

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**A2 GCE**

**F224/01**

**HUMAN BIOLOGY**

**Energy, Reproduction and Populations**

**MONDAY 8 JUNE 2015: Afternoon**

**DURATION: 1 hour 15 minutes**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.**

**OCR SUPPLIED MATERIALS:**

**Insert (inserted)**

**OTHER MATERIALS REQUIRED:**

**Electronic calculator**

**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

**The Insert will be found inside this document.**

**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 60.**



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

**You may use an electronic calculator.**

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

**Any blank pages are indicated.**

**Answer ALL the questions.**

- 1 Some couples are unable to conceive naturally. The Human Fertilisation and Embryo Authority (HFEA) regulates the use of fertility treatment and other assisted conception procedures that are carried out in the UK.**

**A possible cause of male infertility may be anatomical abnormalities of the male reproductive system.**

**One procedure that has been developed in recent years is Surgical Sperm Removal (SSR).**

**In this procedure, microsurgery is carried out under local anaesthetic and a fluid containing sperm is collected directly from the epididymis.**

- (a) (i) Name the structure through which sperm normally leave the epididymis.**

\_\_\_\_\_ [1]

- (ii) Suggest why the concentration of sperm in the fluid collected from the epididymis will be greater than that in semen.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

**(b) Sperm that has been collected using SSR may be used in IVF treatment or in ICSI.**

**(i) State what the initials IVF and ICSI represent.**

**IVF** \_\_\_\_\_

**ICSI** \_\_\_\_\_

**[1]**

**(ii) More embryos result from the use of SSR-collected sperm in ICSI than from the use of SSR-collected sperm in IVF treatment.**

**Suggest why.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ **[1]**

- (c) The successful outcome of fertility treatment is pregnancy. If a woman suspects that she may be pregnant, a pregnancy test stick may be used to confirm the pregnancy.**

**The test stick contains free molecules of an antibody attached to coloured beads containing a dye. The antibodies are specific to the hormone Human Chorionic Gonadotrophin (HCG), which is produced during pregnancy.**

- (i) State the region of the antibody molecule that is attached to the coloured bead AND state the region that will bind to HCG.**

**Region attached to coloured bead**

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**Region that will bind to HCG**

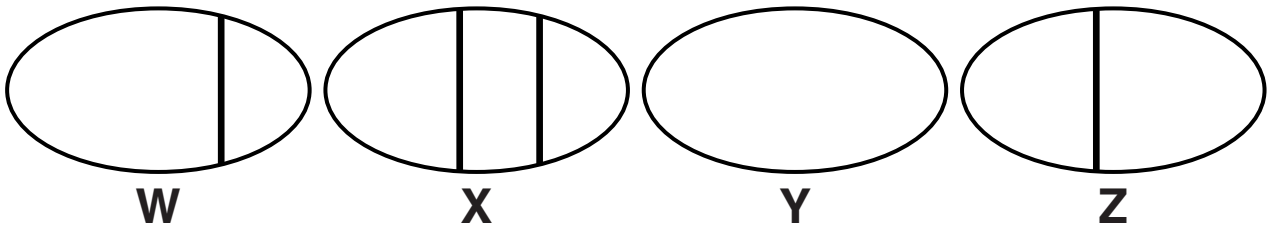
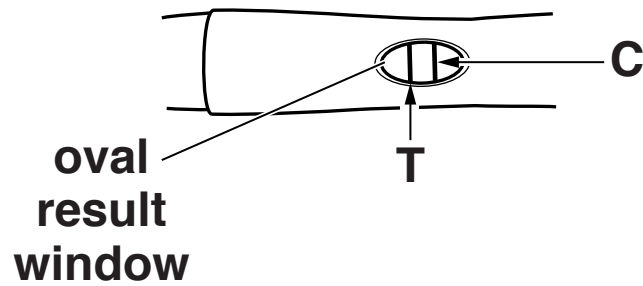
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**[1]**

- (ii) Fig. 1.1 shows a pregnancy test stick and four possible results, W, X, Y and Z, that could appear in the oval result window.

