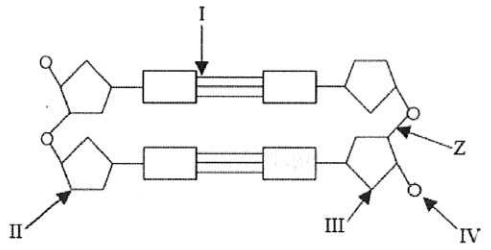
Jerry

Nucleic Acids Test 2019 *[44 marks]*

1. What usually distinguishes DNA from RNA? *[1 mark]*

	DNA	RNA
A.	strands are symmetrical	strands are antiparallel
B.	contains adenine	contains cytosine
C.	pentoses linked to phosphates	pentoses linked to bases
(D.)	double stranded	single stranded

This question refers to the following DNA diagram.



2. Which points to the 3′ end of a strand of DNA? *[1 mark]*

A. I
(B.) II
C. III
D. IV

3. The percentage of thymine in the DNA of an organism is approximately 30 %. What is the percentage of guanine? *[1 mark]*

AT 60%

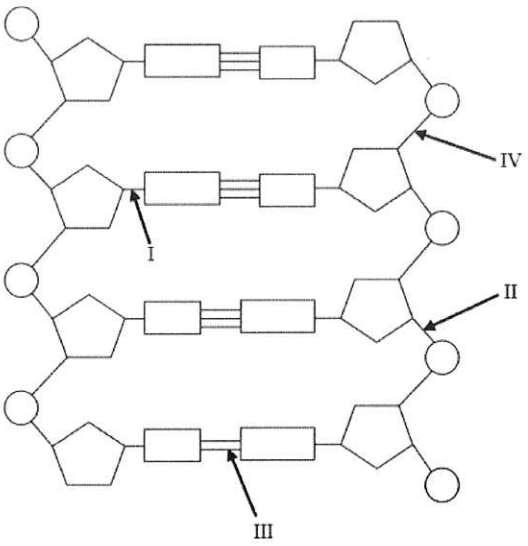
GC 40%

A. 70 %
B. 30 %
C. 40 %
(D.) 20 %

4. Which of the following are connected by hydrogen bonds? *[1 mark]*

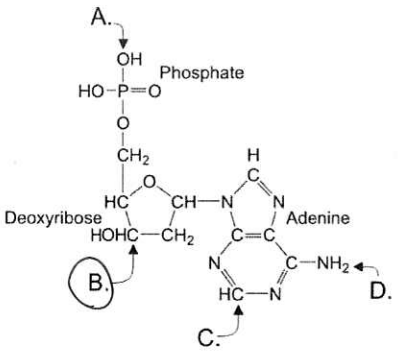
A. Hydrogen to oxygen within a molecule of water
B. Phosphate to sugar in a DNA molecule
C. Base to sugar in a DNA molecule
(D.) Hydrogen to oxygen between two different molecules of water

5. In the model of the DNA molecule shown below, which arrows point to covalent bonds? *[1 mark]*



A. I, II and III only
B. II, III and IV only
C. I, III and IV only
D. I, II and IV only

6. Which letter (A–D) indicates where a new nucleotide would attach? *[1 mark]*

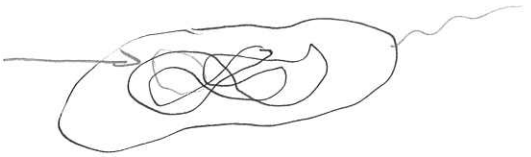


7. How does DNA replicate? *[1 mark]*

A. The deoxyribose of a free nucleotide is linked to the phosphate of the last nucleotide in the chain.
B. The phosphate of a free nucleotide is linked to the deoxyribose of the last nucleotide in the chain.
C. Nucleotides are linked in a 3′ to 5′ direction and the new strands are anti-parallel to the template strands.
D. Nucleotides are linked in a 5′ to 3′ direction and the new strands are parallel to the template strands.

