MARKING KEY

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SECTION ONE—MULTIPLE CHOICE *[40 marks]*

Questions 1–20

1 B	11 B
2 C	12 A
3 D	13 C
4 B	14 D
5 D	15 D
6 A	16 A
7 D	17 B
8 A	18 A
9 C	19 D
10 D	20 C

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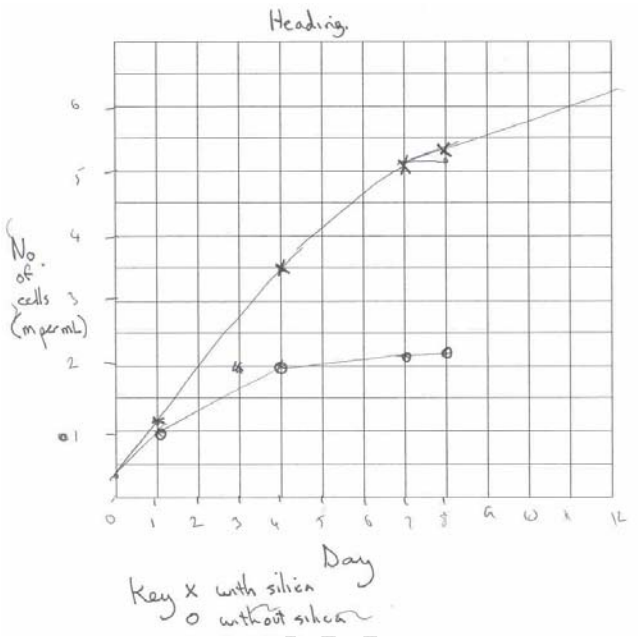
SECTION TWO—SHORT ANSWERS *[120 marks]*
Questions 1–6

Question 1 **[20 marks]**

(a) Graph all these data on the single grid provided.



Description	Marks
Correct choice of graph—line graph	1
Appropriate labels, scale and units on axes	1
Key given	1
Accuracy of plotting points	1
Heading: concise, explanatory title identifying each set of data.	1

(b) For this investigation give the following:

(i) A hypothesis this investigation may be testing.

Description	Marks
States hypothesis—Silica will increase the growth rate of *Chaetoceros sp.* or similar.	2

(ii) The dependent variable

Description	Marks
States the dependent variable—growth rate millions per mL.	1

(iii) The independent variable

Description	Marks
States the independent variable—presence or absence of silica.	1

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(c) Name four variables that would have to be controlled for the investigation to be reliable.

Description	Marks
States any four controlled variables such as: • same environmental conditions e.g. O_2, CO_2, pH, temperature • light intensity • container the same shape or size • same source of alga • time of day of sampling • method of cell counting.	4
States 1 to 3 controlled variables.	1-3

(d) Write a conclusion from these data on growth of Chaetoceros.

Description	Marks
States a relationship between the growth in silica and no silica such as: • absence of silica from the culture medium for *Chaetoceros* results in depressed growth or • *chaetoceros* grows better with silica in the culture medium than without silica. or similar	2

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Question 2 **[20 marks]**

Diagrams showing a human sperm cell and a human ovum.

(a) (i) Write the name of the structure that would contain the cells' DNA.

Description	Marks
The nucleus.	1

(ii) Name the type of cell division which gives rise to sperm cells.

Description	Marks
Meiosis (reduction division).	1

(iii) Sperm cells are haploid. What does this mean?

Description	Marks
Contain half the normal chromosome number of a body (somatic) cell.	1

(b) (i) Sperm cells have many mitochondria. What does this suggest about the special needs of sperm cells?

Description	Marks
Energy need/requirement.	1

(ii) Name **two** inputs and **two** outputs of sperm cell mitochondria.

Description	Marks
Inputs: oxygen, glucose, ADP, P: any two.	2
Outputs: carbon dioxide, water, energy (ATP), metabolic waste: any two.	2

(iii) The seminal fluid which transports the sperm cells contains large amounts of a simple sugar called fructose. What is the likely function of this simple sugar?

