

1.

The site of RNA production is _____.

- A) Smooth endoplasmic reticulum
- B) Nucleolus
- C) Ribosomes
- D) Golgi apparatus
- E) No answer

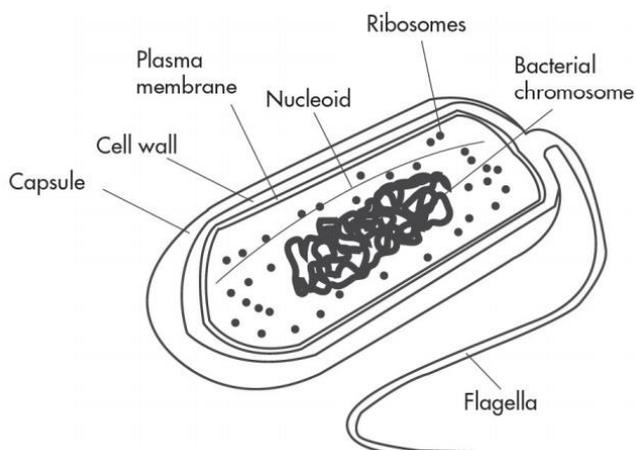
Answer: B)

2.

Vibrio cholerae (shown below) are highly pathogenic bacteria that are associated with severe gastrointestinal illness and are the causative agent of cholera.

In extreme cases, antibiotics are prescribed that target bacterial structures that are absent in animal cells.

Which of the following structures is most likely targeted by antibiotic treatment?



- A) Cytoplasm
- B) Plasma membrane
- C) Ribosomes
- D) Cell wall
- E) No answer

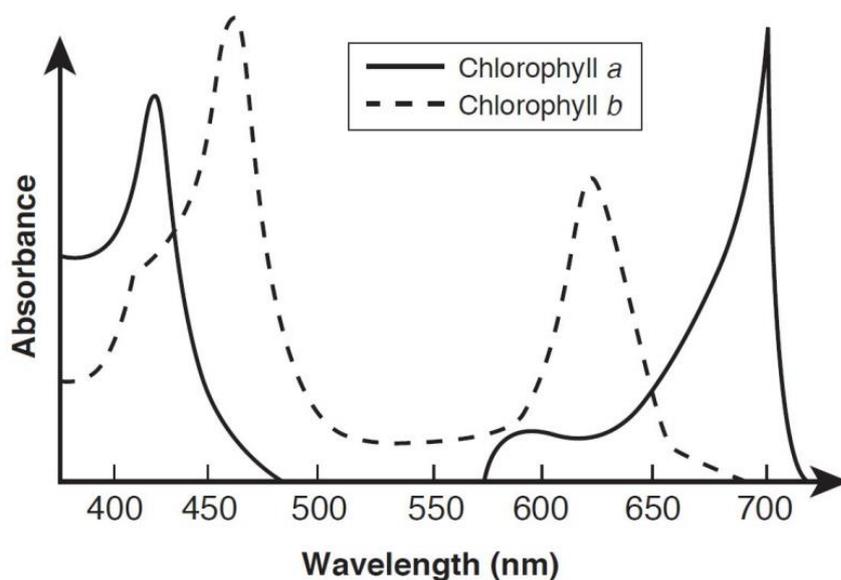
Answer: D)

3.

Chlorophyll is a green pigment present in the chloroplasts of algae and plants. It is essential for catalyzing the light-dependent cycles in photosynthesis.

A scientist purifies both forms of chlorophyll (a and b) from plant chloroplasts and evaluates them for light absorption using a spectrophotometer.

Using the spectrophotometer data provided below, at what wavelength is the absorbance of chlorophyll a at its maximum?



