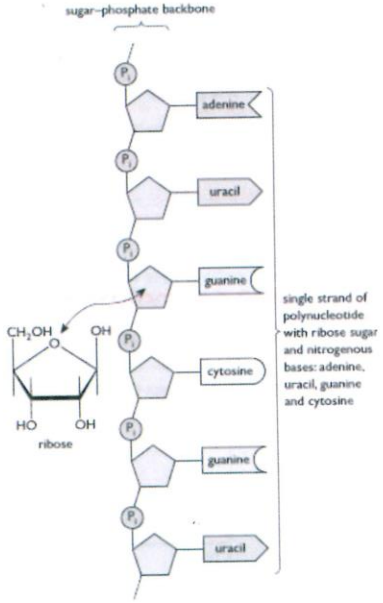
RIBONUCLEIC ACID

RNA nucleotides are made up of a **phosphate** group, the 5C sugar **ribose** and one of the four bases **adenine**, **cytosine**, **guanine** or **uracil**.

RNA is single stranded formed from a **single** polynucleotide chain; therefore there is no relationship between the number of purine and pyrimidine bases.



There are 3 types of RNA, all involved in protein synthesis:

Messenger RNA (**mRNA**) is formed in the nucleus during **transcription** in **protein synthesis**. It carries **genetic code** into the cytoplasm.

Ribosomal RNA (**rRNA**) is formed in the **nucleolus** of the **nucleus**, leaving through the nuclear pores to form **ribosomes** in the cytoplasm. These are the site of **protein synthesis**.

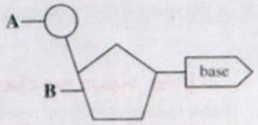
Transfer RNA (**tRNA**) is found only in the **cytoplasm** where it **transports specific amino acids** to the ribosomes during **translation** of **protein synthesis**.

Differences between DNA and RNA

	DNA	RNA
5C pentose sugar	deoxyribose	ribose
Nucleotides/ bases	Adenine Cytosine Guanine Thymine	A C G Uracil
Structure	double helix	single stranded

6 The diagram below represents the structure of a nucleotide of DNA.

Examiner Only: Marks | Remark



(a) Name the parts labelled **A** and **B**.

A phosphate

B deoxyribose [2]

(b) The table below shows the percentage composition of bases in the DNA of a number of species.

Species	Adenine	Cytosine	Guanine	Thymine
E. coli (a bacterium)	24	26	26	24
Yeast	32	18	18	32
Salmon	29	21	21	29
Pig	29	21	21	29
Human	30			

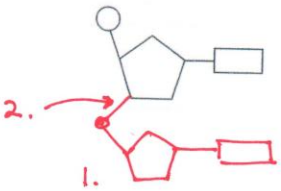
Examiner Only: Marks | Remark

(i) **Complete the table** to show the percentage of cytosine, guanine and thymine that you would expect for human DNA. Explain how you arrived at the answers provided.

- 20 C & G, 30 T;
- T has same amount as A as they base pair
- leaving 40 to be shared between C & G (which also base pair); [3]

8 (a) The diagram below shows a nucleotide which forms **part of an RNA molecule**. Draw another nucleotide **in the space below** to show how nucleotides bind together in RNA.

Examiner Only	
Marks	Remark



1 = new nucleotide below

2 = bonds P & ribose

[2]

(b) State **two** differences between nucleotides of RNA and nucleotides of DNA.

1. RNA ⇒ ribose ; DNA ⇒ deoxyribose ;
   ⇒ uracil ⇒ thymine ;
2. _____

_____ [2]

(c) 30% of the bases in a DNA molecule are adenine. Determine what percentage of the bases are cytosine. (Show your working.)

60% = A and T ;

so 40% = G and C

↳ C = 20% in DNA

Answer _____ [2]

1 (a) Complete the following passage by using the most appropriate terms from the list to fill the gaps. Each term should not be used more than once.

anti-parallel	β-pleated sheet	covalent
double helix	hydrogen	parallel
polypeptide	ribose	sugar-phosphate

DNA is found in the nucleus. The molecule is twisted into a double helix ..... in which each of the strands are anti-parallel ..... It has two sugar - phosphate ..... backbones attached to one another by complementary bases. These bases pair in the centre of the molecule by means of ...hydrogen... bonds. [4]

(b) Table 1.1 shows the relative proportions of different DNA bases in four different organisms.

Table 1.1

	relative proportions of bases in DNA as a percentage			
organism	A	C	G	T
human	30.9	19.8	19.9	29.4
grasshopper	29.3	20.7	20.5	29.3
wheat	27.3	22.8	22.7	27.1
E. coli	24.7	25.7	26.0	23.6

(i) Describe the patterns shown by the data given in Table 1.1.

1. %/amount C and G similar (in all orgs) ;
2. %/amount A and T similar (in all orgs) ;
3. different/named organisms have different proportions of bases/named base ;
4. greatest similarity between human & grasshopper ;
5. least similarity between bacteria & other 3 ; [3]
6. E coli has similar proportions of all bases / slightly more CG than AT / named eukaryote has more AT than GC ;
7. comparative figures with units to support statement ; eg human C = 19.8% and G = 19.9% human has more A (30.9%) than wheat (27.3%) = 2 marks (mp 3&7).

(ii) Suggest how the data given in Table 1.1 might have been helpful to scientists in working out the structure of DNA.

suggests:
- A bonds | pairs | links | connects | joins to T;
- C " " " " " to G;
- purines bond to pyrimidines;
- complementary base pairing | which bases pair with eachother | base pairing rules;
- bases point inwards not outwards; [2]

(c) DNA in the nucleus acts as a template for the production of RNA.

Complete the table below to show **three** ways in which the structure of DNA differs from that of RNA.

feature	DNA	RNA
number of strands	2 | double	1 | single
bases present	T A, C, G	U A, C, G
sugar present	deoxyribose	ribose

[3]

(d) DNA codes for the structure of polypeptides.

State the role of messenger RNA (mRNA).

- carries | transports the (complementary DNA) code | genetic information | copy of gene;
- out of the nucleus;
- to the ribosome | RER | site of translation;
- for protein | polypeptide synthesis; [2]

[Total: 14]

1.1.7 DNA REPLICATION

The work of **Rosalyn Franklin** using x-ray crystallography established the shape as an **α helix.**

Watson and **Crick** gathered information from various Sources and built a **model**. The model established the **method** by which **DNA replication** could occur.

Before cells divide the chromosomes must be copied in a process called replication. This allows DNA to be passed unchanged from parent to daughter cells and from parent to offspring.

- The enzyme **DNA helicase unzips** the two strands of DNA by **breaking** the **hydrogen bonds** between bases.
- Each of the original strands acts as a **template** for the formation of two new DNA molecules.
- **Free DNA nucleotides** are linked to the template strands in the correct sequence, due to the free nucleotides following the **complementary base pairing** rules with the bases on the template strands.
- The new DNA strands are joined together by the enzyme **DNA polymerase**.
- Each of the new DNA molecules contains one original template strand and one new DNA strand. This method of replication is called **semi-conservative replication.**