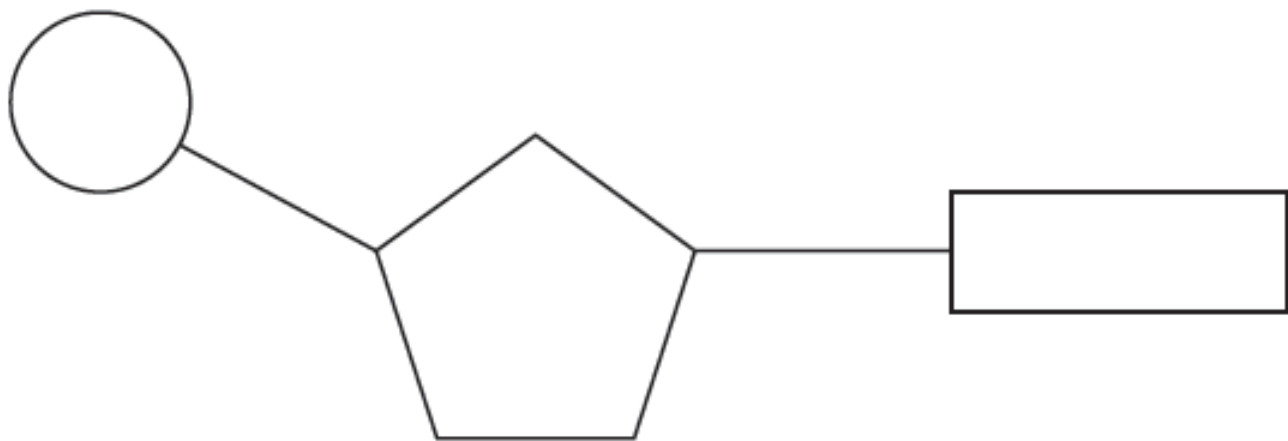


**WJEC (Wales) Biology A-level**  
**Topic 1.5: Nucleic Acids**  
**Questions by Topic**

1. The diagram below shows a simple nucleotide.



(a) On the diagram above, draw a circle around the component that contains nitrogen.

[1]

(b) Describe two differences between a DNA nucleotide and an RNA nucleotide.

[2]

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An experiment was carried out to determine the relative percentages of the bases in DNA from various organisms. The results are shown in the table below.

Source of DNA	Relative percentage of base in sample			
	Adenine	Guanine	Thymine	Cytosine
human	30.9	19.9	29.4	19.8
sea urchin	32.8	17.7	32.1	17.3
wheat	27.3	22.7	27.1	22.8

(c) DNA is a double stranded molecule. Explain how the data in the table supports the concept of complementary base pairing.

[2]

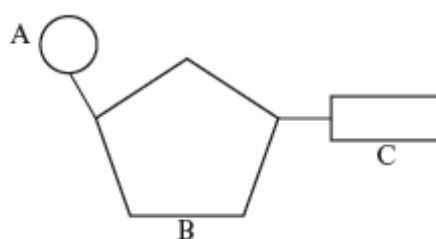
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2. (a) The diagram below shows a unit which makes up nucleic acids.



(i) Name the structural unit shown.

[1]

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(ii) Name component A

[1]

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(iii) Name component B in DNA and

[1]

DNA .....

RNA .....

(iv) Name the four components found in DNA, represented by C.

[2]

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(b) Describe how the structural units, drawn in part (a), are arranged in DNA molecules.

[4]

