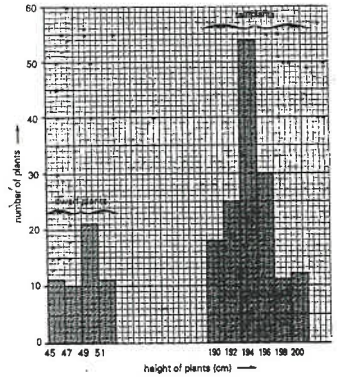
Past HKCEE Questions
Genetics
Paper I

1. In garden pea plants, the height of the stem is controlled by a pair of alleles. The allele for tallness (T) is completely dominant over that for dwarfness (t).
When the flowers of a single tall plant (195 cm) were self-pollinated, the plants produced were of different heights. Their height variation is shown in the chart below:



(i) With reference to the above chart,
(1) deduce the genotype of the parent plant, and give one reason to support your answer.
(2) construct a genetic diagram to illustrate this cross, and hence work out the genotypic ratio of the F1 generation.
(3) state separately the total number of dwarf plants and that of tall plants.
(ii) Give one reason why the dwarf plants are not of the same height.
(iii) How would you show which individual among the tall plants is homozygous for tallness? (HKCEE 1986)

2. In fruitflies, body colour is controlled by one pair of genes. In a genetic experiment, three groups of fruitflies A, B and C, each of which consisted of individuals of the same genotype for body colour, were crossed as follows:

Cross I

	♂		♀
Parent	A grey	×	A grey
F_1	72 grey		23 black

Cross II

	♂		♀
Parent	A grey	×	B grey
F_1	all grey		

Cross III

	♂		♀
Parent	A grey	×	C black
F_1	62 grey		68 black

(i) Of the crosses I, II and III, which ONE would enable you to determine the dominant character for body colour in fruitflies? State the dominant character for body colour. (2 marks)
(ii) Using the symbol R to represent the dominant gene for body colour and r for the recessive gene,
(1) state the possible genotypes of A, B and C. (3 marks)
(2) illustrate cross III by means of a genetic diagram. (3 marks)
(iii) How would you determine whether a fruitfly with the dominant character for body colour is homozygous or heterozygous? (2 marks)
(HKCEE 1987)

3. In mice, the fur colour is controlled by a pair of alleles. The allele for black fur (B) is dominant over that for brown fur (b). Two black mice (the parental generation) were allowed to mate several times, and their F_1 offspring were always black. When the F_1 mice were allowed to mate among themselves, a total of 80 F_1 offspring were produced, of which 74 were black and 6 were brown.
(i) Based on the fur colours of the F_1 and F_2 generations, state the probable genotype(s) of the F_1 mice. (2 marks)
(ii) Use a genetic diagram to show how the brown F_2 mice were produced from the F_1 mice. (3 marks)
(iii) Suggest the probable genotype(s) of the parental generation. (2 marks)
(iv) What breeding experiment would you perform to confirm the genotype of each parent? Explain your answer. (3 marks)
(HKCEE 1988)

4. In a certain species of pea plant, the flower colour is controlled by a pair of alleles. The table below gives the results of two separate crosses

Parent		Cross I: red flower × white flower	Cross II: red flower × red flower
Number of offspring with	red flowers	503	705
	white flowers	497	224

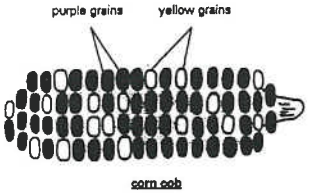
(i) State the recessive character for flower colour. Explain your answer. (2 marks)
(ii) Using the symbol F to represent the dominant allele for flower colour and f for the recessive allele, list all the possible genotypes of
(1) the parent with red flowers in cross I.
(2) the offspring with red flowers in cross II. (2 marks)
(iii) Explain the following genetic terms:
(1) allele,
(2) phenotype, and
(3) hybrid. (3 marks)
(iv) Suppose N is the chromosome number in the gametes of the plant, what is the chromosome number in the cells of its flower petals? (1 mark)
(HKCEE 1989)

