## Section A

Select the **BEST** answer to the question provided and mark it on your Test Score Answer Sheet. A correct answer is worth **1 mark**. Section A = **25 marks total**.

1) The *ORK* gene encodes a protein that ends up in the Endoplasmic Reticulum (ER) lumen. The intrinsic information that directs ORK protein to the ER is provided by:

a. BiP chaperone protein in the ER lumen
b. the Nuclear Localization Signal
c. a hydrophobic signal sequence at the N-terminus of ORK
d. interaction between the ribosome and the translocon

2) The Miller-Urey experiment demonstrated that:

a. organic molecules are derived from the fusion of two primitive prokaryotic cells
b. life may have arisen via spontaneous generation
c. Earth's primitive atmosphere could give rise to the building blocks of life
d. life must have extraterrestrial origins

3) Evidence for the Endosymbiont theory does NOT include:

a. the presence of double membranes in mitochondria and chloroplasts
b. high levels of cardiolipin in the mitochondria inner membrane
c. the existence of prokaryotic-like microtubules
d. that chloroplasts and mitochondria have their own genomes

4) Which of the following would have the largest Smooth Endoplasmic Reticulum?

a. intestinal epithelial cells of an 18-year old BIOL*1090 non-drinker
b. chloroplasts from sea algae scraped from an old Scotch barrel
c. liver cell of a 72 year old alcoholic male
d. a bacterial cell growing in a vat of beer

5) Translocon integral membrane complexes are found:

a. in the Golgi complex membrane
b. in the rough endoplasmic reticulum (RER) membrane
c. in the smooth endoplasmic reticulum (SER) membrane
d. in the RER lumen

6) Which of the following is **true** regarding the nucleolus?

a. it is a membrane-bound vesicle inside the nucleus
b. it is the site of rRNA transcription
c. it fuses with the lysosome
d. apoptosis signals originate within it

7) A virus with a **lytic** life cycle is more likely to:

a. insert viral DNA into the host genome
b. kill the host cells
c. produce a provirus
d. invade T-cells and cause acquired immune deficiency syndrome (AIDS)

8) Given the structure of protein X below, choose the answer which best describes its location in the cell. N = amino terminus, C = carboxyl terminus, ooooo = signal sequence, X = charged amino acids, @ = hydrophobic amino acids, "-" is any amino acid.

**protein X**: N-ooooo----------XXX@@@@@@@@@XXX----------C

a. integral membrane protein located in the endoplasmic reticulum
b. soluble protein localized in the lysosome
c. transmembrane protein located in nucleolus
d. chaperone protein located in ER lumen

9) Using the same key as in question 8, which answer best describes the location of protein Y?

**protein Y**: N-ooooo----------C

a. protein Y is an integral membrane protein
b. protein Y will be targeted to the lumen of the endoplasmic reticulum
c. protein Y is a cytosolic protein
d. removal of the signal sequence will cause protein Y to be degraded

10) One function of the Trans Golgi Network is:

a. to send off vesicles containing modified proteins
b. to synthesize COPII protein
c. to support the production of ribosomes
d. to receive vesicles directly from the endoplasmic reticulum

11) A nuclear localization signal (NLS) fused to green fluorescent protein (GFP) and injected into a fat cell:

a. would cause lipid vesicles to glow green
b. would cause catastrophic breakdown of microtubules
c. would be excreted into the extracellular space
d. would show green fluorescence in the nucleus

12) **Colchine** depolymerizes microtubules. Which of the following cells might have been treated with colchicine?

a. a nerve cell that does not have a high internal $K^+$ concentration
b. a plant cell with a collapsed vacuole
c. a muscle cell in which the vesicles do not move
d. a heart cell with no nucleolus

13) What distinguishes the outer leaflet from the inner leaflet of the plasma membrane? The presence of:

a. cholesterol
b. transporter membrane proteins
c. glycoproteins
d. ionic gradients across the membrane

14) The transition of a lipid bilayer from a crystalline gel to a liquid crystal state:

a. increases the fluidity of the membrane
b. could be caused by a decrease in temperature
c. would prevent movement of membrane proteins
d. is likely due to saturation of lipid chains

15) Which of the following is **not** true about **ion channels**?

a. they require ATP to facilitate passive movement
b. they selectively allow ions to pass through
c. they move ions down a concentration gradient (higher to lower)
d. they form gates that can be open or closed

16) A **chemiosmotic** mechanism:

a. uses the interaction of $H^+$ and $O_2$ to generate water
b. uses ATP to generate proton motive force
c. depends on electrons ($e^-$) to make ATP
d. requires a membrane to separate high and low concentrations of ions