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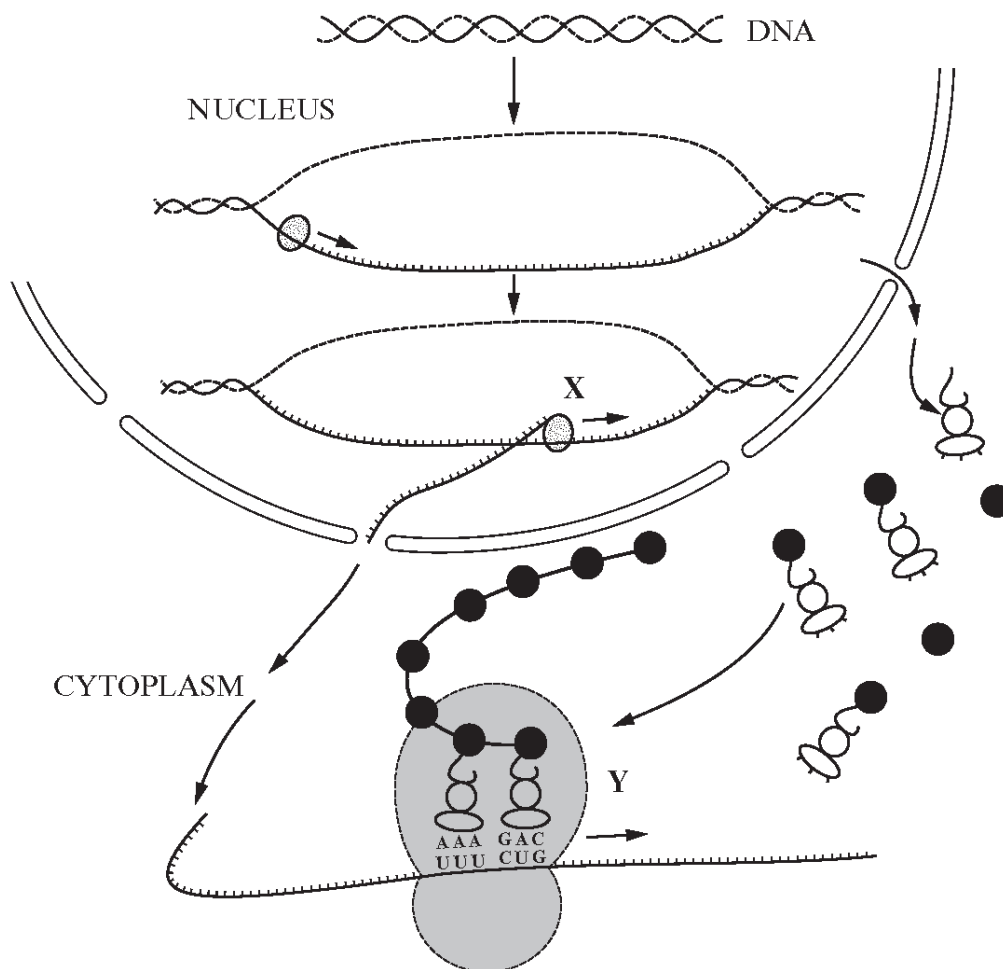
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(c) Describe the function of DNA molecules in cells.

[1]

3. The diagram represents stages of protein synthesis.



- (a) (i) Give the name of the processes taking place at X and Y. [2]

X .....

Y .....

- (ii) On the diagram label the following structures using clear lines and the letters given. [8]

M = messenger RNA

N = nuclear pore

O = RNA polymerase

P = codon

Q = ribosome

R = transfer RNA

S = three hydrogen bonds between complementary bases

T = template/sense strand of DNA

- (b) Transfer RNA (tRNA) molecules are very specific and will only carry one type of amino acid depending on three unpaired nitrogenous bases on the molecule (the anticodon). The table shows the type of tRNA molecules which combine with certain amino acids.

<i>Amino acid</i>	<i>anticodon</i>
glycine	CCU
cysteine	ACA
arginine	GCA
alanine	CGU

