

SECTION A

Read carefully

- 1 Check that the answer sheet provided is for Biology Higher (Section A).
- 2 Fill in the details required on the answer sheet.
- 3 In this section a question is answered by indicating the choice A, B, C or D by a stroke made in ink in the appropriate place in the answer sheet—see the sample question below.
- 4 For each question there is only **one** correct answer.
- 5 Rough working, if required, should be done only on this question paper—or on the rough working sheet provided—**not** on the answer sheet.
- 6 At the end of the examination the answer sheet for Section A **must** be placed inside the front cover of this answer book.

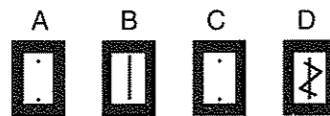
Sample Question

The apparatus used to determine the energy stored in a foodstuff is a

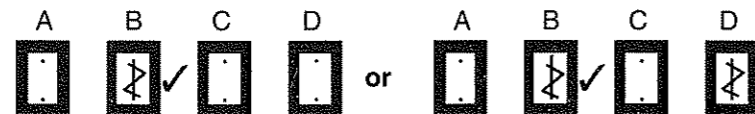
- A respirometer
- B calorimeter
- C klinostat
- D gas burette.

The correct answer is **B**—calorimeter. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown in the example on the answer sheet.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer D to an answer B, your answer sheet would look like this:



If you want to change back to an answer which has already been scored out, you should enter a tick (✓) to the **right** of the box of your choice, thus:



SECTION A

All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

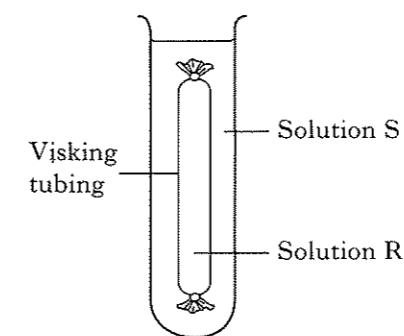
1. When an animal cell is immersed in a hypotonic solution it will
 - A burst
 - B become turgid
 - C shrink
 - D become flaccid.
2. Which statement referring to plant cell walls is correct?

They contain

 - A phospholipids and are permeable to solutes
 - B carbohydrate and are permeable to solutes
 - C phospholipids and are selectively permeable to solutes
 - D carbohydrate and are selectively permeable to solutes.
3. Visking tubing is selectively permeable. In the experiment shown below to demonstrate osmosis, the following results were obtained.

Initial mass of Visking tubing + contents = 10.0 g

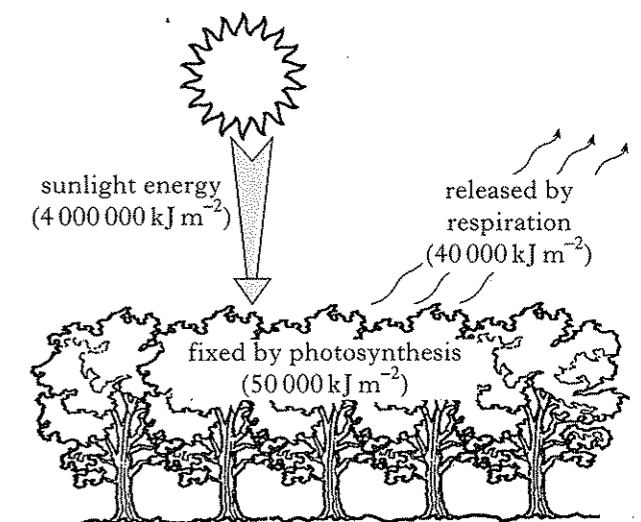
Mass of Visking tubing + contents after experiment = 8.2 g



The results shown would be obtained when

- A R is a 5% salt solution and S is a 10% salt solution
- B R is a 10% salt solution and S is a 5% salt solution
- C R is a 10% salt solution and S is water
- D R is a 5% salt solution and S is water.

4. The diagram below shows the energy flow in an area of forest canopy during 1 year.



What percentages of available sunlight energy are fixed by the trees in photosynthesis and are present in new growth and stored food?

	Percentage of available energy fixed in photosynthesis	Percentage of available energy present in new growth and stored food
A	0.25	2.25
B	1.00	1.25
<input checked="" type="radio"/> C	1.25	0.25
D	2.25	1.00

5. If a DNA molecule contains 8000 nucleotides of which 20% are adenine, then the number of guanine nucleotides present is
 - A 1600
 - B 2000
 - C 2400
 - D 3200.

[Turn over

6. Which of the following is composed of protein?
- A Antibody
B Glycogen
C Nucleotide
D Polysaccharide

7. The stages of infection of a host cell by a virus are listed below.

- 1 Host cell bursts, releasing new viruses.
- 2 Host cell DNA is inactivated.
- 3 Virus binds to host cell and injects DNA.
- 4 Virus DNA directs synthesis of new viruses.

The sequence in which these events occurs is

- A 3,2,4,1
B 1,2,4,3
C 3,4,2,1
D 2,4,3,1.

8. Which of the following correctly identifies the functions of phagocytes and lymphocytes?

- A Phagocytes produce antibodies; lymphocytes engulf bacteria.
B Phagocytes engulf bacteria; lymphocytes produce antibodies.
C Phagocytes produce antigens; lymphocytes produce antibodies.
D Phagocytes produce antibodies; lymphocytes produce antigens.

9. In tomato plants, the allele for purple stem **P** is dominant to its allele for green stem **p** and the allele for hairy stem **H** is dominant to its allele for smooth stem **h**. The following cross was carried out



32 offspring were produced from this cross.

How many offspring would be expected to have purple, smooth stems?

