

3. Information transfer is fundamental to all living organisms. For **two** of the following examples, explain in detail how the transfer of information is accomplished.
- a) The genetic material in one eukaryotic cell is copied and distributed to two identical daughter cells
  - b) A gene in a eukaryotic cell is transcribed and translated to produce a protein
  - c) The genetic material from one bacterial cell enters another via transformation, transduction, **or** conjugation
4. To survive, organisms must be capable of avoiding, and/or defending against, various types of environmental threats. Respond to **each** of the following.
- a) Describe how adaptive coloration, mimicry, **or** behavior function as animal defenses against predation. Include **two** examples in your answer.
  - b) Describe how bacteria **or** plants protect themselves against environmental threats. Include **two** examples in your answer.
  - c) Compare the human primary immune response with the secondary immune response to the same antigen.

END OF EXAMINATION

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<b>→ intestine → increases calcium absorption</b> <b>→ kidney → increases calcium reabsorption</b>
Normal range of calcium ions in blood: 10 mg/100 mL <ul style="list-style-type: none"> <li>• calcitonin inhibits osteoclasts from releasing calcium</li> <li>• vitamin D enables PTH to increase calcium ion uptake by the intestines</li> </ul>

**c) body temperatures in mammals**

**4 pts max**

<ul style="list-style-type: none"> <li>• <b>hypothalamus</b> (or the word “<b>brain</b>” without modifiers)</li> <li>• <b>peripheral/central thermoreceptors</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>neural activity → peripheral vascular tissue (capillaries, skin surface, extremities) → vasodilation/increases heat loss</b></li> <li>• <b>neural/hormonal activity → sweat glands → sweat production/evaporative cooling</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>neural activity → peripheral vascular tissue → vasoconstriction/reduces heat loss</b></li> <li>• <b>neural activity → skeletal muscle → shivering/generates heat</b>                <b>→ papillary muscles → piloerection/hair raising/increases insulation</b>                <b>→ skeletal muscle → muscle tone/generates heat</b></li> <li>• <b>neural activity → brown adipose tissue → increases metabolic activity/generates heat</b></li> </ul>
<p><b>When temperature of the body rises above the set point:</b></p> <ul style="list-style-type: none"> <li>• <i>evaporative</i> cooling (sweating, panting)</li> </ul> <p><b>When body temperature drops below the set point:</b></p> <ul style="list-style-type: none"> <li>• shunting</li> <li>• thyroxin increases metabolism (generates heat)</li> <li>• the blood is rewarmed by countercurrent exchange (heat conduction from the warm blood to returning blood is redirected to the internal parts of the body before reaching extremities)</li> <li>• electron transport is uncoupled in brown fat</li> </ul> <p><b>Behavioral responses must be physiologically related to the choice and the link clearly made</b>            Ex: neural activity → skeletal muscle → locomotion (e.g., seek warmth, seek shade)</p>

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## **Question 3 Scoring Guide**

- a) The genetic material in one eukaryotic cell is copied and distributed to two identical daughter cells. The maximum for part a is 6 points**

Part a is asking for “copy” and “distribute”, there is an **internal maximum of four points** for each.

### **a part 1 DNA Replication (max 4 points)**

- 1 – when DNA is copied – interphase, S phase of cell cycle
- 1 - recognition of origin site on DNA
- 1 - concept of unwinding enzyme
- 1 - RNA primer
- 1 - DNA polymerase – functional definition
- 1 - Concept of complementary relationship among bases – semiconservative
- 1 - Discontinuous/continuous or lagging /leading or Okazaki fragments (due to antiparallel backbones and 5' to 3' generation of new segments)
- 1 - DNA ligase – functional definition
- 1 - Other/Elaboration – telomere replication, proofing by DNA polymerase, expanded details

### **a part 2 Mitosis (max 4 points)**

- 1 - concept of chromatid pairs or ‘doubled chromosomes’
- 1 - prophase – condensation, spindle formation
- 1 - metaphase – alignment of chromosomes
- 1 - anaphase – separation of chromatids or equivalent statement
- 1 - telophase or origin of cytokinesis – nuclear membrane reforms, cell plate or cell furrow
- 1 - Other or Elaboration – cell cycle control, cell surface area/volume ratio and mitosis, MTOC(microtubule organizing center), centromere or kinetochore attachment

- b) The gene in a eukaryotic cell is transcribed and translated to produce a protein. There is a maximum of 6 points for this part.**

This part asks for transcription and translation, there is an **internal maximum of four points** each.

### **b part 1 Transcription (max 4 points)**

- 1 - Functional definition: DNA sequence to RNA sequence
- 1 - Promoter Recognition
- 1 - RNA polymerase – function
- 1 - Complementarity relationships (T to U)
- 1 - 5' to 3' – growth of new strand
- 1 - Start site/ Termination Sequences
- 1 - Introns/Exons – with general explanation
- 1 - Caps/ Tails – with general explanation
- 1 - Other or Elaboration: sense and antisense, transcription factors, spliceosomes, multiple RNA's, enhancers, conserved segments