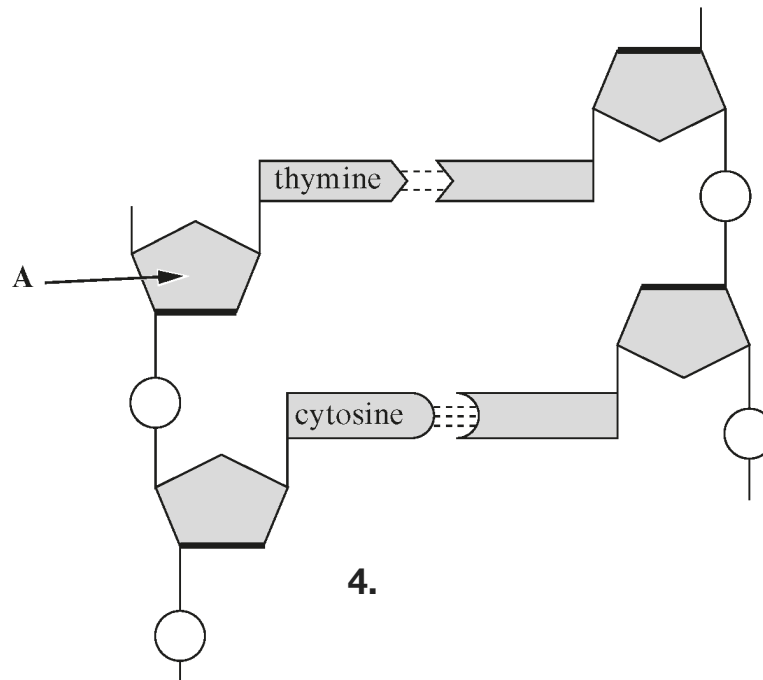
Using the information given, state the nucleotide sequence on the DNA molecule which codes for the following polypeptide. [2]

glycine-cysteine-arginine-alanine.

(Total 12 marks)

4.

The diagram represents the molecular structure of part of a DNA molecule.



- (a) Name part A.

[1]

4. (b) Part of a DNA molecule has the following sequence of bases.

T-A-T-C-G

- (i) In the table below write the letters for the sequence of bases of the complementary portion of DNA. [1]

DNA molecule	T	A	T	C	G
complementary DNA					

- (ii) Biochemical analysis of a sample of DNA showed that 30% of the bases were guanine.  
Calculate the percentage of the bases in the sample which would be adenine.  
Show your working. [2]

Answer ....

(Total 4 marks)

5. Meselson and Stahl investigated whether DNA replicated in a conservative or semiconservative way.

- (a) What is meant by the term semiconservative replication? [2]

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- (b) The bacterium *Escherichia coli* (E.coli) was cultured in a nutrient broth, containing the heavy isotope as a source of nitrogen  $^{15}\text{N}$  instead of the normal  $^{14}\text{N}$ . After several generations all of the DNA in all of the bacteria contained the heavy isotope  $^{15}\text{N}$ . They were then washed and transferred to a  $^{14}\text{N}$  medium and allowed to replicate. After each generation, bacteria were removed and ruptured to release the DNA. The DNA was then placed in a medium and spun in a centrifuge. The position of the DNA in the medium was then determined.