8. What are the fundamental packaging units of eukaryotic chromosomes? *[1 mark]*

(A.) Nucleosomes
B. Centromeres
C. Histones
D. Nucleoids region



9. Some regions of DNA do not code for the production of proteins. What are these regions of DNA used as? *[1 mark]*

A. They have no known function and are recycled to provide nucleotides
B. Gene regulation and coding for production of enzymes used in translation
(C.) Telomeres and coding for production of tRNA
D. Introns and coding for production of structural proteins

Alternative splicing

10. Which are necessary to make DNA replication semi-conservative? *[1 mark]*

I. Separation of the strands by RNA polymerase
II. Complementary base pairing
III. Use of a pre-existing strand as a template

A. I and II only
B. I and III only
(C.) II and III only
D. I, II and III

11. In which process(es) do nucleosomes play a role in eukaryotes? *[1 mark]*

I. tRNA activation recharging
II. Transcription regulation
III. DNA supercoiling

A. I only
B. II only
(C.) II and III only
D. I, II and III

12. This is a sequence of nucleotides from a section of mRNA. *[1 mark]*

AUGAAACGCACGCAG

From which DNA sequence has it been transcribed?

A. ATGAAACGCACGCAG
B. UACUUUGCGUGCGAC
C. TACUUUGCGTGCGTC
(D.) TACTTTGCGTGCGTC

13. What is a feature of transcription? *[1 mark]*

A. Both strands of a DNA molecule act as a template for mRNA.
B. Nucleoside triphosphates become nucleotides by losing three phosphates.
C. RNA polymerase binds to the promoter region.
D. The sense strand acts as a template for mRNA.

14. Which model represents transcription? *[1 mark]*

A.
– A A T C G G A C T T A C –
– U U A G C C U ↑ ↑ ↑ ↑ ↑ –
→ G A A U G –

B.
– A A T C G G A C T T A C –
– aa aa aa ↑
aa

C.
– A A U C G G A C U U A C –
– aa aa aa ↑
aa

D.
– A A T C G G A C T T A C –
– T T A G C C T ↑ ↑ ↑ ↑ ↑ –
→ G A A T G –

Key:
A, C, G, T, U = nucleotides
aa = amino acids
= enzyme
= ribosome

[Source: © International Baccalaureate Organization 2015]

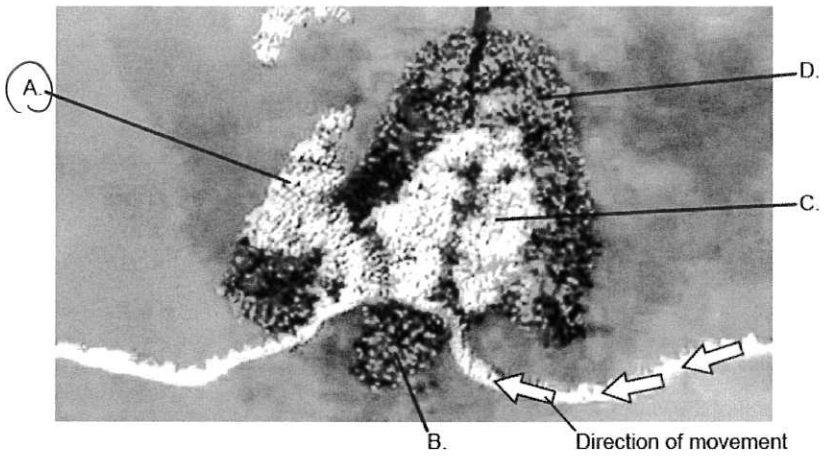
15. What makes up eukaryotic RNA immediately after transcription? *[1 mark]*

A. Exons, introns and primers
B. Exons and introns
C. Introns only
D. Exons only

16. Which cell component synthesizes actin and myosin? *[1 mark]*

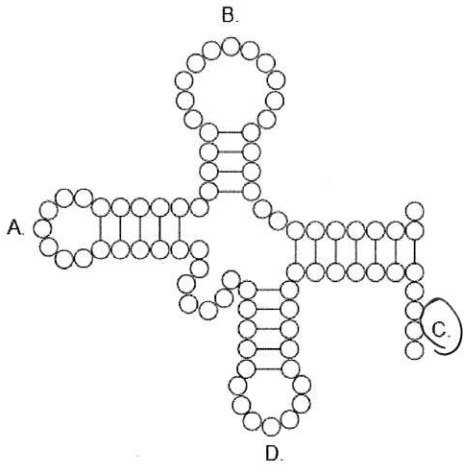
A. Free ribosomes
B. Rough endoplasmic reticulum
C. Smooth endoplasmic reticulum
D. Nuclear membrane

17. This image is taken from a visualization of a eukaryotic ribosome. The arrows show the direction of movement of mRNA. Which letter represents a tRNA exiting from the E site? *[1 mark]*



[Source: Adapted from Cold Spring Harbor Laboratory DNA Learning Center (www.dnalc.org)]

