OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2804

Central Concepts

Tuesday **20 JUNE 2006** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator
Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read each question carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu	**Max.**	**Mark**
1	15	
2	15	
3	14	
4	10	
5	18	
6	11	
7	7	
TOTAL	90	

This question paper consists of 20 printed pages and 4 blank pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 **(a)** The following are different stages in meiosis. Each stage has been given a letter.

anaphase II	metaphase II	anaphase I	prophase I	telophase II	metaphase I
M	**N**	**P**	**Q**	**R**	**S**

(i) Using **only** the letters, arrange these stages in the correct sequence.

.....

..... [1]

(ii) State the letter of the stage when each of the following processes occur.

pairing of chromosomes .....

centromeres divide .....

crossing over .....

bivalents align on equator .....

nuclear membrane reforms ..... [5]

(iii) State **two** processes that occur in a cell during interphase to prepare for a meiotic division.

1 .....

2 ..... [2]

(b) Haemophilia A is a sex-linked genetic disease which results in the blood failing to clot properly. It is caused by a recessive allele on the X chromosome. Fig. 1.1 shows the occurrence of haemophilia in one family.

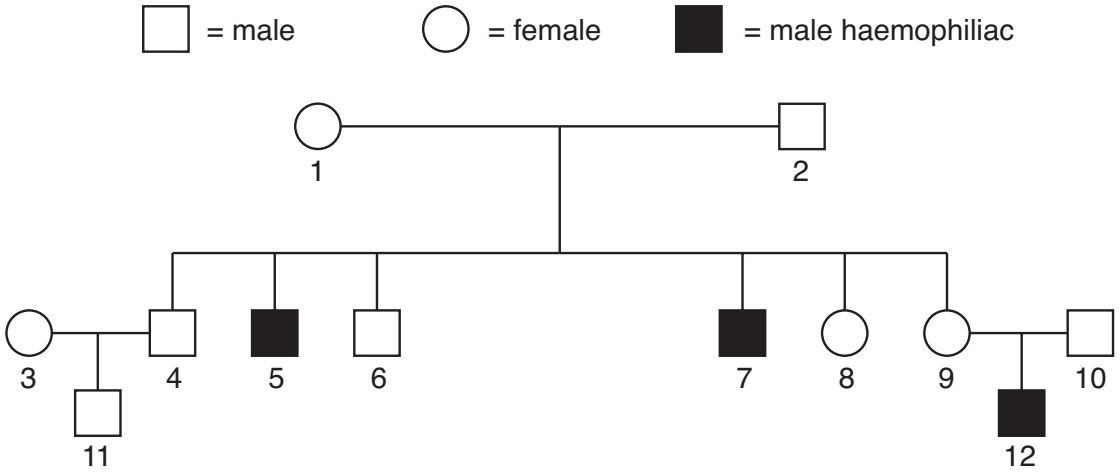

Fig. 1.1

(i) Using the following symbols:

H = dominant allele **h** = recessive allele

state the genotypes of the following individuals. The first one has been completed for you.

individual	genotype
1	X^HX^h
2	.....
5	.....
6	.....
9	.....

[4]

(ii) State the probability of individual 8 being a carrier of haemophilia.

..... [1]

(iii) Explain why only females can be carriers of haemophilia.

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..... [2]

[Total: 15]

[Turn over

2 An investigation was carried out into photosynthesis and respiration in a leaf. The net uptake of carbon dioxide by the leaf in bright light, and the mass of carbon dioxide released in the dark were determined at different temperatures. The results are shown in Table 2.1.

Table 2.1

temperature / °C	5	10	15	20	25	30
net uptake of CO_2 in bright light / mg g^{-1}dry mass h^{-1}	1.3	2.4	3.0	3.3	3.0	2.2
release of CO_2 in dark / mg g^{-1}dry mass h^{-1}	0.4	0.7	1.0	1.4	1.9	2.8
true rate of photosynthesis / mg CO_2 g^{-1}dry mass h^{-1}						

(a) (i) State **two** types of tissue in a leaf where there is a net uptake of carbon dioxide in bright light.

