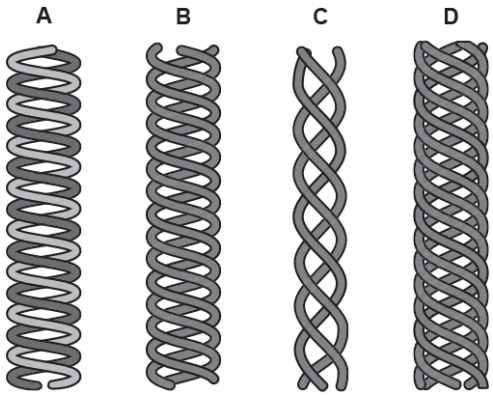
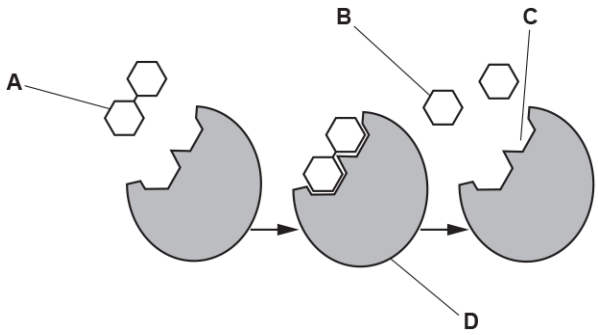
What Happens in Cells (H)

1. Which structure most closely resembles DNA?



Your answer ☐ **[1]**

2. Look at the model of enzyme activity.



Which label represents the active site of an enzyme?

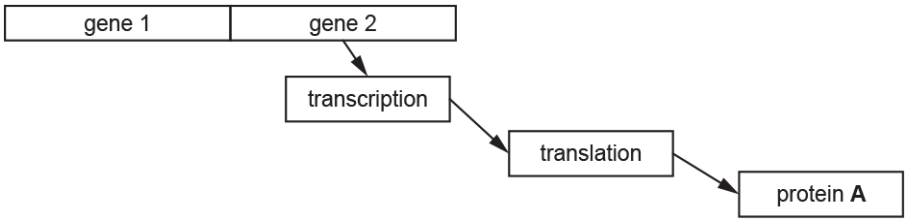
Your answer ☐ **[1]**

3. Which biological molecule is **not** a polymer?

A Amylase
B DNA
C Nucleotide
D Starch

Your answer ☐ **[1]**

4. Gene **1** and gene **2** are both needed for the production of protein **A**.



What is the function of **gene 1** in this process?

A It codes for the amino acids in protein **A**.
B It codes for the mRNA needed to make protein **A**.
C It acts as the site for protein synthesis.
D It controls the expression of **gene 2.**

Your answer ☐ **[1]**

5. During protein synthesis the DNA that codes for a particular protein is copied. This copy is called mRNA.

The diagram below shows the base sequence for a section of DNA.

G G T G C A T A T

What would be the complementary sequence of mRNA for this section of DNA?

A C C A C G T A T A
B C C A C G U A U A
C G G T G C A T A T
D G G U G C A U A U

Your answer ☐ **[1]**

6 (a). Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

Write the words **allele, chromosome, genome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

Smallest feature	
Largest feature	

[1]

(b). One in 500 people are heterozygous for HC.

There are 66 000 000 people in the UK.

Calculate how many people in the UK are heterozygous for HC.

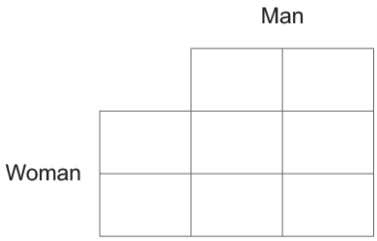
Number of people = ... **[1]**

(c). A woman who does not have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

Complete the genetic diagram to explain your answer.

Use **D** for the dominant HC allele and **d** for the recessive allele.



Probability = ... **[2]**

(d). The allele that is affected by HC codes for a protein called LDL receptor protein.
The faulty allele often has four extra nucleotides, making a total of 2521 nucleotides.

Calculate the number of **amino acids** found in the healthy, **unaffected** protein.

Number of amino acids = ... **[2]**

7. Protein synthesis takes place inside cells.

Describe what happens during protein synthesis.