18. Where does a tRNA-activating enzyme attach the appropriate amino acid to the tRNA molecule? *[1 mark]*

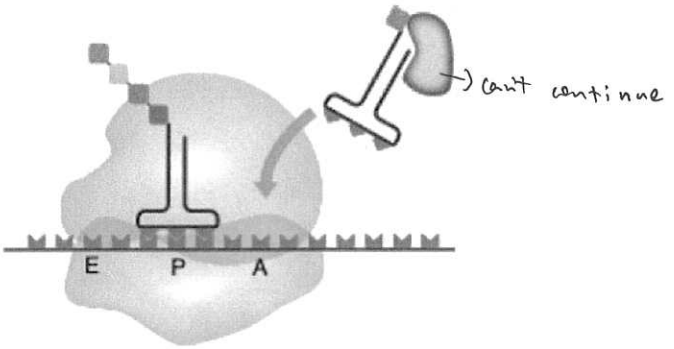


19. What does post-transcriptional modification of eukaryotic mRNA include? *[1 mark]*

I. Introns are removed from mRNA.
II. Exons are joined together to form mature mRNA.
III. A 5' cap and 3' poly-A tail are added to mRNA.

A. I only
B. I and III only
C. II and III only
D. I, II and III

20. The following diagram shows a ribosome during translation. *[1 mark]*



[Source: http://upload.wikimedia.org/wikipedia/commons/d/d1/ProteinTranslation.svg]

What describes the specific stage of translation?

A. Initiation
B. Elongation
C. Termination
D. Translocation

21. Some regions of DNA act as telomeres or produce tRNA. State **one** other function of DNA sequences that do **not** code for protein. *[1 mark]*

Introns can provide varied splicing options, thus creating diversity of the proteins being produced afterwards.

22. Outline the structure and functions of nucleosomes. *[4 marks]*

A nucleosome is two and a half wraps of DNA along with the histone, which consists of 8 parts.
It's the foundamental unit of eukaryotic chromosomes, providing possibility of activation (acetylation) and silence (methylation) of DNA if necessary by wrapping up and super coiling (gene regulation).
The structure of nucleosome after it's condensed can also shield important genetic material from mutagens, like X-rays, etc.

4

23a. DNA replication involves a number of enzymes including DNA polymerase. Identify **one** other enzyme involved in DNA replication. *[1 mark]*

helicase

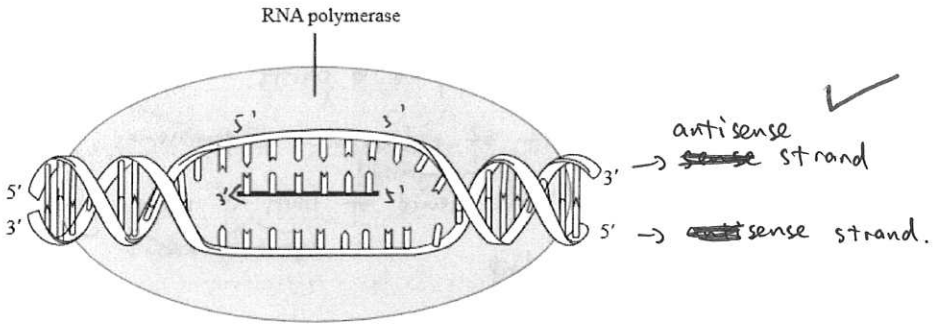
1

23b. Explain the role of Okazaki fragments in DNA replication. *[2 marks]*

Since natural elongation can only develop on 5'→ 3' direction, Okazaki fragment enables the replication on the lagging strand. They're pieces of DNA nucleotides added after to RNA primers. They will be later connected by ligase after the RNA primers are changed into DNA primers by DNA polymerase I.

2

The diagram below shows the process of transcription.



1

23c. Label the sense and antisense strands. *[1 mark]*

+1 0

23d. Draw an arrow on the diagram in question 23c. to show where the next nucleotide will be added to the growing mRNA strand. *[1 mark]*

will growing on 5'→ 3' direction, which is to the left.

c2

24a. Outline the structure of ribosomes. 读题，必要结构. *[6 marks]*

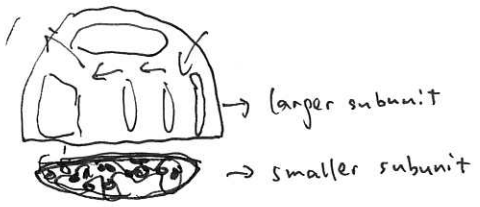
Ribosome is an essential part of translation from mRNA to proteins.