Description	Marks
Energy source for respiration.	1

A student examined four cell types from four different living organisms using an electron microscope. She placed a mark in the table below when she was certain a cell component (organelle) was present, otherwise she left the space blank.

	CELL TYPE			
CELL COMPONENT	I	II	III	IV
nucleus	+		+	+
nucleolus			+	+
cell wall		+		
cell membrane	+		+	+
cytoplasm	+	+	+	+
vacuole				+
chloroplast		+		
mitochondrion		+	+	

(c) From these observations the student made the following conclusions. Indicate whether, on the basis of the data in the table, you believe her conclusions are true or false. Give reasons for your decision in each case.

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(i) Cells II and III must be from animals.

Description	Marks
False.	1
Cell II has chloroplast and cell wall which are plant features.	1

(ii) Cells I and IV require no energy.

Description	Marks
False.	1
All living cells require energy.	1

(d) Two of the cell components (organelles) in the table shown earlier are able to produce ATP in respiration.

(i) Name the **two** cell components (organelles) and indicate whether they use aerobic or anaerobic respiration.

Description	Marks
Mitochondria: aerobic respiration.	2
Cytoplasm: anaerobic respiration.	2

(ii) Write the word equation for the reaction occurring in aerobic respiration.

Description	Marks
Glucose + oxygen ---------- carbon dioxide + water + energy.	1

(e) From the structure of the cells shown in the diagrams at the beginning of this question and the information you have been given, give two reasons why sperm cells have a higher surface area to volume ratio than ova.

Description	Marks
Long thin shape of sperm cell: less volume than spherical ova.	1
Sperm are motile so need more fructose from surroundings OR Higher SA:Vol increases rate of diffusion of fructose into sperm cell.	1

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Question 3 **[24 marks]**

(a) Using symbols of your own choosing and evidence from the pedigree, explain clearly the mechanism of inheritance of the heart disease.

Description	Marks
Autosomal dominant.	1
Symbols e.g. A = disease/affected, a = healthy/normal.	1
Evidence: II7 x II8 (both affected) produce III5 (unaffected offspring).	1
Reference to cross disproving sex-linkage e.g. I1 or II8 produce unaffected offspring.	1

(b) Indicate the likely genotype(s) of the following four individuals.

Description	Marks
I 2: aa (homozygous recessive).	1
II 7: Aa (heterozygous).	1
III 4: aa (homozygous recessive).	1
III 8: Aa or AA. (heterozygous or homozygous dominant).	1

(c) The farmer plans to cross II 4 and III 2.

(i) What is the probability that their first offspring will have the disease? Show your working.

Description	Marks
Probability 50%	1
Parents: Aa x aa Gametes: ½A + ½a ½a + ½a	1
F1 generation: A a a Aa Aa a Aa Aa	1
F1 genotype: ½Aa + ½aa [F1 phenotype: ½ disease + ½aa normal]	1

(ii) What is the probability that their second offspring will be a normal male? Show your working.

Description	Marks
25%	1
50% chance of being male	1
50% chance of normal trait	1
½ x 50% = 25%	1

(d) Define the following terms **[4 marks]**

(i) Alleles.

Description	Marks
The different forms or variants of a certain gene	1

(ii) Homozygous.

Description	Marks
A pair of alleles of a certain gene are the same for the genotype of a particular organism	1

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(iii) Heterozygous

Description	Marks
A pair of alleles of a certain gene are different in the genotype of a particular organism	1

(iv) Autosomal chromosomes (autosomes)

Description	Marks
Pairs of chromosomes which are not the sex chromosomes	1

(e) The farmer wishes to know whether individual III 6 is homozygous or heterozygous. How could this be determined? Show your working.

Description	Marks
Test cross with double recessive: III6 x aa.	1
If III6 is AA expect all offspring to be heterozygous (Aa).	1
If III6 is Aa expect ratio as in (c): ½Aa + ½aa.	1
Several lambs (progeny) would be needed.	1

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Question 4 **[16 marks]**

(This question is common to the stage three sample examination Q16.)

