



TEST CODE **02107020**

FORM TP 2005171

MAY/JUNE 2005

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

$2\frac{1}{4}$ hours

**Candidates are advised to use the first 15 minutes for
reading through this paper carefully.**

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this question paper answer booklet.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

You must attempt **ALL THREE** questions in this section. You should **NOT** spend more than 30 minutes on this section.

1. The rates of enzyme catalysed reactions can be influenced by the pH at which they occur. Table 1 shows the relative reaction rates for salivary amylase and arginase at different pH values.

- (a) On the graph grid provided, plot a graph of the relative rates for BOTH salivary amylase and arginase. [6 marks]

TABLE 1: REACTION RATES FOR TWO ENZYMES

pH values	Relative reaction rates	
	Salivary amylase (units)	Arginase (units)
4.5	2.2	0
5.0	5.0	0
5.5	8.0	0.2
6.0	13.0	1.0
6.5	17.0	4.0
7.0	18.0	7.0
7.5	16.0	9.0
8.0	11.0	11.8
8.5	6.0	13.5
9.0	2.0	16.0
9.5		18.0
10.0		17.8
10.5		15.0
11.0		14.0

- (b) Using the graph, determine the optimal pH for
- (i) arginase activity _____ [1 mark]
- (ii) salivary amylase activity _____ [1 mark]

- (c) Compound X is a substrate that has two parts, Part 1 and Part 2. Part 1 can be digested **ONLY** by arginase and Part 2 **ONLY** by salivary amylase. Both enzymes are required for the complete digestion of compound X.

Determine the optimal pH at which BOTH of these enzymes together digest compound X.

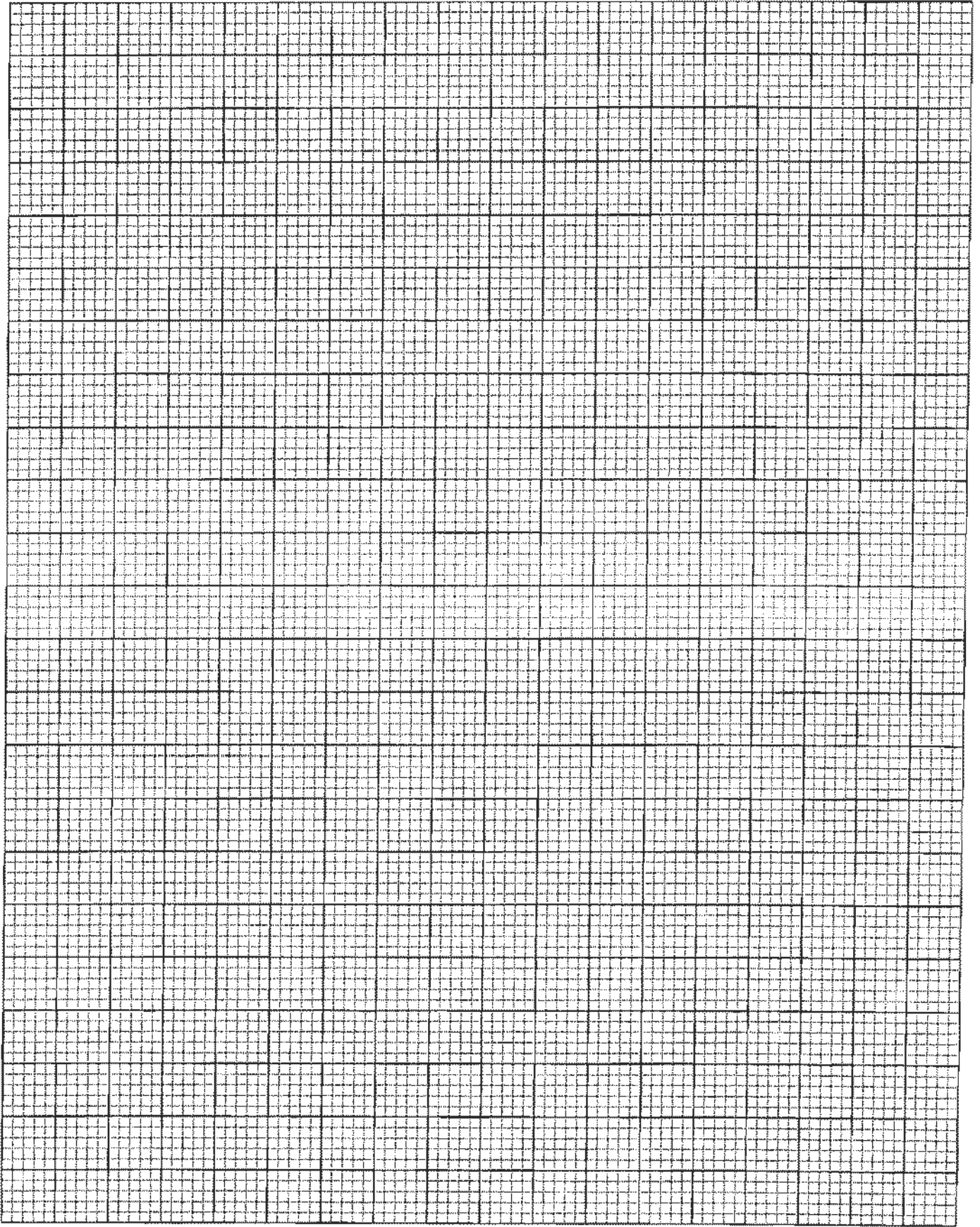
_____ [1 mark]