It has 2 subunits, a larger one and a relatively smaller one.

There's a place between the two subunits for mRNA in order to read the codons.

There're 3 sites in the larger subunit, which allows tRNA to ~~base~~ enter, match the anticodon to the codon, elongate the amino acid / polypepride chain, and then exit the ribose.

It can slide over the mRNA as the translation develops.



2

① made of protein
② made of r RNA
③ large & small subunit
④ APE. aminacyl, peptidyl, exit. E.
⑤ 3 binding sites
⑥ can be free / bond in enkaryote.
⑦ 70s ribosome in prokaryoter / 80s in enkaryot.

24b. Explain the process of transcription leading to the formation of mRNA. *[8 marks]*

transcription is the process of ~~changing DNA~~ getting mRNA from DNA template.

It has three steps. initiation, elongation and termination.

In initiation, RNA polymerase sticks to the part of the DNA that's going to be transcripted.

DNA ~~one~~ double strands are splitted (unwound) into ~~two tubes~~ and free RNA nucleotides flows into the RNA polymerase. (but only one of the two strands are used).

The DNA template ~~strand~~ is transcripted according to the rule: adenine → uracil, thymine → adenine, cytosine → guanine, guanine → cytosine.

RNA polymerase move along the DNA strand as the transcription carries on. The transcripted part of DNA is recoved as the RNA polymerase move, and formed mRNA floats out of mRNA as well.

The transcription stops ~~for~~ when a stop sigal is detected.

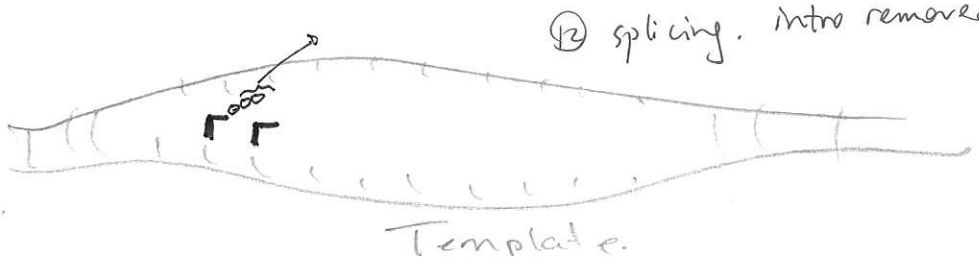
In prokaryotic cells, translation can happen ~~after~~ before transcription ends since it doesn't as a nucleus. True

In enkaryotic cells, mRNA is further process so that mature mRNA is gained. (how?)

5

① RNA polymerase
② binds to promoter.
③ unwind
④ bind to nucleotide
⑤ bind to anti-sense strand.
⑥ 5'→3'
⑦ A-U, C-G
⑧ phosphorylation, lose 2 phosphate
⑨ terminator signal
⑩ RNA detach, DNA rewind
⑪ RNA polymerase detach
⑫ splicing. intro removed → mature.

16/24



Name Jerry Class C Date 19/3/28.

Bubble Answer Sheet

18/20

(A) (B) ● (D)

1. (A) (B) (C) (D) ✓	18. (A) (B) (C) (D) ✓	35. (A) (B) (C) (D)	
2. (A) (B) (C) (D) ✓	19. (A) (B) (C) (D) ✓	36. (A) (B) (C) (D)	
3. (A) (B) (C) (D) ✓	20. (A) (B) (C) (D) B	37. (A) (B) (C) (D)	
4. (A) (B) (C) (D) ✓	21. (A) (B) (C) (D)	38. (A) (B) (C) (D)	
5. (A) (B) (C) (D) ✓	22. (A) (B) (C) (D)	39. (A) (B) (C) (D)	
6. (A) (B) (C) (D) ✓	23. (A) (B) (C) (D)	40. (A) (B) (C) (D)	
7. (A) (B) (C) (D) ✓	24. (A) (B) (C) (D)	41. (A) (B) (C) (D)	
8. (A) (B) (C) (D) ✓	25. (A) (B) (C) (D)	42. (A) (B) (C) (D)	
9. (A) (B) (C) (D) ✓	26. (A) (B) (C) (D)	43. (A) (B) (C) (D)	
10. (A) (B) (C) (D) ✓	27. (A) (B) (C) (D)	44. (A) (B) (C) (D)	
11. (A) (B) (C) (D) ✓	28. (A) (B) (C) (D)	45. (A) (B) (C) (D)	
12. (A) (B) (C) (D) ✓	29. (A) (B) (C) (D)	46. (A) (B) (C) (D)	
13. (A) (B) (C) (D) ✓	30. (A) (B) (C) (D)	47. (A) (B) (C) (D)	
14. (A) (B) (C) (D) ✓	31. (A) (B) (C) (D)	48. (A) (B) (C) (D)	
15. (A) (B) (C) (D) ✓	32. (A) (B) (C) (D)	49. (A) (B) (C) (D)	
16. (A) (B) (C) (D) A	33. (A) (B) (C) (D)	50. (A) (B) (C) (D)	
17. (A) (B) (C) (D) ✓	34. (A) (B) (C) (D)		

