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Family Name					
Given Name/s					
Student Number					
Teaching Period	Semester 2, 2017				

ENV206 – Environmental Physiology	DURATION	
	Reading Time:	10 minutes
	Writing Time:	180 minutes
INSTRUCTIONS TO CANDIDATES		
EXAM CONDITIONS		
<p><u>You may begin writing from the commencement of the examination session.</u> The reading time indicated above is provided as a guide only.</p>		
This is a CLOSED BOOK examination		
No calculators are permitted		
No handwritten notes are permitted		
No dictionaries are permitted		
ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED	
No additional printed material is permitted	1 x 20 Page Book 1 x 4-Multiple Choice Answer Sheet 1 x Scrap Paper	

**THIS EXAMINATION IS PRINTED
DOUBLE-SIDED.**

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Section A

Short Response Questions

Answer all 6 questions.

Total number of marks for this section: 90

This section should be answered in the Answer Booklet provided.

Marks for each question are the same.

Suggested time allocation for Section A: 90 minutes.

Question 1

You are observing a section of a plant root through a microscope to determine how a fungus is causing disease to the fine roots of a plant. The diagram on the next page shows what you see.

The transverse section through the root has been stained so that:

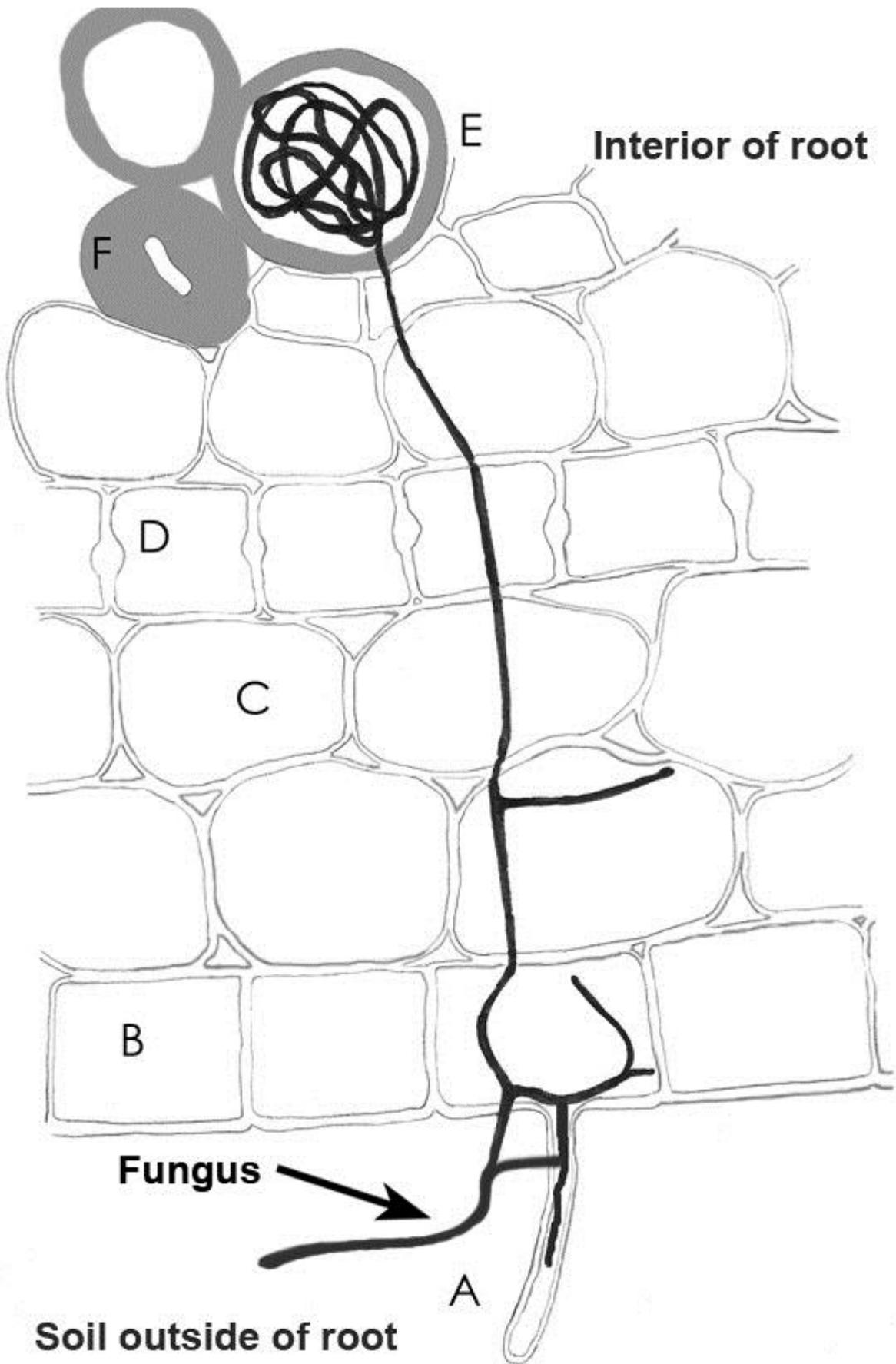
- the fungus is dark purple (black on the diagram on the next page and indicated by the arrow),
- lignin is red (but is shaded in grey on the diagram such as for cell F) and
- cellulose is green (cell walls are just outlined, such as the cell wall of the cell labelled C).

