OXFORD CAMBRIDGE AND RSA EXAMINATIONS

AS GCE

F222/01/TEST

HUMAN BIOLOGY

Growth, Development and Disease

TUESDAY 7 JUNE 2016: Afternoon

DURATION: 1 hour 45 minutes
plus your additional time allowance

MODIFIED ENLARGED 24pt

Candidate forename		Candidate surname	

Centre number					Candidate number				

Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

Advance Notice (inserted)

OTHER MATERIALS REQUIRED:

Electronic calculator
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

An Advance Notice is enclosed for use with this examination.

Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

Use black ink. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions.

Read each question carefully. Make sure you know what you have to do before starting your answer.

Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 100.

You may use an electronic calculator.

You are advised to show all the steps in any calculations.

✎ Where you see this icon you will be awarded marks for the quality of written communication in your answer.

Any blank pages are indicated.

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Answer ALL the questions.

1   This question is based on Case Study 1: 25 BY 25

   (a) Scientists have predicted that if the non-communicable disease (NCD) framework is put into practice, by 2025 the mortality rate for cardiovascular disease (CVD) is likely to be reduced to a greater extent than the mortality rate for cancer.

   (i) Suggest TWO reasons why the CVD mortality rate is likely to be reduced to a greater extent than the cancer mortality rate.

   _____

   _____

   _____

   _____ **[2]**

   (ii) Scientists predict that reducing mortality from breast cancer will be difficult. Effective screening, however, can help reduce mortality rate.

   Table 1.1 shows four techniques that are used to screen for breast cancer.

   Complete Table 1.1 by:

   inserting the missing terms in column 1 and column 2

   inserting a tick (✓) or a cross (✗) as appropriate in column 3 and column 4 for each technique.   **[4]**

Table 1.1

SCREENING TECHNIQUE	TYPE OF RADIATION DETECTED	PRODUCES THREE-DIMENSIONAL IMAGE	REQUIRES INJECTION OF RADIOACTIVE SUBSTANCE
MRI scans		✓	✗
PET scans			
	Infrared radiation		
CT scan			

[4]

(iii) It is estimated that one in six cancers is associated with chronic bacterial or viral infections.

Suggest ONE way that chronic viral infections may cause cancer or increase the risk of developing cancer.

_____

_____

_____

_____

_____ [2]

(iv) Carcinogens can affect proto-oncogenes and tumour suppressor genes.

Outline the role of proto-oncogenes and tumour suppressor genes in cells.

proto-oncogenes _____

_____

tumour suppressor genes _____

_____

[2]

(b) Scientists have estimated that the mortality rate from CVD could be reduced by up to 34% by the year 2025 if the NCD framework proposed by the World Health Organisation (WHO) is implemented.

Coronary heart disease (CHD) is an example of a CVD.

(i) List THREE factors, other than diet and smoking, that may account for differences in CHD mortality rates between different regions of the world.

1 _____

_____

2 _____

_____

3 _____

_____

[3]

(ii) The CHD mortality rate in the UK is decreasing.

CHD morbidity, however, has been rising in the UK and this has increased the financial burden of treating the disease. Diets that are high in fat and salt have been blamed for the increase in CHD morbidity.

Suggest TWO reasons why CHD mortality is decreasing in the UK even though CHD morbidity is increasing.