- A 24
B 16
C 8
D 4

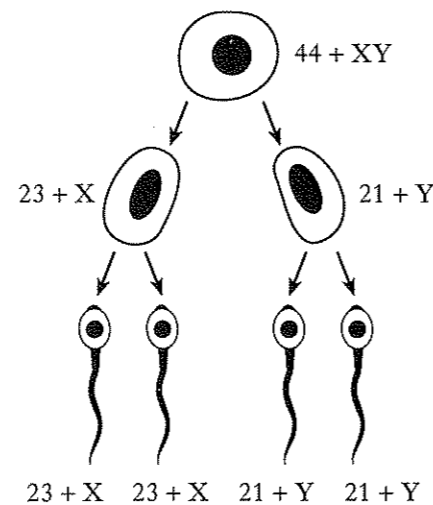
10. A cross between two pea plants, one of which was heterozygous for seed colour and shape, produced offspring in the ratio of 3 with yellow, round seeds : 1 with yellow, wrinkled seeds.

What was the genotype of the other parent?

- A Heterozygous for colour and shape
B Homozygous for seed colour only
C Homozygous for colour and shape
D Homozygous for seed shape only

Questions 11 and 12 refer to the information below.

The diagram shows the chromosome complement of cells during the development of abnormal sperm.

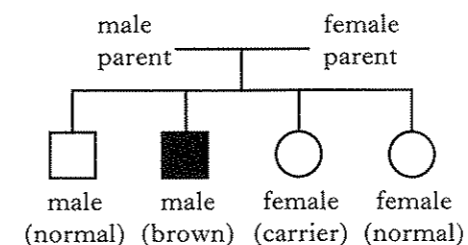


11. The diagram illustrates the effect of
- A crossing over
B polygenic inheritance
C non-disjunction
D independent assortment of chromosomes.

12. A sperm with chromosome complement 23 + X fertilises a normal haploid egg. What is the chromosome number and sex of the resulting zygote?

	Chromosome number	Sex of zygote
A	24	female
B	46	female
C	46	male
D	47	female

13. The colour of tooth enamel is a sex-linked characteristic. The allele for brown tooth enamel (**e**) is recessive to the allele for normal tooth enamel (**E**). The following family tree refers to this condition.



What are the genotypes of the parents?

- A $X^E Y$ and $X^E X^e$
B $X^E Y$ and $X^e X^e$
C $X^e Y$ and $X^E X^E$
D $X^e Y$ and $X^E X^e$

14. Four genes, **P**, **R**, **S** and **T** are found on a pair of homologous chromosomes. Crosses were carried out and the cross-over value calculated, giving the following results.

Cross	Cross-over value
$PpRr \times ppr$	32
$PpSs \times pss$	4
$RrSs \times rrs$	28
$RrTt \times rtt$	10

Which of the following is the most likely sequence of genes on the chromosome?

- A P T S R
B R S P T
C S P R T
D T R S P

15. The dark variety of the peppered moth became common in industrial areas of Britain following the increase in the production of soot during the Industrial Revolution.

The increase in the dark form was due to

- A dark moths migrating to areas which gave the best camouflage
B a change in the prey species taken by birds
C an increase in the mutation rate
D a change in selection pressure.

16. A new species of organism is considered to have evolved when a population

- A is isolated from the rest of the population by a geographical barrier
B shows increased variation due to mutations
C can no longer interbreed with the rest of the population
D is subjected to increased selection pressures in its habitat.

17. Reproductive incompatibility between different species of plant may be overcome by

- A recombinant DNA technology
B the use of mutagens
C somatic fusion of cells
D using polyploid parents.

18. The table shows the effect of the water content of the guard cells on the state of a stoma. Which line is correct?

	stoma open/closed	state of guard cells
A	open	flaccid
B	open	plasmolysed
C	closed	flaccid
D	closed	turgid

[Turn over

19. Which of the following are adaptations of xerophytic plants?

- A Leaves with small surface area and a thin waxy cuticle
- B Leaves which are rolled and covered in hairs
- C Leaves with a large surface area and a thick waxy cuticle
- D Leaves which are hairy and have many stomata

20. Grass is a plant which can survive despite being grazed constantly by herbivores such as sheep and cattle. It is able to tolerate grazing because

- A it is a wind-pollinated plant
- B it grows constantly throughout the year
- C it possesses poisons which protect it from being eaten entirely
- D it has very low growing points which send up new leaves when older ones are eaten.

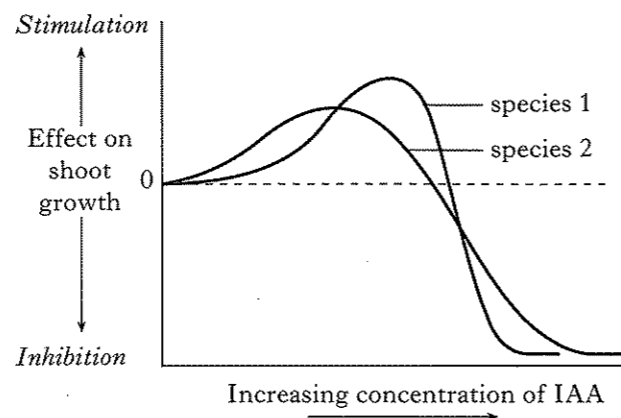
21. Phenylketonuria is a condition that results from

- A differential gene expression
- B chromosome non-disjunction
- C the influence of an environmental factor
- D an inherited gene mutation.

22. The plant growth substance IAA (indole acetic acid) is of benefit to humans because it can function

- A as a herbicide and as a rooting powder
- B as a herbicide and to break dormancy
- C in the malting of barley and to break dormancy
- D as a rooting powder and in the malting of barley.

23. An investigation was carried out into the effect of IAA concentration on the growth of shoots of two species of plant. The graph below gives a summary of the results.



Which one of the following conclusions is justified?