The fungus is growing into the outermost cells of the root (B), then into large cells with blue/green thin cell walls (C) and then through a ring of box like cells with thickened side walls (D) and on into the stele (E/F). The fungus is concentrating in a cell that is circular in cross section and has thick cell walls that are stained red (i.e. grey in the diagram) indicating that it is lignified (E).

SEE THE DIAGRAM ON THE NEXT PAGE

- What is the name and function of the structure marked A which is on the outer surface of the root specimen?
- What **tissue system** does cell B belong to?
- Has the cell marked C developed a secondary cell wall?
- By what two main pathways can nutrients pass from cell A to cell D? What is the difference between these two pathways?
- What is the function of the cell/ring of cells marked D in relation to nutrient uptake by the plant?
- What type of cell is cell E and what is its likely transport function?
- What type of cell is F? Would, or would it not, be able to undergo meristematic activity (undergo cell division) in response to damage to adjacent cells? Explain your answer.
- How is the fungus likely to be causing disease of the plant i.e. what process(es) is the fungus likely to be affecting?

(Marks: 15)



Question 2

Light harvesting in photosynthesis is accomplished by Photosystems I and II, discrete structural units embedded in the thylakoid membrane of the chloroplast.

Briefly describe how the two photosystems work together to convert light energy to chemical energy. Use a diagram to illustrate your answer if you wish.

(Marks: 15)

Question 3

Describe the light independent reactions of photosynthesis and then describe the biochemical and structural differences between C3 and C4 plants.

Why do C4 plants have an advantage under hot conditions with respect to (a) the functioning of Rubisco and (b) water use efficiency?

(Marks: 15)

Question 4

Explain why active transport is so important in the movement of phosphate ions to the root?

Explain briefly how mycorrhizae and phosphatases aid uptake of phosphorus from the soil.

Briefly, why is phosphate uptake by plants more problematic than nitrate uptake in a clay soil?

If phosphate ions are being concentrated inside the cells of the root, explain in detail how the phosphate is moving through the cell membrane.

(Marks: 15)

Question 5

What are the lateral meristems that are present in the stem of a woody plant? Name the tissues produced by those lateral meristems.

What are the functions of each of the tissues produced by the lateral meristems?

What are the main cell types involved in the vertical and lateral movement of materials in the stem of a woody plant? What is their transport role?