5. The following table shows the heartbeat rates of 38 students at rest:

Heart beat per minute	Number of students
56 – 60	4
61 – 65	7
66 – 70	11
71 – 75	9
76 – 80	4
81 – 85	1
86 – 90	1
91 – 95	0
96 – 100	1

(i) Using graph paper, plot a histogram of these results. (4 marks)
(ii) Do these results show continuous or discontinuous variation? Give a reason for your answer. (2 marks)
(iii) Other than heartbeat rate, give ONE human example of
(1) continuous variation.
(2) discontinuous variation. (2 marks)
(HKCEE 1989)

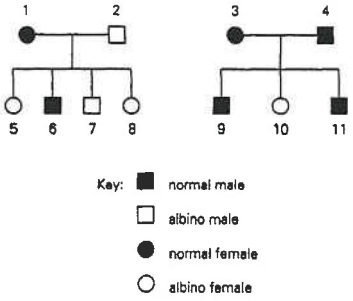
6. A corn (maize) plant produces groups of male flowers at the apex and groups of female flowers in the lower parts of the plant. In a crossing experiment, pollen grains from one plant were transferred to the female flowers of another plant. After fertilization, each group of female flowers developed into corn grains on a cob. The diagram below shows one side of such a corn cob which bears grains of two different colours, purple and yellow.



corn cob

(i)
(1) State the number of yellow and purple grains as shown in the diagram. (1 mark)
(2) To what simple ratio do these numbers approximate? (1 mark)
Assuming that the grain colour is controlled by a single pair of alleles, answer the following questions:
(ii) With respect to grain colour, deduce the genotypes and phenotypes of the parent plants. Explain your answer.
(Note: A genetic diagram will NOT be accepted.) (4 marks)
(iii) If plants developed from two yellow grains are crossed, what is/are the possible colour(s) of the grains in the resulting corn cobs? Explain your answer. (2 marks)
(HKCEE 1990)

7. In humans, normal body pigmentation is determined by a pair of alleles. A person lacking body pigments is called an albino. Answer the questions with reference to the following two pedigrees:



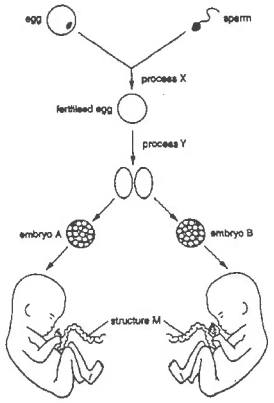
(i) Which character, normal body pigmentation or albino, is recessive? Explain your answer.
(Note: genetic diagrams will NOT be accepted.) (4 marks)
(ii)
(1) Explain by means of a genetic diagram, the expected phenotypic ratio of the offspring when individual 6 is married to individual 10. (Note:

Use D to represent the dominant allele, and d to represent the recessive allele.) (4 marks)

(2) Suppose the first 3 children of this couple have normal body pigmentation, what will be the chance of their 4th child being an albino? (1 mark)

(HKCEE 1991)

8. In human reproduction, occasionally a fertilized egg may split and develop into two embryos. These embryos will eventually develop into two identical offspring. The following diagram shows some of the stages described above:



(i) Name the organ in which sperms are produced. (1 mark)

(ii)

(1) Name the type of cell division by which eggs are produced. (1 mark)

(2) Explain the significance of this type of cell division on the chromosome number of the offspring. (2 marks)

(iii) Where does process X normally occur in the female reproductive tract? (1 mark)

iv. Name the type of cell division involved in process Y. (1 mark)

(iii) Among the children of individuals 1 and 2, list those who can donate blood to

(1) individual 1. (1 mark)

(2) individual 2. (1 mark)

(HKCEE 1991)

9. In maize, the dominant gene G is for chlorophyll production and the recessive gene g is for inability to produce chlorophyll. In a cross between two green plants, seeds were collected and allowed to germinate. Of the 935 seeds germinated, 705 developed into green seedlings. The rest developed into non-green seedlings, all of which died within 14 days after germination.

