T A S M A N I A N

S E C O N D A R Y

A S S E S S M E N T

B O A R D

BY826

Biology

2001 External Examination Report

General Comments

The examination paper was very well received by candidates and teachers of the subject. It was seen as very fair and suitably straight forward, which gave all the candidates a chance to show what they knew in all the questions. The content and range of questions covered the syllabus very well and there were sufficient open-ended questions to allow candidates to extend themselves in most sections. The style of the questions also addressed the main concepts well.

Criticisms of the paper were relatively few. There were a few minor wording errors that slipped past the review process. These errors did not appear to confuse candidates but extra care was taken in the marking process to see that candidates were not disadvantaged. Generally these were not seen as making any real difference to the candidates. In some cases more careful wording and mark allocation would have made the questions clearer and better discriminators. It was noted that there was not as much coverage of plants.

Once again section B proved to be the most difficult, probably due to the greater level of application of understanding needed and this was reflected in the cut-offs. Section C produced quite high marks, this was in a large part due to the very straight forward nature of Q13 where many candidates received close to full marks.

Written examination

The following section specifically comments on candidate's performance in the exam. Marking examiners offer suggested answers to each question followed by specific comments on aspects such as how the question was assessed, where candidates gained and lost marks and where candidates misinterpreted questions. Comments on the open-ended questions may necessarily be limited to general comments rather than a suggested answer.

The suggested answers are by no means prescriptive and a number of them go into greater detail than would be required to gain full marks. Candidates providing different but valid answers were rewarded accordingly.

Section A Criterion 3

Question 1

(a)
B	Golgi Body or Golgi Apparatus	
C	Cell or Plasma Membrane	
D	Centriole (or Centrosome)	
E	(Contractile) Vacuole	(½ mark each – 2 marks total)

(b) 300 micrometres (2 marks) (1 mark given for 0.3 mm)

(c) (i) Mitochondrion (1 mark)
1 mark for either of – production of ATP
– site of aerobic respiration
– site of Krebs Cycle
½ mark for – site of cell energy production or similar

(ii) Any two of the following: – Cell Wall,
– Chloroplasts
– Large Vacuole (½ mark each – 1 mark total)

Examiner's comments

Question 1 was generally very well answered with the majority of candidates receiving between 5 and 7 marks and virtually none getting 2 or less. The only marks that were lost were due to the candidates inability to convert millimetres to micrometres in (b) and an inadequate description of the function of the mitochondria in (c).

Question 2

(i) Z (½ mark)
Reason must include the reference to the following points and relate these to the table to get the full 1½ marks.
– Most (99%) DNA (genetic material) is in the nucleus.
– Mitochondria also contain DNA (1%) for replication.
– No DNA found in the remainder of the cell.

(ii) Y (½ mark)
Reason must include the reference to the following points and relate these to the table to get the full 1½ marks.
– Most RNA is ribosomal (60%). Ribosomes attached to rough ER.
– RNA present in the nucleus (12%) as mRNA manufactured in the nucleolus.
– tRNA in the remainder of the cell (24%).

Up to 1 mark was given for Y being protein and therefore X being RNA if it was argued that proteins are made at the ribosomes and transported throughout the ER, making proteins (Y) the highest concentration in ER and ribosomes.

Examiner's Comments

The majority of candidates who attempted question 2 correctly identified DNA and RNA. Marks were often lost for failing to relate the characteristics of DNA and RNA to the table and only explaining one aspect of the figures in their reasons, for example saying DNA is found almost entirely in the nucleus without mentioning 1 percent in the mitochondria or its absence in the remainder of the cell.

A number of candidates did give X as their answer in Part (ii), but credit was only given if it was accompanied by an explanation similar to that given above.

Question 3

(a) Organism A, (½ mark) because of the elongated shape the dye will diffuse (or move in) quicker due to an increase in surface area to volume ratio. (½ mark) Spherical shape has the least SA:Vol ratio. (1 mark)

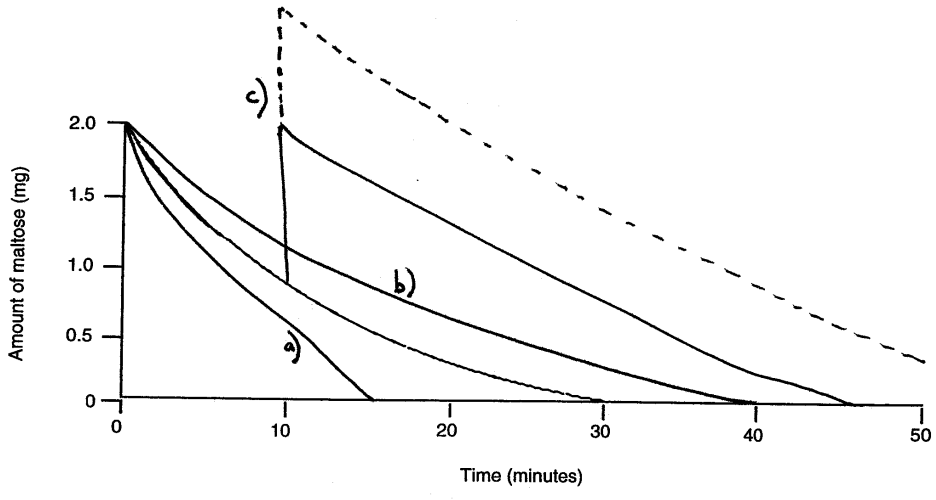
(b) Organism B, (½ mark) because of being smaller in size the dye will diffuse (or move in) (½ mark) quicker due to an increase in the surface area to volume ratio. (1 mark)