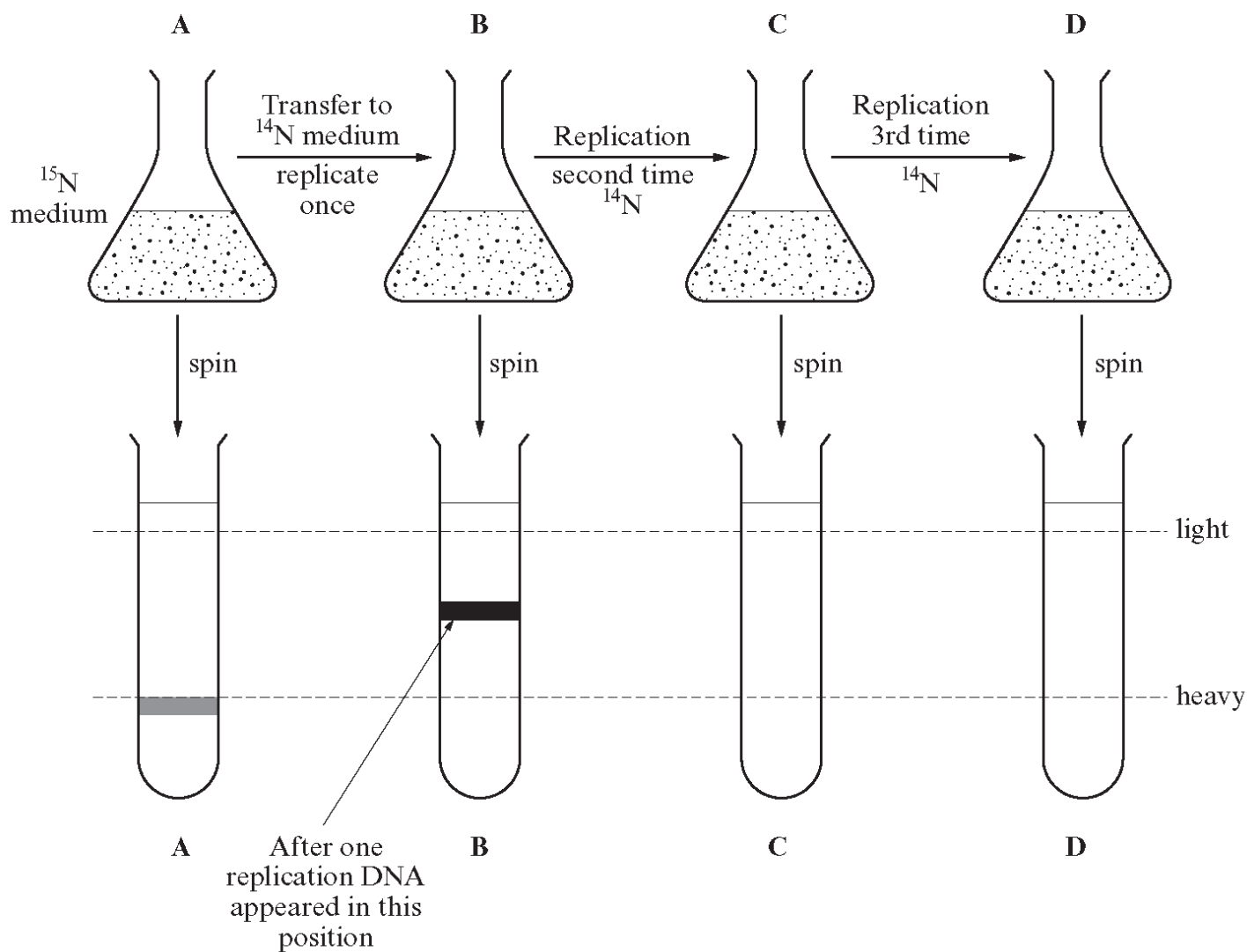
- (i) Name the part of the DNA molecule which contained the  $^{15}\text{N}$ . [1]

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- (ii) If they wanted to show the relative position of DNA from different samples of bacteria, suggest **two** variables which would need to be controlled in the centrifugation process. [2]

1. ....
2. ....

(c) The diagram represents the results which they obtained.



(i) Explain why the results in tubes **A** and **B** support semiconservative replication.

[3]

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(ii) Complete diagrams **C** and **D** to show the pattern and relative proportions of DNA you would expect.

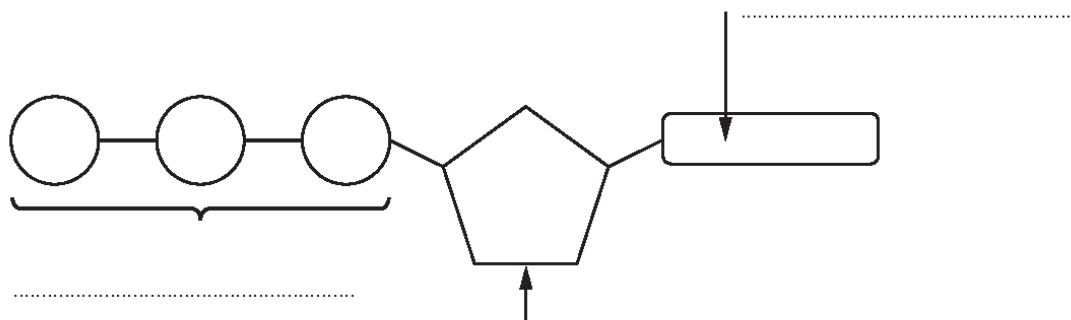
[2]

(Total 10 marks)



6.