(i) Deduce the genotypes of the parent plants. Explain your answer without using a genetic diagram. (4 marks)

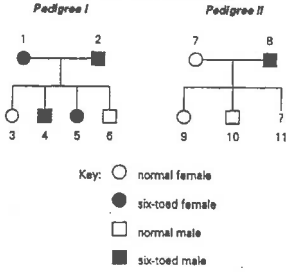
(ii) Of the 705 green seedlings, how many of them have a heterozygous genotype for chlorophyll production? Explain your answer with the help of a genetic diagram. (5 marks)

(iii) Explain why some of the seeds which were unable to produce chlorophyll could still germinate. (1 mark)

(HKCEE 1992)

10. Most people have five toes on each foot. Occasionally a person is born with six toes as shown in the photograph below:

The number of toes is an inherited character controlled by a pair of alleles. The diagram below presents two pedigrees showing the inheritance of this character:



(i) Based on Pedigree 1, which allele, five-toed or six-toed, is dominant? Explain your answer without using a genetic diagram. (5 marks)

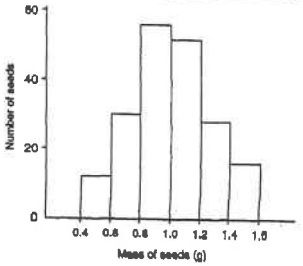
(ii) What will be the chance of individual 11 being six-toed? Explain your answer by means of a genetic diagram.
(Note: Use T to represent the dominant allele, and t to represent the recessive allele.) (4 marks)

(iii) In order to ensure that none of her children will have the six-toed character, individual 5 wants to have her extra toes removed by surgical operation before she marries individual 10. Do you think her idea can work? Explain your answer. (2 marks)

(HKCEE 1993)

11. The seeds of the garden pea are either green or yellow in colour. This character is controlled by a pair of alleles. A yellow seed germinated and developed into a mature plant. This plant was then self-pollinated and 190 seeds were produced. The colour and the mass of the seeds are recorded in the following table and histogram respectively.

Colour of seeds	yellow	green	white
Number of seeds	143	46	1



(i) With reference to the information given, state the type of variation shown by the colour of the seeds. Explain your answer. (2 marks)

(ii) The mass of the seeds can be affected by both environmental and genetic factors.

(1) Suggest one environmental factor that may result in the difference in the mass of the seeds. (1 mark)

(2) Suggest two main causes of genetic variation that lead to the difference in the mass of the seeds. (2 marks)

(iii) Based on the given information, deduce the genotype for seed colour of the original yellow seed. Explain your answer. (Genetic diagrams are not accepted.) (3 marks)

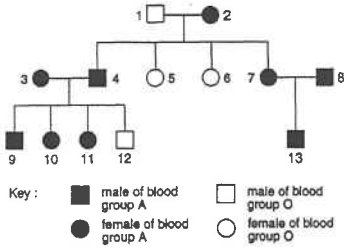
(iv) The white seed colour was most likely caused by a mutation of the allele that controls seed colour.

(1) What is meant by mutation? (1 mark)

(2) Suggest one part of the flower of the mature plant where this mutation could have occurred. (1 mark)

(HKCEE 1994)

12. The pedigree below shows the inheritance of blood groups in a family:



(i) Based on the given information, which blood group, A or O, is the dominant character? Explain your answer without using a genetic diagram. (5 marks)

(ii) State the possible genotype(s) of

(1) individual 7.

(2) individual 13.

