RECOGNISING ACHIEVEMENT

Oxford Cambridge and RSA Examinations

Advanced Subsidiary General Certificate of Education

HUMAN BIOLOGY
Growth, Development and Disease

2857

Specimen Paper 2003

Additional materials: Ruler (cm/mm)
Electronic calculator

TIME 1 hour

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and candidate number in the spaces above.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

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.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- *You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.*

FOR EXAMINER'S USE		
Question number	**Max.**	**Mark**
1	**14**	
2	**14**	
3	**11**	
4	**10**	
5	**11**	
TOTAL	**60**	

1 A karyotype may be used to diagnose a chromosomal mutation.

(a) State what is meant by a *chromosomal mutation.*

_____

_____

_____ **[2]**

(b) **Fig. 1.1** shows the karyotypes of two individuals, A and B, that have chromosomal mutations.

Individual A
Turner's syndrome

Individual B
Klinefelter's syndrome

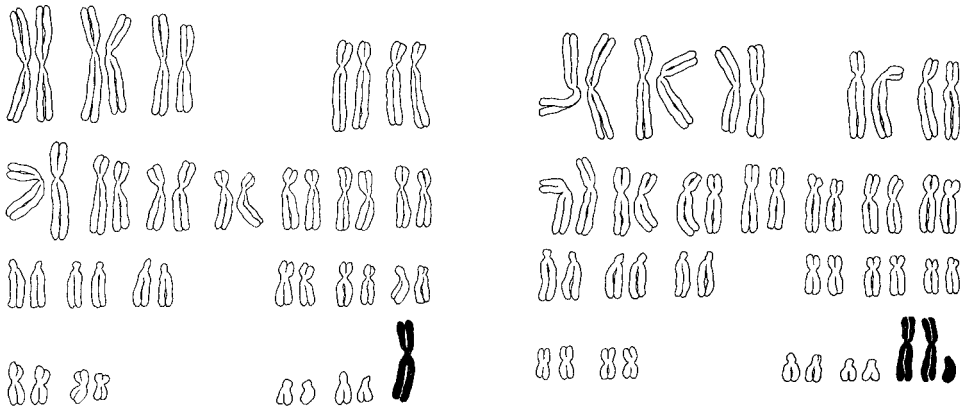

Fig.1.1

(i) Describe how the karyotypes of individuals **A** and **B**, shown in **Fig. 1.1**, differ from normal karyotypes.

A _____

_____

_____

B _____

_____

_____ **[4]**

1 **(b)** **(ii)** It is now believed that a gene on the Y chromosome determines the sex of an individual by coding for the production of a substance called *sex determining factor.*

Suggest what effect the presence of this factor would have on the sexual development of individual **B** in the foetal stage.

[1]

(c) *In this question, one mark is available for the quality of written communication*

Describe in detail, how a cytogeneticist would produce a karyotype using a sample of amniotic fluid.

[6]

Quality of Written Communication [1]

2 **(a)** Monitoring the growth rate of an infant is a convenient way of checking that the infant is healthy.

State **two** ways in which infant growth may be monitored, other than by measuring height.

1 _____

_____

2 _____

_____ **[2]**

(b) **Fig 2.1** shows the average heights of boys and girls at yearly intervals.