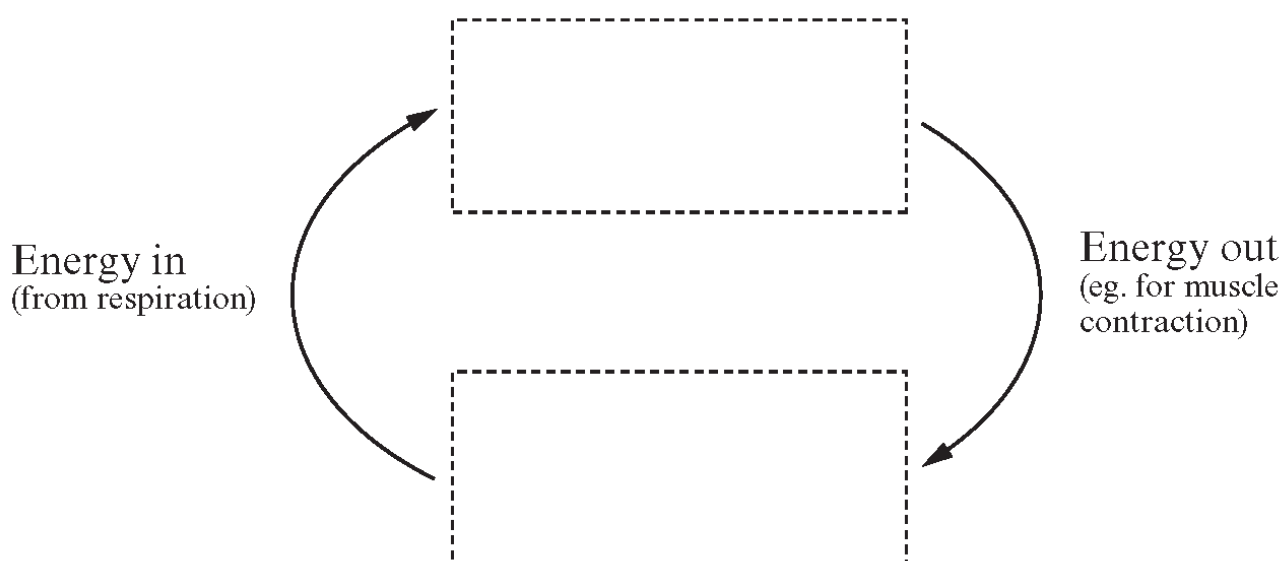
The diagram below shows a molecule of ATP.



(a) (i) Label the component parts of the molecule. [2]

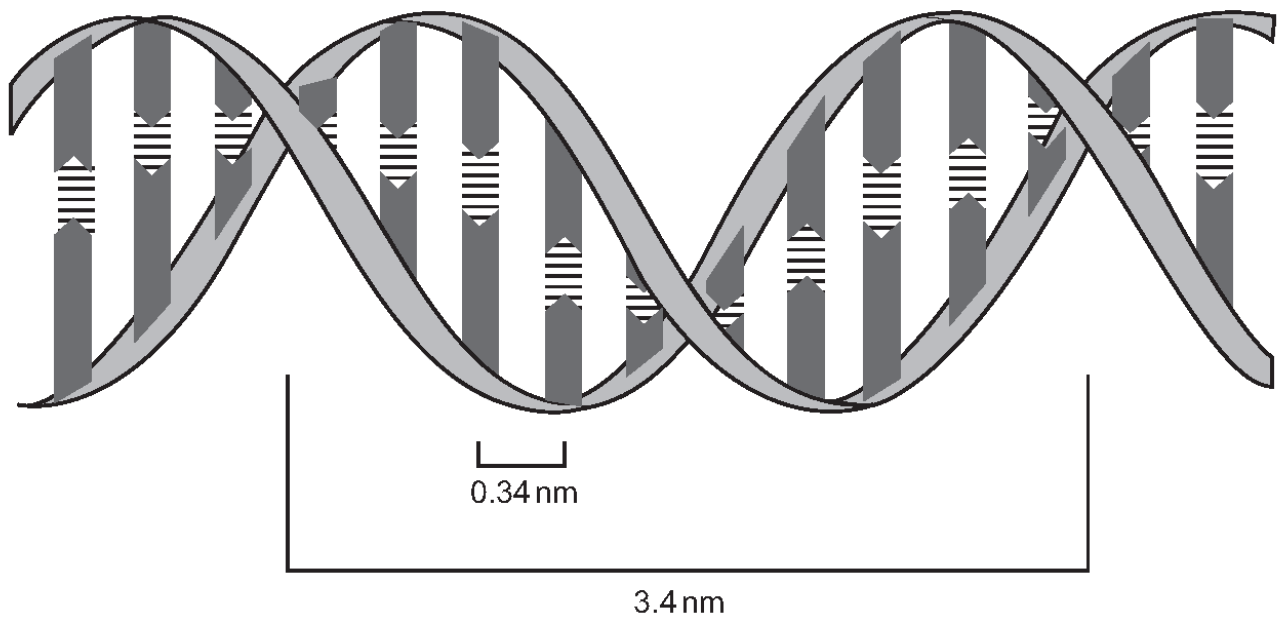
(ii) Give the full name of the molecule. [1]