**FIG. 1.1**

**KEY: C = control line**  
**T = positive test line**



**Complete the table below to indicate which conclusions can be drawn from the results shown in windows W to Z in Fig. 1.1.**

**Choose from the following:**

**pregnant**

**not pregnant**

**result not valid.**

<b>Result window</b>	<b>Conclusion</b>
<b>W</b>	
<b>X</b>	
<b>Y</b>	
<b>Z</b>	

**[2]**

**[TOTAL: 8]**

- 2 After the London 2012 Olympic Games, a ‘blog’ on the UK’s Department of Health website stated:**

**‘we must deliver on our promise to create a sustainable and long term health legacy and encourage the nation to get more active, not just in the next few months but for years to come’**

**(14th August 2012)**

- (a) There are health benefits associated with taking regular exercise.**

**One benefit of long term exercise is a decrease in blood cholesterol level.**

- (i) Why does a reduction in blood cholesterol levels benefit the cardiovascular system?**

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**[2]**

- (ii) State ONE benefit of exercise on the SKELETAL system.**

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**[1]**



- (b) The ability of the body to take in, transport and use oxygen is known as the  $\text{VO}_2$  max.**

**One consequence of taking regular aerobic exercise is that the  $\text{VO}_2$  max increases.**

**Some athletes use illegal methods such as taking recombinant erythropoietin to increase their  $\text{VO}_2$  max.**

- (i) State the organelle where aerobic respiration takes place AND the stage of aerobic respiration that requires oxygen.**

**Organelle \_\_\_\_\_**

**Stage of aerobic respiration \_\_\_\_\_**

**[2]**

- (ii) Explain why the use of recombinant erythropoietin increases the  $\text{VO}_2$  max.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ **[2]**

- (c) To improve aerobic fitness, exercise must be taken regularly. Both the frequency and duration of each exercise session will affect the rate of improvement in fitness.**

**Two studies on aerobic fitness were carried out over a period of 20 weeks. One study varied the frequency of the exercise sessions. The other study varied the duration of the exercise sessions.**

**Both studies contained three groups of subjects that exercised and one group that did not exercise.**

**In the FREQUENCY study, the subjects that exercised:**

**exercised for 1, 3 or 5 days each week**

**exercised for 30 minutes each session.**

**In the DURATION study, the subjects that exercised:**

**exercised for 3 days each week**

**exercised for 15, 30 or 45 minutes each session.**

**In both studies, an initial fitness assessment was carried out.**

- (i) Identify ONE variable that would need to be controlled in BOTH studies in order to make a valid comparison of the effect of frequency of exercise and duration of exercise on fitness.**