- A Species 1 shows its maximum stimulation at a lower IAA concentration than species 2
- B Species 2 is more inhibited by the highest concentrations of IAA than species 1
- C Species 2 is stimulated over a greater range of IAA concentrations than species 1
- D Species 1 is stimulated by some IAA concentrations which inhibit species 2

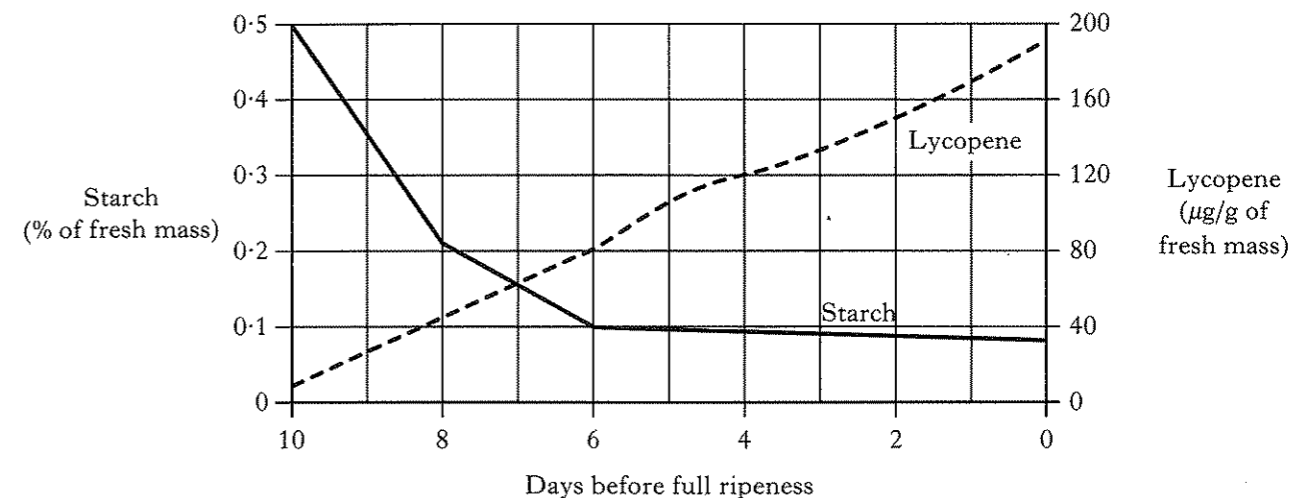
24. Which of the following developments, in the growth of a flowering plant, is caused by gibberellic acid (GA)?

- A Growth of dwarf plants to normal heights
- B Breakdown of cellulose by barley embryos
- C Leaf abscission
- D Stimulation of fruit formation

25. Plants grown in the dark have

- A green leaves and short internodes
- B green leaves and long internodes
- C yellow leaves and short internodes
- D yellow leaves and long internodes.

26. The graph shows the changes in concentration of starch and of a red pigment, lycopene, which occur as tomatoes ripen.



What valid conclusion may be made from the graph?

During the ripening process of tomatoes,

- A starch is converted into the red pigment lycopene
- B starch is broken down and lycopene is synthesised
- C starch is broken down to provide energy for the synthesis of lycopene
- D the faster starch is broken down, the greater the rate of synthesis of lycopene.

27. Which line identifies correctly the effect of increased secretion of Anti Diuretic hormone (ADH) on the composition and volume of urine?

	Concentration of urea	Concentration of glucose	Volume of urine
A	no change	no change	increase
B	increase	increase	decrease
C	increase	no change	decrease
D	decrease	no change	increase

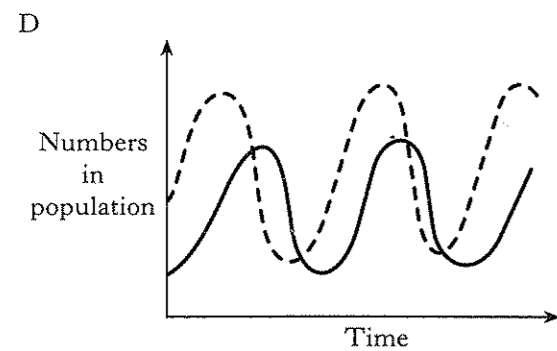
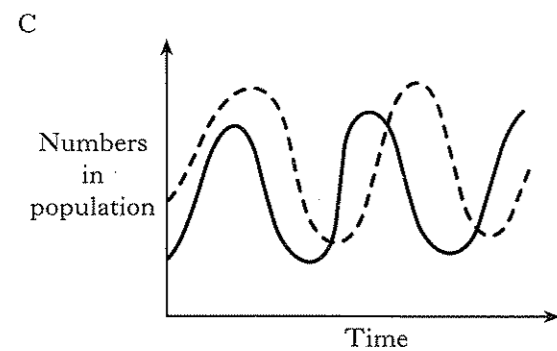
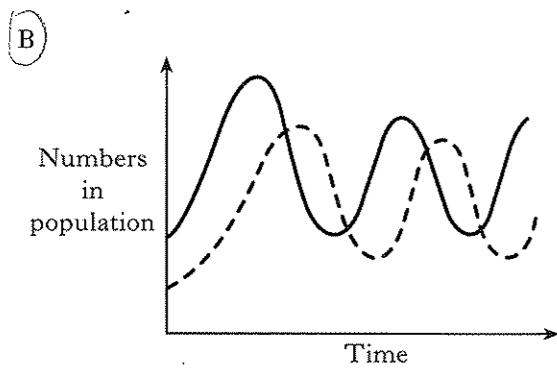
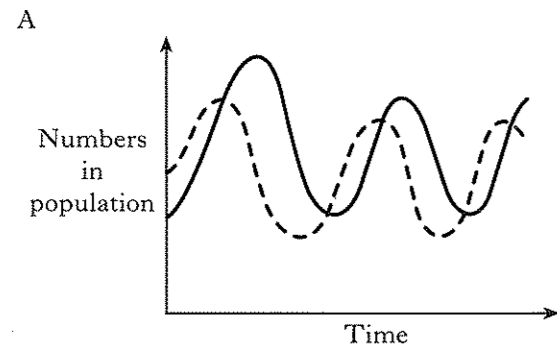
28. Which of the following correctly identifies the locations of the centres that monitor blood water concentration and temperature in humans?