(c) Organism C, has an advantage when a small surface area to volume ratio is a benefit and the organism is trying to minimise gains/losses through diffusion/osmosis for example: in a toxic environment, to maintain internal temperature, maintain internal nutrients and prevent too much water loss or gain too much water via osmosis, due to the movement of nutrient and heat transfer being slower etc.
1 mark for an advantage of small surface area to ratio
1 mark for the reason

Examiner's comments

The question was attempted by every candidate and was generally very well answered. Most candidates were able to obtain 4 marks as most candidates had a very good understanding of how size and shape affects the surface area to volume ratio. Candidates did however have some difficulty in part c) of the question.

Question 4



(a) The graph had to be of the same shape and be below the original line and end around 14 minutes. (Technically if the amount of enzyme was not the only limiting factor the graph could end anywhere between 14 and 30 mins.)
½ mark for shape of graph
½ mark for ending below the original line

(b) The graph had to be the same shape as the original and end around the 40 minute mark.

½ mark for shape of graph
½ mark for being above the original line and ending around 40 minutes.

(c) The graph had to follow the same line until 10 minutes and then rise to 2 or above if 1g used and then follow the same shape as original graph and end around 45 minutes or not end at all of used the 1g of maltose.
½ mark for rising at 10 minutes
½ mark for the correct shape of graph

Examiner's comments

Almost every candidate attempted this question. There was a typo error in part c) mg should have been used not g. This resulted in some flexibility in the answer to accommodate both interpretations of the graph.

Question 5

(a) The freshwater has a lower concentration of ions (hypotonic) than inside the organism. (1 mark) Therefore there is a net diffusion of water into the animal (1 mark) by osmosis.(1 mark) Ions would diffuse out.(1 mark)
The animal may swell/burst or osmoregulate or expel water or use a contractile vacuole.(1 mark)

(b) Any two of the following:
Plant cells have a cell wall (1 mark) and therefore they cannot burst.(1 mark) Once a certain amount of water enters the cell becomes fully turgid (1 mark) and the tendency for water to enter the cell is balanced by the amount leaving. (1 mark)

(c) Ions would be excreted/removed (1 mark) by active transport / exocytosis / osmoregulation.(1 mark)
or Water would have to be regained (1 mark) by pinocytosis for e.g. (1 mark)
or Osmoconform (1 mark) by accumulating /retaining ions. (1 mark)
or Form a spore (1 mark) which would be impermeable to water/ions. (1 mark)

Examiner's comments

(a) Well answered. However, a disappointing number of candidates thought that a unicellular animal was a fish and that cells will explode when too much water enters them.
(b) Satisfactorily answered.
(c) Any reasonable suggestion was given credit.

Question 6

As plants are submerged they receive insufficient light (½ mark) therefore their ability to photosynthesise decreases (½ mark) and less oxygen is produced. (½ mark) Plants carry out limited respiration (½.mark) using up stored nutrients and some of the remaining oxygen. Due to lack of oxygen plants eventually die. (½ mark) Dead plants are broken down by bacteria and fungi (½ mark) using oxygen (½ mark) for respiration.(½ mark) Fish die because they cannot respire (½ mark) because of a lack of oxygen (½ mark).

Examiner's comments

This question was very poorly answered. Many candidates did not relate their answer to the question, instead just defined photosynthesis and respiration. They did not gain any marks for this.

Other candidates only answered part of the question. They did not discuss the effect of being submerged on the plants ability to photosynthesise, or the effect of decomposition on oxygen availability or why fish needed oxygen.

Section B Criterion 4

Question 7

(a) Kinixys erosa- Urea (½ mark)
Testudo elegans- Uric acid (½ mark)

(b) Origin of nitrogenous waste:
- Breakdown of proteins/amino acids/nucleic acids OR
- Excess protein in the diet OR
- The liver

(any 1 of the above for 1 mark)

ALSO accepted
- Proteins/amino acids/nitrates from dietary intake of any of the following plants / animals / food sources

(c)
– The production of ammonia uses less energy than the production of uric acid
– Conservation of water is not important for turtles living in aquatic environments and can therefore dilute ammonia quickly to non-toxic levels
– Turtles living in a desert environment produce non-toxic uric acid which is insoluble and can be excreted as a paste.
– Uric acid can accumulate in the body without causing problems

(any 3 of the above points for 3 marks)

Examiner's comments

(a) Well answered by the majority of candidates.
(b) Many candidates gave vague responses when answering this question, for example "atmosphere" or "plant" but did not explain how this relates to nitrogenous waste. It is important to address the question specifically.
(c) Most candidates were able to gain 2 out of 3 marks for this question. Candidates needed to use the table as support for this question and the most frequent mistake was to relate their answer to diet rather than habitat.