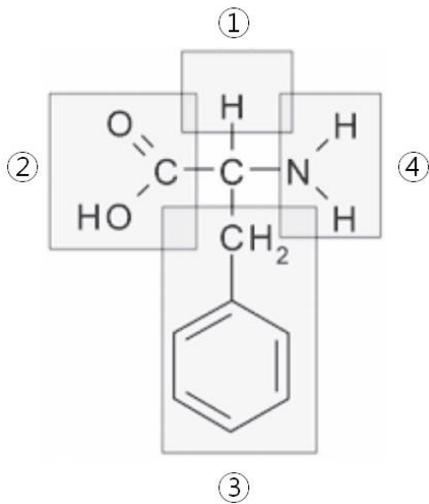
- A) 450 nm
- B) 500 nm.
- C) 600 nm
- D) 700 nm
- E) No answer

Answer: D)

4.

Amino acids are the basic molecular units which compose proteins. All life on the planet forms proteins by forming chains of amino acids.

Which labeled component of the amino acid structure of phenylalanine shown below will vary from amino acid to amino acid?



- A) ①
- B) ②
- C) ③
- D) ④
- E) No answer

Answer: C)

5.

Which of the following contain both hydrophilic and hydrophobic properties and are often found in cell plasma membranes?

- A) Nucleotides
- B) Phospholipids
- C) Water
- D) Amino acids
- E) No answer

Answer: B)

6.

Maltotriose is a trisaccharide composed of three glucose molecules linked through α -1,4 glycosidic linkages formed via dehydration synthesis.

What would the formula be for maltotriose?

(Please note that glucose is a simple sugar with the molecular formula $C_6H_{12}O_6$)

- A) $C_{18}H_{36}O_{18}$
- B) $C_{18}H_{32}O_{18}$
- C) $C_{18}H_{32}O_{16}$
- D) $C_3H_6O_3$
- E) No answer

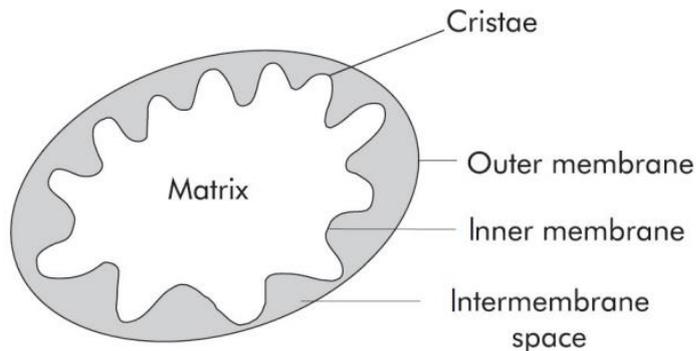
Answer: C)

7.

The mitochondrion is a critical organelle structure involved in cellular respiration.

Below is a simple schematic of the structure of a mitochondrion.

Which of the structural components labeled below in the mitochondrion is the primary location of the citric acid cycle?



- A) Inner membrane
- B) Matrix
- C) Intermembrane space
- D) Outer membrane
- E) No answer

Answer: B)

8.

DNA replication occurs through a complex series of steps involving

several enzymes.

Which of the following represents the correct order beginning with the earliest activity of enzymes involved in DNA replication?

- A) Helicase, DNA ligase, RNA primase, DNA polymerase
- B) DNA polymerase, RNA primase, helicase, DNA ligase
- C) RNA primase, DNA polymerase, DNA ligase, helicase
- D) Helicase, RNA primase, DNA polymerase, DNA ligase
- E) No answer

Answer: D)

9.

Viruses and bacteria have which of the following in common?

- A) Ribosomes
- B) Nucleic acids
- C) Flagella
- D) Mitochondria
- E) No answer

Answer: B)

10.

Meselson and Stahl performed an elegant experiment using bacteria grown in heavy nitrogen (^{15}N) to show that DNA replication is semi-conservative.

After growing the bacteria in heavy nitrogen, they switched the cultures to ^{14}N for two rounds of replication.

They then examined the cells by density centrifugation, comparing the double helices by density.

What is a likely result?

(Please note that each round of the replication replicates the DNA double helices.)

