

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

1.	Question	Marking details	Marks Available
1	(a)	Base clearly circled;	1
	(b)	(The pentose in) RNA is ribose <u>and</u> in DNA is deoxyribose; the base thymine is only found in DNA <u>and</u> the base uracil is found in RNA; NOT: ref. helix/strands/uracil and thymine unqualified	2
	(c)	Adenine with thymine <u>and</u> cytosine with guanine; Appropriate use of {data/ratios} for {human/sea urchin/wheat}; Need data on both A T and C G NOT 'they are the same' or reference to ratio the same in all organisms	2
	<b>Question 1 total</b>		<b>[5]</b>

2. (a)

(i)

Nucleotide; 1

(ii)

Phosphate / phosphoric acid / PO<sub>4</sub> / PO<sub>3</sub><sup>-</sup>;

NOT phosphorus / P; 1

(iii)

Deoxyribose in DNA and ribose in RNA (both); 1

(iv)

Adenine, Thymine, Cytosine, Guanine (1 if 1 error). 2

(b)

Any 4

Pairing described A-T and C-G (both needed);

Backbone / Chains / polynucleotide formed by alternating sugar phosphate groups;

two chains connected / joined by base pairs;

hydrogen bonding;

two chains (twisted) to form a helix / double helix;

NOT alpha helix.

4

Accept labelled diagram.

(c)

{forming template / code / instructions} for {protein synthesis / mRNA / amino acid sequence / primary structure of protein / transcription} (accept Replication in dividing cells) /

NOT genetic material alone.

1

Question total 10

3.	(a) (i)	X	transcription;	2
		Y	translation;	
	(ii)	8 marks on diagram S- to line between anticodon/codon; T – to solid line not dotted line; R not if just labelled to black circle		8
	(b)	CCT	ACA GCA CGT	
		All correct 2 marks		
		2/3 correct 1 mark		

4. (a) deoxyribose/ pentose/ 5 C sugar 1

(b) (i) A-T-A-G-C 1

(ii) Guanine pairs with cytosine/ G pairs with C = 60%/ G+ C = 60%;  
 A+T= 40%  
 A= 20% (any two)  
 Correct answer = 2 marks 2

(Total 4 marks)

5.	(a)	Each strand of DNA used as a template to make a new DNA strand;	
		New DNA (mols) made of an old/original strand linked to a new strand; (not: if ref. to new DNA strand)	2
	(b) (i)	nitrogenous bases/organic bases/purines and pyrimidine bases/ all four named (not: bases/letters only/nucleotide)	1
	(ii)	spin (at same) speed; (Same) time; (Same) density/concentration of gel; (Same) temperature (not: pH/ref. volume or mass)	
			Max 2
	(c) (i)	Tube A all heavy/ $N^{15}$ ; Tube B DNA mixture of heavy and light (so intermediate position)/ $N^{15} + N^{14}$ ; DNA in B must be made from one strand of heavy and one light; If conservative would get two bands in light and heavy position.	
			Max 3
	(ii)	C intermediate and light equal amounts; (touching dotted lines) D intermediate and light more light than intermediate e.g. shown as thicker or wider line;	

6.	(a) (i)	phosphate; pentose/ribose; adenine (all correct for 2; 1 error = 1) (not: adenosine/nitrogenous base)	2
	(ii)	adenosine triphosphate (not: triose phosphate/ATP)	1
	(b) (i)	ATP <u>drawn</u> as in part a in upper box; ADP two Ps attached + <u>1P</u> not attached in lower box.	1
	(ii)	protein synthesis/biosynthesis/active transport/nerve conduction/cell division/ <u>avp</u> (not: metabolism/growth/movement)	1
			<b>Total 5 marks</b>

7.

Question		Marking details	Marks Available
7	(a)	$(3.4/0.34) \times 5$ or $3.4 \times 5/0.34$ = 50 Correct Answer = 2 marks correct calculation, incorrect answer = 1 mark Wrong unit = 1 mark only	2
	(b)	Any <b>one</b> from: double {stranded / polynucleotide chains} / not single stranded; helical; NOT alpha helix antiparallel strands;	max1
	(c)	(i) <u>RNA</u> ; NOT mRNA, tRNA, rRNA The percentages of G and C are not equal and so there is <u>no</u> (complementary) <u>base pairing</u> ; (ii) Pyrimidine;	2
		<b>Question 7 total</b>	<b>[6]</b>

8.

Question			Marking details	Marks Available						
				S	AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)	ribosome + rRNA is ribosomal RNA/constituent of ribosomes (1) OR Nucleolus + synthesis of RNA			1		1		
		(ii)	$15.5/100 \times 50\,000\,000\,000 = 1$ mark $= 7\,750\,000\,000 / 7.75 \times 10^9 = 2$ marks $= 7.8 \times 10^9 = 3$ marks			3		3	3	
		(iii)	different mRNA for every {protein/polypeptide}/many different genes/one gene one polypeptide/OWTTE (1) ref to base triplet code hypothesis (in mRNA/DNA) giving $\{64/4^3\}$ triplets (1) tRNA molecules have anticodons which have three bases (which are complementary to codons)/tRNA are specific to one amino acid(1)			3		3		
			<b>Question 8 total</b>		0	7	0	7	3	0

9.

