CSEC Integrated Scier
Question 3
Exemplar 1

3. (a) A carpenter working outdoors decided to take a break. He left all his tools in the sun. When he returned, he picked up a nail and the hammer by its wooden handle to finish the job. He observed that the handle of the hammer was warm and the nail was hot.

(i) Suggest how heat energy is transferred.

Heat energy from the sun travels to the Earth ~~through~~ by radiation, this heat energy is absorbed by the hammer as well as the nail which were left exposed to the sunlight.

(2 marks)

(ii) Explain why the handle of the hammer and the nail had different temperatures.

The nail, being metal, is a much better conductor of heat than the wood which makes the ~~hammer~~ handle of the hammer.

(2 marks)

(iii) The carpenter automatically drops the hot nail as he picks it up. Explain how the nervous systems causes the carpenter to respond in this manner.

Upon picking up the hot nail, the nerve cells in the skin of the man's fingers picks up on the intense heat, sending a quick impulse to the ~~nerve brain~~ nervous system which initiating the "fight or flight" reflex as the hot nail is percieved as danger. ~~An~~ another impulse is the sent back to the muscles in the man's hand to drop the nail immediately to avoid damage to his body.

(4 marks)

(iv) Name the process by which the heat is transferred from the nail to the carpenter's hand.

conduction.

(1 mark)

(v) On very hot days the carpenter prefers to hold the nails with a glove made of thick cloth. How does the glove prevent his hand from being burnt by the nail?

The cloth acts as an insulator. Therefore the glove made of thick cloth absorbs the heat from the nail but does not pass it on to the man's hand. **(1 mark)**

(b) Figure 4 is an incomplete diagram showing the formation of a sea breeze.

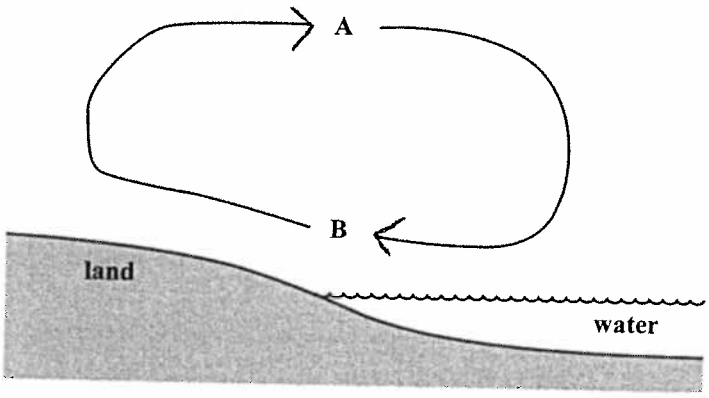

Figure 4. Diagrammatic representation of a sea breeze

(i) What is meant by convection as it relates to heat?

Convection is the process by which heat is transferred through water. **(1 mark)**

(ii) Indicate on Figure 4 the MOST likely direction of the airflow by placing arrows at A and B. **(1 mark)**

(iii) Explain why the air flows in the direction that you indicated on Figure 4.

The land heats up more rapidly than the water. As the land heats up, the hot air rises and cool air from over the water comes underneath the warm air to take its place. The hot air moves over the water where it cools and then travels down and again over the land to replace more ~~both~~ hot air which has risen, resulting in a cycle. **(3 marks)**

Total 15 marks

Integrated Science

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Comments

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Part (a) This candidate provided an excellent response to this part of the question; answers to (i), (ii), (iv) and (v) showed the candidate's use of scientific terms to adequately explain the concept of heat transfer; the answer to (iii) showed that the candidate knows what a reflex action is but lacked clarity of expression and therefore lost some marks in this part.

Part (b) This candidate provided an excellent response to this part of the question; the answer to (i) showed the candidate's understanding of heat transfer and answers to (ii) and (iii) showed the candidate's ability to use the knowledge and understanding of heat transfer to explain land and sea breezes.