- (d) Name TWO factors, in addition to pH, that can affect an enzyme's catalytic activity.

_____ [1 mark]

Total 10 marks

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2. (a) Consider the following hormones:--

(F) Follicle Stimulating Hormone

(L) Leutenizing Hormone

(O) Oestrogen

(P) Progesterone (when not pregnant)

Write the circled symbol for EACH hormone on the graph in Figure 1 at the exact day where the hormone is at its maximum concentration during the menstrual cycle. (You may sketch in the graph lines to assist you if you wish.)

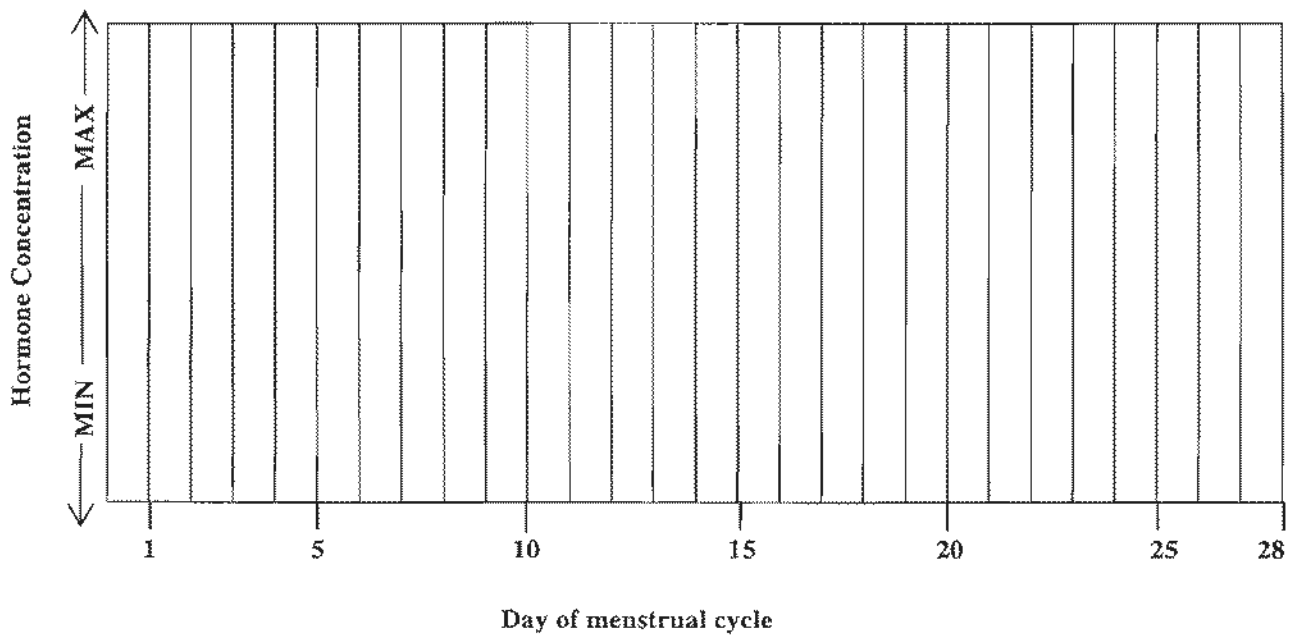


Figure 1. Hormone at its maximum concentration

[3 marks]

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- (b) Figure 2 is a microscopic section of a human ovary.

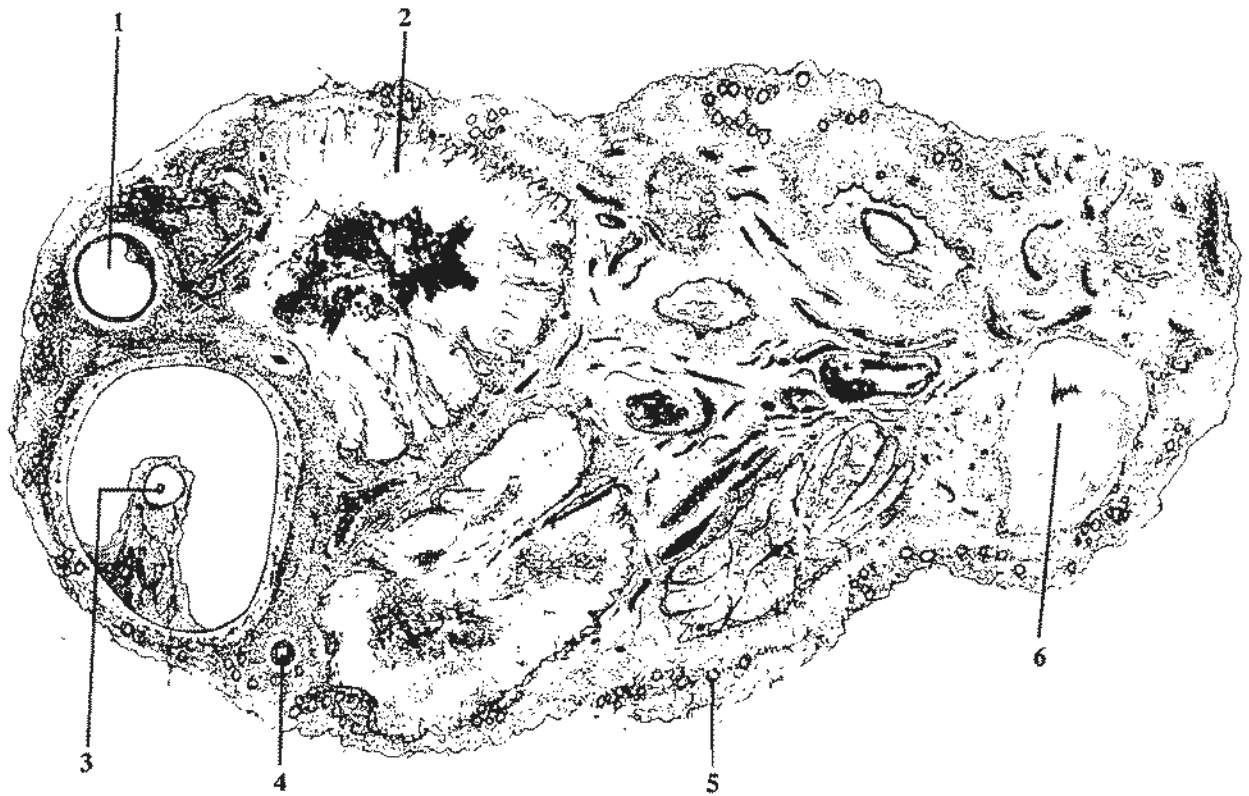


Figure 2. Section of a human ovary

*Histology Colour Atlas of Microscopic Anatomy, 3rd Edition. Sobotta/Hammerson
Urban and Schwarzenberg Inc.*

- (i) In the space provided below, at a magnification of 0.5, draw a plan diagram of the ovary in Figure 2 to show the distribution of the major tissues.

