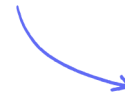


Practice Paper 2

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Total Marks

/50

- 1 (a)** Agriculturalists in Mozambique investigated the optimum planting conditions for sweet potato plants. Sweet potato (*Ipomoea batatas*) is a popular root crop, with increasing use as a staple vegetable. Variables under investigation were the spacing of seed sowing and the optimum use of fertilisers to achieve a maximum yield.

Plant spacing (16, 20 and 25 cm between plants) was combined with three nitrogen addition rates of 30, 35 and 40 grams per square metre (g m^{-2}) in separate test plots of area 1.5m^2 . The source of nitrogen used in the study was urea ($\text{CH}_4\text{N}_2\text{O}$). Other growing conditions were kept constant, to determine the optimal combination of spacing and nitrogen addition.

The study ran for 175 days after planting individual *I. batatas* seeds in the respective conditions. The results of the study are summarised in the table below.

Spacing distance / cm	Urea level added / g per m^2	Mean underground dry mass / g per plant	Mean Crop Yield / tonnes per hectare*
16	30	30	12.9
	35	54	21.4
	40	58	19.8
20	30	17	7.6
	35	148	40.3
	40	141	35.6
25	30	42	10.8
	35	187	12.8
	40	15	8.4

* 1 hectare = $10\,000\text{m}^2$

Identify the growth conditions that gave the most favourable yield of sweet potatoes in this study.

(1 mark)

(b) Describe the relationship between the mean underground dry mass of the crop and the mean crop yield of sweet potatoes in this study.

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(1 mark)

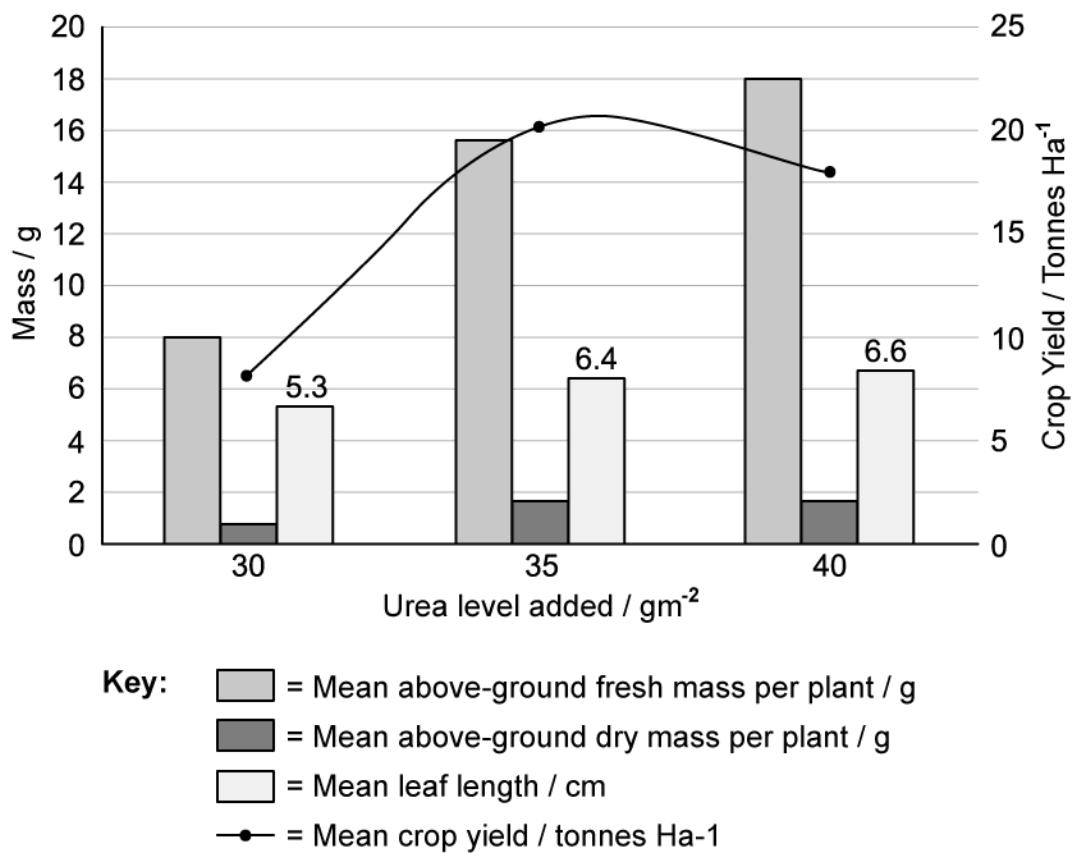
(c) Compare and contrast the effects of increasing spacing and increasing urea addition, in terms of underground dry mass and crop yields.

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(3 marks)

(d) Suggest, with a reason, why the choice of units of crop yield quoted in this study (tonnes per hectare) was not an appropriate one.

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(2 marks)

(e) In another part of this investigation, the mass of plant matter above ground (both fresh mass and dry mass) was measured against leaf length and crop yield for the three levels of urea concentration previously tested. All these data were gathered from sweet potato plants spaced at 20cm distance. The results are shown in the graph below.



The scientists concluded that a planting regime of plants spaced 20cm apart with an addition of urea more than 35 gm⁻² should be recommended to farmers. Evaluate the scientists' conclusion, using the data above and from part a).