35 ~~39~~/44 77% 80%

Nucleic Acids Test 2019 *[44 marks]*

1. What usually distinguishes DNA from RNA? *[1 mark]*

	DNA	RNA
A.	strands are symmetrical	strands are antiparallel
B.	contains adenine	contains cytosine
C.	pentoses linked to phosphates	pentoses linked to bases
D.	double stranded	single stranded

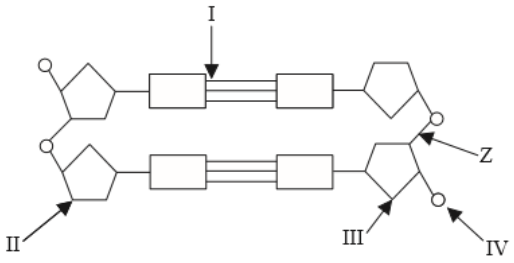
Markscheme

D

Examiners report

These questions proved to be too easy.

This question refers to the following DNA diagram.



2. Which points to the 3′ end of a strand of DNA? *[1 mark]*

A. I
B. II
C. III
D. IV

Markscheme

B

Examiners report

N/A

3. The percentage of thymine in the DNA of an organism is approximately 30 %. What is the percentage of guanine? *[1 mark]*

A. 70 %
B. 30 %
C. 40 %
D. 20 %

Markscheme

D

Examiners report

N/A

4. Which of the following are connected by hydrogen bonds? *[1 mark]*

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

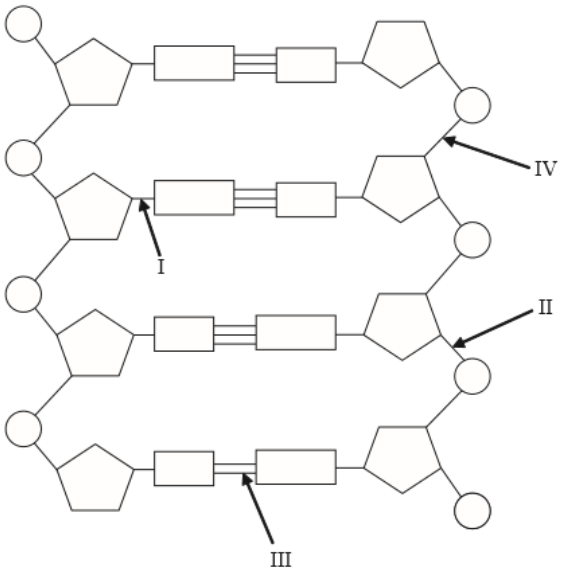
Markscheme

D

Examiners report

N/A

5. In the model of the DNA molecule shown below, which arrows point to covalent bonds? *[1 mark]*



A. I, II and III only
B. II, III and IV only
C. I, III and IV only
D. I, II and IV only

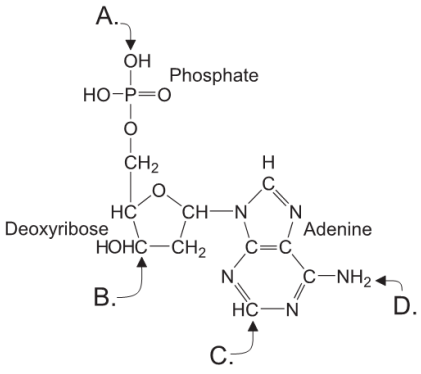
Markscheme

D

Examiners report

N/A

6. Which letter (A–D) indicates where a new nucleotide would attach? *[1 mark]*



Markscheme

B

Examiners report

[N/A]

7. How does DNA replicate? *[1 mark]*

A. The deoxyribose of a free nucleotide is linked to the phosphate of the last nucleotide in the chain.
B. The phosphate of a free nucleotide is linked to the deoxyribose of the last nucleotide in the chain.
C. Nucleotides are linked in a 3′ to 5′ direction and the new strands are anti-parallel to the template strands.
D. Nucleotides are linked in a 5′ to 3′ direction and the new strands are parallel to the template strands.