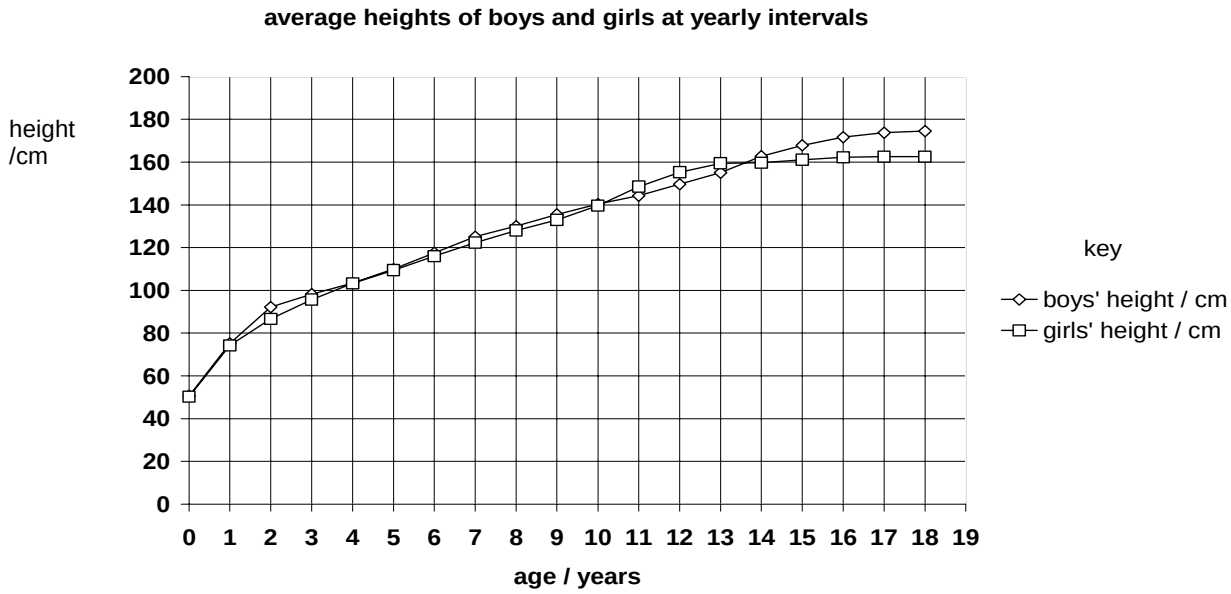

Fig.2.1

(i) Using the information in **Fig. 2.1**, compare the pattern of growth in boys and girls. Credit will be given if you use figures to support your answer.

_____

_____

_____

_____ **[4]**

2 **(b)** **(ii)** Explain the reasons for the differences in the pattern of growth of boys and girls between 10 and 18 years.

[2]

(iii) **Table 2.1** shows the average height for males, aged 12-15 years.

Table 2.1

Age/years	Height/cm
12	149
13	155
14	162
15	167

Calculate the percentage increase in growth between 12 and 14 years. Show your working and give your answer to two decimal places.

Answer_____% **[2]**

(c) State and explain **two** factors that could slow down the growth of a child.

[4]

3 Mitosis is a type of nuclear division that is part of a controlled process called the cell cycle.

(a) **(i)** State the phase of the cell cycle in which DNA replicates.

_____ **[1]**

(ii) If a cell possesses **two** chromosomes, state how many **chromatids** will be visible in prophase.

_____ **[1]**

(iii) State the phase of the cell cycle at which two daughter cells are produced.

_____ **[1]**

(b) Describe the role of centrioles in the process of cell division in human cells.

_____

_____ **[1]**

(c) Identify the **two** stages of mitosis shown in **Fig. 3.1** and **Fig. 3.2**. In each case, state **one** reason for your answer.

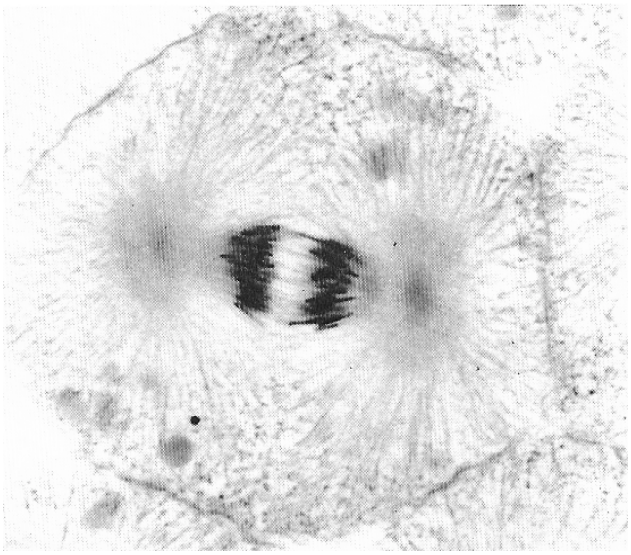

Fig. 3.1

Stage of mitosis in **Fig. 3.1**: _____

Reason: _____

_____ **[2]**

3 **(c)** continued

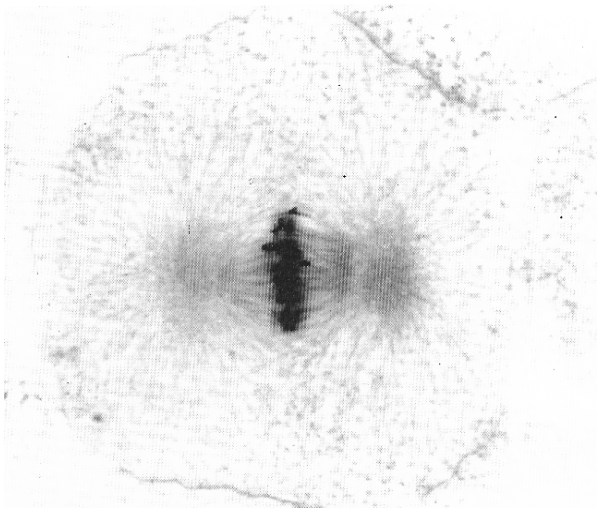

Fig. 3.2

Stage of mitosis in **Fig. 3.2**: _____

Reason: _____

_____ **[2]**

(d) The cell cycle is controlled by genes. Describe and explain what may happen if changes occur in a gene that controls the cell cycle.