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**[1]**

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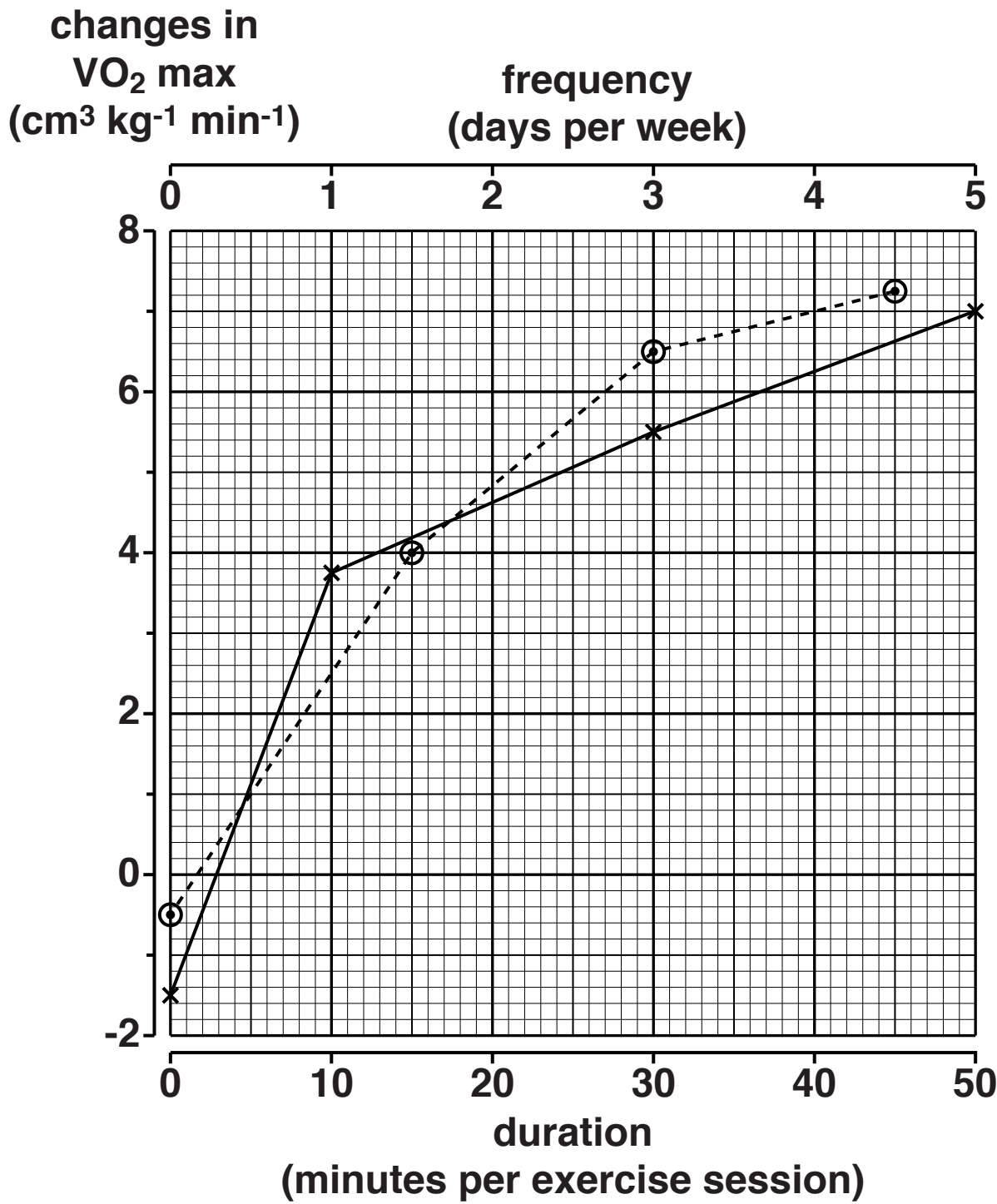
Fig. 2.1 is a graph of the results obtained from the studies.

FIG. 2.1

KEY:

× = frequency

⊙ = duration



- (ii) Using Fig. 2.1, calculate the percentage increase in  $\text{VO}_2$  max that can be achieved by doubling the duration of the exercise session from 15 to 30 minutes.

Show your working.

Answer = \_\_\_\_\_ % [2]

- (iii) A fitness trainer said, “You can still keep improving if you miss a session – just do a longer session next time”.

Using data from Fig. 2.1, what EVIDENCE is there to support this statement?

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[2]

[TOTAL: 12]

**3 'Spirulina' are photosynthetic bacteria belonging to a group known as the Cyanobacteria. Unlike other Cyanobacteria, 'Spirulina' do not fix nitrogen.**

**(a) Name ONE species of bacterium that CAN fix nitrogen.**

\_\_\_\_\_ **[1]**

- (b) **‘Spirulina’ are widely grown in some parts of the world for use as food for humans and animals.**