	Blood water concentration	Temperature
A	Hypothalamus	Pituitary gland
B	Hypothalamus	Hypothalamus
C	Pituitary gland	Hypothalamus
D	Pituitary gland	Pituitary gland

[Turn over

29. Which of the following graphs correctly shows the relationship between prey and predator populations?

Key
 ——— prey
 - - - predator



30. List P gives three reasons why population monitoring may be carried out.

List Q gives three species that are monitored by scientists.

List P

List Q

- | | |
|--------------------------|------------------|
| 1 Valuable food resource | W Stonefly |
| 2 Endangered species | X Humpback whale |
| 3 Indicator species | Y Haddock |

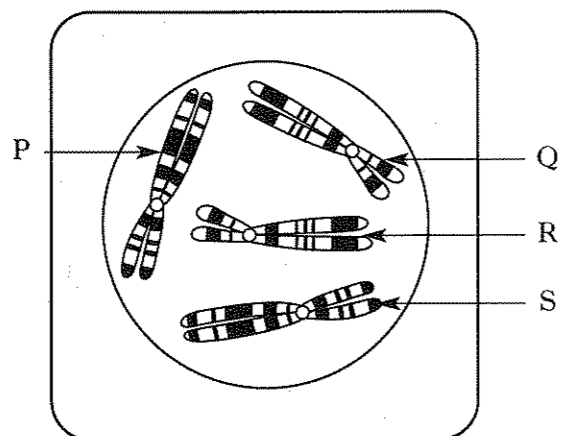
Which of the following correctly matches reasons from list P with organisms from list Q?

	Reasons		
	1	2	3
A	W	X	Y
B	Y	W	X
C	X	Y	W
D	Y	X	W

[Turn over for Section B on Page ten]

Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of this answer book.

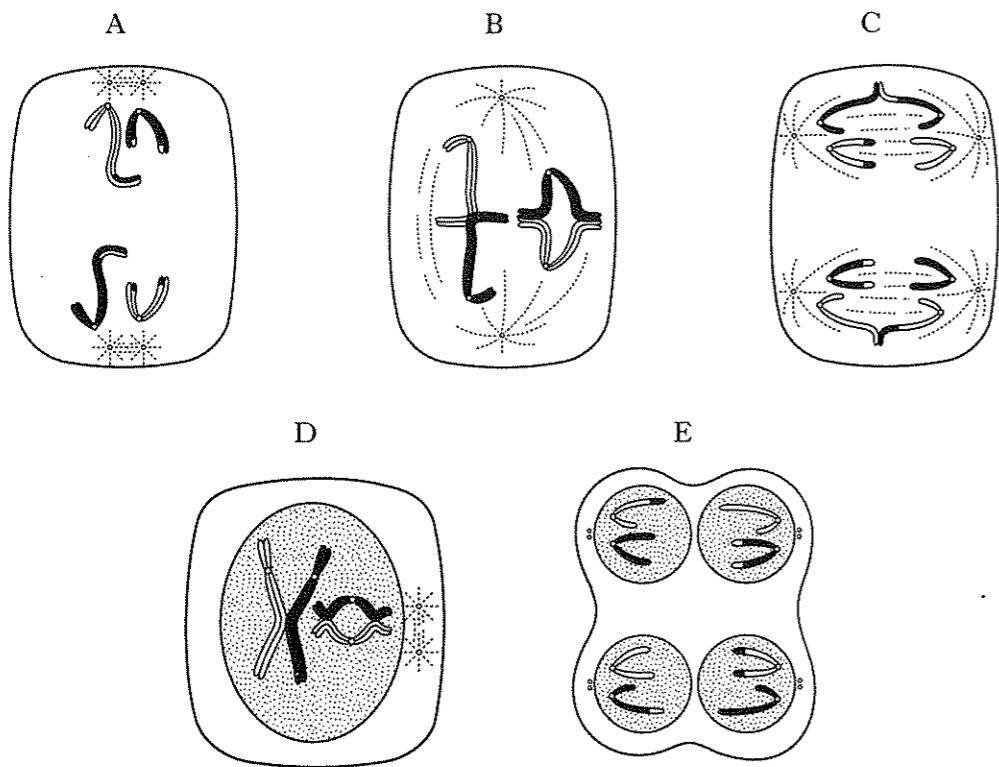
6. (a) The diagram below represents an early stage in the process of meiosis in a cell from the testes of an insect.



Which letter shows the homologous partner of chromosome P?

Letter S

- (b) The diagrams below show five later stages in the process of meiosis. The diagrams are **not** in the correct order.



Using the letters, show the order in which these stages occur during the process of meiosis.

_____ → _____ → _____ → _____ → _____

Marks

1

1

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6. (continued)

- (c) Apart from mutations, state **two** other events which occur during meiosis that result in genetic variation.