Define the symbols you use. (4 marks)

(iii) Among the children of individuals 1 and 2, list those who can donate blood to

(1) individual 1. (1 mark)

(2) individual 2. (1 mark)

(HKCEE 1995)

13. Tomato plants produce fruits of two different shapes, spherical and pear-shaped. The shape of the fruit is controlled by a pair of alleles. In a study, two separate crosses were performed and the results are shown below:

Cross	Parent plants with	Number of daughter plants with	
		pear-shaped fruits	spherical fruits
A	pear-shaped fruits × spherical fruits	48	42
B	pear-shaped fruits × spherical fruits	0	84

(i) Which fruit shape is controlled by the dominant allele? Explain how you arrived at your answer. (Marks will not be given for genetic diagrams.) (4 marks)

(ii) State the genotype of the parent plant with spherical fruits in

(1) cross A,

(2) cross B.

Define the symbols you use. (3 marks)

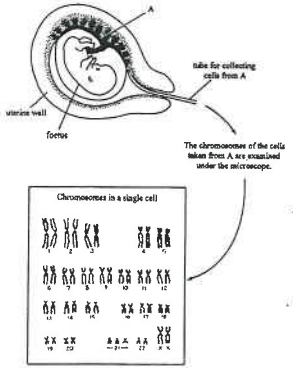
(iii) The parent plant with pear-shaped fruits in

cross A is self-crossed. Use a genetic diagram to show the result. (3 marks)

(iv) Explain whether the self-cross mentioned in (iii) is a kind of sexual or asexual reproduction. (2 marks)

(HKCEE 1996)

14. The diagram below outlines a clinical test used to examine whether a human foetus has any abnormality in its chromosomes:



(i) The cells of A and the cells of the foetus have the same genetic composition. How would you explain this? (2 marks)

(ii)

(1) With reference to the chromosomes in the diagram, state the sex of the foetus. (1 mark)

(2) Describe how the sex of this foetus is determined at the time of fertilization. (3 marks)

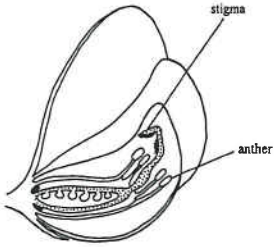
(iii) What abnormality is found in the chromosomes of the foetus? (1 mark)

(iv) As the uterine wall may be stimulated to contract when removing cells from A, what would be the risk associated with this test? (1 mark)

(v) State two differences between the blood entering the foetus and that leaving the foetus. (2 marks)

(HKCEE 2000)

15. The diagram below shows a section of a pea flower:



(i) Under natural conditions, pea flowers are self-pollinated, i.e. the stigma receives pollen grains from the same flower. Suggest one advantage and one disadvantage of this method of pollination. (2 marks)

(ii) In a genetic experiment, a scientist wanted to ensure that the stigma of a pea flower only received the pollen grains of another pea flower. Suggest how the scientist could achieve this by making use of a plastic bag and a brush. (3 marks)

(iii) The colour of the pea pod (fruit) is controlled by a pair of alleles. The scientist first crossed a pea plant homozygous for green pods with another pea plant homozygous for yellow pods to produce the first filial generation (F_1). She then allowed the F_1 plants to self-pollinate to produce the second filial generation (F_2). The results of the crosses are summarized in the table below:

Result of the first cross	All F_1 plants produced green pods
Result of the second cross	428 F_2 plants produced green pods 152 F_2 plants produced yellow pods

(1) What can you conclude from the result of the first cross? (1 mark)

(2) Use a genetic diagram to show how the pod colours of the F_2 plants were inherited from the F_1 plants. (5 marks)

16. The following table shows the information about some of the characteristics of 20 students in a class:

Student	Height (cm)	Blood group	Ability to roll the tongue
1	136	A	roller
2	168	O	non-roller
3	159	A	non-roller
4	139	O	roller
5	174	O	non-roller
6	167	AB	non-roller
7	165	O	roller
8	164	A	roller
9	161	B	non-roller
10	169	O	roller
11	179	O	roller
12	170	A	non-roller
13	163	B	roller
14	166	B	roller
15	164	A	roller
16	165	B	roller
17	162	O	roller
18	170	AB	roller
19	165	A	roller
20	165	O	roller