1 .....

2 ..... [2]

(ii) Assuming the rate of respiration in the light is equal to the rate of respiration in the dark, calculate the true rate of carbon dioxide uptake in photosynthesis at each temperature and **add the figures to Table 2.1.** [1]

(iii) The term temperature coefficient (Q_{10}) is used to express the effect of a 10 °C rise in temperature on the rate of a chemical reaction. It is calculated in the following way:

$$Q_{10} = \frac{\text{rate of reaction at } \mathbf{t} + 10\,°C}{\text{rate of reaction at } \mathbf{t}\,°C}$$

where **t** = any given temperature.

Between 5 °C and the optimum temperature for enzyme-catalysed reactions, the Q_{10} is approximately 2.

Discuss whether the data in Table 2.1 supports this statement for both respiration and photosynthesis.

respiration .....

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photosynthesis .....

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..... [4]

(iv) When plants are grown in glasshouses during autumn and winter, when the natural light intensities are low, it is important that temperatures are kept relatively low.

With reference to respiration **and** photosynthesis, explain why it is essential to do this.

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..... [3]

(b) The carbon dioxide taken up by a leaf enters the chloroplasts.

Name and describe the **biochemical pathway** which fixes the carbon dioxide into hexose sugars in the chloroplasts.

name of pathway .....

description .....

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..... [5]

[Total: 15]

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3 Fig. 3.1 is a diagram of a respirometer, which can be used to measure the oxygen uptake of woodlice.