(a) (i) Name two possible sources of excess nutrients in the Peel Inlet.

Description	Marks
Fertilisers from agricultural and domestic sources.	1
Sewage from domestic leach tanks.	1

(ii) Name two possible causes of water turbidity in the Peel Inlet.

Description	Marks
Boating activity.	1
Strong winds.	1

(b) (i) Briefly explain two ways the turbidity could affect the population of macro algae.

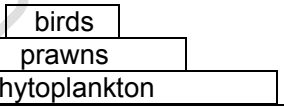
Description	Marks
Reduced light reaching plants reduces photosynthesis.	1
Oxygen levels reduced.	1

(ii) Explain briefly how the turbidity would affect the populations of commercially important species such as larger fish, crabs and prawns.

Description	Marks
Producers are food for the consumers and therefore support the food web.	1
Number of producers reduced will also reduce consumer populations.	1

(c) (i) Draw a biomass pyramid for the following food chain.

Phytoplankton → prawns → waterbirds

Description	Marks
Drawing 	1
Labelling	1

(ii) Briefly explain the shape of the food pyramid you have drawn in terms of energy flow and dissipation.

Description	Marks
Energy flow reduced when transferred to next level (next organism in the food chain).	1
Energy is 'lost' as heat which dissipates at each level.	1

(iii) Give **two** reasons why spraying insecticide is bad for the ecosystem. Briefly explain your answers.

Description	Marks
Non-specific: affects all insects including those that are beneficial.	1
Affects the food web: insects.	1

(iv) Suggest two methods, besides spraying, which could help reduce the mosquito population.

Description	Marks
Release sterile mosquitoes into the population.	1
Increase natural predators/introduce disease or predator.	1

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Question 5 **[20 marks]**

Cells use a range of structures and processes to regulate their metabolism and to interact with the environment.

(a) Give two reasons why organisms need each of the following.

(i) DNA

Description	Marks
Protein synthesis.	1
Store/transfer genetic material.	1

(ii) Nutrients

Description	Marks
Provide materials for growth.	1
Provide energy for living/metabolic processes.	1

(b) Briefly describe, or present a clearly labelled diagram, to illustrate the process of osmosis.

Description	Marks
Net movement of water across a semi-permeable membrane.	1
Movement (of water) from a solution of lower concentration to one of higher.	1
Larger molecules unable to pass through semi-permeable membrane.	1

(c) (i) Define photosynthesis.

Description	Marks
Process by which organic compounds/sugars/carbohydrates are produced.	1
Produced from inorganic compounds using solar/light energy.	1

(ii) What are the raw materials required for photosynthesis?

Description	Marks
Water.	1
Carbon dioxide.	1

(iii) What are the products of photosynthesis?

Description	Marks
Sugars/carbohydrates/glucose/starch.	1
Oxygen.	1

(vi) Name the cellular structures (organelles) essential for photosynthesis and explain their role in the process of photosynthesis?

Description	Marks
Chloroplasts.	1
Capture/trap light energy.	1
Using chlorophyll.	1

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(v) Specialised structures are present in typical leaf tissue to aid the process of photosynthesis. Name these structures and briefly explain their role.

Description	Marks
Stomata/guard cells.	1
Controlled opening that allows carbon dioxide to enter the plant from the air.	1

(d) (i) Suggest one way in which the processes of diffusion and osmosis are similar.

Description	Marks
No energy is required as substances move along a concentration gradient.	1

(ii) Suggest one way in which the processes of diffusion and osmosis are different.

Description	Marks
Osmosis is the net movement of WATER against a concentration gradient.	1

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Question 6 **[20 marks]**

(a) Biological classification is based upon a hierarchical system of grouping organisms.

(i) Briefly describe three key features of this particular system.

Description	Marks
Based on grouping organisms with similar structural features.	1
Gross to specific: kingdom/phylum to species.	1
Each species has two names (binominal nomenclature) in latin or greek.	1

(ii) In classifying plants, classification is mainly based upon the presence of cellular features such as:

Description	Marks
Presence of a cellulose cell wall.	1
Presence of chloroplasts.	1
Large vacuole.	1

(iii) List three reasons why it is important to classify organisms?