1 _____

2 _____

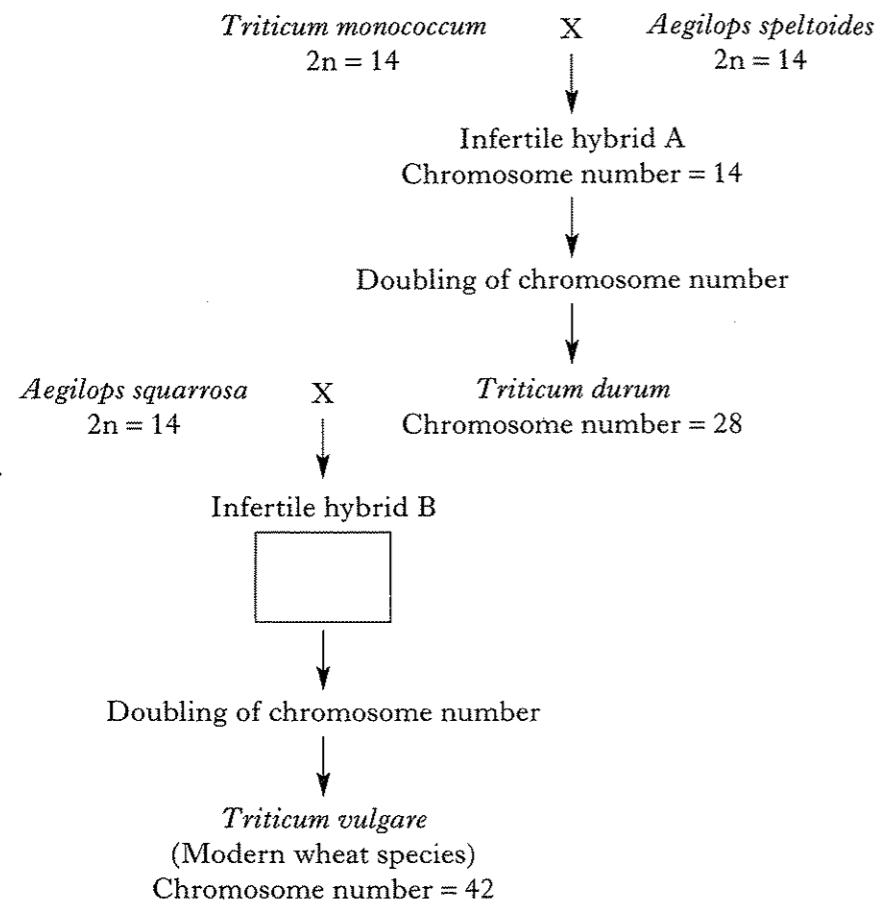
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7. The diagram below represents the evolution of one species of modern wheat (*Triticum vulgare*) through polyploidy.



(a) Write the chromosome number of infertile hybrid B into the box in the diagram.

(b) By how many times is the haploid number of modern wheat greater than that of the earliest wheat *Triticum monococcum*?
Space for calculation

Number of times _____ 1

(c) Name the **two** species in the diagram which can be described as being polyploid.

1 _____ 2 _____ 1

Marks

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7. (continued)

(d) Give **one** advantage for humans of polyploidy in crop plants such as wheat.

1

(e) Why is it important to conserve species of *Triticum* such as *Triticum durum* and *Triticum monococcum*?

1

[Turn over

Marks

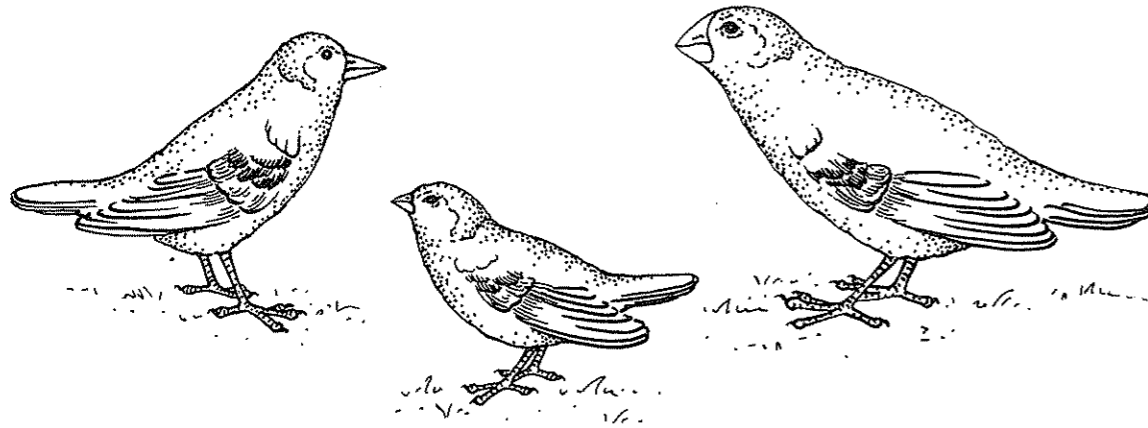
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8. (a) The Galapagos islands are an isolated group of islands that lie 1500 kilometres from the mainland of South America. Marks

It is believed that at one time in the past, members of a species of finch were blown across to the islands and evolved in isolation.

There are now 14 species of finch on the islands. Each species exploits a different food source. This can best be seen from the shapes of their beaks.

The diagrams below show the beaks of three different species of finch on the islands.



(i) Explain how the evolution of these species of finch illustrates adaptive radiation.

2

(ii) Name **two** isolation mechanisms involved in the evolution of new species.

1 _____

2 _____

1

8. (continued)

Marks

(b) The table below shows the mass of water gained and lost by a desert rat over a 24 hour period.

	Mass of water lost or gained (g)
Food	6
Metabolic water	54
Exhalation	45
Urine	12
Faeces	3

(i) What evidence from the table supports the statement that homeostatic control of water occurs in desert rats?

1

(ii) Describe **one** behavioural adaptation shown by the desert rat to reduce water loss and explain how this helps in water conservation.

Adaptation _____

Explanation _____

1

[Turn over

9. (a) A species of marine worm responds to sudden decreases in light intensity by withdrawing into its tube. Marks

In an experiment, 20 worms were exposed to the stimulus at 1 minute intervals for 6 minutes.

Trial number	Number of worms showing a response
1	20
2	20
3	16
4	10
5	4
6	0

(i) Complete the table below by inserting the type of behaviour shown at trials 1 and 6.

Trial number	Type of behaviour
1	
6	

(ii) What is the advantage to the marine worms of the change in behaviour that occurs between trials 1 and 6?