_____

_____

_____

_____

_____

_____ **[2]**

(c) Scientists predict three possible trends for the global reduction in NCD mortality by the year 2025. Fig. 1.1 shows these trends and the estimated reductions in NCD mortality.
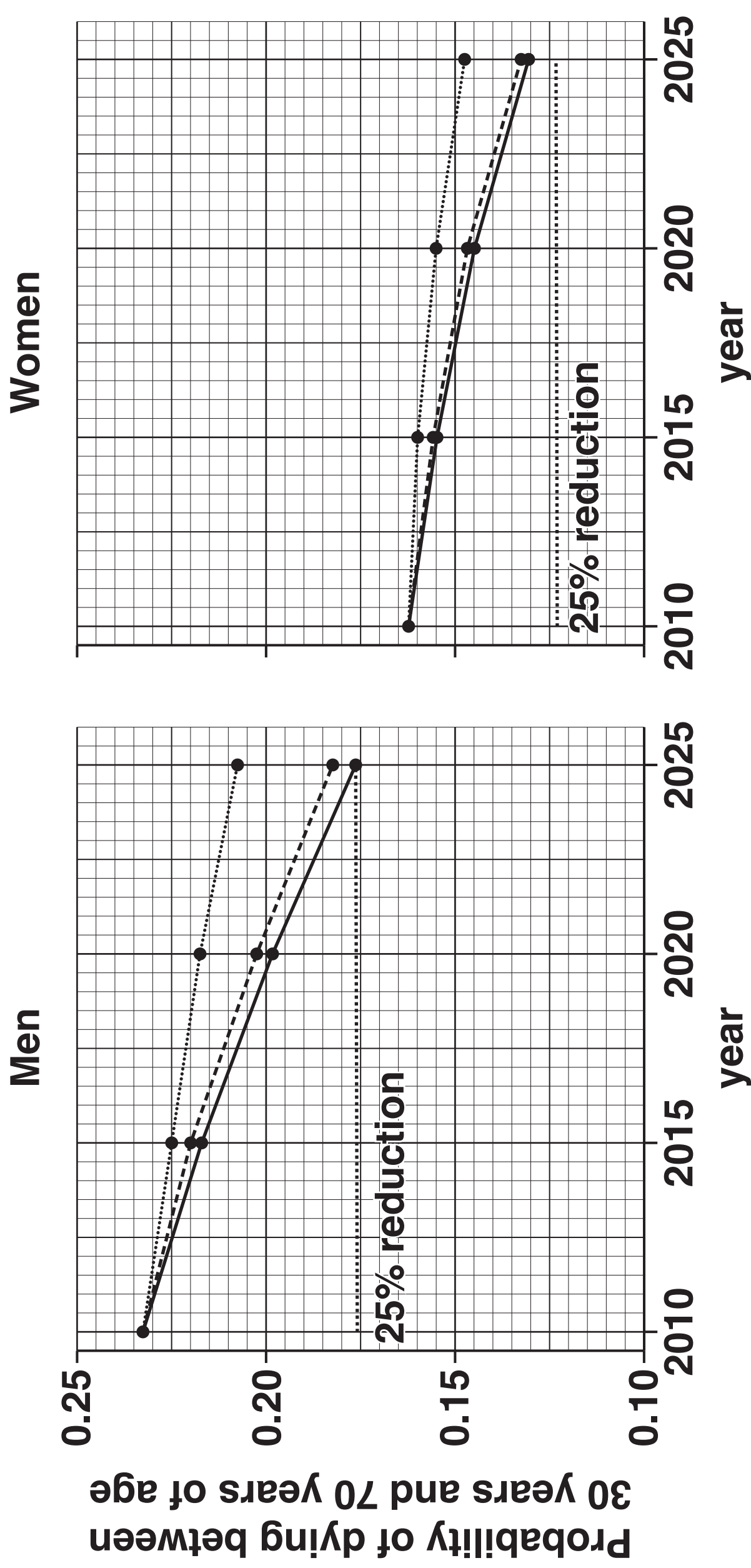
Use the information in Fig. 1.1 to assess the likelihood of the World Health Organisation (WHO) achieving its target of a 25% reduction in NCD mortality by 2025.

_____

_____

_____

_____

_____

_____

_____

_____ **[3]**

Fig. 1.1.

Key:

⋯•⋯ trend without the NCD framework

–•– trend if risk factor targets achieved

—•— trend if tobacco use is reduced to levels lower than the target

9

(d) Asthma is a chronic respiratory condition that causes approximately 250 000 deaths per year worldwide.

Different types of medication are used to treat asthma:

fast-acting medication treats asthma attacks

slow-acting medication controls asthma in the long-term.

Name ONE type of fast-acting and ONE type of slow-acting medication used for treating asthma and explain how each medication helps to relieve the symptoms of asthma.

fast-acting medication _____

explanation _____

_____

_____

slow-acting medication _____

explanation _____

_____

_____

[4]

[TOTAL: 22]

2 **This question is based on Case Study 2: THE THRIFTY PHENOTYPE**

(a) In the UK, fetal growth measurements are taken during pregnancy and nutritional advice is given to mothers by medical professionals.

    (i) Outline the antenatal care offered to mothers OTHER THAN nutritional advice and fetal growth measurements.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[5]**

(ii) Suggest how the oxygen and nutrient supply to a fetus could be monitored during pregnancy.