Description	Marks
Aids identification of organisms by separating into groups with common features.	1
Aids relationship studies between organisms both living and extinct.	1
Establish and name organisms as separate species.	1

(b)

[From: Board of Studies New South Wales, 1998]

(i) Using the key provided, identify the order to which the organism, pictured below, belongs. Make sure you list the numbers, including the letters, of all the steps of the key that you used.

Description	Marks
1a – 2b – 4b – Thysanura (silverfish).	4

(ii) Is the organism shown below an insect?

Description	Marks
No.	1

(iii) Describe two features that justify your decision.

Description	Marks
Two distinct body parts whereas insects have three distinct body parts.	1
Eight legs present whereas insects have six legs.	1

(c) (i) Define the term species.

Description	Marks
Similar group of organisms with many/most characteristics in common.	1
Have the ability to reproduce fertile offspring.	1

(ii) A donkey can mate with a zebra to produce a hybrid animal known as a zonkey. Would a zonkey have a scientific name? Explain your answer.

Description	Marks
No.	1
Cannot produce fertile offspring so not recognised as a separate species.	1

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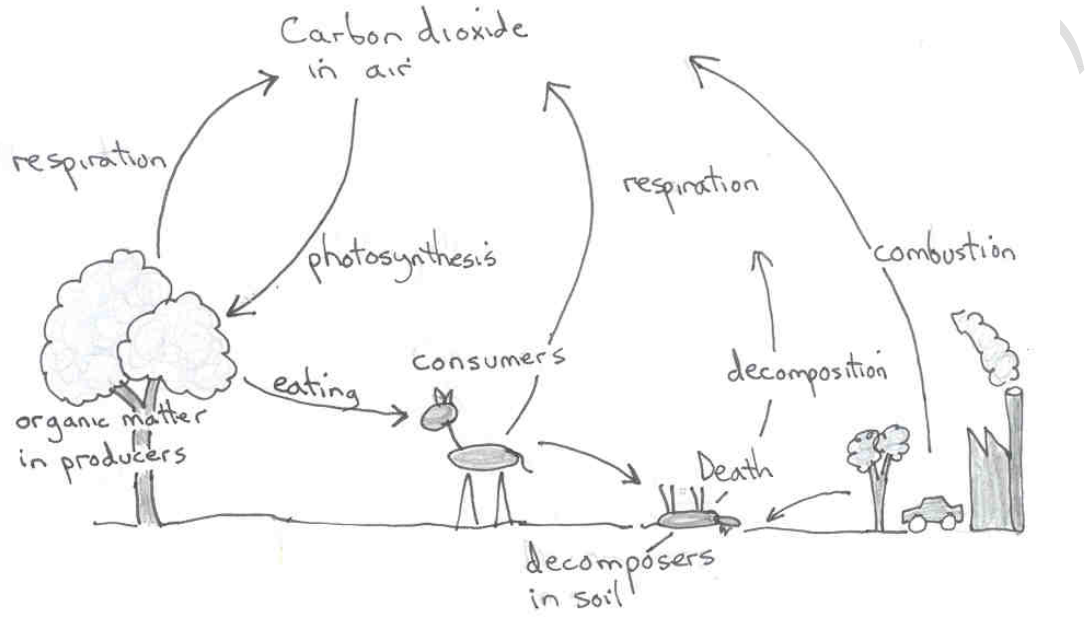
SECTION THREE—EXTENDED ANSWERS *[40 marks]*

Question 7

(a) Explain, with the aid of a large and clearly labelled diagram, exactly how carbon dioxide from the air enters the living component of an ecosystem. Your explanation, supported by a labeled diagram, should show how and why carbon dioxide is used by plants and ways by which carbon dioxide might eventually return to the non-living environment.