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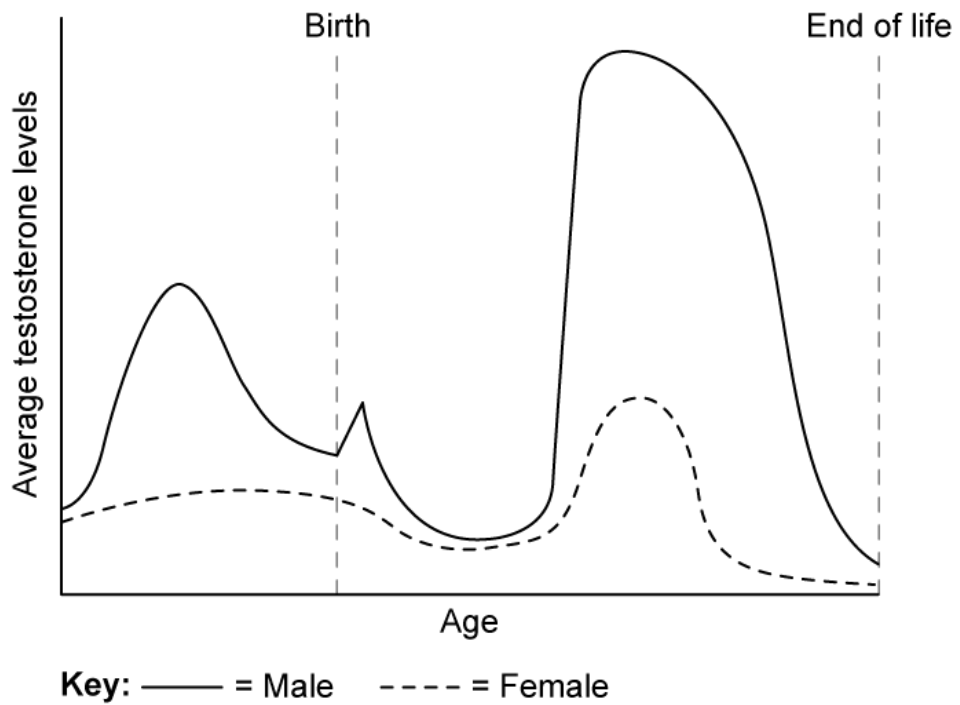
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(4 marks)

2 (a) The graph below shows changing testosterone levels in male and female humans from before birth until old-age. Note that the scale on the x axis is not evenly distributed.



Compare and contrast the changes in testosterone levels for males and females.

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(3 marks)

(b) Outline the reason for the difference in testosterone levels between males and females.

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(3 marks)

(c) Label the graph in part a) with an **X** at roughly the point at which puberty begins in males.

(1 mark)

(d) State **two** physiological changes that would occur in males at the point you have marked **X** on the graph in part a).

(2 marks)

- 3 (a)** Human red blood cells can be categorised into different blood groups based on the structure of a surface glycoprotein (antigen). The ABO blood groups are controlled by a single gene with multiple alleles (A, B, O). The table below shows all the genotypes for all the possible blood groups.

Phenotype	Genotype
Blood Group A	$I^A I^A$ $I^A i$
Blood Group B	$I^B I^B$ $I^B i$
Blood Group AB	$I^A I^B$
Blood Group O	ii

A child has blood group AB and their father has blood group A.

Identify the possible phenotypes of the mother.

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(2 marks)

- (b)** Suggest which pattern of inheritance is exhibited in the AB blood group.

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(1 mark)

- (c)** A woman with a family history of colour-blindness and a man with normal colour vision wish to start a family but are concerned that all their children will be colour-blind. They decide to speak to a genetic counsellor.

Suggest why the parents are concerned.

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(2 marks)

(d) Genetic testing showed that the woman was carrying the gene for colour-blindness. The genetic counsellor provided information about the chances of having children with colour blindness.

Using the following symbols:

X^B = an X chromosome carrying the normal allele for colour vision

X^b = an X chromosome carrying the allele for colour blindness

(i) Identify all the possible genotypes for female and male offspring.

(ii) Predict the probability of having a child with colour-blindness.

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(3 marks)

- 4 (a)** Lupus is an autoimmune disease in which the immune system will produce autoantibodies against the body's own tissue. This results in a variety of symptoms, including inflammation of the skin and organs to more serious ones such as organ failure and strokes.

Compare and contrast an autoimmune response to the immune response against a pathogen.

(2 marks)

- (b)** The symptoms of lupus can get progressively worse over time.

Based on your knowledge of lymphocytes, suggest a reason for this.

(2 marks)

- (c)** There are a variety of ways to treat lupus. One form of treatment involves administering immunosuppressive drugs which prevents the activation of lymphocytes.

Explain the impact that this form of treatment could have on a lupus patient.

(2 marks)

5 (a) *One mark is available for clarity of communication throughout this question.*

Use your knowledge of protein structure to explain the term, 'specificity' in the context of immunoglobulins and their mode of action.

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(3 marks)

(b) Outline, with examples, the main roles that proteins play in organisms.

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(4 marks)

(c) For each of the proteins listed **A - D** below, state one aspect of its structure and one function that is enabled by the structural feature that you have stated.

- A. Ribulose Bisphosphate Carboxylase (RuBisCo)
- B. Spider silk
- C. Immunoglobulins
- D. Rhodopsin

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(9 marks)