- A) Half of the DNA was labeled with ^{15}N and half was labeled with ^{14}N .
- B) One strand of each new DNA molecule was labeled with ^{15}N , and the

other strand was labeled with ^{14}N .

C) One band averaging the two molecular masses of nitrogen is seen.

D) Two bands are seen; one band averaging the two molecular masses of nitrogen and the other one representing a lighter molecular mass of nitrogen.

E) No answer

Answer: D)

11.

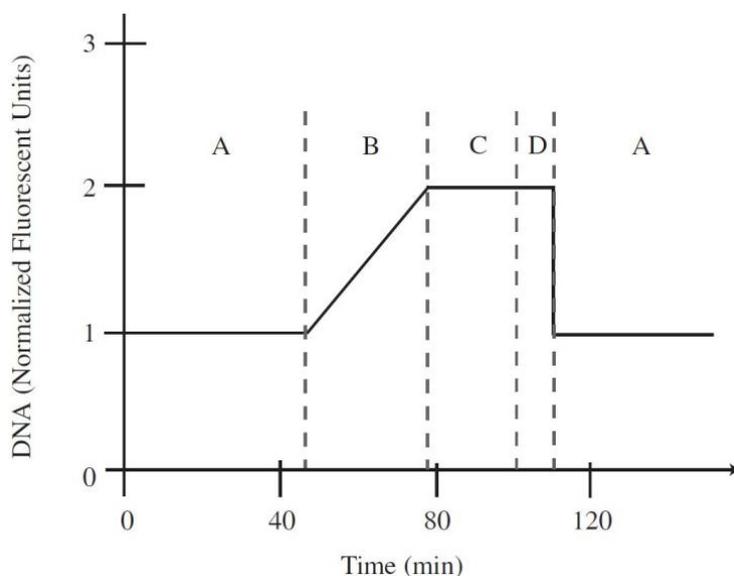
An experiment is performed to evaluate the amount of DNA present during a complete cell cycle.

All of the cells were synced prior to the start of the experiment.

During the experiment, a fluorescent chemical was applied to cells, which would only fluoresce when bound to DNA. The results of the experiment are shown below.

(DNA in the figure below indicates the amount of DNA per cell)

Differences in cell appearance by microscopy or changes in detected DNA were determined to be phases of the cell cycle and are labeled with the letters A–D.



During which of the labeled phases of the experiment would the cell undergo S phase?

- A) Phase A
- B) Phase B
- C) Phase C
- D) Phase D
- E) No answer

Answer: B)

12.

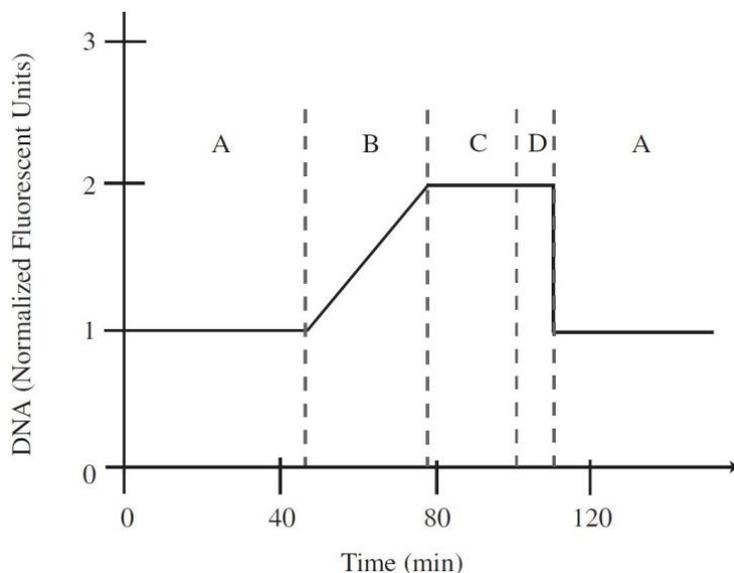
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(DNA in the figure below indicates the amount of DNA per cell)

Differences in cell appearance by microscopy or changes in detected DNA were determined to be phases of the cell cycle and are labeled with the letters A–D.