Description	Marks
Diagram clear and well labelled.	1
Arrows indicating correct direction of carbon dioxide through cycle.	1
Carbon dioxide enters green plant by diffusion via stomata when open.	1
Used to produce sugar/carbohydrates during photosynthesis (equation not required).	1
Energy stored in carbon-containing organic/carbohydrate molecules.	1
Plants/carbohydrates consumed directly by herbivores/1^{o} consumers to obtain energy.	1
Plants/carbohydrates consumed indirectly by carnivores/2^{o} consumers to obtain energy.	1
CO_2 as waste product of cellular respiration, in both plants and animals, returns to air.	1
Combustion: CO_2 also returns to air as product of pollution/burning of fossil fuel.	1
Decomposers return carbon from the remains of dead plants and animals.	1

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(b) Adaptations for survival can be considered as structural, physiological or behavioural. Clearly distinguish the difference between the three types of adaptation and describe, using named examples, how each type of adaptation might help an organism survive in a terrestrial habitat.

Differences

Description	Marks
Structural: physical features, or altered (adapted) parts of the body, that aid survival.	1
Physiological: a (internal) function of the organism's body that is adapted to aid survival.	1
Behavioural: actions performed by an organism that aid survival.	1

Examples for survival in a terrestrial environment

Structural

		Marks
Any suitable named example	Any related structural adaptation	2
e.g. Penquins	Blubber/double layer feathers for warmth	
e.g. Numbat	Tongue designed to collect termites	
e.g. Mulga tree	Shaped to catch rain/extensive shallow root system	

Physiological

		Marks
Any suitable named example	Any related structural adaptation	2
e.g. Penquins	Countercurrent heat exchange of blood to warm feet.	
e.g. Quokkas	Survive long periods without water to drink.	
e.g. Creosote bush	Roots produce toxins to prevent other plants growing.	

Behavioural

		Marks
Any suitable named example	Any related structural adaptation	2
e.g. Desert hopping mouse	Burrowing/nocturnal to avoid heat/predators	
e.g. Penquins	Huddle in groups for warmth	
e.g. Mulga tree	Reduced number of stomata to preserve water.	

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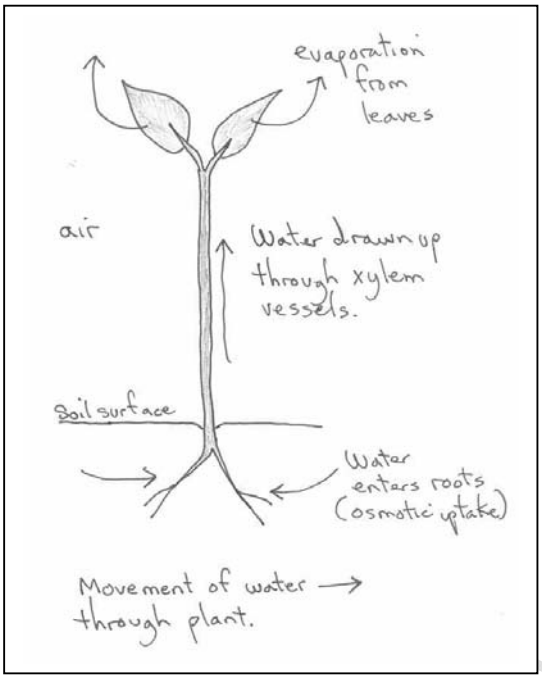
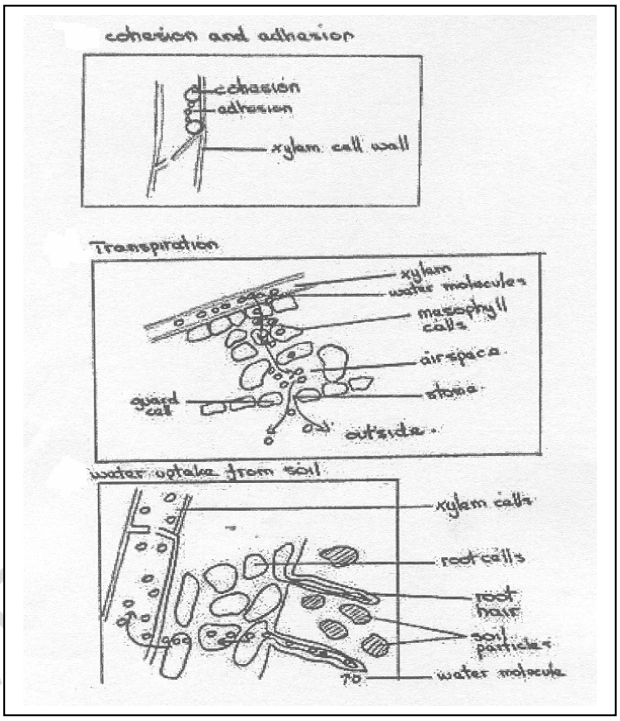
Question 8