**Green bacterial ‘mats’ need to be harvested. Once harvested they are dried and processed.**

**‘Spirulina’ is also sold in the United Kingdom as a dietary supplement in the form of capsules, tablets or powder.**

**Fig. 3.2 below is an extract from a leaflet promoting the benefits of ‘Spirulina’ as a dietary supplement.**

**FIG. 3.2**

**Spirulina is one of the most concentrated and nutritious food sources in nature.**

**Spirulina contains all the amino acids.**

**Spirulina is a rich source of many vitamins such as B3 (nicotinamide), B9 (folate), C and D.**

**Spirulina is rich in all essential minerals.**

**Spirulina is rich in essential fatty acids.**

**Spirulina is a good source of antioxidants.**

**Using the information given in Fig. 3.2 about the substances found in 'Spirulina':**

- (i) identify ONE substance which is necessary for the synthesis of haemoglobin;**

\_\_\_\_\_ [1]

- (ii) identify ONE substance which forms part of a respiratory co-enzyme;**

\_\_\_\_\_ [1]

- (iii) identify ONE substance which may prevent DNA damage;**

\_\_\_\_\_ [1]

- (iv) identify ONE substance which is recommended in routine pre-conceptual care.**

\_\_\_\_\_ [1]



- (c) In 'Spirulina', the light independent stage of photosynthesis is very similar to that in green plants.**

**Outline how complex organic molecules such as lipids are produced from the light independent stage of photosynthesis.**



**In your answer, you should use appropriate technical terms, spelled correctly.**

[illegible]

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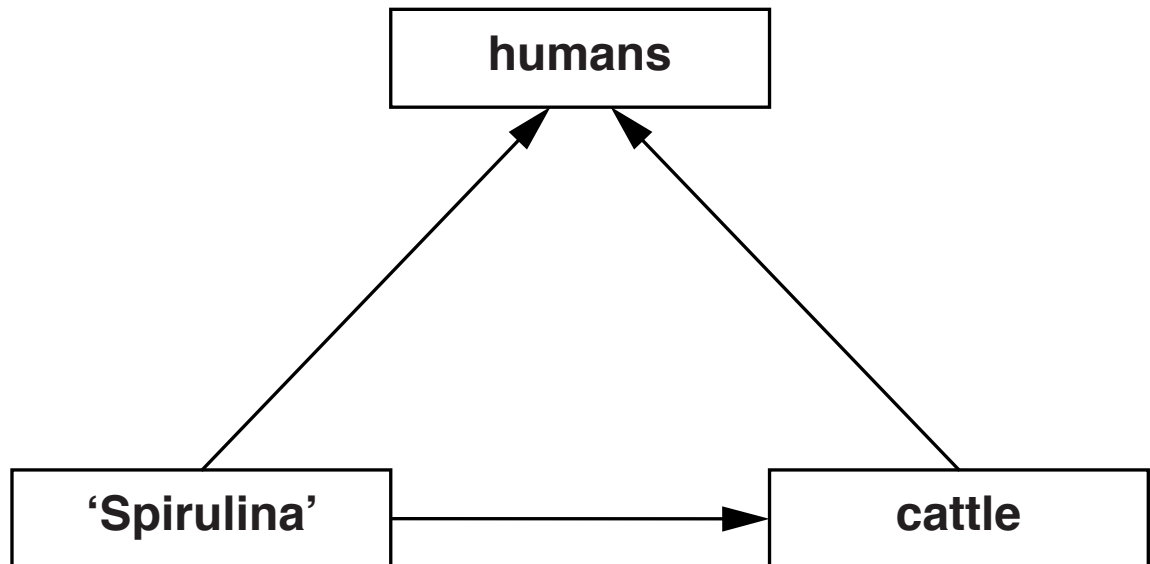
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- (d) Dried 'Spirulina' can be eaten directly by humans or fed to cattle.

Fig. 3.3 shows a food chain involving 'Spirulina'.