(i)

(1) Draw a bar chart to show the distribution of students with different blood groups. (3 marks)

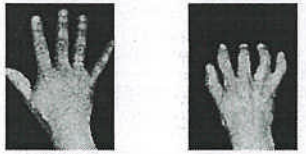
(2) What type of variation does blood group show? (1 mark)

(ii) In humans, the ability to roll the tongue is determined by a pair of alleles. Students 1 and 2 are sisters. Both of their parents are tongue rollers. Deduce, with reasons, whether the allele for tongue rolling is dominant or recessive.
(Marks will not be awarded to genetic diagrams.) (5 marks)

(iii) Students 19 and 20 are twin brothers. Are they identical or non-identical twins? Give a reason for your answer. (2 marks)

(HKCEE 2001)

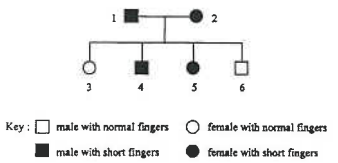
17. An inherited abnormality in humans is the occurrence of unusually short fingers. The photographs below show a hand with normal forgers and a hand with this abnormality:



Normal fingers *Short fingers*

Source: Adrian E. Flatt, *The Care of Congenital Hand Anomalies*, Missouri: Quality Medical Publishing Inc., 1994.

The length of fingers is controlled by a pair of alleles. The allele for short fingers probably arose from a mutation of the allele for normal fingers. The following pedigree shows the inheritance of this abnormality in a family:



(i)

(1) What is meant by mutation? (1 mark)

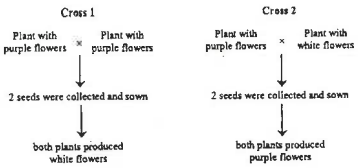
(2) Explain how a mutation in a person may lead to a change in the metabolic activities of his cells. (2 marks)

(ii) Deduce which character, normal forgers or short forgers, is dominant. Explain your deduction. (5 marks)
(Marks will not be awarded for genetic diagrams.)

(iii) Individual 6 is going to marry a female homozygous for normal fingers. Draw a genetic diagram to show the result of the cross.
(Use F to stand for the dominant allele and f for the recessive allele.) (3 marks)

(HKCEE 2002)

18. Individuals of a certain type of plant produce either purple or white flowers. The flower colour is controlled by a pair of alleles. A gardener carried out two crosses with this type of plant and the results are shown below:



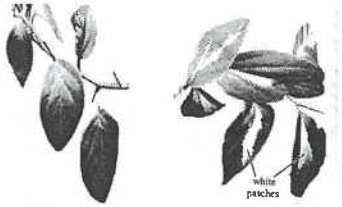
(i) Based on cross 1, deduce the dominant flower colour. Explain your deduction.
(Marks will not be awarded for genetic diagrams.) (5 marks)

(ii) Use symbols to show the possible genotypes of the parents in cross 2. Define the symbols you use. (3 marks)

(iii) If the purple-flower parent in cross 2 was self-pollinated (i.e. the stigma receives pollen grains from the same plant) and a large number of offspring was produced, predict the phenotypes of the offspring and their ratio. (3 marks)

(HKCEE2003)

19. The following pictures show two plants of the same species. Plant A has green leaves. Plant B is a new form recently discovered by a scientist; it has variegated leaves.



Plant A *Plant B*

The scientist performed an experiment by self-crossing plant **A**. A large number of offspring were obtained and they all produced green leaves. He then **repeated** the same procedure with plant B and all the offspring produced variegated leaves.

(i) Assuming that the colour pattern of the leaves is controlled by a pair of alleles, what deductions can be made from the above results regarding the genotypes of plants A and B? Explain how you arrive at your deductions. (3 marks)
(Marks will ***not*** be awarded for genetic diagrams.)