Question 8

(a) Increase in breathing rate increases the rate at which air enters and leaves the alveoli (1 mark). This maintains the diffusion gradients of oxygen and carbon dioxide between the alveoli and the blood (1 mark).

Increase in pulse rate means that blood is being moved through the capillaries around alveoli faster (1 mark). This maintains the difference in diffusion gradients, as there is an increase in oxygenated blood leaving and deoxygenated blood coming to the lungs (1 mark).

(b) More oxygen reaches the cells for respiration of energy for muscle contraction (1 mark).
The waste product carbon dioxide produced by respiration is quickly removed, as it is poisonous (1 mark).

Examiner's comments

(a) Most candidates were able to explain what happens when breathing rate and pulse rate are increased, however many candidates did not relate this information to the question and thus did not address the question by explaining how each of these helps to increase the rate of diffusion.
(b) The majority of candidates successfully answered this question.

Question 9

(a) The men being mammals are able to thermoregulate (use homeostasis to maintain constant internal temperature whilst the temperature reaches 127 degrees outside)(1 mark) The steak is composed of dead cells and hence incapable of thermoregulation. (1 mark)

Temperature increases are detected by thermoreceptors which send messages to the effectors which can result in a variety of responses. For the third and fourth mark, any 2 of the following were accepted which explained how the men's temperatures were reduced:

– The men are able keep body temperature from rising by sweating
– Air from lungs contain moisture to cool down
– Vasodilation of blood vessels
– Metabolic rate decreases
– Men would dehydrate eventually

Comment as to what happens to the steak were also given marks such as:

– steaks' proteins denatured (ie cooked)
– steak has a greater surface area to volume ratio and hence gains heat more rapidly

Other accepted responses included:

– Description of how negative feedback works.
– Radiation loss will not occur as outside temperature is greater than inside and hence there would be a net input of energy.

(b) NO, the lizard would not survive (½ mark) as it cannot thermoregulate (½ mark) as it is an ectotherm (cold blooded) (1 mark) and internal temperature would increase to match the environment.
Also accepted:

– As the lizard cannot use behavioural mechanisms it will die (1 mark)
– As lizards have a high surface area to volume ration will quickly heat up (1 mark)
– Lizards cannot sweat and therefore cannot cool down (1 mark)

Any 2 comments here required.

(c) People lose less heat by evaporation of sweat from their bodies (1 mark) due to the decreased water vapour gradient between the air and the skin. Consequently body temperature increases (1 mark)

also accepted:

– dehydration causes death(1 mark)
– at higher temperatures enzymes denature and this leads to death (1 mark).

Examiner's comments

(a) Common errors in this part included:
– Humans do not pant. **Too** many candidates said this.
– Skin used as protection, steak did not have any - not a good reason
– Many thought this was a respiration question not a homeostasis question

Many candidates did not give explanations showing understanding of homeostasis and consequently did not receive full marks.

(b) Some of the better answers discussed the responses of the lizard and were given full marks even if they were unsure if the lizard would die because 20 minutes may not be long enough to be fatal.

(c) Some common errors in this section included:
– less oxygen in the air therefore death
– increase in humidity leads to flooding of lungs by water droplets hence death (commonly said).

Question 10

(a) Possible effects: No longer able to store bile. (1 mark) The capacity of bile to emulsify (break down) fats/lipids is reduced (1 mark)
Possible compensations: Reduce intake of fats, avoid fatty foods/ eat less fat (1 mark)

(b) Possible effects: dehydration due to less absorption of water; diarrhoea; less microbial fermentation of food; reduced vitamin production by bacteria; reduced absorption of some ions; inability to store faeces. (maximum 2 marks)
Possible compensations: increased intake of water, relevant vitamins, minerals in diet; greater reabsorption of water and ions from filtrate in kidney; adjustment to the amount of fibre in diet; if only a small amount removed the remaining intestine may be able to compensate; if large amount removed a colostomy bag may be needed. (1 mark)

Examiner's comments

(a) Generally well answered but common errors included:
– candidates believe gall bladder produces bile
– body can still emulsify fats, but not as well regulated- candidates think this ceases
– removal of gall bladder does not shut off path of bile to small intestine.

Many answers were too general and did not discuss the effect on fats / lipids specifically.

(b) Most candidates were able to show some understanding of one possible effect with better answers indicating two or three of those listed above. Candidates needed to link the loss of function with appropriate methods of compensation. Poor answers failed to show specific understanding of the role of the large intestine, making very general comments, such as 'digestion will not happen as well as it should'.

Question 11

(a) Donkey 1 is red (½ mark). Donkeys 3 and 4 are the same colour but produced a foal (no. 8) of different colour. This indicates that 3 & 4 are heterozygous (Gg) and that the solid colour represents grey (grey coat colouring being dominant). The white symbols represent red coat.

