of a protein.

b. Describe the general structure of an amino acid.

c. What bond is found between two amino acids to form a dipeptide.

d. Describe and structure and function of the protein's primary structure.

e. Describe and structure and function of the protein's secondary structure.

f. Describe and structure and function of the protein's tertiary structure.

3) Structure of Lipids

a. State the three elements that make up lipids.

b. Describe the structure of a triglyceride.

c. What type of bond occurs between the atoms in a triglyceride.

d. Describe and compare a saturated and unsaturated triglyceride.

e. Another type of lipid is a phospholipid, describe the structure and function of these in cell plasma membrane.

Cellular Ultrastructure

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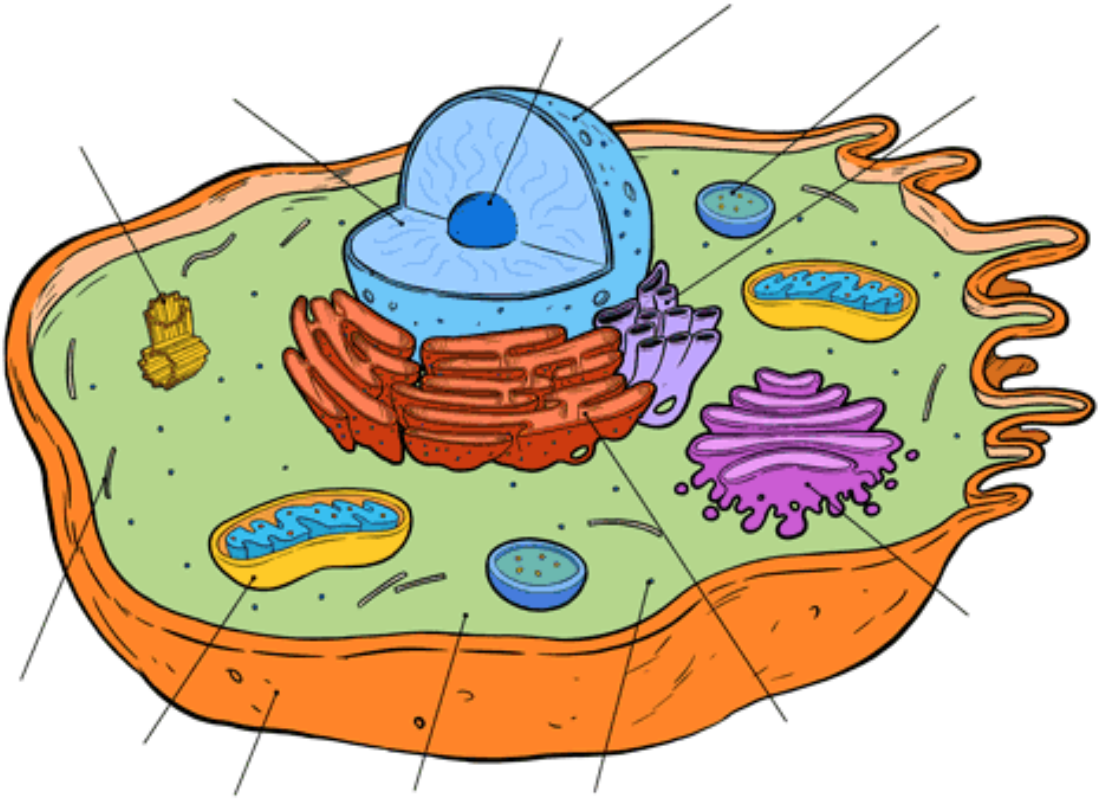
Task

1) Label the diagram of an animal cell below.

For extra support scan the QR code below to see structures that need placing on the diagram



2) List the structures labelled above in the table and state their function within the cell

Structure	Function

Nervous system

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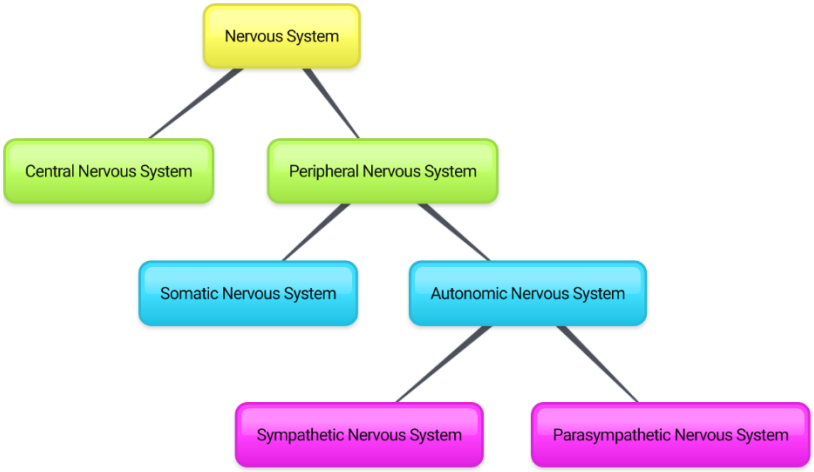
Structure of the nervous system