(ii) In order to find out which colour pattern is dominant, the scientist performed another experiment by crossing plant A with plant B. Explain how the results of this cross would enable him to determine the dominant phenotype. (3 marks)

(iii) The white patches on the leaves of plant B might be caused by mineral deficiency instead of genetic changes. If this is the case, what mineral is likely to be deficient? What is the function of this mineral in plants? (2 marks)

(HKCEE 2004)

20. Complete the following paragraph with suitable words selected from the list below:

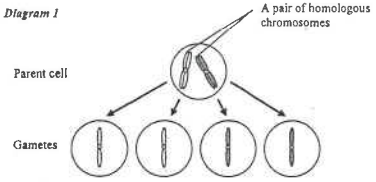
chromosome / diploid / dominant / embryo / gamete / haploid /heterozygote / homozygote / meiotic cell division / mitotic cell division / mutation /protein / recessive

Genes are the basic units of inheritance. They are carried on the (a) in the nucleus of a cell. A gene may exist in different forms called alleles. When an organism contains two different alleles of the same gene, it is described as a (b) and the allele that expresses itself is said to be (c). During reproduction, some cells in the sex organs undergo (d). During this process, the alleles in these cells separate from each other and every (e) thus formed will possess only one allele for each gene. After fertilization, the zygote formed will contain alleles occurring in pairs and its chromosome number will become (f).

(HKCEE 2005)

21. Diagram 1 below shows the result of meiotic cell division in gamete formation in humans: (Note: Only one pair of homologous chromosomes is shown.)

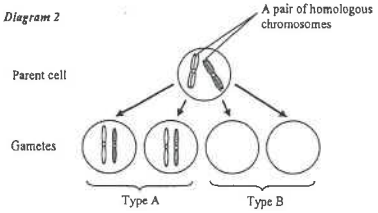
Diagram 1



(i) Based on Diagram 1, give two features that are characteristic of meiotic cell division. (2 marks)

(ii) Sometimes, an abnormality occurs during meiotic cell division in gamete formation in humans. Diagram 2 below shows the abnormality concerning a pair of homologous chromosomes:

Diagram 2

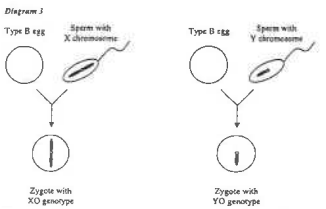


(1) Distinguish between type A and type B gametes. (1 mark)

(2) Name a genetic disorder that will develop if a type A egg is fertilized successfully by a normal sperm (1 mark)

(3) This type of abnormality in cell division may occur in the sex chromosomes. The type B eggs may fertilize with normal sperms to form zygotes with different genotypes as shown in Diagram 3 below:

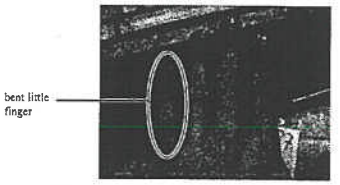
Diagram 3



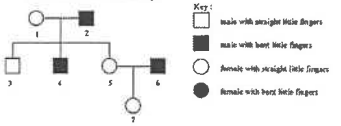
(Note: Only the sex chromosome is shown.)
Suggest why zygotes with XO genotype may develop into an individual but not those with YO genotype. (3 marks)

(HKCEE 2006)

22. The shape of the human little finger can be straight or bent. The photograph below shows a hand with a bent little finger:



The inheritance of the shape of the little finger is controlled by a pair of alleles. The following pedigree shows the inheritance of this trait in a family:



(a) After studying the pedigree, a student could not determine which little finger shape is dominant. However, he drew the following conclusion.

"Either individual 1 or individual 2 must be heterozygous."

Do you agree with this conclusion? Explain your answer with reference to the role of gametes in inheritance. (3 marks)

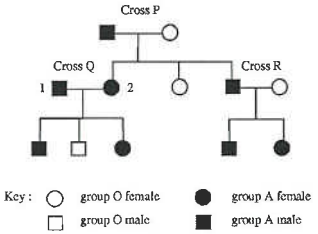
(b) Provided that the allele for the bent little fingers is dominant, deduce the possible genotype(s) of individual 4. (4 marks)
(Marks will not be awarded for genetic diagrams.)