FIG. 3.3



**State AND explain the advantage to human populations of eating dried 'Spirulina' directly rather than using it as cattle feed.**

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[2]

[TOTAL: 12]

- 4 The growth of a human being from a zygote into a sexually mature adult involves many cycles of cell division by both mitosis and meiosis.**

**Once formed, cells may differentiate. Some cells will group and become part of a tissue or an organ. Other cells, such as gametes, remain as individual single cells.**

- (a) The following cells, J, K, L and M, are found in either the human male or human female:**

- J oogonium**
- K primary spermatocyte**
- L secondary oocyte**
- M Sertoli cell.**

**State the cell OR cells from the list above that fit the following descriptions:**

- (i) diploid cells**

\_\_\_\_\_ **[1]**

- (ii) an embryonic diploid cell**

\_\_\_\_\_ **[1]**

- (iii) a cell formed by meiosis I.**

\_\_\_\_\_ **[1]**

- (b) In the menstrual cycle, the activity of the reproductive organs is controlled by hormones. Some of these hormones, such as oestrogen, are steroid hormones. Others, such as follicle stimulating hormone (FSH) and luteinising hormone (LH), are glycoproteins.**

**Oestrogen, FSH and LH molecules carry out their function by binding to receptors.**

**Oestrogen receptors are found in the cytoplasm of target cells.**

**FSH and LH receptors are found on the cell surface membranes of target cells.**

- (i) Suggest why receptors for FSH and LH are located on the cell surface membranes but the receptors for oestrogen are located in the cytoplasm.**

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[2]

- (ii) Name the organ responsible for the secretion of FSH and LH.**

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[1]

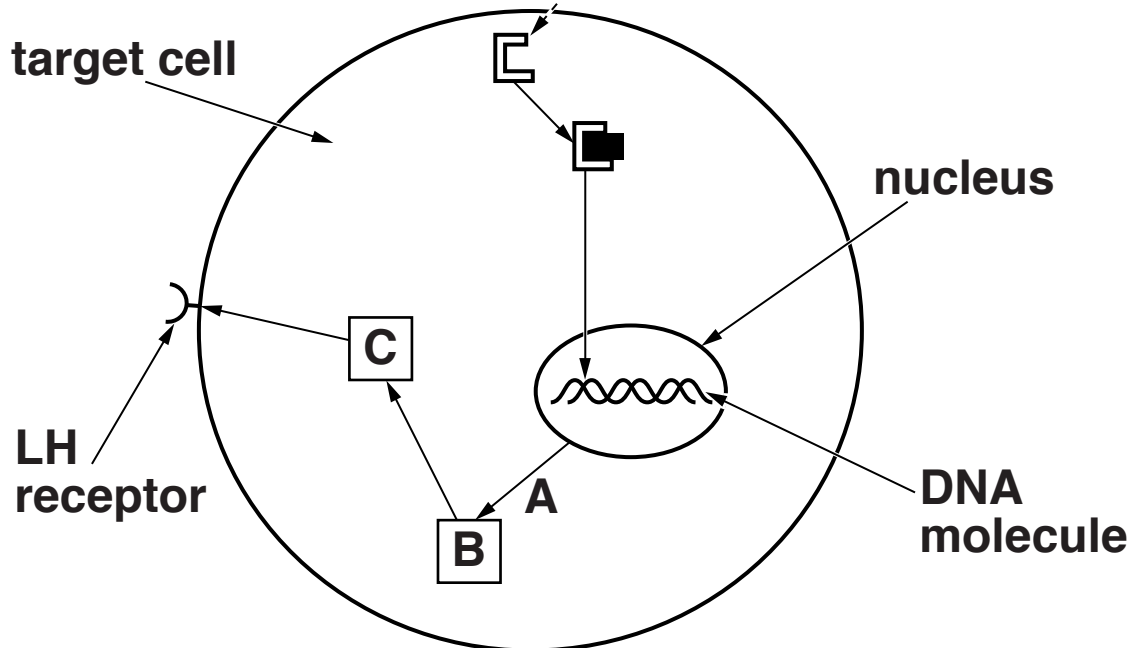
- (c) Fig. 4.1 shows a simplified diagram of the action of the hormone oestrogen on a target cell.

**FIG. 4.1**

**KEY:**

■ oestrogen molecule

◩ oestrogen receptor



- (i) Complete the table below by naming the following molecules and organelles represented in Fig. 4.1.