(b) Parents' genotypes are Gg and Gg.

		No. 3	
		G	g
No. 4	G	GG	Gg
	g	Gg	gg

The phenotype of GG and Gg in the offspring are grey coats, the probability of grey = 3/4

(c) (_ x 62) + (_ x 22) = 31 + 22 = 53

(d) The zonkey has two different sets of chromosomes from its parents that do not match. Thus pairing of homologous chromosomes during meiosis cannot occur so that the zonkey cannot produce viable, haploid gametes.

Examiner's comments

(a) Poor answers to this question were very common. The majority of candidates were able to state that donkey No. 1 was red but few were able to give an adequate explanation. Many candidates made the assumption that the solid colour represented the characteristic due to the dominant gene (presumably because this is often the case in examples studied although this was not stated in the information given. Many more stated that the colour of No. 2 must be due to the dominant gene because he was the same colour as all his known offspring. Others assumed that the most common trait was the dominant one. Poorly explained comments about recessive genes skipping a generation did not receive full marks. Misreading of the question was quite common with a significant number of candidates attempting to give the colour of the unborn foal. Misuse of terms was also common (i.e. heterozygous dominant; donkey 8 is recessive)

(b) This part of the question was well answered by the majority of candidates. The most common errors were either failure to realise that both parents were heterozygous, or giving the incorrect probability after showing the correct information on a Punnett square.

(c) Well answered. The most common mistakes occurred when candidates deleted two sex chromosomes from the total, or when the two diploid numbers were added together.

(d) Candidates found this question difficult. Many candidates were able to state that infertility was due to the odd number of chromosomes but were unable to link this to gamete formation and/or meiosis. A number were able to explain that gametes had to be haploid and that this would mean halving an odd number of chromosomes. Some candidates thought that 26 pairs of chromosomes would be formed during meiosis with only one unpaired chromosome. Only a few candidates were able to show that they clearly understood about pairing of homologous chromosomes.

Section C Criterion 5

Question 12

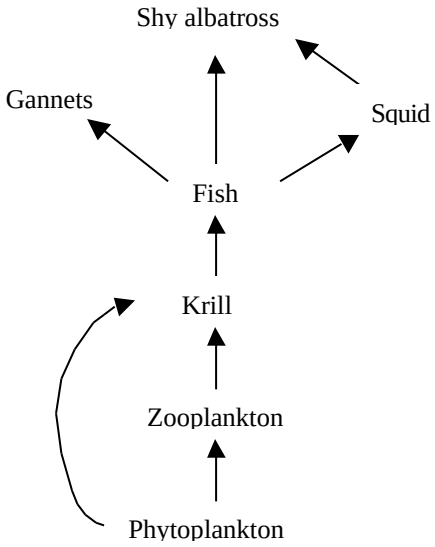
The Lion and Snow leopard are closely related because they are in the same genus (*Panthera*). (1 mark) The Jaguar is equally as closely related as it is also in the same genus. The other cats are not as closely related as they are in different genera. (1 mark)

Examiner's comments

Candidates generally answered the first part of this question well and received one mark. Many candidates didn't get full marks as they failed to comment on the fact that the Jaguar is equally as closely related.

Question 13

(a)



(b) Decomposers or detritivores

(c) (i) zooplankton or krill
(ii) krill or fish

(d) The shy albatross population will decrease in numbers.
Krill are the source of food for the fish. Albatross feed directly on fish or squid, which have krill as their source of food. A reduction in the number of krill through harvesting by commercial fisheries will in turn reduce the fish, squid and shy albatross populations.
Or
Commercial fisheries will reduce the krill population and there will be a reduction in energy/biomass flow in the food web through the fish and squid. The shy albatross population will therefore decrease in numbers.

(e) Parasitic – lice feed directly on the gannets and this is to the detriment of the gannets.

(f) There is a loss of energy/biomass at each trophic level in a food chain. This is due to respiration, movement, excretion and other losses. Only about 10% of the energy that enters a trophic level is transferred onto the next. After five levels there is not enough energy/biomass to sustain another level in an ecosystem.

Examiner's comments

This question was done very well. All candidates were able to gain at least some marks and many candidates answered all parts clearly and correctly.

(a) The food web was completed correctly by most candidates. The errors were usually slip ups resulting from not following through the given information sequentially. Typical errors were that the link between the phytoplankton and krill was missing and the links between the fish and shy albatross were confused. Many odd shaped diagrams were produced and these were accepted, but it is preferred that the diagram goes up the page with each succeeding trophic level. A mark was lost if all the arrows were in the wrong direction or two or more were incorrect. A half mark was lost for each incorrect link in the web. Surprisingly, the arrow from phytoplankton to krill was often reversed.

(b) Most candidates received full marks here

(c) (i) Either zooplankton or krill were accepted. Again most were correct.

(ii) If the first answer to part (i) was zooplankton, then krill was the correct answer. If the first answer was krill, then fish was the correct answer. Krill for both parts (i) and (ii) gained only one mark. The question was done well.