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Marks

2

1

9. (continued)

(b) Hawks are predators which attack flocks of pigeons. The table shows how the percentage of attack success of a predatory hawk varies with the number of pigeons in the flock.

Number of pigeons in the flock	% attack success
2	80
10	50
20	40
40	15

Suggest an explanation for the effect of flock size on attack success shown in the table.

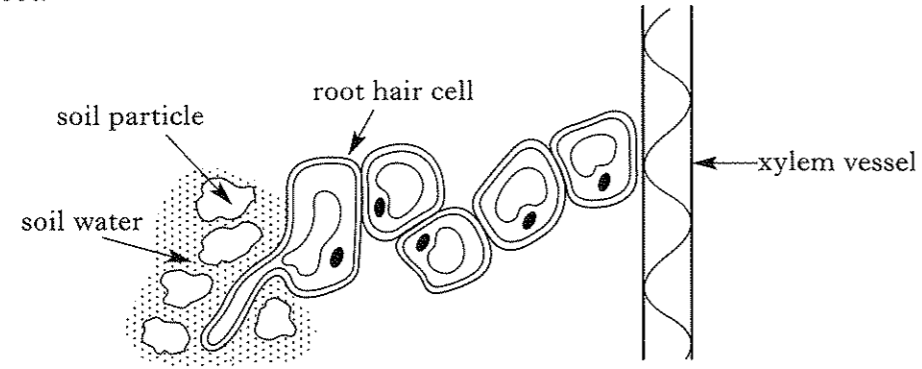
1

(c) Some hawk species show cooperative hunting behaviour. Explain **one** advantage of this type of behaviour.

1

[Turn over

10. (a) The diagram below represents the appearance of some of the cells in a plant root.



- (i) Explain how water moves from the soil into the root hair cell.

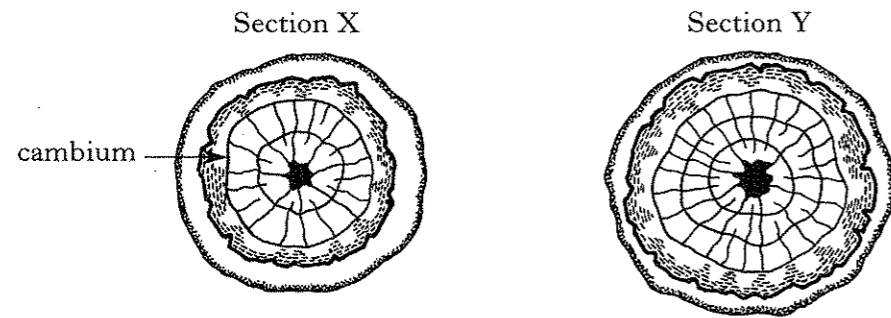
2

- (ii) Name the two forces which allow water to rise as a continuous column within the xylem vessel.

1 _____ 2 _____

1

- (b) The diagram below shows two transverse sections of a stem taken from the same branch.



- (i) State the number of annual rings present in each section.

Section X _____ Section Y _____

1

- (ii) State the role of cambium in the formation of annual rings.

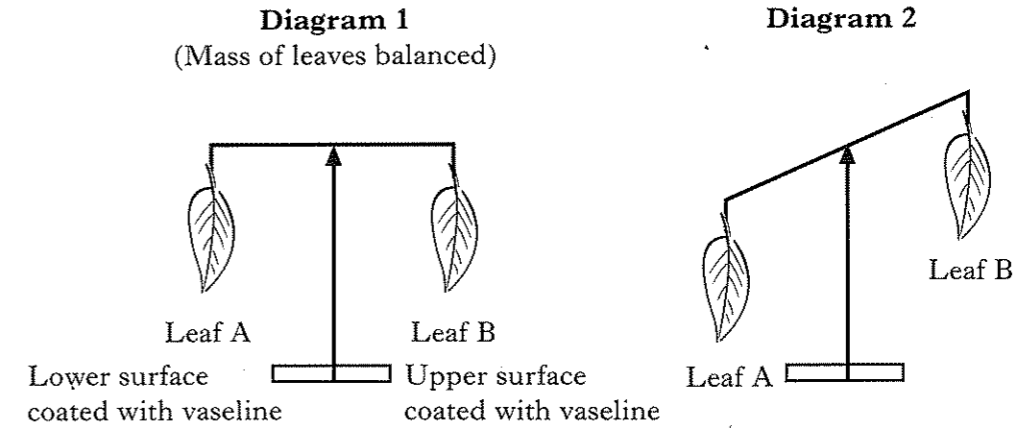
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- (iii) Describe **one** way in which the structure of a spring xylem vessel differs from that of a summer xylem vessel.

1

10. (continued)

- (c) Leaves of the same surface area from the same shrub were treated as shown in **Diagram 1** below. The results after 1 hour, in conditions that promoted water loss, are shown in **Diagram 2**.



- (i) In the following sentences, **underline** one of the alternatives in each pair to make the sentences correct.

The leaf which has $\left\{ \begin{array}{l} \text{more} \\ \text{fewer} \end{array} \right\}$ stomata exposed will lose more mass.

This is $\left\{ \begin{array}{l} \text{leaf A} \\ \text{leaf B} \end{array} \right\}$ which shows that more stomata are present on the $\left\{ \begin{array}{l} \text{upper} \\ \text{lower} \end{array} \right\}$ leaf surface.

1

- (ii) Name a factor that affects the rate of transpiration. Explain how changes in this factor can cause a decrease in the rate of transpiration.