Use terms from the list in your answer.

amino acids **DNA** **mRNA** **transcription**

translation **ribosome**

_____

_____

_____

_____

_____

_____

_____

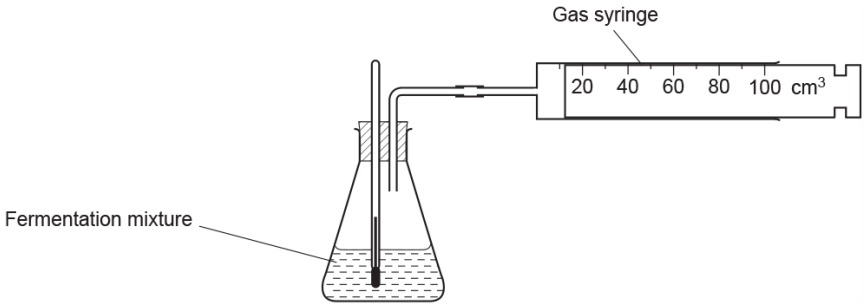
_____

_____ **[4]**

8 (a). Fermentation involves enzymes that break down sugar releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.
She measures the volume of carbon dioxide released in 10 minutes.
The diagram shows the apparatus she uses.



The student could have measured the volume of carbon dioxide by collecting the gas over water in a measuring cylinder.

Why is it better to use a gas syringe?

_____ **[1]**

(b). The student's results are shown in the table.

Temperature (°C)	Volume of carbon dioxide gas (cm^3) released in 10 minutes		
	Trial 1	**Trial 2**	**Trial 3**
25	23	25	22
30	34	27	33

i. Calculate the **mean** rate of gas produced at **25 °C** in cm^3 / minute.

Give your answer to **1** decimal place.

Mean rate of gas produced at 25 °C = ... cm^3 / minute **[3]**

ii. The rate of gas produced at 30 °C is greater than at 25 °C.

Use ideas about enzymes to explain why.

_____

_____

_____

_____ **[3]**

(c). Phenols are chemicals that inhibit enzymes during fermentation.

They bind to amino acids on enzyme molecules.

Suggest how phenols inhibit enzymes.

_____

_____

_____

_____ **[2]**

9 (a). Thirty years ago, identifying a person from their DNA required a large sample of DNA.

Polymerase chain reaction (PCR) is a technique developed in 1983.

PCR allows a single copy or segments of DNA to quickly make multiple copies of a DNA sequence.

i. Many crimes committed over 30 years ago can now be solved using PCR.

Explain why.

_____

_____

_____ **[2]**

ii. Which part of the cell cycle takes place in PCR?

_____ **[1]**

(b).

i. DNA databases involve storing a person's individual DNA profile. The DNA profile identifies DNA sequences present in an individual.

DNA databases are used by many different organisations.

Solving crimes is one use of a DNA database.

Suggest **other** reasons why organisations might need a DNA database.

_____

_____

_____

_____ **[2]**

ii. Write down **one** reason why people might **not** want to be included on a DNA database.

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[1]

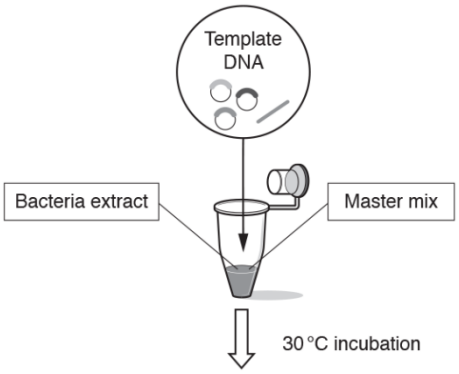
(c). Scientists can make the proteins they need outside of living cells (*in vitro*).

To do this they use cell free protein synthesis kits.

The kit includes three different parts:

- A template DNA molecule
- An extract from bacteria containing mRNA and tRNA nucleotides
- A master mix containing amino acids, energy sources, enzymes and ribosomes.

To make a protein the three different parts are mixed together and incubated for 3 hours at 30 °C.



i. Describe the role of the DNA template and mRNA nucleotides in the production of the protein.

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[2]

ii. Describe the role of the tRNA nucleotides and ribosomes in the production of the protein.