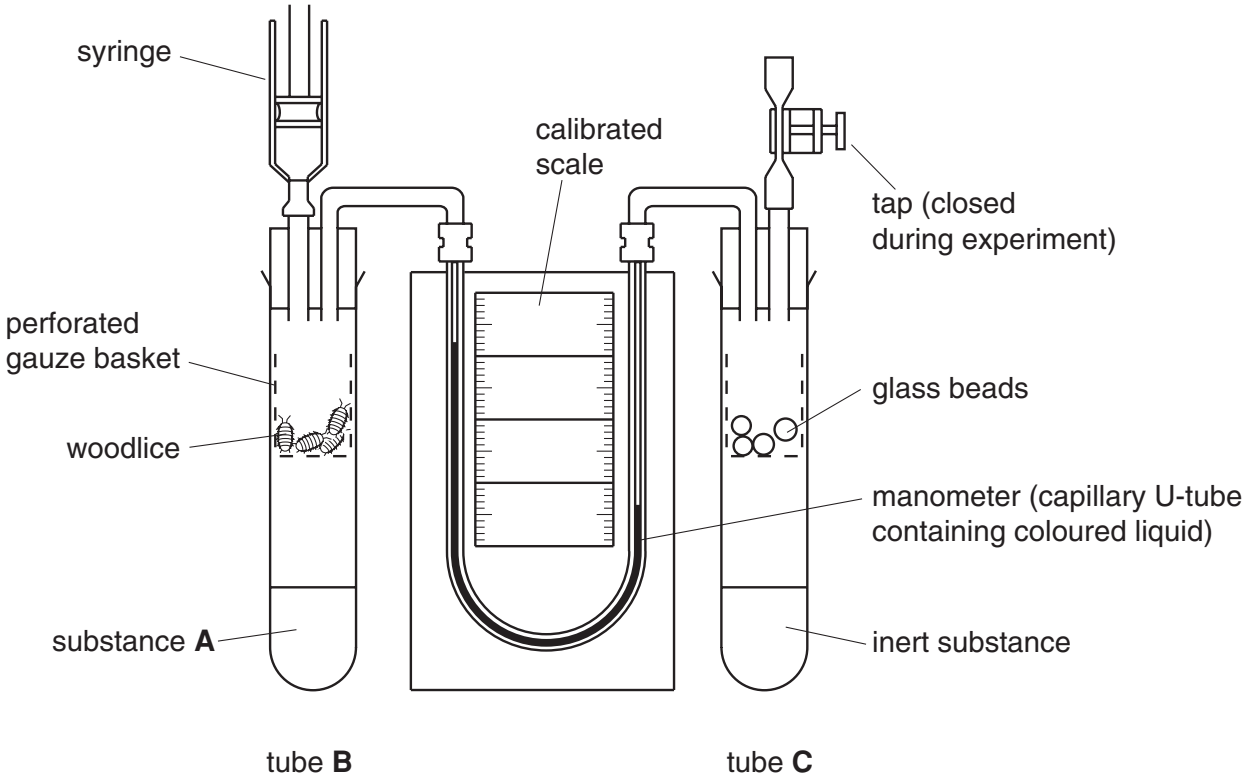

Fig. 3.1

(a) (i) Name substance **A**.

..... [1]

(ii) State the function of substance **A**.

..... [1]

(iii) Describe the function of the syringe in the respirometer.

.....

..... [1]

(b) The respirometer can be used to measure the respiratory quotient (RQ) of the respiring woodlice.

(i) Define the term *respiratory quotient*.

.....

.....

..... [1]

(ii) A student carried out an experiment to determine the RQ of the woodlice.

A value of 1.0 was obtained.

State the type of respiration taking place and the substrate that was respired.

type of respiration .....

substrate ..... [2]

(c) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe how the apparatus shown in Fig. 3.1 could be used to determine the **rate** of respiration of woodlice at different temperatures.

In your answer, explain how the results would be expressed so that valid comparisons can be made between different groups of woodlice.

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Quality of Written Communication [1]

[Total: 14]

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4 Lemmings are small mammals that live near the Arctic circle. Their populations show regular patterns of increase and decrease. In 2003, scientists published results based on a long-term project in East Greenland. They made the following observations.

- Population peaks occurred in regular four year cycles.
- Four main predators feed on the lemmings: Arctic owls, Arctic foxes, long-tailed skuas and stoats.
- Stoats feed only on lemmings; the other predators feed on a range of prey species.
- Stoats reproduce more slowly than lemmings.

(a) Fig. 4.1 shows the changes in the population of lemmings in the East Greenland project area from 1990 to 2002.

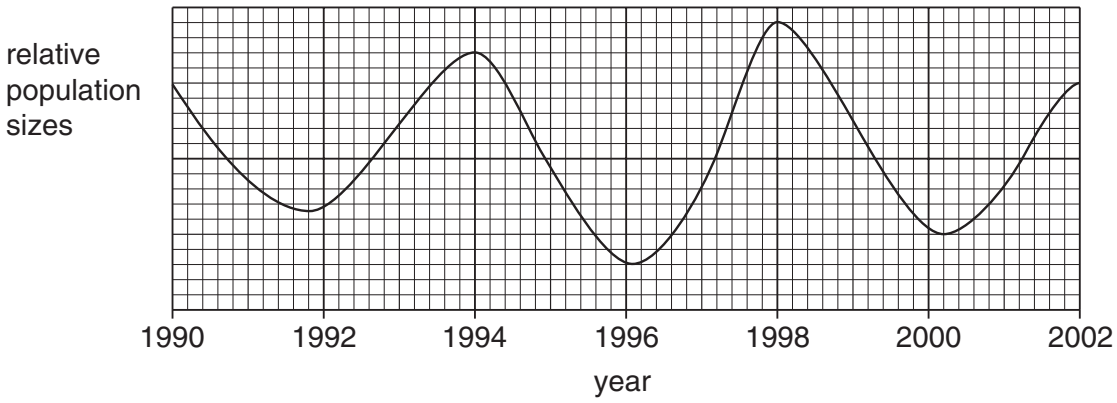

Fig. 4.1

(i) Sketch **on Fig. 4.1** the likely changes in the population size of stoats. [2]

(ii) Suggest **three** environmental conditions, **other than climatic**, that are required for a population explosion of lemmings.

1 .....

2 .....

3 ..... [3]

(b) With reference to the species studied in the East Greenland project, distinguish between interspecific and intraspecific competition.