[3 marks]

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(ii) Identify structures 1 to 6 in Figure 2.

1: _____ 2: _____

3: _____ 4: _____

5: _____ 6: _____

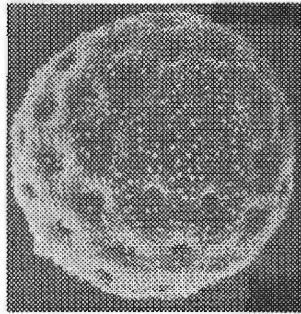
[3 marks]

(c) If the length of the human ovary is 3.5 cm, what is the magnification of your drawing in (b) (i)?

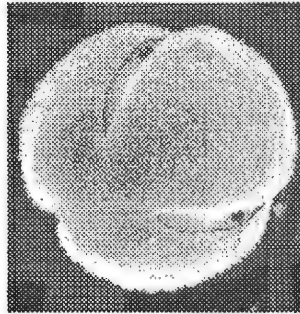
[1 mark]

Total 10 marks

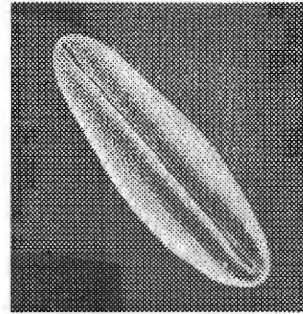
3. Figure 3 below consists of five scanning electronmicrographs of angiosperm pollen grains, showing aperture types and surface features.



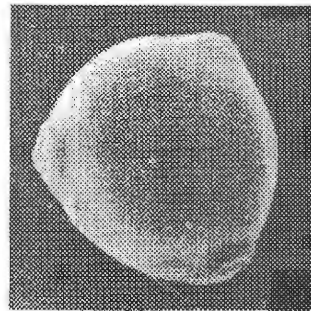
*Chenopodium
oahuense*
Many pores
Diameter: 14 μm



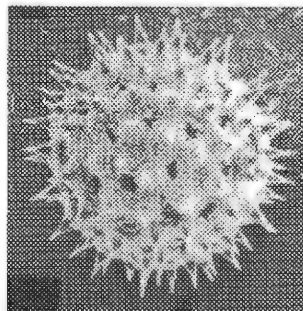
Scuevola glabra
Three pores three slits
Diameter: 33 μm



*Magnolia
grandiflora*
One slit
Diameter: 34 μm



Cucumis sativus
Three pores
Diameter: 55 μm



Ipomea wolcottiana
Many pores
Diameter: 55 μm

Plant Systematics: A Phylogentic Approach, 2nd Edition.
W. Judd et al. Sinauer Associates Inc.

Figure 3. Angiosperm pollen grains

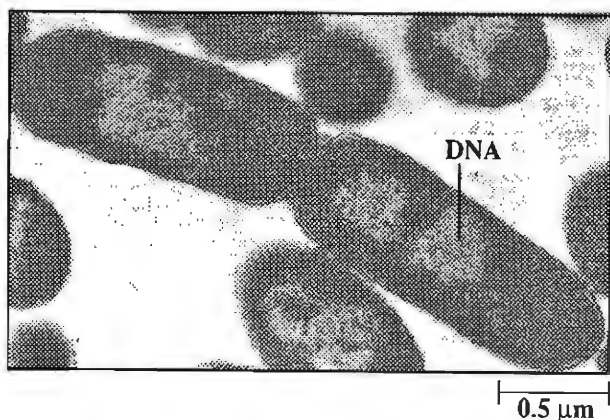
- (a) Using any feature of the pollen grains shown in Figure 3, create a set of dichotomous keys to distinguish between the plants by means of their pollen grains.