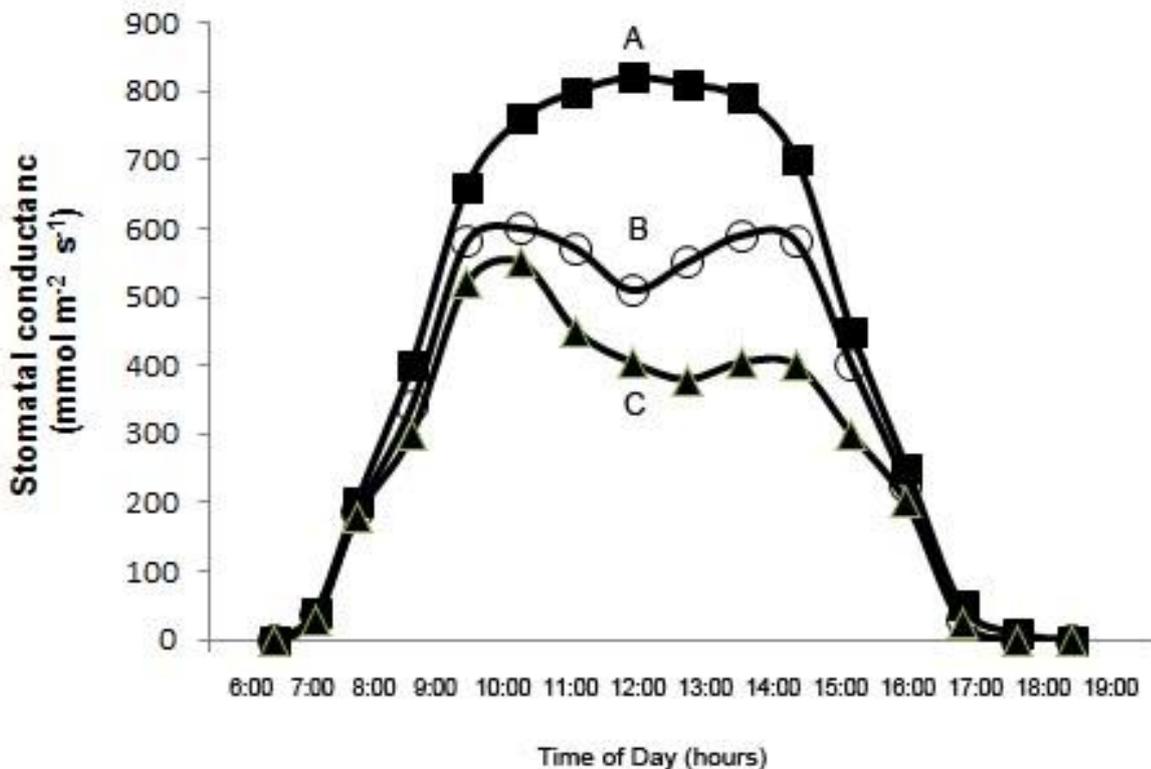
(Marks: 15)

Question 6

Describe how stomata open and close in response to changes in internal leaf carbon dioxide concentration, light intensity, leaf water stress and root water stress.

Stomatal conductance (gs) varies seasonally; briefly describe the differences in gs between the wet and dry seasons of monsoonal North Australia.

The graph below shows the diurnal trend of stomatal conductance under three different soil and vapour pressure deficit (VPD) conditions. Which line best represents gs in a plant experiencing a high VPD and growing in dry soil close to wilting point?



(Marks: 15)

Section B

Multiple Choice Questions

Total number of marks for this section: 90

This section should be answered on the Multiple Choice Answer Sheet provided.
Please ensure that your **name** and **student number** have been written
on the Multiple Choice Answer Sheet and placed in the answer booklet.

Marks for each question are the same.
Suggested time allocation for Section B: 90 minutes.

Question 1

The mechanisms of energy exchange:

- (a) are solar radiation, thermal radiation, reflected radiation, and heat.
- (b) are radiation, convection, conduction and evaporation.
- (c) are radiation, wind, evaporation, and condensation.
- (d) are unlimited.

(Marks: 3)

Question 2

Relative humidity:

- (a) is a useless measurement unless the corresponding heat transfer coefficient is known.
- (b) is a useless measurement unless the corresponding air temperature is known.
- (c) is a useless measurement unless the corresponding absolute humidity is known.
- (d) is a measure of the density of water vapour in air, expressed as grams water per Litre of air.

(Marks: 3)

Question 3

Organismal properties affecting energy exchange include:

- (a) size and shape, latent heat of vaporisation, conductance, and convection.
- (b) absorptivity, metabolic rate, conductance, and water loss.
- (c) radiation, convection, conduction, and evaporation.
- (d) direct solar, indirect solar, reflected radiation, and thermal radiation.