(b) (i) In the spaces indicated below, use drawings similar to the one above to show the changes that this molecule undergoes in cells. [1]



(ii) Apart from muscle contraction, name **one other** process in cells which requires energy. [1]

7. The diagram below shows the DNA structure proposed by Watson and Crick in 1953.



- (a) If the double helix takes 3.4 nm to make one complete turn and base pairs are 0.34 nm apart, how many base pairs would you expect to find in five complete turns?  
Show your working. [2]

Answer = .....

- (b) Give a reason why the diagram shown above must be DNA rather than RNA. [1]

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- (c) The table below shows the bases guanine and cytosine as percentages of the total nucleotides present in three different micro-organisms.

Micro-organism	Base composition (%)	
	G	C
yeast	18.7	17.1
bacteria	36.0	35.7
virus	42.0	13.9

- (i) Suggest which type of nucleic acid is present in the virus shown in the table. Explain your answer. [2]

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- (ii) State the type of base to which cytosine belongs. [1]

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6

8. Protein synthesis involves two stages, transcription and translation. Different types of RNA are involved in each stage.

(a) The table below shows the percentages of the different types of RNA present in a rabbit body cell.

RNA	Percentage of total RNA
RNA present in nucleus	11.5
mRNA	3.5
rRNA	69.5
tRNA	15.5

- (i) Name the organelle that would contain the greatest percentage of RNA. Explain your answer. [1]

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- (ii) The total mass of RNA in a typical rabbit cell contains about 50000000000 nucleotides.

Calculate the approximate number of nucleotides contained in the tRNA of a typical rabbit cell. Give your answer in standard form to two significant figures. [3]

Number of nucleotides in tRNA = .....

- (iii) Explain why there would be large numbers of different mRNA molecules in a rabbit cell but only a maximum of 64 different tRNA molecules. [3]