During which of the labeled phases of the experiment would most likely the cell undergo anaphase?

- A) Phase A

- B) Phase B
- C) Phase C
- D) Phase D
- E) No answer

Answer: D)

13.

A new mammal has recently been discovered in the Amazonian jungle. A karyotype was performed on gametic cells that are haploid and revealed that the animal had 13 completely unique chromosomes.

How many homologous pairs would you expect to find in a diploid cell of the organism following completion of S phase?

- A) 6
- B) 6.5
- C) 13
- D) 26
- E) No answer

Answer: C)

14.

A new species of tulip was recently discovered.

A population of pure red tulips that are dominant was crossed with a population of pure blue tulips that are recessive.

The resulting F1 generation was all purple. The resulting progeny exhibited a mixture of the traits (purple)

This result is an example of which of the following?

- A) Complete dominance
- B) Incomplete dominance
- C) Codominance
- D) Linkage
- E) No answer

Answer: B)

15.

In pea plants, tall (R) is dominant over short (r) and green (G) is dominant over yellow (g). If a pea plant heterozygous for both traits is crossed with a plant that is recessive for both traits, approximately what percentage of the progeny plants will be tall and yellow?

- A) 0%
- B) 25%
- C) 66%
- D) 75%
- E) No answer

Answer: B)

16.

Which of the following is a reason why certain traits do not follow Mendel's Law of Independent Assortment?

- A) Certain traits are not completely dominant.
- B) It only applies to eukaryotes.
- C) The genes are linked on the same chromosome.
- D) Heterozygotes have both alleles.
- E) No answer

Answer: C)

17.

A recessive allele of a gene has a calculated frequency of 0.3 in a population. Assuming the population is in Hardy-Weinberg equilibrium, what percentage of the population is expected to be heterozygous for the gene?

- A) 0.09
- B) 0.42
- C) 0.49

D) 0.7

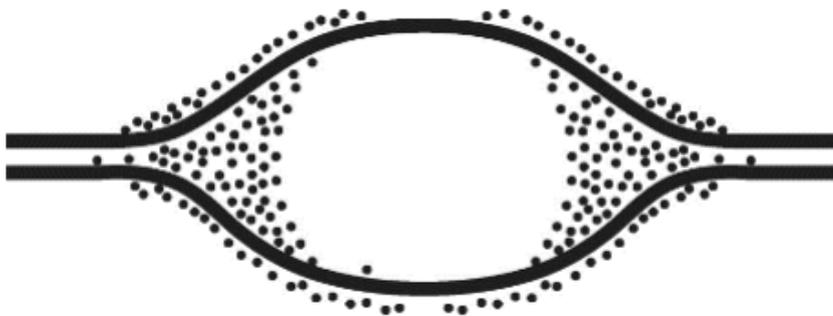
E) No answer

Answer: B)

18.

In the experiment below, DNA is allowed to replicate in an environment with all necessary enzymes, deoxyadenosine triphosphate (dATP), dCTP, dGTP, and radioactively labeled dTTP (^3H thymidine) for several minutes and then switched to nonradioactive medium (nonradioactive dTTP). It is then viewed by electron microscopy and autoradiography. The figure below represents the results.

Grains represent radioactive material (radioactively labeled dTTP).



Which is the most likely interpretation?

A) There are two replication forks.

B) Thymidine is only being added where the DNA strands are furthest apart.

C) Thymidine is only added at the very beginning of replication.

D) Replication proceeds in one direction only.

E) No answer

Answer: A)

19.

Using table of codons, identify a 5' \longrightarrow 3' sequence of nucleotides in the DNA template strand for an mRNA coding for the polypeptide sequence Phe-Pro-Lys.