(Marks: 3)

Question 4

Some animals are more tightly coupled to the radiant environment, and others are more closely coupled to the convective environment, and this is primarily dependent on:

- (a) body size of the animal.
- (b) whether they are endotherms or ectotherms.
- (c) the emissivity of the animal.
- (d) metabolic rate.

(Marks: 3)

Question 5

Energy from solar radiation consists of:

- (a) 45% from the visible spectrum.
- (b) 10% from the ultraviolet spectrum.
- (c) 45% from the near infrared spectrum.
- (d) all of the above.

(Marks: 3)

Question 6

Convective heat transfer is influenced by:

- (a) the boundary layer only.
- (b) the boundary layer, wind speed, and shape of the object.
- (c) the boundary layer, wind speed, and the Stefan Boltzmann Law.
- (d) none of the above.

(Marks: 3)

Question 7

A pyranometer:

- (a) uses the Stephen-Boltzman relationship to calculate a surface temperature.
- (b) measures infrared thermal radiation.
- (c) measures total solar radiation (direct solar radiation + indirect solar).
- (d) all of the above.

(Marks: 3)

Question 8

Lactic acid, produced as a result of anaerobic respiration, is found:

- (a) in the working muscle, in the liver, and in the blood.
- (b) in the working muscle only.
- (c) in the blood only.
- (d) none of the above are correct.

(Marks: 3)

Question 9

The eggs of megapode birds:

- (a) have unusually low metabolic rates for their size.
- (b) have unusually long incubation periods.
- (c) can change the egg shell conductance by increasing the number of pores in the shell during incubation.
- (d) all of the above are correct.

(Marks: 3)

Question 10

The use of operative temperatures in the study of Galapagos Land Iguanas:

- (a) could have been achieved by either solving an energy balance equation or by building physical models with the characteristics of the animals.
- (b) demonstrated that their ability to escape from predators was related to their body temperature.
- (c) demonstrated that the animals behaviourally selected different body temperatures in different seasons.
- (d) all of the above.

(Marks: 3)

Question 11

Indirect calorimetry:

- (a) is a method for measuring metabolic rates of animals, but it is seldom used because of the associated technical difficulties.
- (b) involves measuring the amount of heat produced by an animal over a period.
- (c) involves measuring the oxygen consumed, and the carbon dioxide produced, by an animal.
- (d) none of the above is correct.

(Marks: 3)

Question 12

The rate of diffusion across a respiratory membrane is dependent on:

- (a) the size of the partial pressure gradient, the surface area of the exchange surface, and the thickness of the exchange surface.
- (b) the density of mitochondria.
- (c) whether the animal is an endotherm or an ectotherm.
- (d) none of the above is correct.

(Marks: 3)

Question 13

Reptile eggs:

- (a) like bird eggs, typically lose 15% of their initial mass before hatching.
- (b) can be either parchment shelled or pliable shelled, but rigid shelled eggs are only found in birds.
- (c) can double their mass during incubation if they have parchment shells.
- (d) are all ectohydric.

(Marks: 3)

Question 14

The Bohr effect:

- (a) effectively **lowers** oxygen affinity.
- (b) facilitates the unloading of oxygen at the tissue.
- (c) both of the above.
- (d) none of the above.

(Marks: 3)

Question 15

Green tree frogs:

- (a) have no resistance to evaporative water loss.
- (b) have some resistance to evaporative water loss.
- (c) have about the same amount of resistance to evaporative water loss as a lizard.
- (d) have a boundary layer resistance to evaporative water loss, but no cutaneous resistance to evaporative water loss.

(Marks: 3)

Question 16

The movement of gas across the gas exchange surface of a lung or gill is always by:

- (a) simple passive diffusion.
- (b) active diffusion.
- (c) convection.
- (d) active transport.

(Marks: 3)

Question 17

During a dive, turtles:

- (a) use oxygen from the air stored in their lungs.
- (b) have a reduced Bohr effect.
- (c) both a and b above.
- (d) use their swim bladders extensively.