_____

_____

_____

_____ **[3]**

4 The following passage is about the use of stem cell technology.

Blood cells of all types develop from haemopoietic (blood forming) stem cells that originate in the bone marrow. These unspecialised stem cells are said to be pluripotent, as they divide repeatedly by mitosis and can differentiate into all the cells of the blood and immune system. Damage to stem cells affects a person's ability to produce appropriate numbers of fully functioning blood cells and platelets. Transplanted bone marrow can be used to treat a patient whose own marrow contains damaged stem cells. Bone marrow need not be donated by someone else. In some circumstances, stem cells from the patient's own marrow can be used for treatment. Stem cells are collected and stored prior to the patient receiving chemotherapy or radiotherapy. The stored cells are cultured and treated before being reintroduced back into the patient. Future developments for stem cell technology could include the removal and storage, at birth, of stem cells from the umbilical cord.

(a) **(i)** Describe the main features of a pluripotent stem cell.

[2]

(ii) Explain the meaning of the term *differentiation.*

[2]

(iii) Stem cells collected from the patient, for future use, may include malignant (cancerous) cells. Suggest how these cells might be treated before transplanting them back into the patient.

[1]

4 **(b)** Removal of stem cells from the umbilical cord at birth, which could then be stored for future treatment, appears to be a good insurance against future disease.

State **two** advantages and **two** disadvantages of such a programme.

Advantages:

1 _____

_____

2 _____

_____

Disadvantages:

1 _____

_____

2 _____

_____ **[4]**

(c) Customised blood cells could be manufactured to seek out and destroy malignant or virus-infected cells. Suggest which type of blood cell could be used for this research.

_____ **[1]**

5 **(a)** Tuberculosis (TB), is a world wide disease that is caused by two bacteria, *Mycobacterium tuberculosis* and *M. bovis.*

In the United Kingdom, school children are immunised with a vaccine against TB known as the BCG vaccine. However, before a vaccine is given, a child is tested for existing immunity using the Heaf (tuberculin) test.

Describe how the Heaf test is carried out to help diagnose if a child already has immunity toTB.

_____

_____

_____

_____

_____

_____

_____ **[4]**

5 **(b)** Discuss the problems involved in controlling the transmission of the human immunodeficiency virus (HIV).

[7]

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MARK SCHEME

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1 Please ensure that you use the **final** version of the Mark Scheme.
You are advised to destroy all draft versions.

2 Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If **two** (or more) responses are required for one mark, use only **one** tick. Half marks (½) should never be used.

3 The following annotations may be used when marking. **No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.**

X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

4 The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5 In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), examiners should look at the responses given and make a judgement as to whether they are correct, incorrect or 'neutral'. They should then mark the first answer(s) given (unless they are judged to be 'neutral') up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6 Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7 Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8 An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct **and** answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

Abbreviations, annotations and conventions used in the Mark Scheme	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	( )	=	words which are not essential to gain credit
	____	=	(underlining) key words which **must** be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	ora	=	or reverse argument

Question	Answer	Mark
1(a)	a change in the structure of chromosomes (in a cell); a change in the number of chromosomes (in a cell) / change in diploid number; named eg;	2 max
1(b)(i)	*individual A* 45 instead of 46 chromosomes / one less chromosome than normal; single sex chromosome instead of pair / X instead of XX; X chromosome lost from pair 23 / from pair of sex chromosomes; **[2 max]** *individual B* 47 instead of 46 chromosomes / one extra chromosome than normal; 3 sex chromosomes instead of one pair / XXY instead of XY; one extra X chromosome on pair 23 / on pair of sex chromosomes;**[2 max]** both may result from non-disjunction;	4 max
1(b)(ii)	stimulates the secretion / production of male hormones / named; that stimulate the production of male genitalia / named part; the baby would be male at birth;	1 max
1(c)	centrifugation of amniotic cells / cells are spun down to the bottom of the tube / amniotic fluid is centrifuged to sediment the amniotic cells / AW; cells transferred to a nutrient solution; containing phytohaemagglutinin; which stimulates mitosis in the cells; cells incubated; for 3 days at 37°C; to allow cells to reproduce / divide by mitosis; colchicine is added; to stop spindle fibre formation; cell division / nuclear division / mitosis stops; at metaphase; weak saline / salt solution / hypotonic solution / solution of a higher water potential is added; cells swell up and chromosomes spread out; chromosomes are photographed; individual chromosomes/chromosome pairs are cut matched; chromosome pairs / homologous pairs of chromosomes are arranged in decreasing order of size; chromosome pairs / homologous pairs of chromosomes numbered 1 to 23; AVP; eg ref' to automated process	6 max
	QWC: clear, well organised using specialist terms;	6 max
	Total mark:	14