17) Which of the following is **not** an indicator of a cell undergoing **apoptosis**?

a. cytochrome c protein leaks out of mitochondria
b. colchicine is produced by the cell to depolymerize microtubules
c. executioner procaspases are converted to active caspases
d. DNA, cytoskeleton and nucleus start to break down

18) The Rough Endoplasmic Reticulum (RER)

a. has no role in the synthesis of phospholipids
b. contains ribosomes on the membrane facing the lumen
c. is directly connected to the Golgi complex
d. is continuous with the Nuclear Envelope

19) Which of the following does not describe the function of COPI-coated vesicles?

a. they transport vesicles in an retrograde direction
b. they could carry material from the Golgi stack to the Endoplasmic Reticulum
c. they fuse with clathrin-coated vesicles to direct them to lysosomes
d. they retrieve proteins that were accidentally exported from the ER

20) Plant vacuoles carry out all the functions listed below **except**:

a. fusion with plasma membranes to eliminate waste products by exocytosis
b. maintaining osmotic balance and turgor pressure
c. sequestering pigments such as anthocyanin
d. isolation of toxic compounds

21) Which statement best describes the function of the **Arp 2/3** complex?

a. it is an F-actin based motor protein
b. it depolymerizes actin
c. it nucleates F-actin polymerization at branch points
d. it binds to cofilin to mediate severing of actin filaments

22) Which of the following cytoskeletal structural components do **not** have polarity?

a. intermediate filaments
b. F-actin
c. microtubules
d. keratin monomer protein

23) One function of the nuclear pore complex (NPC) is to:

a. synthesize the phospholipid bilayer of the nuclear envelope
b. carry out co-translational import of nuclear proteins
c. export rRNA transcripts into the cytoplasm
d. import proteins with nuclear localization signals

24) A major function of the nuclear envelope is to:

a. separate the processes of transcription and translation
b. provide a phospholipid bilayer for the nucleolus
c. transport completed ribosomes to the cytoplasm
d. support the lamina

25) Chromatin present in the nucleus is composed mostly of:

a. DNA and RNA
b. lamin and DNA
c. DNA and histones
d. cotton candy and Kit Kat bars

## Section B

Answer the questions below in the spaces provided. DO NOT USE ACRONYMS. Section B is worth a **total of 13 marks**.

1) Fill in the blanks in this table (**4 marks**):

| cytoskeleton polymer | monomer protein(s) |
|---|---|
| nuclear lamina | Intermediate filaments → Lamin alpha helices |
| microtubules | alpha + beta tubulin |
| microfilaments | G-actin |

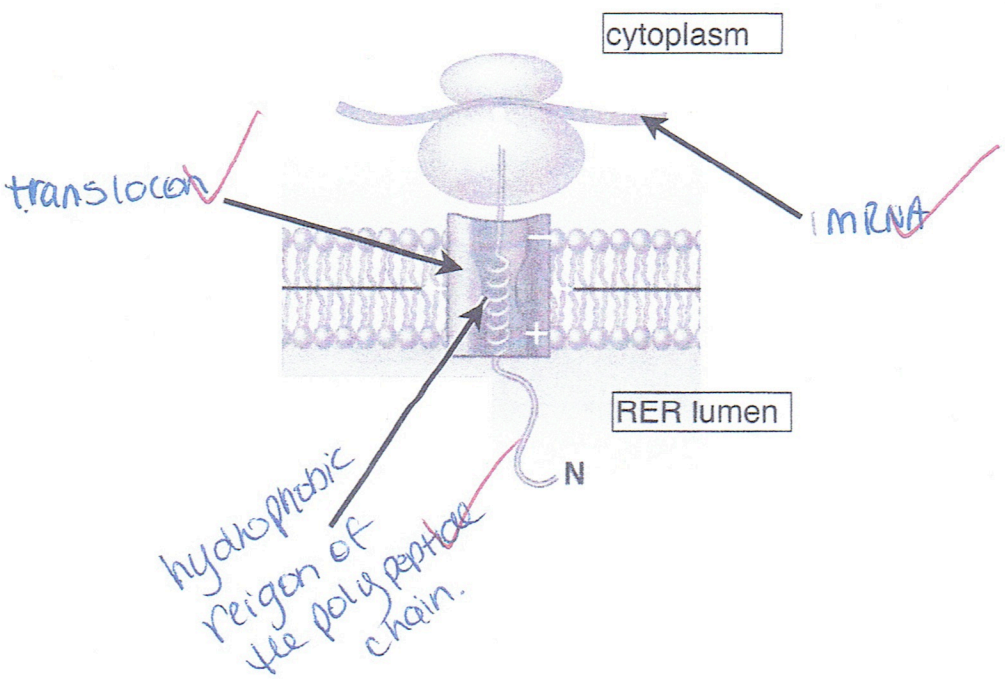
3

2) a. What does the figure below show? (**2 marks**)