(d) The wording of the question was; "Predict what effect …." As a result a candidate gained full marks for a correct prediction without any supporting evidence. .
Full marks were not given for an imprecise prediction.

(e) Most candidates got this correct. The answer commensalism was not accepted because it was felt that a candidate should be aware that the presence of lice are to the detriment of the host.

(f) Most candidates answered this well. This was very pleasing because, coupled with the answers to the previous parts, showed that the level of understanding of this part of the syllabus is very good. Marks were lost mainly for incomplete explanations. It is not sufficient to simply state that energy is lost at each trophic level. This is a statement only and the conclusion that this leads to only five trophic levels because the biomass/energy remaining is insufficient to sustain another, must be given. The statement received one mark. If it was amplified with only 10%, or similar, is passed on, then depending on the construction of the answer another half-mark was given.

Question 14

(a) Succession (1 mark)

(b) Pioneer plants such as lichen arrive first (possibly by wind dispersal), colonise the bare rock and begin its chemical breakdown so that primitive soil production begins. (1 mark)
Once there is a small amount of soil the mosses could invade and grow, followed by grasses. (dispersal by wind, water or birds) (1 mark)
The accumulation of organic matter (humus from dead plants), rich ash from the volcano and wind borne dust particles trapped around the base of pioneer species leads to more soil forming and larger plants like ferns can take hold. (1 mark)
The last plants to arrive are the coconut trees (possibly by sea and not in bird droppings as many candidates suggested) they require the thickest soil. The whole process will eventually lead to the formation of a climax community. (1 mark)

As each organism becomes established and its numbers increase it alters the environment and makes it more suitable for others but in the process it may make conditions less suitable for itself hence its numbers decline. Larger plants also out compete the smaller ones taking light and using up water, nutrients and space. (2 marks)

Examiner's comments

The majority of candidates failed to get full marks for this question. Many confused population dynamics with succession and commented on the carrying capacity being reached as a reason why the some plants declined in number.

Many of those candidates who correctly recognised the graph as a depiction of succession commented accurately on how each species modifies the environment but didn't make reference to the fact that in doing so they often make it unsuitable for themselves and more suitable for others.

Very few mentioned that if the process continues to occur eventually a climax community could result.
Very few used the words pioneer species to describe the first plants to arrive.

Question 15

(a) There would have been a genetic variation within the original species, very small populations becoming established in new areas could have varied in their genetic make up from the bulk of the population (founding effect) or through the formation of a cline across a geographical range. (1 mark for either)
Geographic/ecological isolation then split the populations (1 mark), this could be caused by formation of deserts, separation of Tasmania from the mainland by Bass Straight (½ mark for example(s)). This then led to reproductive isolation for a period of time with no mixing of their gene pools. (½ -1 mark).
The 4 different environments experienced different selection pressures (1 mark) and so natural selection will favour different variations to suit the particular environment (1 mark). Also there would be different mutations in the different environments, which contributes to the variation for natural selection to act on. (½ -1 mark) Additional 1-2 marks for details of the operation of natural selection which leads to different gene frequencies.
Time: a long period of time needed (½ mark) during which the populations may have developed differences that prevent them (successfully) interbreeding if they were reintroduced, and so become distinct species (1 mark). Extra ½ mark given for ways that permanent reproductive isolation can be effected such as different breeding seasons, places, mating rituals etc.

(b) Explanations for the survival of Gilbert's potoroo and the apparent extinction of the broad-faced potoroo include:
(i) Loss of habitat/breeding grounds through logging/deforestation etc which had a greater impact in the broad-faced potoroo's habitat than the Gilbert's potoroo's.
(ii) Introduced predators, e.g. foxes, feral cats etc which had a greater impact in the broad-faced potoroo's habitat than the Gilbert's potoroo's.
(iii) Introduced competitors e.g. rabbits, sheep, cattle etc which had a greater impact in the broad-faced potoroo's habitat than the Gilbert's potoroo's.
(iv) Other similar changes brought about by human impact, e.g. loss of native grasses/food sources, introduction of diseases, parasites which had a greater impact on the broad-faced potoroo than the Gilbert's potoroo.

(v) Other broader changes to the environment e.g. climate change (human impact or natural) that the broad-faced potoroo was better able to adapt to than the Gilbert's potoroo's. This may be due to greater genetic diversity in the population.

(2 marks each)

Examiner's comments

(a) This section of the question seemed to be a very good discriminator and produced a good range of marks. Candidates who got the basic idea that geographic isolation of the individual populations into different environments, where they underwent different adaptations to suit their distinct environments through natural selection got at least half marks. The rest of the marks were given in recognition of the other aspects. The better answers mentioned things like the long time period needed and examples of isolating mechanisms.
Those who described natural selection without dealing with isolation and other aspects of speciation were given half marks at most, usually slightly less. One fairly common misconception was that the variation was due to mating with different species. Another significant minority used Lamarck's theory as the basis for their answer.