Question	Answer	Mark
2(a)	mass / weight; measuring circumference of head; *Accept the first answer given on each answer line (unless the first is judged to be 'neutral'). If all the answer(s) given on one answer line are neutral, then look for a second correct answer on another line.*	**2 max**
2(b)(i)	0-1 years / 4-5 years growth is similar in both sexes; use of figs both axes to support previous statement; growth is greater in boys than girls at 1-4 / 5-11 / 13-18 years; use of figs both axes to support previous statement; at 11- 13 years growth is greater in girls than boys;	**4 max**
2(b)(ii)	puberty occurring; earlier in girls; more muscle develops in boys; ref' to sex hormones; ref' to growth hormones; AVP;	**2 max**
2(b)(iii)	$\frac{(162 - 149)}{149} \times 100$; 8.73 %; *OR correct answer only ;;*	**2**
2(c)	insufficient protein in the diet; to provide the essential/right amino acids; for cells to make proteins; ref to suitable examples e.g. collagen in bone; insufficient calcium; for bone /skeletal development; reduces mechanical strength of bones/rickets; insufficient vitamin D; for calcium absorption from gut; for calcium deposition in bone tissue; deficiency of somatropin; leads to deficiency of growth hormone / somatomedin; reduction of protein synthesis / cell division in tisues; especially in bones; ref to dwarfism; underactive thyroid gland / hypothyroidism; insufficient thyroid hormones; impaired brain development / cretinism; e.g of genetic damage; qualified/explained; AVP;; e.g. social problem, qualified or explained *One mark for factor and one mark for explanation in each case accept first **two** answers unless agreed as neutral.*	**4 max**
	Total mark:	**14**

Question	Answer	Mark
3(a)(i)	interphase;	1
3(a)(ii)	four;	1
3(a)(iii)	cytokinesis;	1
3(b)	makes spindle fibres / spindle organising centre / determines plane of cell division;	1
3(c)	*Fig. 3.1* anaphase; chromatids being pulled towards poles; *Fig. 3.2* metaphase; chromatids arranged on equator / centre of cell**;**	4
3(d)	mutated gene; escapes detection / destruction by immune system; becomes oncogene; cancer producing gene; results in uncontrolled, cell division / mitosis; forms tumour / mass of undifferentiated cells; AVP; eg ref' to benign and malignant tumour	3 max
	Total mark:	11
4(a)(i)	they can specialise / differentiate into many cell types / AW; they can manufacture all the blood cells; a cell that can replicate repeatedly;by mitosis;	2 max
4(a)(ii)	cells becoming specialised; changing their structure; to carry out specific functions; determined by genes switched on or off;	2 max
4(a)(iii)	use chemotherapy to kill malignant cells; use monoclonal antibodies to remove malignant cells; culture over a longer period of time; ensure that no malignant cells remain;	1 max

Question	Answer	Mark
4(b)	*advantages* no self-antigens; unspecialised / lack of resistance / not pre-programmed; store available for future disease treatment; future development may increase ability to treat disease in this way; specialist cells could be synthesised to treat specific disease; may be possible to develop organs for transplant from them / replace damaged cells; may be possible to genetically engineer them; **[2 max]** *disadvantages* ethical problems, qualified; storage capacity limited; longevity of cells; freezer failure / cells may be damaged / mutate; **[2 max]**	**4 max**
4(c)	T (lymphocytes / cells);	**1**
	Total mark:	**10**
5(a)	small amount of protein extracted from TB bacterium; injected just below skin (of upper arm); using six pronged needle / Heaf gun; after 2/3 days interval; reaction / redness, hardening / swelling at site of injection; suggesting child immune to TB; no reaction suggests no immunity to TB;	**4 max**
5(b)	no cure, for AIDS / HIV; no vaccine available; long, incubation / latent period; HIV+ no symptoms / symptomless carriers / difficult to identify / carriers unaware; people resistant, to health warnings / advice, about life style / sexual behaviour; problems with contact tracing; eg people may not be able to identify contacts, may not find them; sharing needles; ® non sterile needles sterile needles provided, seem to condone drug use / not used by addicts; HIV test not always reliable / takes several weeks after infection to show positive; expensive to test the population for HIV; civil liberties argument / AW; problems with condoms; transmitted during breast feeding, advantages may outweigh disadvantages in some countries; mother to foetus route difficult to control; ref' promiscuity qualified; blood, not screened / heat treated initially; any specific problems in developing countries; AVP; e.g. social stigma associated with test;	**7 max**
	Total mark:	**11**
	PAPER TOTAL:	**60**