Question	Marking details	Marks Available
9 (a) (i)	DNA molecule unwinds; Unzips/ breaks hydrogen bonds/ strands separate; (fræe) { <u>nucleotides</u> } {join/align} with {complementary bases/ A to T/ C to G};	3
(ii)	{To join the nucleotides together/ catalyses the addition of nucleotides} to form a {new strand/ backbone/ phosphodiester bonds};	1
(b)	Each new DNA <u>molecule</u> has one {original/ template} strand; And one new strand which has been {made/ synthesised/ <u>replicated</u> };	2
<b>Question 9 Total</b>		<b>[6]</b>



10. (a)

DNA	RNA
Double <u>stranded</u>	Single <u>stranded</u>
helical	Not helical
Deoxyribose/ $C_5H_{10}O_4$ / one less oxygen atom in pentose NOT deoxyribonucleic acid	Ribose/ $C_5H_{10}O_5$ / one more oxygen atom in pentose NOT ribonucleic acid
Contains thymine Not letters Can list all bases present	Contains uracil Not letters Can list all bases present
Only one type	3 types (mRNA, tRNA & rRNA)
(Relatively) long/ larger molecule	(relatively) short/ smaller molecule

Max 3

(b) 23% guanine therefore 23% cytosine;  
(54% made up of adenine and thymine)  
Adenine = 27(%)  
Correct answer = 2 marks

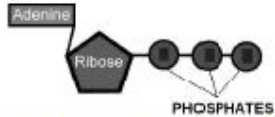
2

11.

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
11.	<p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>description of experiment including details of use of heavy and light isotopes of N and use of ultracentrifugation</li> <li>explanation of how bands seen in centrifuge tube are formed giving details of heavy and light strands for each generation in terms of the heavy and light isotopes of N</li> <li>the relative amounts of DNA in each band are explained</li> </ul> <p>conservative replication:</p> <ul style="list-style-type: none"> <li>always some heavy DNA present</li> <li>increasing mass of light DNA</li> <li>no intermediate DNA</li> <li>because original heavy DNA is not split</li> </ul> <p>Dispersive replication:</p> <ul style="list-style-type: none"> <li>apart from <math>G_0</math>, all DNA would be intermediate in molecular mass</li> <li>getting lighter between <math>G_0</math> and <math>G_3</math></li> <li>because original heavy DNA split between all new molecules</li> </ul>	2	2	5	9		
	<p><b>7-9 marks</b></p> <ul style="list-style-type: none"> <li>detailed description of experimental procedure and explanation of results</li> <li>correct detailed explanation to reject conservative theory</li> <li>correct detailed explanation to reject dispersive theory</li> </ul> <p><i>The candidate constructs an articulate, integrated account, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.</i></p> <p><b>4-6 marks</b></p> <ul style="list-style-type: none"> <li>description of experimental procedure and explanation of results</li> <li>correct explanation to reject conservative theory</li> <li>correct explanation to reject dispersive theory</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>detailed description of experimental procedure and explanation of results</li> <li>correct detailed explanation to reject either conservative theory or dispersive theory</li> </ul> <p><i>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.</i></p>						
	<p><b>1-3 marks</b></p> <ul style="list-style-type: none"> <li>some description of experimental procedure and/or explanation of results</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>correct explanation to reject conservative theory</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>correct explanation to reject dispersive theory</li> </ul> <p><i>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.</i></p>						
	<b>Question 11 total</b>	<b>2</b>	<b>2</b>	<b>5</b>	<b>9</b>		

12.	Question	Marking details	Marks Available
12.	(a)	A – Phosphate; Accept phosphoric acid B – Deoxyribose; NOT pentose C – {Organic/nitrogenous} base; NOT named base (can be neutral)	3
	(b)	Uracil in RNA thymine in DNA; NOT U in RNA and T in DNA RNA is (usually) single stranded, DNA is double stranded; DNA is <u>longer</u> molecule than RNA ; Sugar is ribose in RNA, deoxyribose in DNA;	Max 2
<b>Question 12 Total</b>			<b>[5]</b>

13.

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
13	(a)	 <p>Only one phosphate need be labelled.            Pentagon shape with adenine and 3 phosphates coming off at correct points (1)            Ignore shape of adenine            Correct labels = ribose + adenine + phosphate (1)            Accept adenosine if structures bracketed            Reject pentose            Reject base</p>	2			2		
<b>Question 13 total</b>			<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>