1. Describe the structure and function of the following terms.
    a. Central nervous system

    b. Peripheral nervous system

    c. Somatic nervous system

    d. Autonomic nervous system

e. Sympathetic nervous system

f. Parasympathetic nervous system

2. Using an annoted diagram, explain the role of synapses in the nervous system.

3. Use this opportunity to practice your research and note taking skills. Watch this video on a neuronal process called action potentials. Write notes of key aspects of action potentials. Include questions which you still may have, we can address in September.

Circulatory system

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Revision Science

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Blood Vessels

The blood vessels are the structures in our blood in which blood is transported. There are three types of blood vessels. In the next task you will explain the structure and function of the different blood vessels (to support you, an initial example has been provided).

Arteries

Overall function: *e.g. transport blood away from the heart*

Adaption of artery:	**Explanation of adaptation**
e.g. layers of elastic tissue in wall of artery	*e.g. the elastic tissue enables the blood to remain at high pressure once it has left the heart*

Veins

Overall function:

Adaption of artery:	**Explanation of adaptation**

Capillaries

Overall function:

Adaption of artery:	Explanation of adaptation

Blood Composition

The definition of a tissue is: a collection of cells working together to carry out a specific function. So by definition, blood is a tissue. It is composed of four key components. Research these components and complete the table below.

Blood component	Function	Composition within blood (%)

Disease related to the circulatory system.

Research the following diseases and explain what the conditions are, what the symptoms are, their risk factors and how they are treated.

Coronary heart disease (CHD)

Stroke

Chronic obstructive pulmonary disease (COPD)

Hypertension

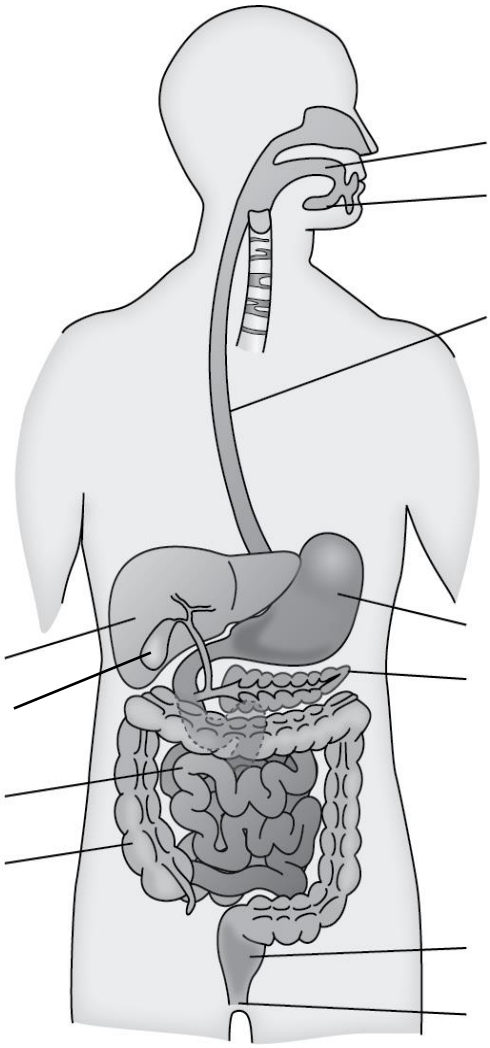
Hypotension

Digestive system

The digestive system consists of organs that break down food, absorb its nutrients, and expel any remaining waste. Most of these organs make up the gastrointestinal (GI) tract. Food passes through these organs. The rest of the organs of the digestive system are called accessory organs. These organs secrete enzymes and other substances into the GI tract, but food does not actually pass through them.

Structures of the digestive system

Complete the diagram below identifying the structures of the digestive system.