_____

_____

_____ **[2]**

(iii) A baby's development is also monitored after birth.

Describe how a newborn baby's head circumference is measured.

_____

_____

_____ **[1]**

(iv) An infant's organ systems develop at different rates.

The letters A to D below correspond to different developmental periods during the human life cycle:

A   0–5 years
B   5–10 years
C   10–15 years
D   15–20 years

Select the letter that corresponds to the fastest period of development in males of:

the nervous system _____

the reproductive system _____
                                                       [2]

(b) An individual who experiences poor nutrition as a fetus has a higher probability of developing diabetes in **ADULTHOOD.**

Suggest the type of diabetes that is likely to develop in adults as a result of fetal under-nutrition.

Explain your choice.

_____

_____

_____

_____

_____

_____

_____ **[3]**

(c) Table 2.1 shows the prevalence of type 2 diabetes among CHILDREN in the USA in 2001 and in 2009.

Table 2.1

	2001 TYPE 2 DIABETES PREVALENCE (per 1000)	2009 TYPE 2 DIABETES PREVALENCE (per 1000)
Female	0.42	0.58
Male	0.26	0.35
Caucasian	0.14	0.17
Asian Pacific Islanders	0.35	0.34
Hispanic	0.45	0.79
Native American Indian	1.22	1.20

Using the information in Table 2.1, compare the changes in the prevalence of type 2 diabetes among children of different genders and ethnic backgrounds in the USA.   [3]

_____

_____

_____

_____

_____

_____

_____

(d) You were told in the case study that early life conditions can influence the probability of developing coronary heart disease (CHD) in adulthood.

Behaviours in adulthood, such as smoking cigarettes, can also increase the risk of developing CHD.

Explain why regular smoking increases the risk of developing CHD.

_____

_____

_____

_____

_____

_____

_____ **[3]**

[TOTAL: 19]

3 Vaccination can be used to reduce the spread of human papilloma virus (HPV) in human populations.

(a) (i) Outline ONE ethical argument against the use of the HPV vaccine in the UK.

_____

_____

_____ [1]

(ii) Explain how the HPV vaccine leads to the development of long-term immunity against HPV in a person receiving the vaccine. [8]

In your answer you should make clear the order in which the events occur.

_____

_____

_____

_____

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_____

17

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_____

(b) A student is revising the structure and functions of phagocytes with a friend.

The student wrote the following description, but the friend spotted three errors.

Phagocytes are leucocytes that provide non-specific defence.

Examples of phagocytes include neutrophils and monocytes.

Phagocytes are attracted to damaged cells by cytokinesis.

They are able to engulf bacterial cells through phagocytosis, which is an example of exocytosis.

Phagocytes have a high concentration of organelles called ribosomes, which contain digestive enzymes.

Choose THREE WORDS from the description that are errors AND write a suitable word to replace each error.

1. error _____

    replacement word _____

2. error _____

    replacement word _____

3. error _____

    replacement word _____

[3]

[TOTAL: 12]

4 Conditions such as Turner syndrome and Klinefelter syndrome can be detected by a laboratory technique called karyotyping.

(a) Complete the following passage, which describes how a karyotype is produced.

A sample of fetal cells is taken from the placenta or amniotic fluid. These cells are then cultured in an incubator. Two chemicals are added to the culture. One chemical stimulates cell division by mitosis and the other chemical, called _____ , prevents spindle formation. This halts mitosis at the start of _____ . The fetal cells swell up when they are added to a salt solution. A third chemical, a _____ , is added to make the _____ visible so that they can be photographed and analysed.

[4]

(b) (i) A friend suggests to a woman who is 10 weeks pregnant that she could have her baby tested for conditions such as Turner syndrome using amniocentesis and karyotyping.

Evaluate the suitability of the procedure suggested by the friend.

_____

_____

_____

_____

_____

_____ **[2]**

(ii) Fetal DNA, originating from the placenta, is present in a mother's blood after 7 weeks of pregnancy.

This fetal DNA can be sampled from the mother's blood in a new procedure known as cell-free fetal DNA (cffDNA) sampling. This represents an alternative to the traditional methods of obtaining fetal DNA, such as amniocentesis.

Suggest TWO advantages of cffDNA sampling over traditional methods, such as amniocentesis.