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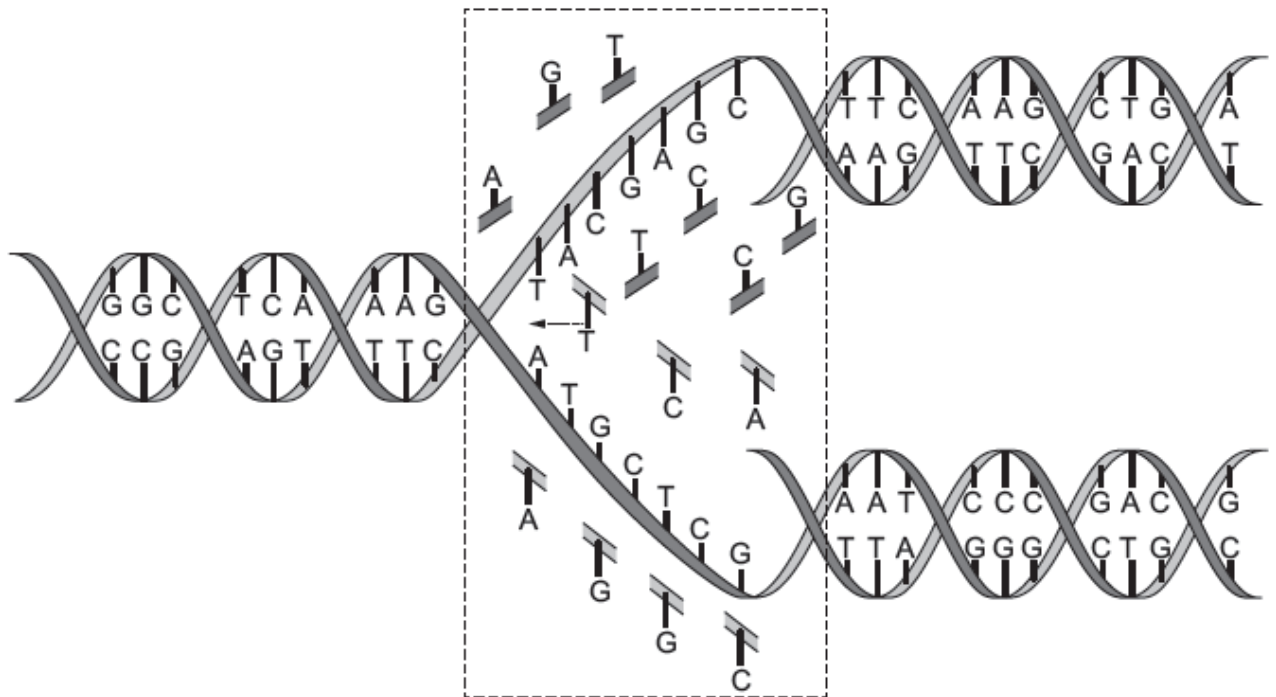
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9. The diagram below illustrates replication of DNA in cells.



(a) (i) Describe the sequence of events shown within the dotted rectangle in the diagram above.

[3]

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(ii) What is the role of DNA polymerase in the process?

[1]

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(b) Explain why the process is referred to as 'semi conservative'.

[2]

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**10.** There are 2 types of nucleic acid: DNA and RNA.

- (a) Complete the table below to describe **three** differences between the structure of DNA and RNA. [3]

DNA	RNA

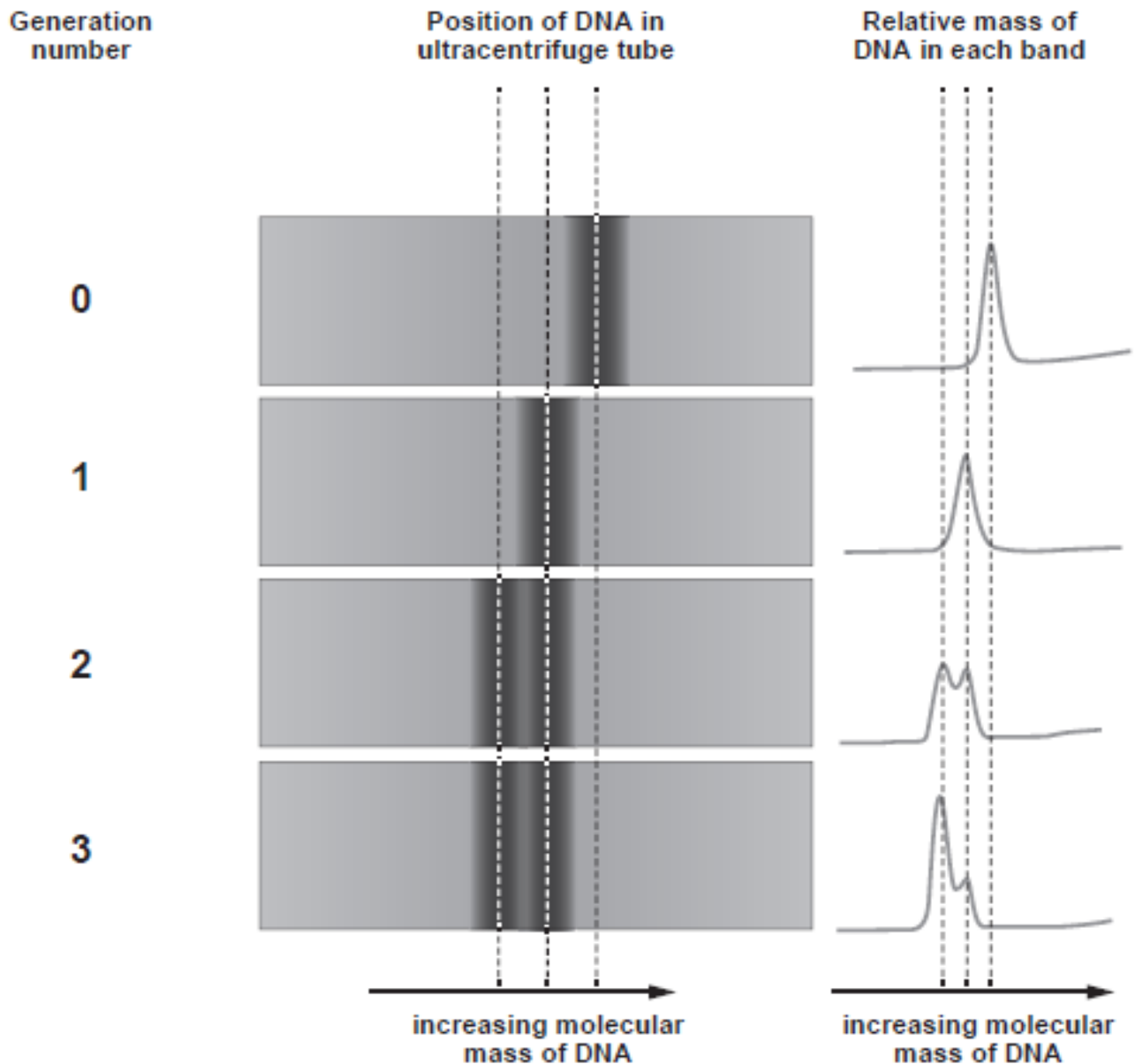
- (b) A sample of DNA was analysed, 23% of the nucleotides contained guanine. Calculate the percentage of nucleotides which contained adenine. Show your working. [2]
- .....
- .....
- .....