		Second Base					
		U	C	A	G		
First Base	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	Third Base	U
		UUC } Phe	UCC } Ser	UAC } Tyr	UGC } Cys		C
		UUA } Leu	UCA } Ser	UAA } Stop	UGA } Stop		A
		UUG } Leu	UCG } Ser	UAG } Stop	UGG } Trp		G
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg		U
		CUC } Leu	CCC } Pro	CAC } His	CGC } Arg		C
		CUA } Leu	CCA } Pro	CAA } Gln	CGA } Arg		A
		CUG } Leu	CCG } Pro	CAG } Gln	CGG } Arg		G
	A	AUU } Ile	ACU } Thr	AAU } Asn	AGU } Ser		U
		AUC } Ile	ACC } Thr	AAC } Asn	AGC } Ser		C
		AUA } Ile	ACA } Thr	AAA } Lys	AGA } Arg		A
		AUG } Met or Start	ACG } Thr	AAG } Lys	AGG } Arg		G
	G	GUU } Val	GCU } Ala	GAU } Asp	GGU } Gly		U
		GUC } Val	GCC } Ala	GAC } Asp	GGC } Gly		C
		GUA } Val	GCA } Ala	GAA } Glu	GGA } Gly		A
		GUG } Val	GCG } Ala	GAG } Glu	GGG } Gly		G

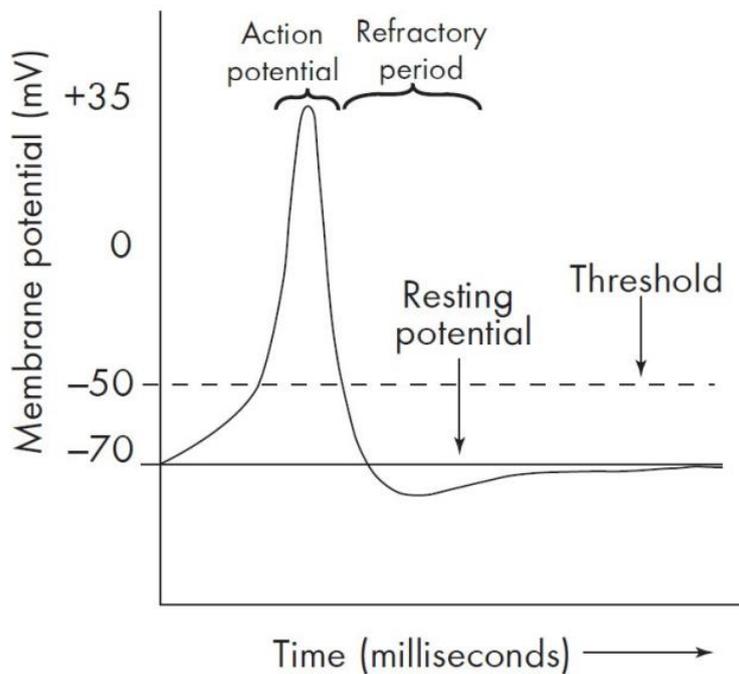
- A) 5'-UUUCCUAAA-3'
- B) 5'-TTTCCTAAA-3'
- C) 5'-AAAACCTTT-3'
- D) 5'-CTTCGGGAA-3'
- E) No answer

Answer: D)

20.

The image below depicts an action potential occurring in an active neuron.

Which of the following best explains why the membrane potential depolarizes at -50 mV?



- A) At -50 mV, voltage-gated potassium channels open, allowing potassium ions (K^+) to rush into the cell.
- B) At -50 mV, voltage-gated sodium channels open, allowing sodium ions (Na^+) to rush into the cell.
- C) At -50 mV, voltage-gated potassium channels open, allowing potassium ions (K^+) to rush out of the cell.
- D) At -50 mV, voltage-gated sodium channels open, allowing sodium ions (Na^+) to rush out of the cell.
- E) No answer

Answer: B)