_____

_____

_____

_____ **[2]**

(c) **(i)** Table 4.1 below lists three conditions diagnosed by karyotyping.

Complete Table 4.1 by indicating the sex chromosomes present in each of the three conditions and the total number of chromosomes in each body cell.

Table 4.1

CONDITION DIAGNOSED	SEX CHROMOSOMES PRESENT	TOTAL NUMBER OF CHROMOSOMES IN EACH BODY CELL
Turner syndrome		
Klinefelter syndrome		
Normal male		

[3]

(ii) Individuals identified as having Turner or Klinefelter syndrome develop physical characteristics associated with their condition.

State ONE example of a typical characteristic found in people with Turner syndrome and ONE example of a typical characteristic found in people with Klinefelter syndrome.

Turner _____

Klinefelter _____

[1]

[TOTAL: 12]

5 Ebola is a viral disease that was first described in human populations in 1976.

Several thousand cases of the disease were recorded in 2014.

Table 5.1 shows the estimated number of Ebola cases and deaths that resulted from the disease. Figures are shown for the world population and for nations located in West Africa.

Table 5.1

NUMBER OF EBOLA CASES		NUMBER OF DEATHS FROM EBOLA	
World	West Africa	World	West Africa
21 364	21 358	8 459	8 458

(a) Use the data to evaluate the validity of the following statements:

the Ebola outbreak was a pandemic

Ebola was more likely to result in deaths in West Africa than the rest of the world.

_____

_____

_____

_____

_____

_____ **[3]**

(b) (i) In 2014, the world's population was estimated to be 7.2 billion.

The total population of the West African nations that experienced Ebola was 231.4 million.

Using the information in Table 5.1, calculate the Ebola mortality rate (deaths per 100 000) for the world and for the West African nations.

World = _____

West Africa = _____

[2]

(ii) Suggest ONE reason for the difference in mortality rates calculated in (b)(i).

_____

_____

_____ [1]

(c) (i) What problems will medical professionals need to overcome when treating diseases caused by pathogens such as the Ebola virus, which has only recently evolved to infect humans?

_____

_____

_____

_____

_____

_____

_____ **[2]**

(ii) A patient diagnosed with Ebola in the UK was treated with blood plasma from a person who had recently recovered from the disease.

This is known as convalescent plasma therapy (CPT).

Suggest why CPT can be effective in the treatment of patients with Ebola.

_____

_____

_____

_____

_____ **[2]**

(iii) Suggest ONE precaution that must be taken when using CPT.

_____

25

_____

_____ **[1]**

(d) Ebola is an example of a notifiable disease.

What is meant by a 'notifiable disease'?

_____

_____

_____ **[1]**

[TOTAL: 12]

6 Mitosis results in the production of diploid cells.

Fig. 6.1 represents one cell cycle, of which mitosis is part.

Fig. 6.1

	Interphase			Mitosis		

1	2	3	4	5	6	7	X
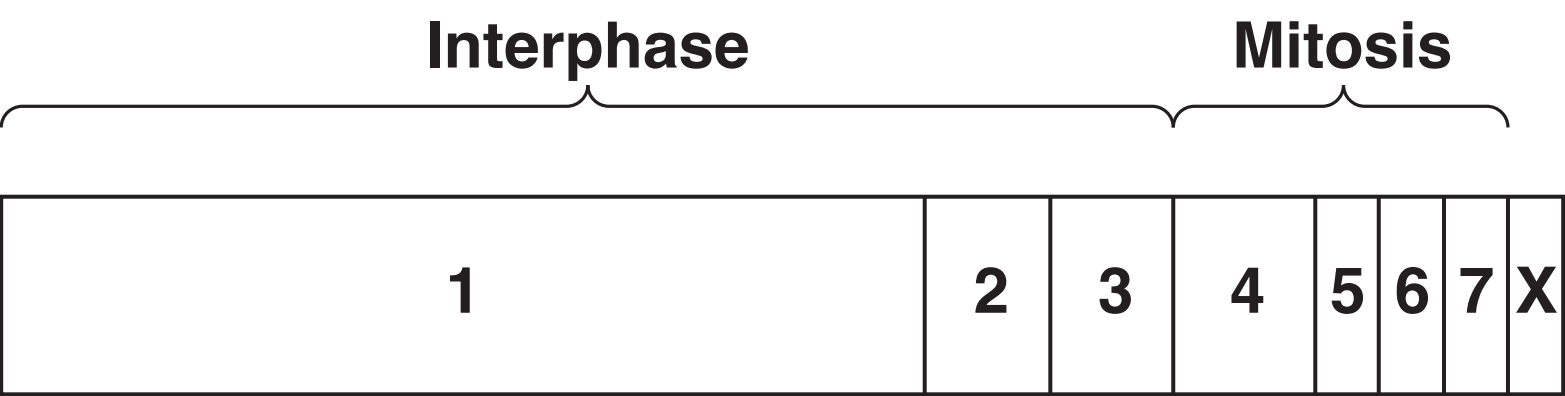
(a) (i) Describe what occurs in the stage labelled X.