1. Explain the two functions of the stomach.

2. Describe the role of the pancreas in digestion.

3. Explain the role of the small intestine in digestion, include the villi and microvilli in your answer.

4. Describe the role of the large intestine.

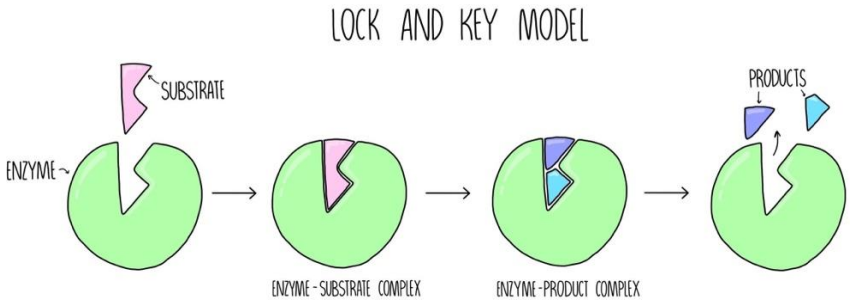
5. Describe the function of bile, including where it is produced, stored, and secreted.

Enzymes

Enzymes are biological catalysts - they speed up the rate of chemical reactions happening inside our body. They work by reducing the activation energy of a reaction. Activation energy is defined as the minimum amount of energy needed for a reaction to happen. If less energy is needed, then reactions can take place as lower temperatures than would be needed without an enzyme. Without the enzymes in our bodies, the reactions that happen inside of us would not be possible at normal body temperature. Remember that enzymes are unchanged at the end of a reaction which means they can be reused.

The lock and key model

At GCSE you learn about the lock and key model. Using the diagram below to explain this model.



The induced fit model

The lock and key model is a great way to explain how enzymes work at GCSE. However, there are limitations to this model, and it is not entirely accurate. The more accurate but complex model we use is the induced fit model.

Use the QR code to watch a video on the induced fit model and write notes below. Include questions which you still may have, we can address in September.

Mathematical skills in BTEC Human Biology

Converting Units

In biology we often come across numbers that are obscenely large or small. To make these numbers easier to work with, we use multiplication factors, these factors have specific prefix and symbols. For example, the standard unit for length is the meter (m). If an object is much smaller than a meter instead of stating its length as 0.001m, we would say it is 1mm. 1mm = 0.001m.
Examples of typical multiplication factors and their prefixes are found below:

Multiplication factors	Prefix	Symbol
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	n

Practice questions

1. The average diameter of a human eyeball is 0.023m. State this value in centimetres

_____ Unit:_____

2. A red blood cell has an average length of 0.000008m. State this value in micrometres

_____ Unit:_____

3. The Saitic nerves are the longest nerves in the human body, running from the lower back down each leg. The average thickness of a Saitic nerve is 18000µm. State this value in the most appropriate unit.

_____ Unit:_____

4. If laid out, the length of the small intestine is 6m and the large intestine is 1.5m. State the total length of the intestines in kilometres.

_____ Unit:_____

Decimal numbers

A decimal number has a decimal point. Each figure before the point is a whole number, and the figures after the point represent fractions.

The number of decimal places is the number of figures after the decimal point. For example, the number 47.38 has 2 decimal places, and 47.380 is the same number to 3 decimal places.

In science, you must write your answer to a sensible number of decimal places (typically two decimal places, but the context of the number might change this)

Practice questions

1. New antibiotics are being tested. A student calculates the area of clear zones in Petri dishes in which the antibiotics have been used. List these in order from smallest to largest.

   $0.0214\ cm^2$ $0.03\ cm^2$ $0.0218\ cm^2$ $0.034\ cm^2$

   _____ _____ _____ _____

2. A student measures the heights of a number of different plants. List these in order from smallest to largest.

   22.003 cm 22.25 cm 12.901 cm 12.03 cm 22 cm

   _____ _____ _____ _____ _____

Standard Form

Sometimes biologists need to work with numbers that are very small, such as dimensions of organelles, or very large, such as populations of bacteria. In such cases, the use of scientific notation or standard form is very useful, because it allows the numbers to be written easily.

Standard form is expressing numbers in powers of ten, for example, 1.5×10^7 microorganisms.

Look at this **worked example**. The number of cells in the human body is approximately 37 200 000 000 000. To write this in standard form, follow these steps:

Step 1: Write down the smallest number between 1 and 10 that can be derived from the number to be converted. In this case it would be 3.72

Step 2: Write the number of times the decimal place will have to shift to expand this to the original number as powers of ten. On paper this can be done by hopping the decimal over each number like this:

until the end of the number is reached.