	Name
Molecule A	
Organelle B	
Organelle C	

[3]

- (ii) Suggest the location AND the role of the target cell shown in Fig. 4.1.**

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**[2]**

- (d) Cells in the endometrium (the lining of the uterus) have receptors for follicle stimulating hormone (FSH).**

**Suggest what effect FSH has on the DNA in the nuclei of cells in the endometrium during days 5 to 14 of the menstrual cycle.**

**Give the reason for your suggestion.**

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**[2]**

**[TOTAL: 13]**

- 5 The Office for National Statistics (ONS) analyses the data collected from the National Census.**

**Information required on the census form includes age, place of residence and the numbers of people in any household.**

**Using this information AND data from the registration of births and deaths, detailed and accurate information on population size in England and Wales can be produced.**

- (a) Suggest why the information collected by the ONS is accurate.**

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**[1]**



- (b) The National Census is carried out every 10 years and the data can be analysed to compare changes in the size and composition of the UK population over time.**

**Fig. 5.1, ON PAGE 2 OF THE INSERT, shows the structure of the population of England and Wales in 2001.**

**The 1960s was a period which experienced a ‘baby boom’ when the birth rate increased significantly.**

**Describe the evidence from Fig. 5.1 that shows that this decade experienced a ‘baby boom’.**

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**[2]**

**(c) The number of births each year depends on TWO factors. One of these factors is the fertility rate of the female population. The fertility rate is measured by the mean number of children born to a woman over her lifetime.**

**(i) Suggest the second factor which will affect the number of births each year in a population.**

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**[1]**

**(ii) In 1911 the fertility rate was 2.8 and the population size was 36.1 million.**

**In 2001 the fertility rate was 1.6 and the population size was 52.0 million.**

**Outline why the population increased in size dramatically despite a fall in the fertility rate.**

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**[2]**

**(d) Fig. 5.2, ON PAGE 3 OF THE INSERT, shows the population graph produced from the census data in 2011.**

- (i) Suggest why there is a significant increase in the population of 20 to 29 year olds on the 2011 graph compared with that of the 10 to 19 year olds on the 2001 graph.**

\_\_\_\_\_  
\_\_\_\_\_ **[1]**

- (ii) Comparing the data from 2001 with the data from 2011, identify ONE effect that the increasing number of 20 to 29 year olds may have had on the size of any other age group AND explain why this might have occurred.**

**Effect** \_\_\_\_\_

\_\_\_\_\_

**Explanation** \_\_\_\_\_

\_\_\_\_\_  
**[2]**

**[TOTAL: 9]**

**6 In recent years, the organisers of the Campaign for Real Ale (CAMRA) have reported a large increase in the number of ‘microbreweries’. These are small scale beer producers who concentrate on the taste and quality of the beer they produce. Beer-making requires yeast cells to respire the sugars found in an extract made from germinated barley grains.**

**(a) Yeast cells carry out both aerobic and anaerobic respiration.**

**(i) Identify one product of BOTH aerobic and anaerobic respiration in yeast cells that is essential in beer production.**

\_\_\_\_\_ **[1]**

**(ii) Identify one product of anaerobic respiration in yeast cells that is NOT produced in aerobic respiration.**

\_\_\_\_\_ **[1]**

**(b) Both aerobic and anaerobic respiratory pathways begin in the cytoplasm.**

**In the cytoplasm, hexose sugars are broken down in a series of steps to form a three-carbon compound. This compound is then metabolised further to allow cells to make some ATP.**

**(i) Outline how ATP is made IN THE CYTOPLASM of yeast and human cells from the metabolism of a three-carbon compound.**



**In your answer, you should use appropriate technical terms, spelled correctly.**

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**[3]**

- (ii) State ONE anabolic process that occurs IN THE NUCLEUS of both human and yeast cells for which ATP is required.

\_\_\_\_\_ [1]

[TOTAL: 6]

**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 margins.**

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