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..... [3]

(c) The carrying capacities for lemmings and for the various predators in this area are all different.

Explain the term *carrying capacity.*

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..... [2]

[Total: 10]

5 An investigation was conducted into the filtration and reabsorption of glucose in the kidney of a mammal.

The glucose concentration in the plasma of the renal artery was increased. The glucose concentrations were measured in the following fluids:

- glomerular filtrate
- urine.

From the measurements obtained, the concentration of glucose in the fluid reabsorbed from the glomerular filtrate was calculated. The results of this investigation are shown in Fig. 5.1.

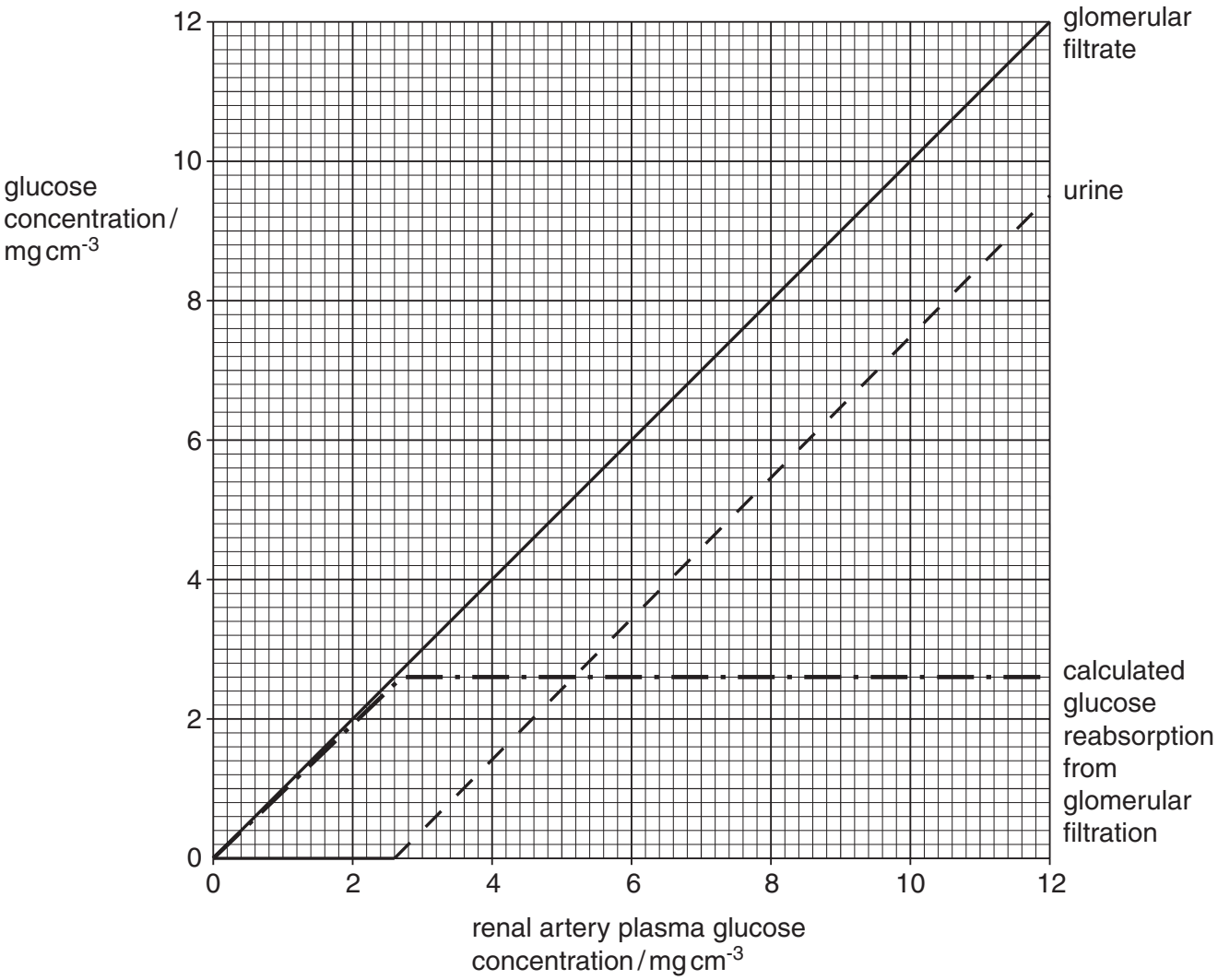

Fig. 5.1

(a) Use the data in Fig. 5.1 to answer the following questions.