Factor _____

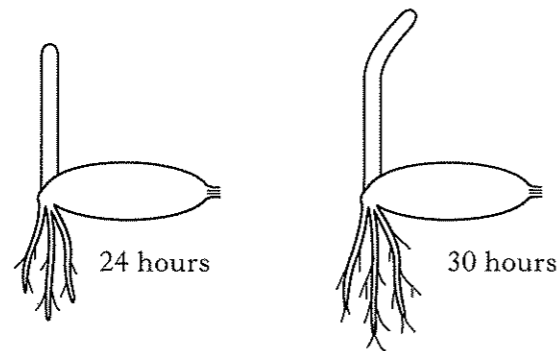
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Explanation _____

1

[Turn over

11. The diagrams below represent the same barley seedling at 24 hours and 30 hours after germination.



- (a) Describe the environmental condition which would result in the direction of shoot growth shown at 30 hours.

1

- (b) Gibberellic acid (GA) has a role in the germination of barley grains.

- (i) Name the part of the barley grain that produces GA.

Name _____

1

- (ii) GA causes part of the barley grain to produce an enzyme. Name the part of the grain and the enzyme produced.

Part of barley grain _____

Enzyme _____

1

- (c) Describe the role of Indole Acetic Acid (IAA) in apical dominance.

1

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12. Flower production in plants may be controlled by the photoperiod.

- (a) Explain what is meant by "photoperiod."

1

- (b) In an experiment, four plants of the same species were exposed to repeated cycles of light and dark. The flowering responses are shown in the table below.

Plant	Light period (hours)	Dark period (hours)	Flowering response of plant
1	13	11	Flowers produced
2	14	10	No flowers produced
3	12	12	Flowers produced
4	15	9	No flowers produced

Using information from the table, complete the sentence below.

In order for plants of this species to flower, they require a minimum _____ period of _____ hours.

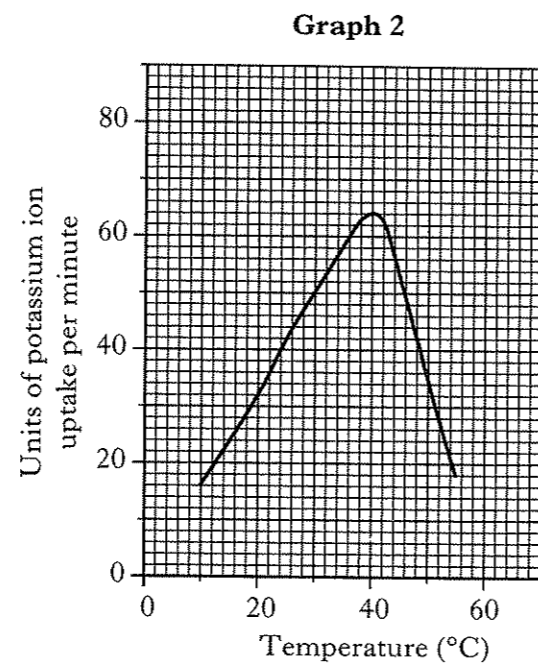
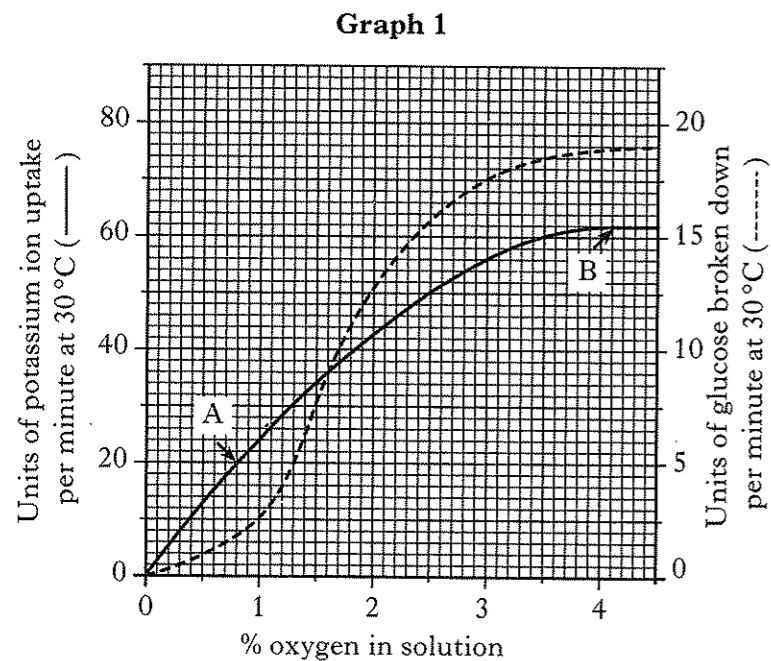
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13. An investigation was carried out into the uptake of potassium ions by animal cells.
Graph 1 shows the rates of potassium ion uptake and breakdown of glucose at 30 °C in solutions with different concentrations of oxygen.
Graph 2 shows the effect of temperature on the rate of uptake of potassium ions at a constant oxygen concentration.



- (a) From **Graph 1**, calculate the percentage increase in the rate of glucose breakdown when the concentration of oxygen in solution is increased from 1.0% to 1.5%.
Space for calculation

Percentage _____ % **1**

- (b) From **Graph 1**, explain the effect of increasing oxygen concentration on the rate of potassium ion uptake.

Marks

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2

13. (continued)

- (c) From the information in **Graphs 1** and **2**, find the oxygen concentration at which the results shown in **Graph 2** were obtained.
Space for calculation

% oxygen in solution _____ **1**

- (d) (i) What evidence from **Graph 1** supports the statement that the percentage of oxygen in solution is limiting potassium ion uptake at point A?

- (ii) Name a factor that could be limiting potassium ion uptake at point B on **Graph 1**.