Markscheme

B

Examiners report

N/A

8. What are the fundamental packaging units of eukaryotic chromosomes? *[1 mark]*

A. Nucleosomes
B. Centromeres
C. Histones
D. Nucleoids

Markscheme

A

Examiners report

This question seemed to be a bit complicated as many candidates confused the term packing units, considering they were the histones instead of the nucleosome. The discrimination index was quite good, showing that it did not prove that difficult to good candidates.

9. Some regions of DNA do not code for the production of proteins. What are these regions of DNA used as? *[1 mark]*

A. They have no known function and are recycled to provide nucleotides

B. Gene regulation and coding for production of enzymes used in translation

C. Telomeres and coding for production of tRNA

D. Introns and coding for production of structural proteins

Markscheme

C

Examiners report

[N/A]

10. Which are necessary to make DNA replication semi-conservative? *[1 mark]*

I. Separation of the strands by RNA polymerase

II. Complementary base pairing

III. Use of a pre-existing strand as a template

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

C

Examiners report

[N/A]

11. In which process(es) do nucleosomes play a role in eukaryotes? *[1 mark]*

I. tRNA activation

II. Transcription regulation

III. DNA supercoiling

A. I only

B. II only

C. II and III only

D. I, II and III

Markscheme

C

Examiners report

[N/A]

12. This is a sequence of nucleotides from a section of mRNA. *[1 mark]*

AUGAAACGCACGCAG

From which DNA sequence has it been transcribed?

A. ATGAAACGCACGCAG
B. UACUUUGCGUGCGAC
C. TACUUUGCGTGCGTC
D. TACTTTGCGTGCGTC

Markscheme

D

Examiners report

An easy question.

13. What is a feature of transcription? *[1 mark]*

A. Both strands of a DNA molecule act as a template for mRNA.
B. Nucleoside triphosphates become nucleotides by losing three phosphates.
C. RNA polymerase binds to the promoter region.
D. The sense strand acts as a template for mRNA.

Markscheme

C

Examiners report

[N/A]

14. Which model represents transcription? *[1 mark]*

A. – A A T C G G A C T T A C –
– U U A G C C U G A A U G –

B. – A A T C G G A C T T A C –
– aa aa aa aa

C. – A A U C G G A C U U A C –
– aa aa aa aa

D. – A A T C G G A C T T A C –
– T T A G C C T G A A T G –

Key:
A, C, G, T, U = nucleotides
aa = amino acids
= enzyme
= ribosome

[Source: © International Baccalaureate Organization 2015]

Markscheme

A

Examiners report

This question turned out to be an easy question, although some candidates confused the answer with the translation process.

15. What makes up eukaryotic RNA immediately after transcription? *[1 mark]*
A. Exons, introns and primers
B. Exons and introns
C. Introns only
D. Exons only

Markscheme

B

Examiners report

[N/A]

16. Which cell component synthesizes actin and myosin? *[1 mark]*

A. Free ribosomes

B. Rough endoplasmic reticulum

C. Smooth endoplasmic reticulum

D. Nuclear membrane

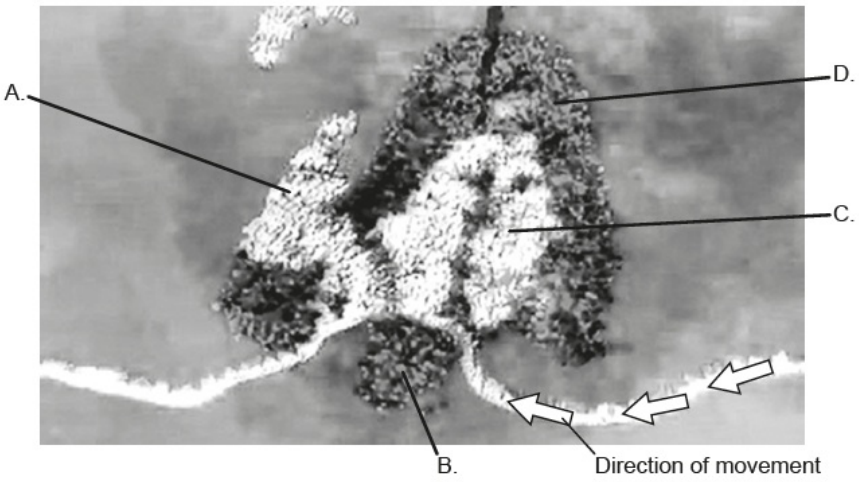
Markscheme

A

Examiners report

[N/A]