(b) This section was well answered to gain 2 marks for an explanation candidates needed to identify some change in the environment or circumstances and relate it to how it affected one species more than the other. Half a mark was reserved for relating how it affected one species over the other. Candidates who simply listed a better adaptation of one species to the environment or how one's environment better suited it received one mark at most. Some candidates carried over the ideas of speciation into this question so answers that simply mentioned natural selection or variation due to mutation received little credit. Other candidates tried to introduce Lamarck's theory.

Section D Criterion 8

Question 16

(a) Adding lime to the soil will cause pink *Hydrangea* flowers to change to blue.
Or
An increase in pH of the soil (or increased alkalinity) promotes formation of blue coloured flowers in *Hydrangeas.* (2 marks)

(b) Dependent variable – colour of flower (pink / blue)
Independent variable – lime / no lime
Or – alkalinity or pH of soil. (1 mark each)

(c) Four variables to be controlled (any four):
- Type of soil
- Amount of watering
- Temperature
- Light intensity
- Humidity
- Hours of daylight
- Amount of fertiliser / nutrients
- Same species of *Hydrangea.* (½ mark each)

Examiner's comments

This question was very well done. The hypothesis was well written in (a) and only a few candidates confused the difference between the dependent / independent variables in (b). Most candidates could identify four variables. The inclusion of lime as one of the variables in part (c) was an error that some candidates made.

Question 17

Tube A Water loss is prevented from the upper surface to establish the amount of water lost from the under side of the leaf. (1½ marks)

Tube B Water loss is prevented from the under surface to establish the amount of water lost from the upper side of the leaf. (1½ marks)

Tube C Control to compare with A & B (½ mark) to make sure that grease does in fact stop water loss (½ mark) and to establish the amount (if any) of water lost from the stem / petiole (½ mark).

Tube D Control to compare with A & B (1 mark), to measure total water loss from whole leaf / stem (½ mark).

Examiner's comments

Candidates did well discussing Tubes A and B. A few answers misused the information by incorrectly referring to oil not grease on the leaves.
Treatment of Tubes C and D were not explained as well as the other two. Many answers failed to identify that these were controls.
Some candidates discussed whether each treatment supported or negated the hypothesis but did not gain full marks if the explanation for each treatment was not included.

Question 18

(a) Five specimens are better than one but this may still be far too few for statistical validity.

(b) Either: They should be selected at random to avoid any form of bias.
Or: They should be matched for age, size, sex, health, etc. to control these variables.

(c) Method (i) involves testing only one specimen at each temperature whereas Method (ii) involves five repeats of the same procedure and is thus slightly more valid.
Method (i) involves holding/ acclimatising individual crayfish at a certain temperature which may be a more accurate measure of the independent variable than Method (ii) which involves continuous temperature change.

Examiner's comments

This question was generally answered quite well but few candidates were able to gain full marks.

(a) Many candidates gained up to 1½ marks for explaining that the more subjects used, the more statistically valid the result but many failed to point out that five specimens may still be far too few.

(b) Most candidates described one or other of the methods suggested above (1 mark) but many failed to explain why they are appropriate. (1 mark)

(c) To gain full marks, candidates were expected to discuss one advantage and one disadvantage of each method. Many answers were incomplete.
Many candidates made comments relating to the relative duration of the two experiments. eg "results would be obtained more quickly in method (i)". These are largely irrelevant. The time difference is not of major importance.
A significant number of candidates raised ethical objections to one or both methods. If appropriate, these gained some credit. Some candidates discussed the temperature range used which was also taken into account. The normal range of temperatures that freshwater crayfish live in is 5ºC – 20ºC. C Answers which indicated that holding crayfish at high temperatures for one hour may have an adverse effect on the health of the crayfish were given credit.

Question 19

(a) There are a number of valid designs possible; the following table highlights the main points which were considered necessary and the marks awarded.

1 mark	**Large sample size**	Take (minimum) 100 people and assign randomly to (minimum) four groups. This will help account for individual variation.
2 marks	**Describe treatment of groups**	Three groups take zinc lozenges within 24 hours of first developing cold symptoms. The other group takes a placebo which does not contain zinc. *(1 mark)* Dosages received are 3 mg, 6.4 mg or 9 mg. (i.e. greater and less than suggested optimum dose) *(1 mark)*
1 mark	**Identify control group**	The group not receiving zinc is the control group, the results from which will be used to compare with the other groups.
1 mark	**Identify independent variable**	The dosage of zinc.
2 marks	**Identify the key controlled variables (constants)**	In order for the results to be valid, many variables that would affect the dependent variable need to be controlled. The groups should be **matched for age, gender, health** etc. *(1 mark)*. A key variable which must be controlled is **diet** – must ensure that no other source of zinc is included in foods or other medication *(1 mark).*
1 mark	**Identify dependent variable (DV)**	The duration of the cold.
2 marks	**Specify how the DV will be measured**	Specify a practical method for quantifying DV - e.g measuring body temperature, subjects to complete a checklist of symptoms, rate severity on a 1-10 scale each day.