In this example that requires 13 shifts, so the standard form should be written as 3.72×10^{13}.

For very small numbers the same rules apply, except that the decimal point must hop backwards. For example, 0.000 000 45 would be written as 4.5×10^{-7}.

Practice questions

1. Change the following values to standard form.
   a. 3060kJ
   b. 140,000kg
   c. 0.01
   d. 21,000,000

2. Give the following numbers in standard form.
   a. 100
   b. 10,000
   c. 0.00018m
   d. 0.000004

3. Give the following as decimals.
   a. 10^6
   b. 4.7×10^9
   c. 1.2×10^{12}
   d. 7.96×10^{-4}

Working with formulae

It is often necessary to use a mathematical formula to calculate quantities. You may be tested on your ability to substitute numbers into formulae or to rearrange formulae to find specific values.

Substituting into formulae

Think about the data you are given in the question. Write down the equation and then think about how to get the data to substitute into the equation. Look at this worked example:

A cheek cell has a 0.06 mm diameter. Under a microscope it has a diameter 12 mm. What is the magnification?

$$magnification = image\ size\ (mm) \div object\ size\ (mm) \text{ or } M = \frac{I}{O}$$

Substitute the values and calculate the answer:

M = 12 mm/0.06 mm = 12/0.06 = 200

Answer: magnification = ×200 (magnification has no units)

Sometimes an equation is more complicated, and the steps need to be carried out in a certain order to succeed. A general principle applies here, usually known by the mnemonic BIDMAS. This stands for **B**rackets, **I**ndices (functions such as squaring or powers), **D**ivision, **M**ultiplication, **A**ddition, **S**ubtraction.

Practice questions

1. Calculate the magnification of a hair that has a width of 6.6 mm on a photograph. The hair is 165 µm wide.

_____

2. Estimate the area of a leaf by treating it as a triangle with base 2 cm and height 9 cm.

_____ Unit:_____

3. Estimate the area of a cell by treating it as a circle with a diameter of 0.7 µm.

_____ Unit:_____

4. A fat cell is 0.1 mm in diameter. Calculate the size of the diameter seen through a microscope with a magnification of ×50.

_____ Unit:_____

5. A Petri dish shows a circular colony of bacteria with a cross-sectional area of 5.3 cm^2. Calculate the radius of this area.

_____ Unit:_____

6. In a photograph, a red blood cell is 14.5 mm in diameter. The magnification stated on the image is ×2000. Calculate the real diameter of the red blood cell.

_____ Unit:_____

7. The cardiac output of a patient was found to be 2.5 dm^3/min and their heart rate was 77 bpm. Calculate the stroke volume of the patient. Use the equation: cardiac output = stroke volume × heart rate.

_____ Unit:_____

Practical skills biology

You need to be confident about the definitions of terms that describe measurements and results in BTEC Level 3 Applied Human Biology. Match the question to the correct defining answer.

When is a measurement valid?	when repeat measurements are consistent/agree closely with each other
When is a result accurate?	how precise repeated measurements are when they are taken by *different* people, using *different* equipment
What are precise results?	when it measures what it is supposed to be measuring
What is repeatability?	when it is close to the true value
What is reproducibility?	how precise repeated measurements are when they are taken by the *same* person, using the *same* equipment, under the *same* conditions
What is the uncertainty of a measurement?	the difference between a measured value and the true value
Define measurement error	the interval within which the true value is expected to lie
What type of error is caused by results varying around the true value in an unpredictable way?	a measuring instrument gives a false reading when the true value should be zero
What is a systematic error?	random error
What does zero error mean?	a consistent difference between the measured values and true values
Which variable is changed or selected by the investigator?	a variable that is measured every time the independent variable is changed
What is a dependent variable?	independent variable
Define a fair test	variables that should be kept constant to avoid them affecting the dependent variable
What are control variables?	a test in which only the independent variable is allowed to affect the dependent variable

Accuracy & precision

A **B** **C** **D**

1. Using the target as a metaphor for a dataset from an experiment.
    1. State and explain which target represents an accurate result.

    2. State and explain which target represents a precise result.

2. Calculate the average and the uncertainty for each set of data:

	Average	Uncertainty
SET A: 15.32, 15.37, 15.33, 15.38, 15.35		
SET B: 16.30, 16.19; 16.24 16.29, 16.23		

The "true" value that we were attempting to measure was: 16.26.

a) Which data set is most precise.

b) Which data set is most accurate.