It shows the co-translational import of an integral membrane protein

2

b. Name the structures indicated by the arrows. (**3 marks**)

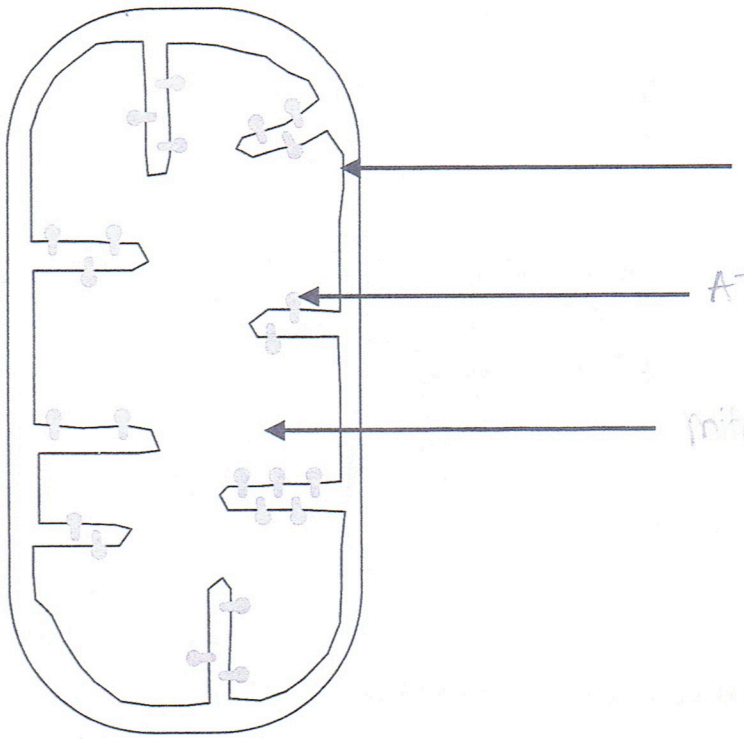



3



8

3) a. A schematic of a mitochondrion is shown below. Name the structures or areas pointed out by the arrows. (**3 marks**)



Inner mitochondrial membrane (cristae are the folds on this surface)

ATP-Synthase

Intermembrane space

3

b. Which compartment has the **lowest** pH. (**1 mark**)

~~Inter-~~ Inner mitochondrial ~~membrane~~ space

0



3

## Section C

Please record your answers to the questions below in the spaces provided. **You may use point form to provide answers to the questions.** Do **NOT** use ACRONYMS. Section C is worth a **total of 12 marks**.

**1) a)** List **four** mechanisms by which substances can cross a biological membrane. For each mechanisms give an example of a molecule that might be used by each. **(4 marks)**

- Passive diffusion: (non-mediated, passive) small, uncharged molecules such as $O_2$.
- Diffusion through a channel protein: (non-mediated, passive) ie Ion channel
  - ① Ligand gated
  - ② Mechano gated
  - ③ Voltage gated
  - molecules that are charged ie $Cl^-$
- Facilitated diffusion: (mediated, passive) utilizes a facilitated transporter to transport molecules such as glucose.
- Active diffusion: (mediated, active) utilizes an active transporter such as ATP synthase to transport molecules such as $H^+$.

4

**b)** Which of these require energy, and what form of energy is used? **(1 mark)**

The active transporter from active diffusion utilizes energy in the form of ATP.

1



5

integral membrane protein

2) Describe the steps required for co-translational import for CD1. **(5 marks)**

- transcription of CD1 begins on a free ribosome (cytoplasmic ribosome)
- A signal recognition particle attaches to the ribosome and pauses transcription.
- The signal recognition particle binds to the signal recognition particle receptor on the rough endoplasmic reticulum.
- The polypeptide chain is inserted into the translocon in the integral membrane protein
- Transcription continues until protein is completed and then a vesicle buds off the rough endoplasmic reticulum, not the pro
in order to transport CD1 to the golgi complex and eventually to the plasma membrane. mus comp afte

5

3) What is the role of CD1? **(2 marks)**

2

Is an integral membrane protein which displays lipid antigens in order to activate the immune system when a foreign substance has entered the cell.



7