(Marks: 3)

Question 18

Nutrients can be transported across an epithelium by:

- (a) having a high convection coefficient.
- (b) both active and passive transport.
- (c) capacitance.
- (d) the Krebs cycle.

(Marks: 3)

Question 19

The following relates to the metabolic cost of flight in birds. Which statement is **FALSE**?

- (a) The ability to sustain high levels of aerobic metabolism is well developed.
- (b) Anaerobic metabolism is a main contributor to providing energy.
- (c) If birds depended on anaerobic metabolism for flight, they would become exhausted quickly.
- (d) More energy is used at faster and slower speeds than is used at intermediate flight speeds.

(Marks: 3)

Question 20

Counter-current exchange:

- (a) is always associated with heat exchange.
- (b) is an adaptation that can maximize either oxygen extraction or heat exchange.
- (c) is only found in kidney tubules.
- (d) is never found in kidney tubules.

(Marks: 3)

Question 21

Euryhaline best describes an aquatic animal that:

- (a) tolerates a wide variation in salt concentrations.
- (b) lives in fresh water environments only.
- (c) lives on salt flats.
- (d) has a limited tolerance to variation in salt concentrations.

(Marks: 3)

Question 22

Which statement is **FALSE**? Camels are able to go long periods without water because they:

- (a) tolerate high levels of dehydration.
- (b) conserve water by decreasing body temperature during the day.
- (c) allow body temperature to fluctuate.
- (d) use fluids from interstitial spaces.

(Marks: 3)

Question 23

Which statement is **FALSE**? In a counter-current gas exchange system where the blood vessel is in contact with the respiratory medium:

- (a) the tension gradient is maintained along the length of the exchange surface.
- (b) the oxygen content of the leaving medium is lower than the leaving blood.
- (c) the oxygen content of the leaving blood is the same as the leaving medium.
- (d) the initial rate of diffusion of the gradient is small.

(Marks: 3)

Question 24

The air-breathing diving mammals that can dive for the longest periods do not store oxygen in lungs. Instead, they:

- (a) use tissue stores of oxygen.
- (b) have a high hematocrit.
- (c) use tissue with a high content of myoglobin.
- (d) all of the above.

(Marks: 3)

Question 25

Considering the net cost of transport for the different modes of locomotion:

- (a) flying is the least expensive.
- (b) swimming is intermediate compared to running and flying.
- (c) running is more expensive than flying.
- (d) flying is less expensive than swimming.

(Marks: 3)

Question 26

Which statement is **FALSE**? During exercise training, VO_2 maximum (the maximum ability to consume oxygen) will increase due to an:

- (a) increase in the Bohr effect.
- (b) increase in the density of blood cells in the circulatory system.
- (c) increase in the density of mitochondria in skeletal muscle.
- (d) increase in the density of capillaries in the muscle.

(Marks: 3)

Question 27

In a deep-sea fish, the gas pressure in the swim bladder is maintained at the secretory and reabsorptive ends. At the secretory end the gas gland produces lactic acid in the blood that results in:

- (a) gas leaving the swim bladder.
- (b) a salting out effect.
- (c) the Root effect.
- (d) both b and c.

(Marks: 3)

Question 28

Metabolic water results from:

- (a) the oxidation of organic materials.
- (b) the chemical breakdown of food with high water content, such as fresh grass.
- (c) the chemical breakdown of food with very low water content, such as dry seeds.
- (d) all of the above.

(Marks: 3)

Question 29

Metabolic rate:

- (a) is a biochemical process unrelated to biophysical ecology.
- (b) is an important part of the thermal energy balance for birds and mammals.
- (c) is an important part of the thermal energy balance for all animals.
- (d) is never an important part of the thermal energy balance of animals.

(Marks: 3)

Question 30

Comparing the pathway for oxygen in reptiles and mammals:

- (a) The lungs of reptiles only have about 50% of the surface area of a similarly sized mammal.
- (b) The lungs of reptiles only have about 1% of the surface area of a similarly sized mammal.
- (c) The mitochondrial membrane surface areas of the two groups are similar.
- (d) The mitochondrial membrane surface area of a reptile is 1% of that of a mammal.

(Marks: 3)