_____

_____ **[1]**

(ii) Name the stage of the cell cycle labelled 1 AND explain why this stage takes up more than 50% of the cell cycle.

name of stage _____

explanation _____

_____

_____ **[2]**

(iii) Chromosomes become visible in stage 4 in Fig. 6.1.

Describe TWO further changes that occur in the cell in stage 4.

_____

_____

_____

_____ **[2]**

(iv) Fig. 6.2 is a photomicrograph showing two stages of mitosis in human cells.
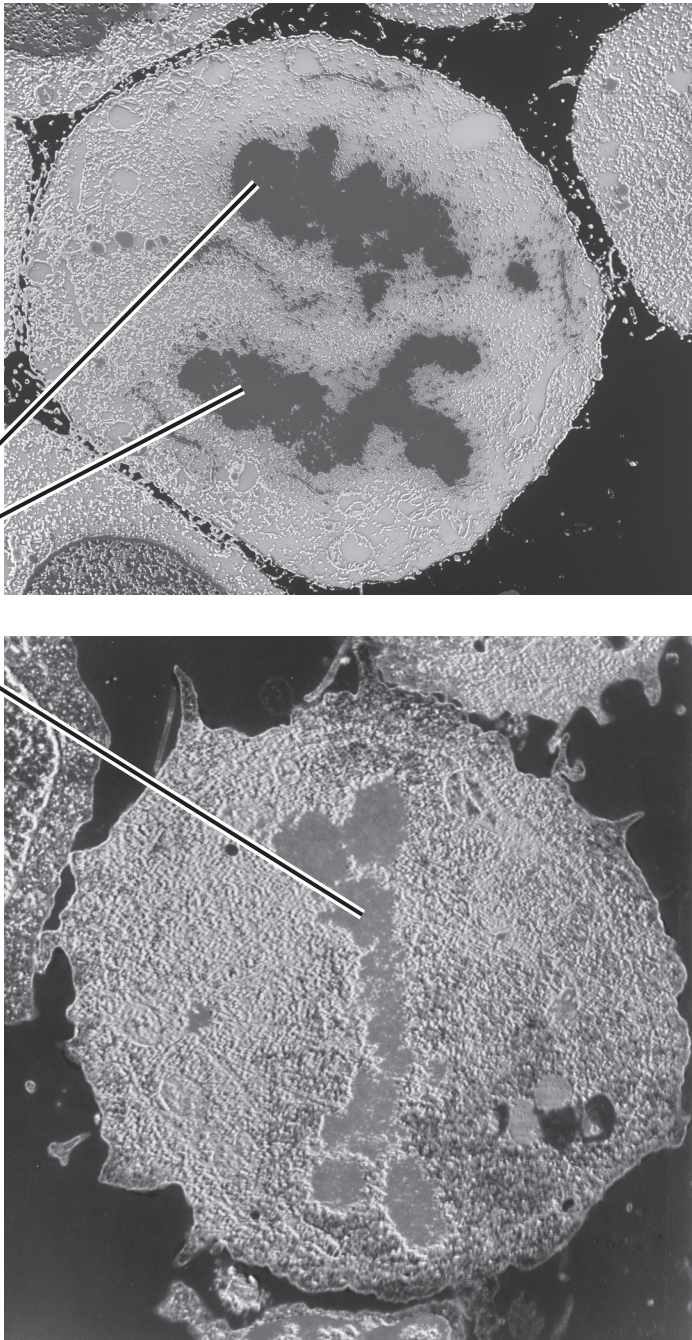
In the box next to each image, state:

the number of the stage (using the information in Fig. 6.1)

the name of the stage shown.