**(Total 5 marks)**

11.

6. In 1958, Matthew Meselson and Franklin Stahl conducted a series of experiments that demonstrated that DNA replication is semi-conservative.

The images below show some of their results.



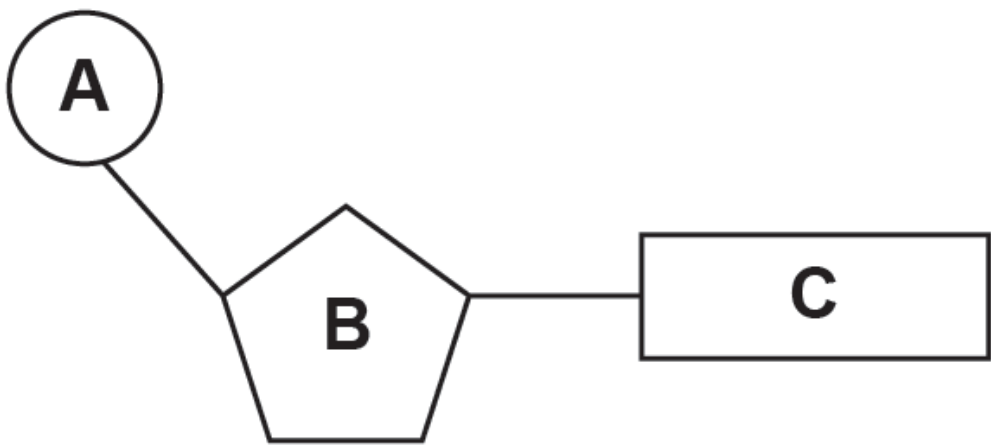
Other theories of DNA replication included:

- conservative replication, in which the original DNA is retained as a double stranded molecule; and
- dispersive replication, where the original DNA is split into many fragments which are then dispersed throughout the replicated molecules.

[illegible]



12. The diagram below shows a component of **DNA**.



Name the parts **A**, **B** and **C**.

[3]

**A** .....

**B** .....

**C** .....

(b) Describe how a polymer of DNA would be different from a polymer of RNA.

[2]

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13.

ATP is regarded as a universal energy currency as it is used in all organisms for cellular processes.

(a) Draw a simple, fully labelled diagram of ATP.

[2]