[3 marks]

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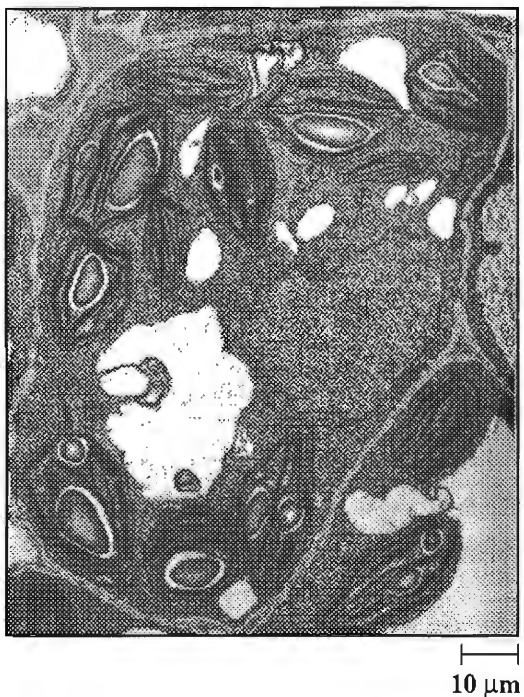
- (b) The five-kingdom classification system consists of the kingdoms: Monera, Protocista, Fungi, Plantae and Animalia.

Using your knowledge of the distinguishing features of the kingdoms and clearly stating which features have been used, determine to which kingdom EACH of the cells in Figure 4 belongs.



Kingdom _____

Features _____

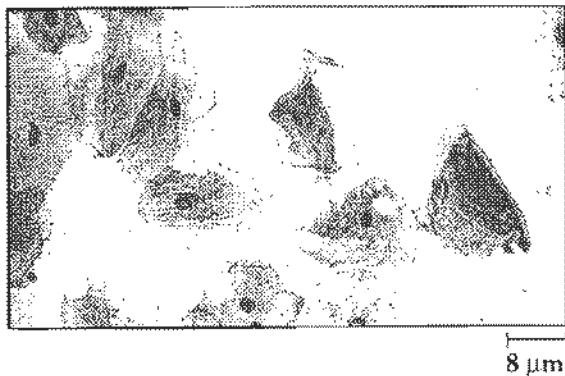


Kingdom _____

Features _____

Biology of Plants, 6th Edition.
P. Raven, R. F. Evert, S. Eichhorn.
W. H. Freeman and Co/Worth Publishers

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Kingdom _____

Features _____

CXC Biology, 3rd Edition.
L. Chinnery et al.
Cambridge University Press

Figure 4. Three types of cells

[6 marks]

- (c) Classification systems are hierarchical in nature.

List the SEVEN categories used in modern classification, starting with the broadest and proceeding to the narrowest category.

[1 mark]

Total 10 marks

SECTION B

You must answer **THREE** questions in this section. Answer **ONE** question **EACH** from Modules 1, 2 and 3. You **MUST** write your answers in the answer booklet provided.

MODULE 1

Answer **EITHER** Question 4 **OR** Question 5.

4. (a) Draw a large, labelled diagram to show the structure and composition of the fluid mosaic membrane.

Describe the function of **FOUR** of the labelled structures. [8 marks]

- (b) Red blood cells, separated from the blood, are placed in fluid on slides A and B. A contains distilled water and B contains molar salt solution. After 20 minutes, all the cells in A burst and those in B are small with wrinkled membranes.