17. This image is taken from a visualization of a eukaryotic ribosome. The arrows show the direction of movement of mRNA. Which letter represents a tRNA exiting from the E site? *[1 mark]*



[Source: Adapted from Cold Spring Harbor Laboratory DNA Learning Center (www.dnalc.org)]

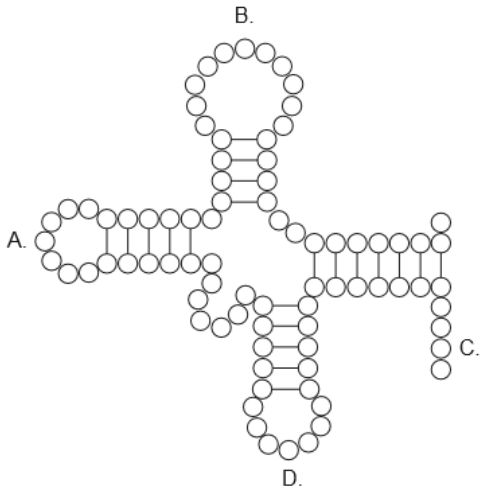
Markscheme

A

Examiners report

[N/A]

18. Where does a tRNA-activating enzyme attach the appropriate amino acid to the tRNA molecule? *[1 mark]*



Markscheme

C

Examiners report

[N/A]

19. What does post-transcriptional modification of eukaryotic mRNA include? *[1 mark]*

I. Introns are removed from mRNA.
II. Exons are joined together to form mature mRNA.
III. A 5' cap and 3' poly-A tail are added to mRNA.

A. I only
B. I and III only
C. II and III only
D. I, II and III

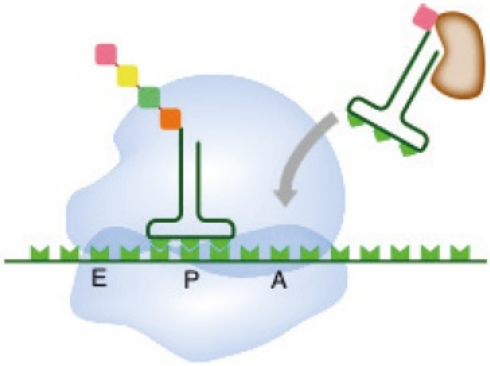
Markscheme

D

Examiners report

[N/A]

20. The following diagram shows a ribosome during translation. *[1 mark]*



[Source: http://upload.wikimedia.org/wikipedia/commons/d/d1/ProteinTranslation.svg]

What describes the specific stage of translation?
A. Initiation
B. Elongation
C. Termination
D. Translocation

Markscheme

B

Examiners report

There was a comment that the diagram was not clear. However this did not seem to have affected the students who generally gave the correct answer of B.

21. Some regions of DNA act as telomeres or produce tRNA. State **one** other function of DNA sequences that do **not** code for protein. *[1 mark]*

Markscheme

a. regulate gene expression

b. act as promoter

c. role in chromosome pairing/crossing over/recombination

d. introns

OWTTE

[Max 1 Mark]

Examiners report

[N/A]

22. Outline the structure and functions of nucleosomes. *[4 marks]*

Markscheme

Remember, up to TWO "quality of construction" marks per essay.

a. found in eukaryotes;
b. consists of DNA wrapped around proteins/histones;
c. histones are in an octamer/group of eight;
d. are held together by another histone/protein;
e. in linker region;
f. help to supercoil chromosomes / to facilitate DNA packing;
g. (function is to) regulate transcription / gene expression;

Examiners report

It was common for four marks to be awarded. Students knew this topic well.

23a. DNA replication involves a number of enzymes including DNA polymerase. Identify **one** other enzyme involved in DNA replication. *[1 mark]*

Markscheme

helicase / RNA primase / (DNA) ligase

Examiners report

All but the weakest candidates were able to name an enzyme involved in DNA replication.