(i) Describe the relationship between plasma glucose concentration in the renal artery and the concentration of glucose in the glomerular filtrate.

.....

..... [1]

(ii) State the plasma glucose concentration in the renal artery above which the kidney is unable to reabsorb all the glucose from the glomerular filtrate.

Answer = ... mg cm^{-3} [1]

(iii) Explain why plasma glucose concentrations in the renal artery greater than the figure you have given in **(ii)** would result in the presence of glucose in the urine.

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..... [3]

(b) Explain why proteins with a relative molecular mass (RMM) greater than 69 000 do not pass from the blood plasma into the glomerular filtrate.

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[Turn over

(c) Following a meal rich in carbohydrates, the plasma glucose concentration rises.

Describe the homeostatic mechanisms that would normally prevent glucose appearing in the urine.

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..... [5]

(d) The kangaroo rat, *Dipodomys spectabilis*, is common in the deserts of North America. It does not need to drink water and feeds mostly on seeds and other dry plant material. It produces very little urine.

(i) Suggest how the kidney of this mammal is adapted to reduce the volume of urine produced.

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(ii) Suggest how desert mammals, such as the kangaroo rat, are able to obtain water from dry seeds.

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..... [3]

[Total: 18]

6 The snail, *Cepaea nemoralis,* lives on the ground amongst leaf litter and herbaceous vegetation.

- It exists in three different colours: brown, pink and yellow.
- In some of these snails, there is a shell banding pattern on this background colour. Snails can therefore be divided into banded and unbanded forms.
- The background colour and banding are controlled by alleles at two separate gene loci.

A group of students in central England carried out the following investigation.

- Samples of snails were collected from populations in two different habitats.
- The first habitat was mixed deciduous woodland where the leaf litter was a dark uniform colour.
- The second habitat was grassland, which is more variable in colour but predominantly pale yellow and green.

The main predator of the snail is the song thrush which has excellent colour vision. It therefore acts as a major selection pressure on these populations.

Table 6.1 shows the percentage of yellow-shelled snails and unbanded snails found in the samples.

Table 6.1

habitat	sample	% of sample yellow	% of sample unbanded
woodland	1	12	88
	2	21	77
	3	12	70
grassland	1	79	21
	2	58	14
	3	83	22

(a) Explain the following terms;

allele .....

.....

locus .....

..... [2]

For Examiner's Use

(b) In this question, one mark is available for the quality of use and organisation of scientific terms.

When the students compared their results with previous investigations in the same habitats, they found that the percentages were very similar.

Using the data in Table 6.1, describe how selection pressures, such as predation by the song thrush, can maintain different allele frequencies in the snail populations in the woodland and grassland habitats.

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Quality of Written Communication [1]

[Total: 11]

[Turn over

7 Parkinson's disease is a disorder of the nervous system. People with this condition are unable to produce enough of the neurotransmitter substance dopamine. This chemical is required in neurone circuits in the brain that control movement.

(a) Outline **two** roles of synapses in the nervous system.

1 .....

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2 .....

..... [2]

Fig. 7.1 illustrates the events at a synapse where the neurotransmitter is dopamine.