Errors in Scientific Investigations

1. In any scientific investigation there can be an array of different errors that occur. These errors can be classified in different ways. Research the following errors, describe what they mean and give an example of how they could appear during an investigation.
   a. Random Error:

   b. Systemic error:

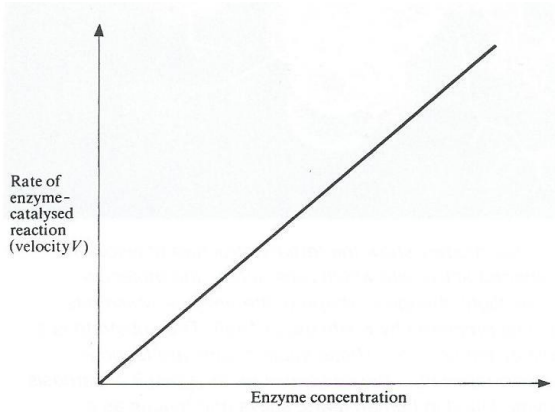
   c. Instrumental error

   d. Human transcriptional error

   e. Human estimation error

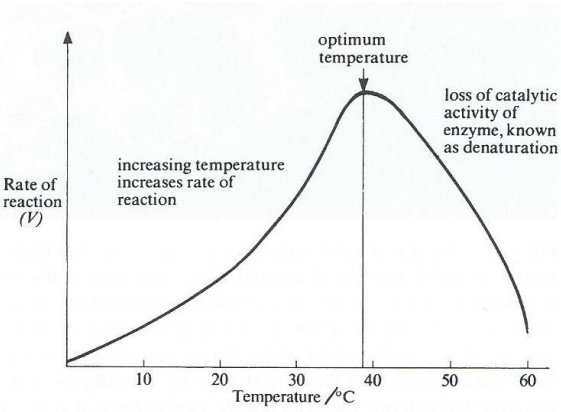
Interpreting Graphs

Graph 1



Relationship between enzyme concentration and the rate of an enzyme-controlled reaction.

Graph 2



Effect of temperature on the rate of an enzyme-controlled reaction.

1. Describe the trend in Graph 1

2. Describe the trend in Graph 2

3. Read the exam question below.

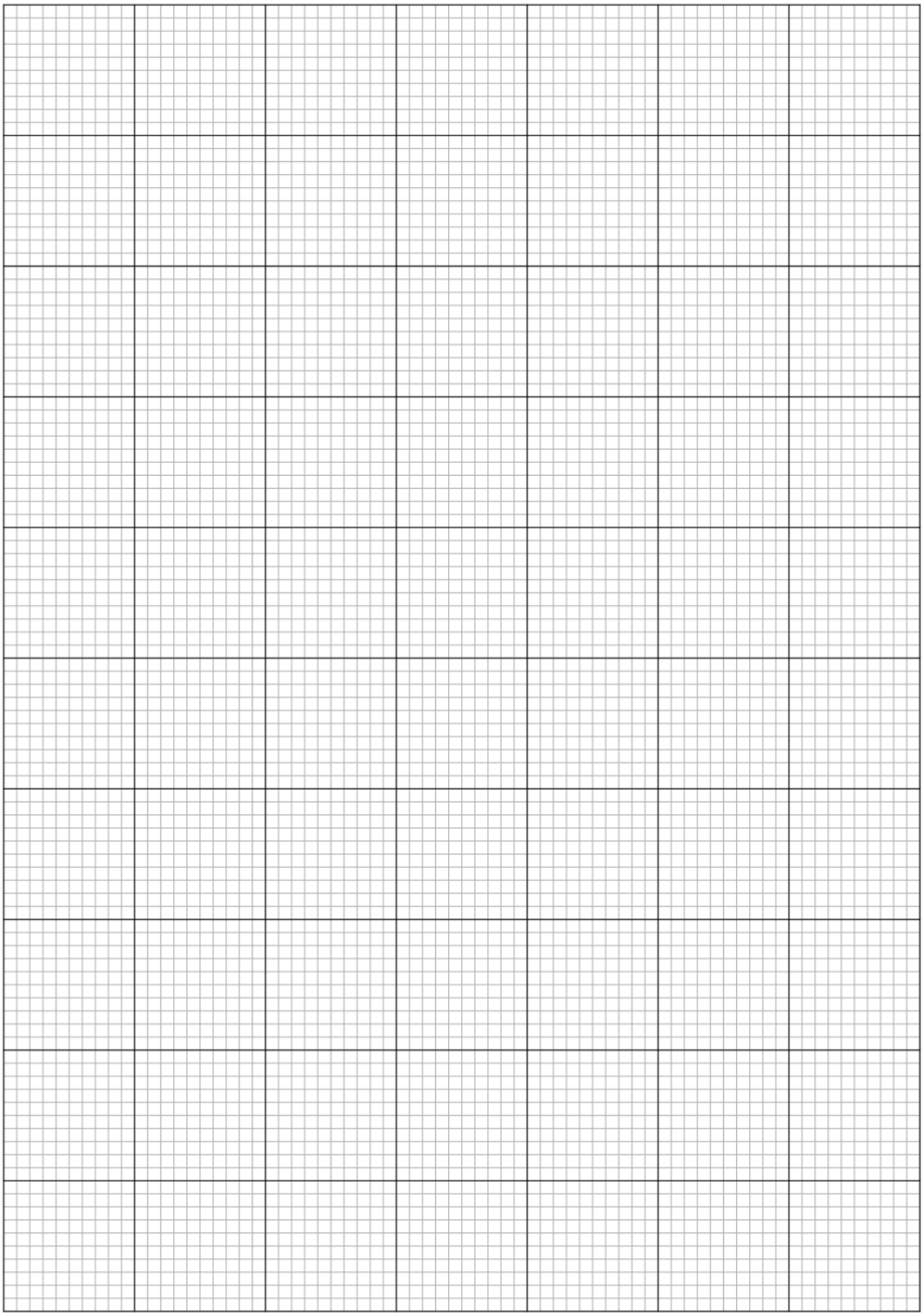
Biological process can be investigated using models.
The effects of cell size under vision can be investigated using cubes of agar jelly to represent cells of different sizes.
Student used cubes have I got jelly containing universal indicator, which changes colour different pH