23b. Explain the role of Okazaki fragments in DNA replication. *[2 marks]*

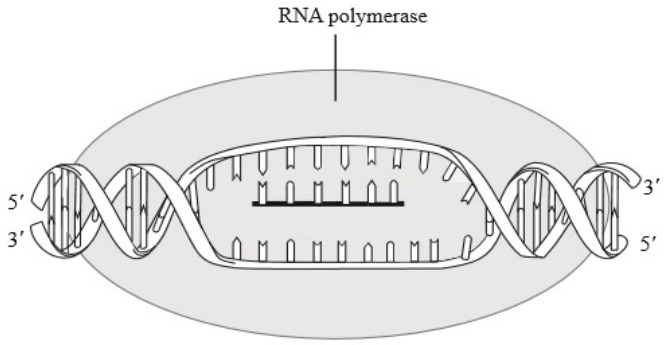
Markscheme

DNA fragments/sections (formed) on the lagging strand;
because replication must be in the 5' –3' direction;
replication starts repeatedly and moves away from replication fork;

Examiners report

This question discriminated very well with the best candidates writing authoritatively about Okazaki fragments, but weaker candidates struggling. Some teachers felt that the word role was inappropriate here, but any answer explaining that Okazaki fragments are formed on the lagging strand because nucleotides can only be added in a 5' to 3' direction would have scored both marks. A common error was to refer to the lagging strand as the antisense strand. This is not correct -on a DNA molecule the lagging strand is the antisense strand for some genes and the sense strand for others.

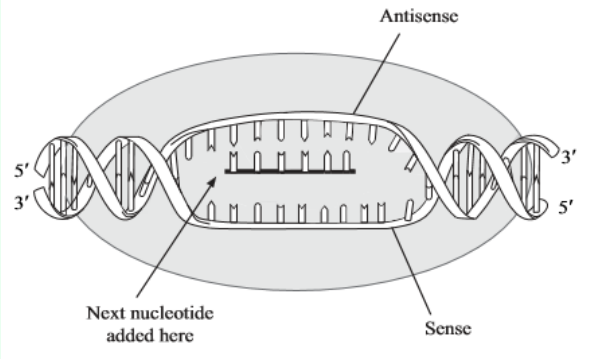
The diagram below shows the process of transcription.



23c. Label the sense and antisense strands. *[1 mark]*

Markscheme

both strands clearly labelled
Check carefully whether the correct strand has been labelled if the labels are shown in helical parts of the DNA.
Reject if the sense strand label points to the mRNA.



Examiners report

About half of the candidates knew that the transcribed strand is the antisense strand, with the others either getting the strands the wrong way round or thinking that the mRNA was either the sense or the antisense strand.

23d. Draw an arrow on the diagram in question 23c. to show where the next nucleotide will be added to the growing mRNA strand. *[1 mark]*

Markscheme

a clearly drawn arrow pointing at the free 3' end of the mRNA strand or to the first free nucleotide on the antisense strand to the left of the mRNA or to a nucleotide added by the candidate to the left hand end of the mRNA

Examiners report

When asked in part (ii) to show where the next nucleotide will be added to the mRNA strand the weakest candidates labelled various places other than an end of the mRNA; of the other candidates, more than half labelled the right hand end, whereas the left hand was the 3' terminal so that is where the 5' end of a nucleotide would be added.

24a. Outline the structure of ribosomes. *[6 marks]*

Markscheme

a. made of protein;

b. made of rRNA;

c. large subunit and small subunit;

d. three tRNA binding sites;

e. Aminacyl/A, Peptidyl/P and Exit/E;

f. mRNA binding site (on small subunit);

g. 70S in prokaryotes / 80S in eukaryotes;

h. can be free / bound to RER (in eukaryotes);

Examiners report

Most knew about the two ribosome subunits and the mRNA binding site. Very few knew that they were made from protein and rRNA. Several answered that there were 3 binding sites, but not what was bound there (tRNA) or what they were called.

24b. Explain the process of transcription leading to the formation of mRNA. *[8 marks]*

Markscheme

a. RNA polymerase; *(polymerase number is not required)*

b. binds to a promoter on the DNA;

c. unwinding the DNA strands;

d. binding nucleoside triphosphates;

e. to the antisense strand of DNA;

f. as it moves along in a 5'→3' direction;

g. using complementary pairing/A-U and C-G;

h. losing two phosphates to gain the required energy;

i. until a terminator signal is reached (in prokaryotes);

j. RNA detaches from the template and DNA rewinds;

k. RNA polymerase detaches from the DNA;

l. many RNA polymerases can follow each other;

m. introns have to be removed in eukaryotes to form mature mRNA;

Examiners report

The process of transcription was well known by most candidates who attempted this question.