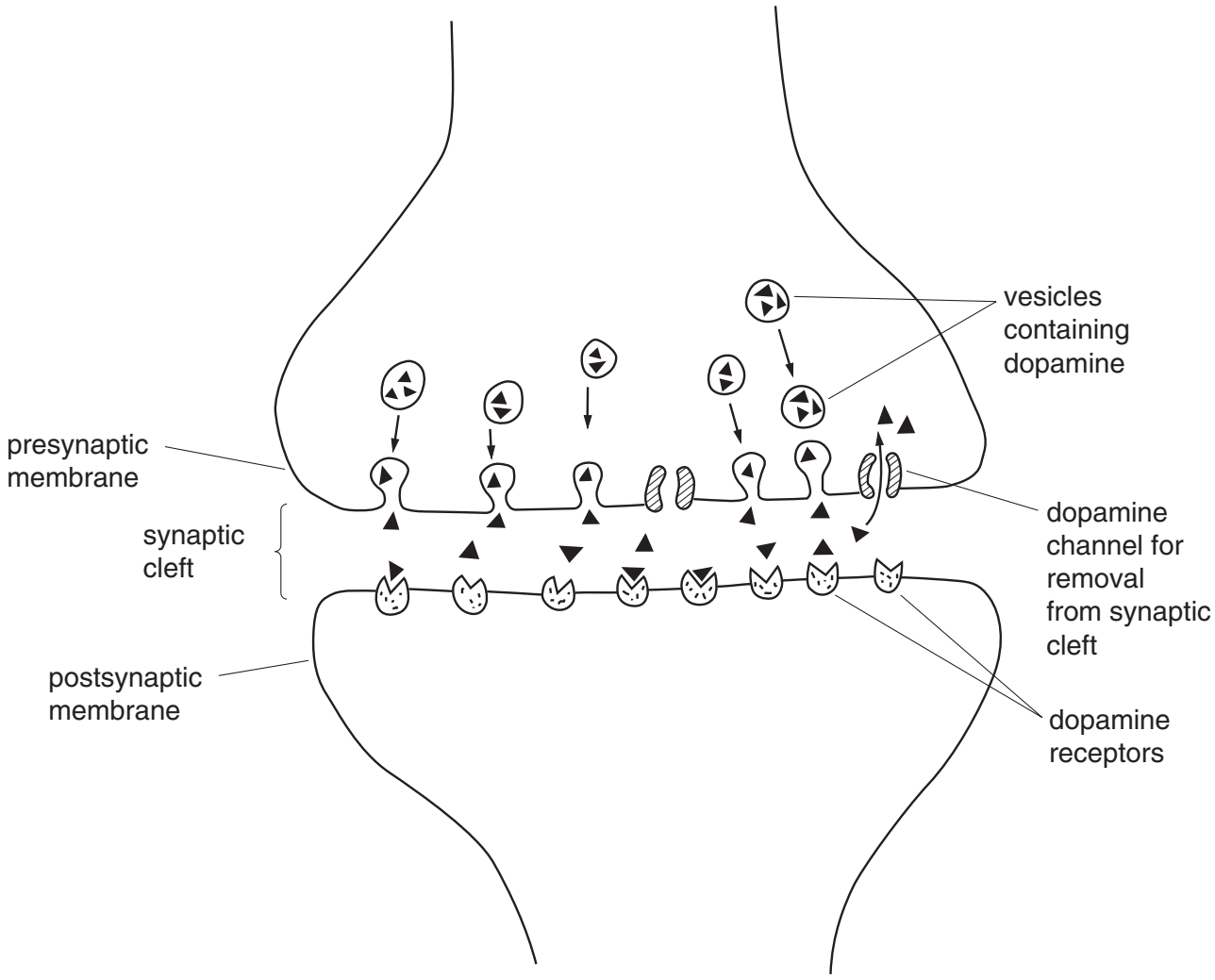

Fig. 7.1

(b) Using **only** the information in Fig. 7.1, list **three** ways in which the events occurring at this synapse are the same as at a cholinergic synapse.

1 .....

2 .....

3 ..... [3]

(c) For the proper functioning of neurone circuits, neurotransmitters have to be removed from the receptors in the postsynaptic membrane and from the synaptic cleft. Explain why this is so.

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..... [2]

[Total: 7]

END OF QUESTION PAPER

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