Discuss the processes involved and give reasons for these results. [6 marks]

- (c) Discuss the mode of operation of primary pumps for moving ions in and out of cells. [6 marks]

Total 20 marks

5. (a) Describe the structure and function of **EACH** of the following:

(i) Endoplasmic reticulum

(ii) Golgi apparatus

(iii) Nucleus

(iv) Chloroplasts

(v) Mitochondria [10 marks]

- (b) With reference to the resolving power of the light microscope, and the electron microscope, explain the use **and** importance of microscopes in biology. [4 marks]

- (c) Examine the following list of structures:

Flower

Mammalian skin

Xylem

Clearly indicate if **EACH** structure in the list is an organ or a tissue. Give **TWO** reasons for **EACH** choice. [6 marks]

Total 20 marks

GO ON TO THE NEXT PAGE

MODULE 2

Answer EITHER Question 6 OR Question 7.

6. (a) Give the names of **THREE** hormones which control sperm production. State the origin and effect of **EACH**. [3 marks]
- (b) Describe the meiotic sequence which occurs in spermatogenesis in the primary spermatocyte from Prophase I to late Anaphase I. [7 marks]
- (c) (i) What structural features or conditions of the female reproductive system must sperm overcome in order to reach from the vagina to the fertilization site? [2 marks]
- (ii) The contraceptive methods in current use have been devised through a knowledge of the processes which normally ensure fertilization.

For **EIGHT** contraceptive methods, comment on the structural or physiological means by which they prevent fertilization. [8 marks]

Total 20 marks

7. (a) Describe the stages of mitosis and indicate clearly how this process ensures that **EACH** daughter nucleus receives a full set of chromosomes. [10 marks]
- (b) Nerve cells in the adult human central nervous system and heart muscle cells remain in interphase while epidermal cells of the skin divide frequently.

With reference to the **functions** of mitotic cell division in the lives of organisms:

- (i) Discuss why damage to the heart and the nervous system (for example, during a stroke) is dangerous. [2 marks]
- (ii) Suggest the effects that would occur if mitosis in skin epidermis were blocked. [2 marks]
- (c) Explain the degree of genetic variability that occurs among asexually reproducing organisms, self-fertilizing organisms and bisexual (male and female) organisms. Give reasons for the degree of genetic variability that occurs. [6 marks]

Total 20 marks

GO ON TO THE NEXT PAGE

MODULE 3

Answer EITHER Question 8 OR Question 9.

8. (a) Using ONE example of epistasis, explain how **and** why the F₂ phenotypes of a dihybrid cross might fail to show the normal 9 : 3 : 3 : 1 ratio for the two characters.

[10 marks]

- (b) The χ^2 test (chi-squared test) is a method used to estimate the probability that the difference between observed results (O), and expected results (E), is due to chance alone.

Plants grown from smooth seeds, (SS dominant) were crossed with plants from wrinkled seeds, (ss recessive). The F₁ progeny were all Ss. The F₂ generation produced 90 smooth seeds and 22 wrinkled seeds.

- (i) Show how you would set out a table to apply the formula:

$$\chi^2 = \sum \left(\frac{(O - E)^2}{E} \right)$$

to find the value of χ^2 where O is the observed and E the expected result.

[6 marks]

- (ii) Once χ^2 is known, how would you use a table of χ^2 values to determine the probability that the difference between observed and expected results is due to chance alone?

[4 marks]

Total 20 marks

9. (a) (i) Describe the THREE types of natural selection. [6 marks]

- (ii) Explain how environmental factors can act as forces of natural selection.

[4 marks]

- (b) (i) A single species of brown cats lives in a relatively homogeneous habitat. An earthquake causes a canyon to be formed which splits the habitat into two parts, dividing the cats into two populations. Environmental pressures cause the emergence of white cats in one population. Sediments gradually fill in the canyon and the two populations of cats now share the same habitat again but they cannot interbreed.

Identify the TYPE of speciation that occurred **and** indicate the mechanisms that contributed to it.

[5 marks]

- (ii) A single species of green tortoise occupies a homogeneous habitat. Climate change causes the formation of two distinctly different habitats that are still in the same general region. Environmental pressures in the two habitats lead to the emergence of brown tortoises in one habitat and green tortoises in the other. The green and brown tortoises cannot now interbreed.

Identify the type of speciation that occurred **and** indicate the mechanisms that contributed to it.

[5 marks]

Total 20 marks

END OF TEST

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