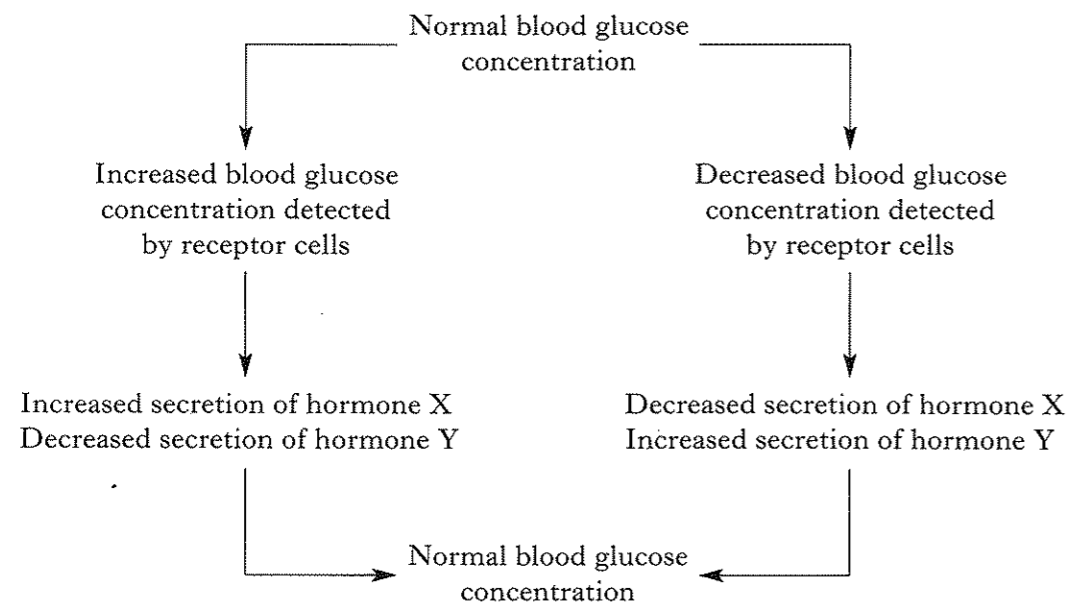
Factor _____ **1**

- (e) Express, as the **simplest whole number ratio**, the units of potassium ion uptake per minute at 10 °C, 20 °C and 40 °C.
Space for calculation

Ratio _____ : _____ : _____ **1**

[Turn over

14. (a) The flow chart below represents part of the homeostatic control of blood glucose concentration in a human.



(i) Name the organ that contains the receptor cells.

Name _____

(ii) Name hormones X and Y.

Hormone X _____

Hormone Y _____

(iii) Excess glucose is converted to a storage carbohydrate within a body organ. Name the storage carbohydrate and the body organ within which it is stored.

Carbohydrate _____

Organ _____

Marks

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14. (continued)

(b) The list below contains terms used to illustrate the control of lactose metabolism in the bacterium *Escherichia coli*.

List of terms

- Structural gene
- Repressor molecule
- Inducer
- Operator
- Regulator gene
- Lactose

Which term matches each of the following descriptions?

<i>Description</i>	<i>Term</i>
Produces repressor protein.	_____
Combines with lactose.	_____
Produces the lactose digesting enzyme.	_____
Acts as the inducer.	_____

3

[Turn over for Section C on Page thirty-six

Marks

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SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Questions 1 and 2 should be attempted on the blank pages which follow.

Supplementary sheets, if required, may be obtained from the invigilator.

Labelled diagrams may be used where appropriate.

1. Answer **either A or B.**

A. Write notes on each of the following:

- (i) succession and climax in plant communities;
- (ii) the influence of density-dependent factors on population changes.

OR

B. Write notes on each of the following:

- (i) the importance of nitrogen and magnesium in plant growth and development and symptoms of their deficiency;
- (ii) the importance of vitamin D and iron in humans.

In question 2, ONE mark is available for coherence and ONE mark is available for relevance.

2. Answer **either A or B.**

A. Give an account of production of protein by genetic engineering and state the advantages of this technique.

OR

B. Give an account of the osmotic problems of salt water bony fish and describe how water balance is maintained in such fish.

[END OF QUESTION PAPER]

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(10)

6

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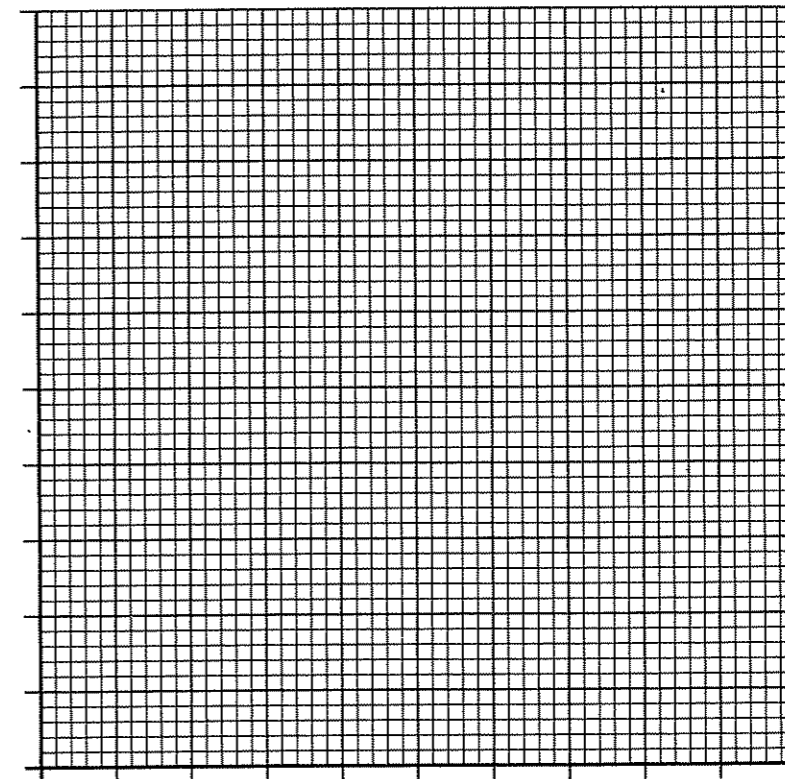
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(10)

(10)

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 4(d)



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