1. The sequence of nucleotides in a section of RNA is:

GCCAUACGAUCG

What is the base sequence of the DNA sense strand?

A. CGGUAUGCUAGC

B. GCCATACGATCG

C. CGGTATGCTAGC

D. GCCAUACGAUCG

(Total 1 mark)

2. What is a codon?

A. A sequence of nucleotides on rRNA that corresponds to an amino acid

B. A sequence of nucleotides on mRNA that corresponds to an amino acid

C. A sequence of nucleotides on tRNA that corresponds to an amino acid

D. A sequence of nucleotides on DNA that corresponds to an amino acid

(Total 1 mark)

3. What happens during the formation of Okazaki fragments?

A. DNA polymerase III adds nucleotides in the 3′ → 5′ direction.

B. DNA polymerase III adds nucleotides in the 5′ → 3′ direction.

C. DNA polymerase I adds nucleotides in the 5′ → 3′ direction.

D. RNA polymerase adds nucleotides in the 3′ → 5′ direction.

(Total 1 mark)

4. The table below shows the codons that determine different amino acids in protein translation.

First base in codon	Second base in codon				Third base in codon
	U	**C**	**A**	**G**	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	—	—	A
	Leu	Ser	—	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

What is the sequence of the amino acids that is being translated from the following mRNA sequence?

5′ AUGGGUGCUUAUUGGUAA 3′

A. Met-Pro-Arg-Ile-Thr

B. Met-Cys-Ser-Tyr-Trp

C. Met-Gly-Ala-Tyr-Trp

D. Met-Gly-Tyr-Ala-Thr

(Total 1 mark)

5. What sequence of processes is carried out by the structure labelled X during translation?

A. Combining with an amino acid and then binding to an anticodon

B. Binding to an anticodon and then combining with an amino acid

C. Binding to a codon and then combining with an amino acid

D. Combining with an amino acid and then binding to a codon

(Total 1 mark)

6. What is replicated by a semi-conservative process?

A. Messenger RNA (mRNA) only

B. Messenger RNA (mRNA) and transfer RNA (tRNA) only

C. Messenger RNA (mRNA), transfer RNA (tRNA) and DNA only

D. DNA only

(Total 1 mark)

7. Which enzyme catalyzes the elongation of the leading strand?

[Source: image from W K Purves, *et al.*, (2003) *Life: The Science of Biology*, **4**, Sinauer Associates (www.sinauer.com) and W H Freeman (www.whfreeman.com)]

A. RNA polymerase

B. Helicase

C. DNA polymerase

D. Ligase

(Total 1 mark)

8. The percentage of thymine in the DNA of an organism is approximately 30%. What is the percentage of guanine?

A. 70%

B. 30%

C. 40%

D. 20%

(Total 1 mark)

9. Which of the following are connected by hydrogen bonds?

A. Hydrogen to oxygen within a molecule of water

B. Phosphate to sugar in a DNA molecule

C. Base to sugar in a DNA molecule

D. Hydrogen to oxygen between two different molecules of water

(Total 1 mark)

10. Which molecule is found in both DNA and RNA?

A. Ribose

B. Uracil

C. Phosphate

D. Amino acid

(Total 1 mark)

11. Rice (*Oryza sativa*) is usually intolerant to sustained submergence under water, although it grows rapidly in height for a few days before dying. This is true for one variety, *Oryza sativa japonica*. The variety *Oryza sativa indica* is much more tolerant to submergence.

Three genetically modified forms of *O. sativa japonica*, GMFA, GMFB and GMFC, were made using different fragments of DNA taken from *O. sativa indica*.

The plants were then submerged for a period of 11 days. The heights of all the plants were measured at the beginning and at the end of the submergence period.

(a) (i) State which group of rice plants were the shortest at the beginning of the experiment.

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(1)

(ii) Calculate the percentage change in height for the *O. sativa japonica* unmodified variety during the submergence period. Show your working.

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(2)

(b) Explain how the error bars can be used to compare the results for *O. sativa indica*.

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(2)

(c) Deduce the general relationship between the growth of all the *japonica* varieties and their stated tolerance level.

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(1)

(d) Outline the use of the binomial system of nomenclature in *Oryza sativa*.

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(2)

In the same experiment, the researchers hypothesized that the capacity to survive when submerged is related to the presence of three genes very close to each other on rice chromosome number 9; these genes were named *Sub1A*, *Sub1B* and *Sub1C*. The photograph below of part of a gel shows relative amounts of messenger RNA produced from these three genes by the submergence-intolerant variety, *O. sativa japonica*, and by the submergence-tolerant variety, *O. sativa indica*, at different times of a submergence period, followed by a recovery period out of water.

(e) (i) Determine which gene produced the most mRNA on the first day of the submergence period for variety *O. sativa japonica*.

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(1)

(ii) Outline the difference in mRNA production for the three genes during the submergence period for variety *O. sativa indica*.

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(2)

(iii) Compare the mRNA production for the three genes during the submergence period between the two varieties.

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(2)

(f) Deduce, using all the data, which gene was used to modify GMFC.

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(2)

(g) Evaluate, using all the data, how modified varieties of rice could be used to overcome food shortages in some countries.

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(2)
(Total 17 marks)

12. The diagram below shows two nucleotides linked together to form a dinucleotide.

(a) (i) Identify the chemical group labelled I.

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(1)

(ii) State the type of bond labelled II.

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(1)

(b) Distinguish between the sense and antisense strands of DNA during transcription.

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(1)

(c) Compare the DNA found in prokaryotic cells and eukaryotic cells.

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(2)

(Total 5 marks)

13. *Up to two additional marks are available for the construction of your answers.*

(2)

(a) Eukaryotic cells have intracellular and extracellular components. State the functions of **one named** extracellular component.

(4)

(b) Outline, with an example, the process of exocytosis.

(5)

(c) Translation occurs in living cells. Explain how translation is carried out, from the initiation stage onwards.

(9)

(Total 20 marks)