Fig. 6.2

Chromosomes

Number of stage (see Fig. 6.1)
_____
Name of stage
_____

Number of stage (see Fig. 6.1)
_____
Name of stage
_____

[2]

(b) Meiosis is a type of nuclear division that produces haploid daughter cells (gametes). It also results in genetic variation in gametes.

Crossing-over introduces genetic variation during prophase I of meiosis. Further genetic variation is introduced during metaphase I and metaphase II of meiosis.

Explain why the genetic variation produced in MEIOSIS II is dependent on crossing-over.

_____

_____

_____

_____

_____ **[2]**

[TOTAL: 9]

7 *Mycobacterium tuberculosis* causes the infectious disease tuberculosis.

Strains of *M. tuberculosis* have evolved that are resistant to several antibiotics.

(a) Explain how *M. tuberculosis* can evolve resistance to antibiotics AND describe how hospital staff and medical professionals can help to prevent the spread of these resistant strains. **[8]**
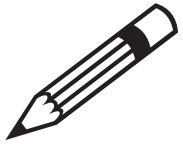
In your answer, you should provide a balanced account of both aspects of the question.

_____

_____

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_____

(b) Fig. 7.1 shows an electron micrograph of *M. tuberculosis* bacteria.

Fig. 7.1
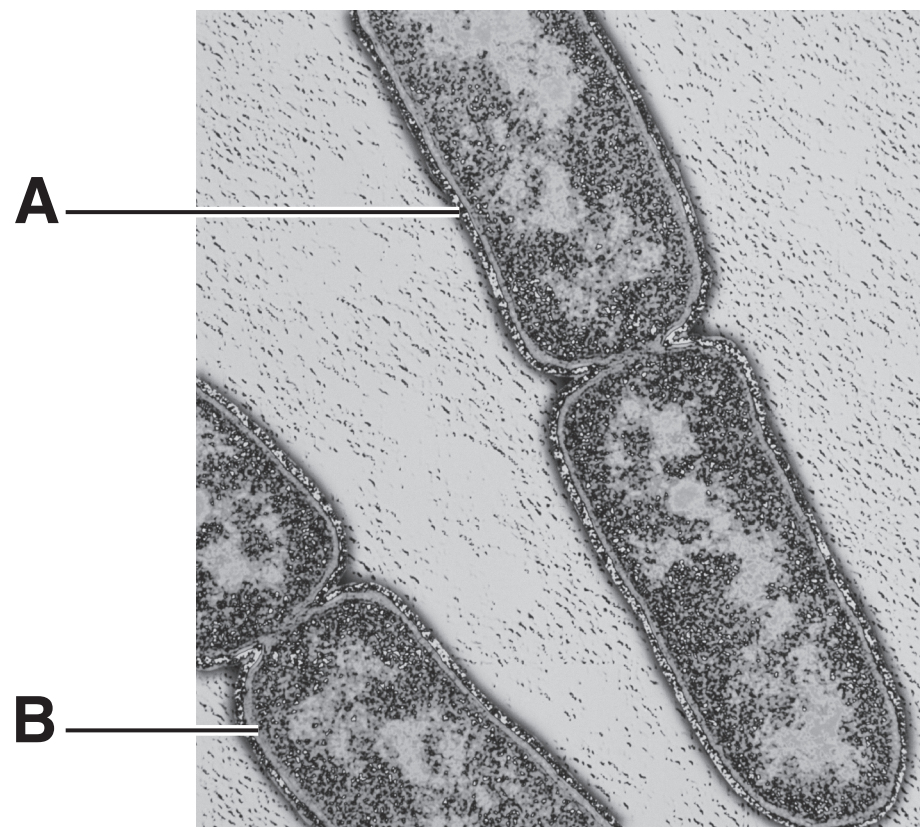
The structure labelled B (pale layer) is a cell wall.

  (i) Identify structure A (dark layer).

_____ [1]

 (ii) Name the substance from which structure B is

made. _____ [1]

(iii) State ONE difference between the DNA in cells such as those shown in Fig. 7.1 and the DNA present in lymphocytes.

_____

_____ [1]

(c) In 2014, scientists discovered a new antibiotic called teixobactin.

The effectiveness of teixobactin in controlling bacterial growth was compared with that of two established antibiotics in a series of tests. Some of the test results are shown in Fig. 7.2.