- Five sizes of cubes were cut from a larger block using a scalpel.
- Cubes were placed in a beaker containing hydrochloric acid enough to cover the cubes and a stopwatch was started.
- After two minutes the cubes were removed, rinsed with distilled water and blotted dry.
- Acid absorbed at the outside, continued diffusing towards the centre of the blocks.
- The time taken for the blocks to turn entirely red was recorded.

Cube	Length of one side of agar cube (mm)	Surface area to volume ratio	Time taken to turn red (min)			
			Test 1	Test 2	Test 3	Mean
A	5	1.20	6.4	2.9	5.4	4.9
B	10	0.60	14.8	15.5	14.6	15.0
C	20	0.30	30.6	28.3	27.4	28.8
D	30	0.20	44.1	42.2	43.0	43.1
E	40	0.15	58.7	60.1	57.4	58.7

Questions found on next page.

1. In the space below, plot a graph of meantime, taken to turn red against surface area to volume ratio.



2. Describe the trend shown in the graph.

3. An identical procedure was carried out on a cube of unknown signs. This cube turned red after 21.5 min.
   Use your graph to estimate the surface area to volume ratio of this cube.

1. The electrical activity of the heart can be monitored, using an electrocardiogram (ECG) trace. Figure 1 shows the ECG pattern for a single normal heartbeat.

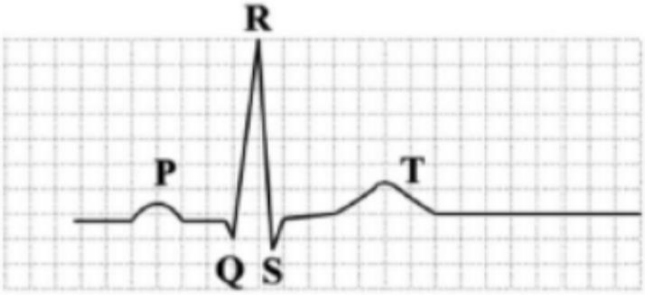


Figure 1

Figure 2 shows an ECG trace for a person with normal heart rhythm and figure 3 shows the trace for a person with tachycardia.

Figure 2

Figure 3

a) Calculate the percentage increase in heart rate for the person with tachycardia compared to the person with normal heart rhythm.
Use data between points, **A** and **B** on ***figure 2*** and points **C** and **D** on ***figure 3*** for your calculations.
Show your working. Give your answer to the nearest whole number.

_____%

b) The most obvious feature of tachycardia is an increased heart rate. Using the information in ***figure 1, figure 2*** and ***figure 3,*** what are the other key features of tachycardia.