1 mark BONUS	**Acknowledge problems associated with human experimentation**	e.g. need approval of ethics committee, use of double blind methodology, subjective nature of DV measurement.
1 mark	**Treatment of results.**	The results will be tabulated and **average duration of cold to be calculated for each group**. Compare averages to see if there is a significant difference in the DV for the groups.
0.5 marks	**Replication**	The experiment should be repeated a number of times to ensure that the results are consistent.

Deduct marks for: Impractical procedures (e.g. confining subjects)
Unethical procedures (e.g. infecting people with cold virus)

NOTE: It is NOT recommended that candidates present their answer in table format, but rather as a written answer. This should include the information from the right hand column of the above table. Headings can be useful in helping to organize information.

(b) No significant difference between control and experimental groups (1 mark) or control group has colds of shorter duration than experimental groups (1 mark). Credit was also given to answers indicating that 6.4 mg of zinc did not reduce cold duration by half.

Examiner's comments

(a) Generally well done by most candidates. However, many did not provide a method which tested the **dosage** of zinc required (by including a number of experimental groups which received different amounts of zinc). A common error was to simply state that "results were collected, data tabulated and graphed" without giving indication of **what** was actually measured (e.g. changes in body temperature, rating of severity of symptoms). It should also be noted that it is not generally possible in experiments involving humans to "take 1000 people of the same age, height, weight, health etc.". For this reason, a large sample size (greater than 20 per group, and often considerably larger) is needed, and individuals should be randomly assigned to groups to ensure that groups have an equivalent range of variation for these factors.

(b) A surprising number of candidates gave results which would **support** the hypothesis.

Section E Criterion 9

Question 20

(a) (i) Statement is not valid (½ mark)
About 5% of the American Indian population would have had diabetes prior to 1940 (1mark).
To gain the other half mark, the candidate had to state, or indicate in some way that extrapolation was needed to determine this. Some candidates stated that the graph did not start at 0 in 1940, and it would not have reached 5% in a single year, so one can assume there must have been some diabetes before this. Others referred to the slope of the line for Indians on a traditional diet to justify their statement. Both these approaches were given full marks if clearly explained.

(ii) Statement is valid – (½ mark)
50% of American Indians on a western diet have diabetes (½ mark)
Graph has reached a plateau, therefore this is unlikely to increase further (½ mark)
To receive full marks, candidates had to express some reservations about the certainty of this answer. Many candidates pointed out correctly in part 'b' that diabetes is a late onset disease. This means that at any given time, all of the population will not be affected because they will not all have reached middle age, even if they will develop the disease eventually. A small number of candidates did make this conclusion, or indicated in some way that they were making an assumption in stating that not all Indians would develop diabetes. These were given full marks.

(b) A wide variety of answers were accepted (2 marks). These included:
- Often diabetes is a late onset disease, and occurs only after many years of eating a western diet, in middle age.
- The western diet itself became higher in sugars and fats between 1940 and 1990, increasing adverse health effects of the diet, including diabetes.
- Impact of bad diet takes time. We have only recently reached the point where most American Indians have been on a western diet since childhood.
- More sedentary lifestyle in recent years, added to increasingly poor diets has increased incidence.
- Awareness and detection of diabetes has increased, previously Indians may have had diabetes and not reported it, or even died as a result.
- American Indians may initially have combined their traditional diet with a western diet, and only gradually converted to a full western diet, or may have had some protection from the more natural diet they consumed during childhood.
- The American Indians who were most likely to adopt a western diet would have been the younger people who would have worked or gone to school with other Americans. Diabetes does not affect many young people, and so it would have taken time for them to be affected.

Examiner's comments

On the whole Question 20 was well answered, with almost 10% of candidates scoring the full six points. The vast majority of candidates scored between 3 and 5 points.

The major problems encountered were of two types:

(1) For part a, some candidates failed to base their answer on the data in any way.
Eg. For part a) i) stating that of course Indians had no diabetes before 1940 because they were on a very healthy diet, low in fat and high in fibre.
For part a) ii) stating that American Indians on a western diet would not all get diabetes because diabetes is genetic and not affected by diet.
There were other variations of this. Candidates were given some credit for those parts of such answers which were correct (ie. ½ mark for saying not all American Indians would get diabetes on a western diet), but no candidates were given full marks unless they did base their answer on the data.

(2) Unacceptable answers to part b) were quite varied, but included a large contingent of apparent followers of Lamarck, who stated in various ways that exposure to the western diet causes diabetes to be passed to the offspring in the genes. There were others who believed that the Indians had become adapted to the diet over the 50 years of exposure, so the incidence of diabetes levelled off.
A few individuals provided more original approaches that unfortunately could not be given credit, including:
- Spread of the diabetes gene through the population due to natural selection.
- Breakdown of immunity to a fatty diet increased susceptibility to diabetes.
- Biomagnification of diabetes, or of American Indians.
- Logistical growth.