(a) Transpiration can be considered as a necessary evil for plants.

Using clearly labelled diagram(s) to support your answer summarise the process of transpiration and discuss why transpiration can be seen as an advantage and a disadvantage for plants.





Description	Marks
Labelled diagram(s) similar to above that support summary points below.	2
Transpiration: loss of water from the leaves causing movement of water from the roots.	1
Process begins with evaporation mainly through stomata in leaves (due to a water potential difference between the atmosphere and the soil).	1
Water drawn up xylem vessels: continuous/unbroken column of water (due to cohesion between water molecules and adhesion between water and xylem vessel walls).	1
Water uptake: from soil into root hair cells by osmosis.	1
Advantages: water supply for photosynthesis. transport minerals to leaves. no energy expended by plant (passive process).	2
Disadvantages: water loss/wilting/dehydration. restricts distribution of plants.	2

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For copyright reasons this text cannot be reproduced in the online version of this document but may be viewed at http://www.nrw.qld.gov.au/factsheets/pdf/pest/pa21.pdf (p.1, adaptation)

[From: Land Protection, 2006]

Suggest steps that should have been taken before the cane toad was first introduced to prevent it from becoming a pest and discuss the kinds of biological controls that might be used to control the cane toad population in the future.

Description	Marks
Research species in country of origin.	1
Ensure specific to target organism (pest).	1
Lengthy quarantine/isolation to study all aspects (complete life cycle, behaviour, etc.).	1
Not poisonous/detrimental to native species (unlikely to introduce exotic disease).	1
Not compete with native species for food/habitat/breeding grounds.	1
Predator to kill and eat pest in preference to other prey.	1
Parasite to weaken, kill or sterilise pest.	1
Disease that targets pest.	1
Competitor that reduces pest resources such as food, habitat and breeding grounds.	1
Sterilize males (expense factor may be commented on).	1

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ACKNOWLEDGEMENTS

SECTION TWO

Question 6(b) Adapted from: Board of Studies New South Wales. (1998). *1998 Biology 2 Unit: Higher School Certificate Examination* (pp. 22–23, q. 35(f)). Retrieved August, 2007, from http://www.boardofstudies.nsw.edu.au/hsc_exams/hsc2000exams/hsc00_biology/98BIOLGY.PDF.

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SECTION THREE

Question 8(b) Adapted from: Land Protection. (2006). *Cane toad: Bufo marinus* (p. 1). Retrieved August, 2007, from Department of Natural Resources and Water website: http://www.nrw.qld.gov.au/factsheets/pdf/pest/pa21.pdf.

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Biology
Sample external written examination
Stage 2
Mapping questions to content

Course content	*Ecosystems: biodiversity and sustainability*	*Continuty of species*	**The functioning organism**	Working as a Biologist
Section one-multiple choice				
Question				
1	√			
2				√
3				√
4			√	
5			√	
6			√	
7		√		
8		√		
9		√		
10			√	
11	√			
12			√	
13	√			
14			√	
15			√	
16	√			
17	√			
18		√		
19				√
20				√
Section two- short answers				
21				√
22		√	√	
23		√		
24	√			
25			√	
26	√			
Section three-extended answers				
27	√		√	
28	√		√	

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