Using the information in Fig. 7.2, discuss the relative effectiveness of antibiotics in controlling bacterial growth.

_____

_____

_____

_____

_____

_____

_____

_____ **[3]**

[TOTAL: 14]

Fig. 7.2

Key:
- --✗-- Control
- ·⊙· Vancomycin
- —●— Oxacillin
- —▫— Teixobactin
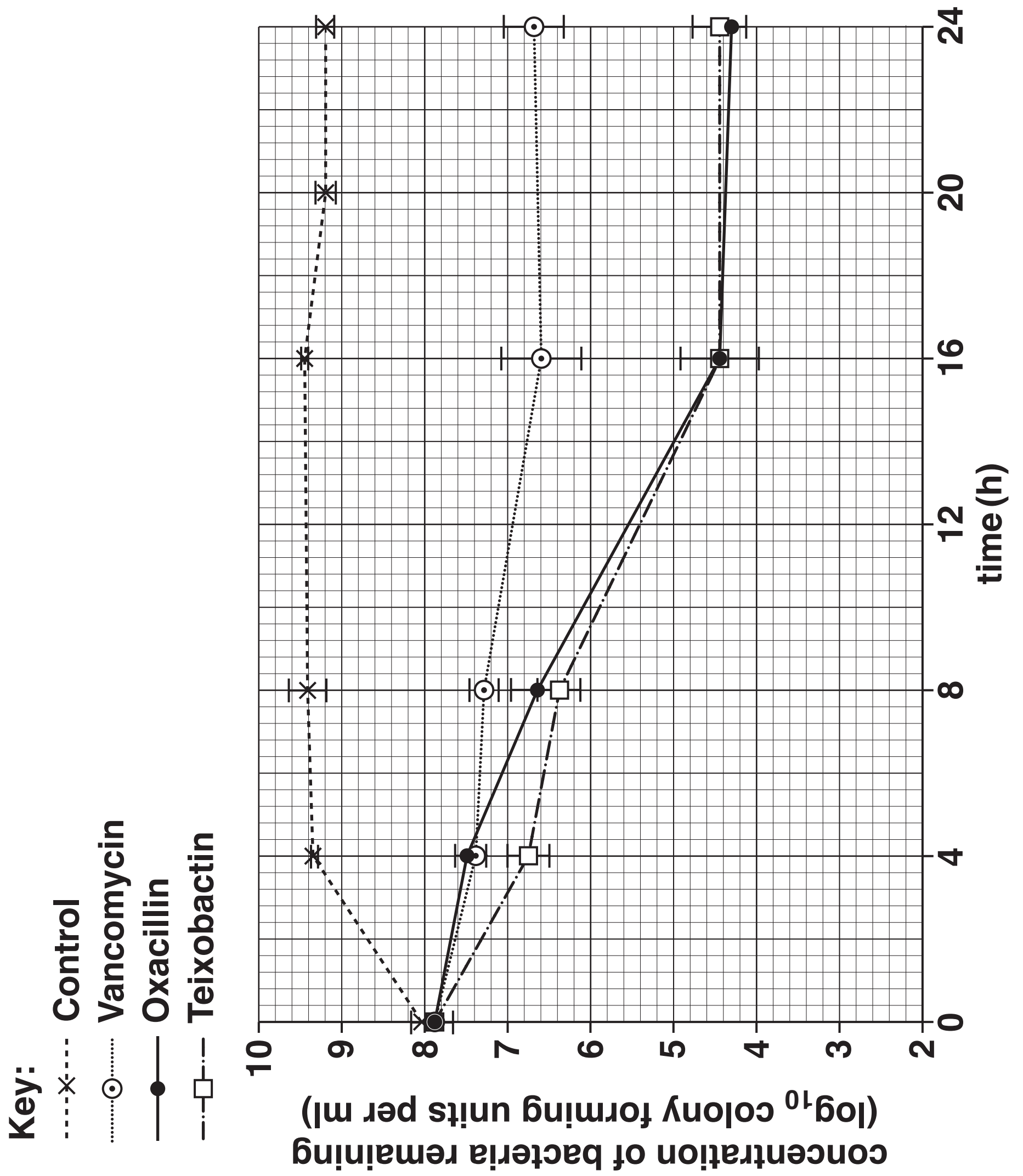
END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

35

37