Question 21

Difference 1
The sample size. NEJM: 120 000, JAMA: 1029 (1 mark)
Effect on results
The NEJM study used a larger sample size which makes the results of the study more reliable (1 mark) as it decreases the effects of individual differences (½ mark) thus better representing the larger population. (½ mark)

– larger sample results likely to be more statistically valid

Difference 2
Time period over which the study was undertaken. NEJM:20 years, JAMA: one point in time (1 mark)
Effect on results
The results of the NEJM study, which tracked medical records for 20 years would be more reliable (1 mark) as the HRT link with breast cancer may not be apparent in the short term. (1 mark)

Difference 3
Method of data collection. NEJM:medical records, JAMA:interviews(1 mark)
Effect on results
Medical record more reliable (½ mark) and objective(½ mark) than interviews where information collected can be subjective. (1 mark)

Difference 4
NEJM considered risk groups and compared, JAMA didn't. (1 mark)
Effect on results
Looking at risk groups takes into account environmental factors that could promote the growth of the disease (1 mark) which is important because diseases are not affected so much by a single factor as by a number of factors (1 mark)

Examiner's comments

Most candidates easily identified the differences (usually the first 3 above) but had difficulties in adequately expressing an understanding of the effects that the differences would have on the results.
In explaining the effects on the results many candidates used terms such as "accurate" or "precise" without being more specific with regard to the meaning in the context of the question.
It was quite common for candidates to use terms such as "reliable" and "valid" but not further indicate their understanding of these terms.
A common mistake in expression when explaining the advantage of a larger sample size was to claim that individual differences or anomalies would be reduced rather than that the "effects" of these would be reduced.
Candidates tended to say that the interviewed women could "tell lies" whereas the medical records were "proof" rather than use the terms "subjective" and "objective".

Question 22

(a) 13:00 – 19:00, 14:00 – 18:00, 1pm – 7pm or 2pm – 4pm.

(b) *D. hydei* lays eggs for 6 daylight hours and 10 dark hours peaking at 40% oviposition at 8pm which is in the dark. It appears that this species prefers dark conditions for oviposition although it is able to lay a small percentage of its eggs when it is light.

D. immigrans only lays eggs in daylight hours with a maximum of 42% oviposition at midday. This species in totally dependent on light for oviposition
D. simulans lays eggs for 10 daylight hours and all dark hours and the percentage oviposition only varies between 6% and 15%. This suggests that the egglaying of this species is independent of light exposure.

(c) *D. hydei* would probably lay more of their eggs because this species lays most of its eggs at low light intensities and halving the midday light intensity would increase the times suitable to this species.
D.immigrans would lay less eggs because this species prefers high light intensity with 42% of its oviposition occurring when light intensity is at its peak. Halving this would mean that there would be no time during the 24 hour period when conditions were really suitable.
D. simulans would have an unchanged oviposition percentage as its egg laying is not dependent on light intensity.

Examiner's comments

This question was well done by most candidates with 7 or 8 out of 11 being the most common scores.

(a) There was some confusion about the times on the horizontal axis and answers of 13:00 – 19:00, 14:00 – 16:00, 1pm – 7pm or 2pm – 6pm were all accepted as correct.

(b) This part of the question said to use the data, so that answers which did not include any specific reference to the data were unable to gain full marks.
The most common error was to describe the graph in terms of time and percentage oviposition rather than light exposure. There was also little in the way of attempts to compare and contrast, rather than just describe. Another common error was to read the vertical axis as number of eggs rather than percentage oviposition.

(c) This part of the question required an explanation and many candidates simply wrote down two consequences. Many incorrectly thought that halving the light intensity would make it dark and a surprising number misread halving as having and so got the question completely wrong.

Question 23

(a) During December and January, when the chicks are being fed (1 mark), the little penguin's diet is almost entirely fish. (1 mark) In March, they eat almost entirely cephalopods (1 mark). This coincides with the young leaving the nest. (1 mark) From June to September when the little penguins are not breeding, they eat mainly crustaceans with some cephalopods and fish. (1 mark) During October to September, when eggs are being laid and chicks are hatching, (1 mark) there is an increase in the diet of fish and decrease of cephalopods/crustaceans. (1 mark)

(b) They were able to supplement their diet by increasing their intake of other fish or of cephalopods and crustaceans. (1 mark for either of these two alternatives)

Examiner's comments

(a) This question was one in which many candidates scored well where they could accurately read and describe the trends of a graph and then relate those trends to other given data (i.e., the breeding cycle).
Of those who struggled with this question, misconceptions were:
- Failure to identify that the columns in the graph represented relative (i.e., comparative) dietary amounts.
- Mistakenly reading the columns as population numbers or prey available.
- Assuming that all the data was as a consequence of the high mortality of pilchards in 1995, hence treating the question as one on population dynamics.

- Finally, a majority of candidates were unsure of how to answer a question directing them to *relate* graphical data to other data. Therefore almost all answers included attempts to *explain* relationships rather than simply to state them. Marks were not deducted for this, however candidates often focused more on explanations, overlooking a simple statement of relationship and thereby losing marks.

(b) As one candidate aptly stated: "there are many fish in the sea" (other than pilchards, that is). Because there was no indication of the time of the pilchard mortality other than 'in 1995', candidates were given fair leeway with their answers. Reference to the fact that the pilchard population may have recovered was given credit. Most candidates were able to score well on this one.

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