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[2]

10. Switching off the protection mechanism described in part **(b)** involves the plant making a **protein.**

Scientists have put extra copies of the gene for this protein into the plants. This makes the plant make more mRNA molecules.

i. Explain why making more mRNA will switch off the mechanism faster.

[2]

ii. Scientists have found that the genetically modified plants make 20% more biomass.

Use the agricultural food chain on page 21 to calculate the increase in biomass this would provide for humans.

Answer = kg **[2]**

iii. Inserting extra copies of a plant's gene into a plant is a type of genetic modification (GM).

Another example of GM involves inserting a bacterial gene into a plant which makes the plant produce an insecticide.

Suggest reasons why.

[2]

11 (a). Students investigate how to extract DNA from peas.

Stage 1:

- Chill 10 cm^3 of ethanol. Keep it on ice throughout the method for use in stage 2.
- Make a thick 'soup' by blending 100 cm3 of peas with salt and cold water. Blend for 15 seconds in an electric blender.
- Strain the 'soup' through a mesh strainer and collect the liquid part in a beaker.
- Add 30 cm^3 of washing-up liquid and swirl to mix.
- Let the mixture settle for 510 minutes in a water bath at 60°C.

One group of students made a water bath using a beaker of water, thermometer and Bunsen burner. Another group used an electric water bath.

Write down **two** advantages of using an electric water bath.

1 ----------

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2 ----------

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[2]

(b). Low temperatures protect DNA by slowing down the activity of enzymes that destroy DNA. High temperatures break down membranes in the cell.

To extract DNA, some methods use a water bath at 60°C but other methods do not use an increased temperature.

Suggest **two** reasons for the different methods.

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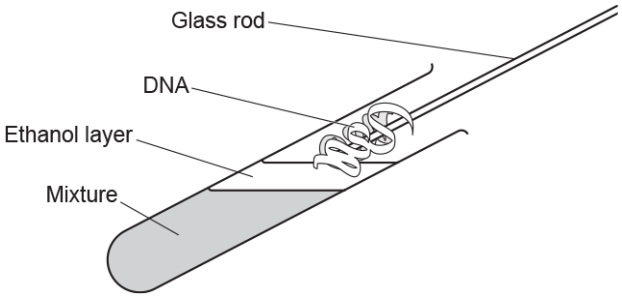
[2]

(c). Stage 2 isolates the DNA.



- Pour the mixture collected from stage **1** into a test tube until a third full. Add protease enzymes to the test tube.
- Slowly pour cold ethanol at an angle of 45° into the tube. Ethanol will float on top.
- DNA is soluble in water, but salted DNA does not dissolve in ethanol and will form white clumps where the water and ethanol layers meet.
- Twirl a glass rod and the DNA will collect on the rod.
- Dry the sample on a pre-weighed filter paper and measure the mass of product.

Suggest **two** safety precautions which should be taken at stage **2**.

Explain why each safety precaution is needed.

1 Safety precaution: ----------

Explanation: ----------

2 Safety precaution: ----------

Explanation: ----------

[2]

(d). Look at the table. It shows the results from the two groups of students in the investigation.

Type of water bath used	Mass of DNA collected (mg)			
	Test 1	Test 2	Test 3	Mean
Beaker of water and Bunsen burner				22.9
Electric	33.6	32.3	32.3	.....

i. Calculate the mean mass collected in the investigation using the electric water bath.

Give your answer to **1** decimal place.

Answer = ---------- mg **[2]**

ii. The range of the three test readings for the beaker of water and Bunsen burner was 3.4.

Does the evidence support using an electric water bath instead of a beaker of water and Bunsen burner?

Explain your answer.

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[2]

12.

i. An egg develops in a follicle before ovulation. The follicle has a diameter of 25×10^{-3} mm at the start. This follicle grows to 20 mm in diameter just before the egg is released.

Calculate the increase in size of the diameter of the follicle.

Give your answer to **2** decimal places.

Answer = _____ mm **[3]**

ii. The failure of a follicle to increase in size can result in less production of oestrogen.

Explain what effect this may have on the uterus.

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[1]

iii. Explain how hormones can be used to treat infertility in women.

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[3]

iv. Infertility can also be caused by problems in the male.

Plasmin is a protease enzyme important in sperm movement.

Explain how changes to the structure of DNA could result in the plasmin enzyme being faulty.

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[2]

END OF QUESTION PAPER