(c) Individuals 5 and 6 are going to have another child. What is the probability of their second child having straight little fingers? Illustrate your answer with a genetic diagram. (5 marks)

(HKCEE 2007)

Past HKCEE Questions
Genetics
Paper II

99
Directions: Questions 50 and 51 refer to the pedigree below, which shows the inheritance of blood groups in a family:



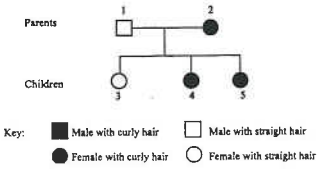
99-50
Which cross(es) can be used to deduce which blood group (A or O) is dominant?
A. cross Q only
B. cross R only
C. crosses Q and R only
D. crosses P, Q and R

99-51
If A represents the allele for blood group A and O represents the allele for blood group O, what are the probable genotypes of individuals 1 and 2?

	Individual 1	*Individual 2*
A.	AO	AA
B.	AO	AO
C.	AA	AA, AO
D.	AO, AA	AA

99-52
Which of the following are genetically identical?
A. seeds in the same fruit
B. a boy and his twin sister
C. potatoes of the same potato plant
D. sperms produced in the same testis

00.
Directions: Questions 40 to 42 refer to the following information:
The allele for curly hair in humans is dominant to the allele for straight hair. The pedigree below shows the inheritance of curly hair and straight hair in a family:



00-40
What is the chance of having another child who is a boy with straight hair?
A. 0%
B. 25%
C. 50%
D. 100%

00-41
If individuals 4 and 5 are twins, which of the following conclusions can be drawn?
A. They were developed from the same zygote.
B. They were developed from two different zygotes.
C. They are genetically identical for all characters.
D. No definite conclusions can be made.

00-42
Individual 3 is taller than individual 4. Which of the following may contribute to such a difference?
(1) diet
(2) meiosis
(3) fertilization
A. (1) only
B. (1) and (2) only
C. (2) and (3) only
D. (1), (2) and (3)

01-39
The tail of a male rat and a female rat were cut off. What will be the phenotype of their offspring if they mate?
A. All offspring will have tails.
B. Half of the offspring will have tails.
C. Only 1/4 of the offspring will have tails.
D. All offspring will not have tails.

01-42
Which of the following descriptions of chromosomes in humans is correct?
A. Each body cell of a man has only one sex chromosome.
B. Each chromosome duplicates before cell division occurs.
C. During gamete formation, the chromosomes are randomly separated into two groups.
D. The red blood cell and the white blood cell contain the same number of chromosomes.

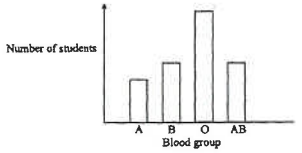
01-55
The eye colour of Siamese cat is controlled by a pair of alleles. A cross between two brown-eyed cats produced four offspring, of which three had green eyes and one had brown eyes. Which of the following is correct?

	Conclusion	Evidence
A.	Brown eye is dominant.	The phenotypic ratio of the offspring is 3:1
B.	Brown eye is dominant.	Two brown-eyed parents produce green-eyed offspring.
C.	Green eye is dominant.	The phenotypic ratio of the offspring is 3:1.
D.	Green eye is dominant.	Two brown-eyed parents produce green- eyed offspring.

02-9
Person Q has a genetic abnormality. The following photograph shows the chromosomes of one body cell of Q

Which of the following statements are correct?
(1) Person Q is a male.
(2) Person Q has 47 chromosomes in all his/her body cells.
(3) All the children of person Q will have this abnormality.
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

02-51
The following bar chart shows the distribution of different blood groups in a class of students:



Which of the following can be concluded from the bar chart?
A. Blood group shows continuous variation.
B. Blood group 0 is the dominant phenotype.
C. Blood group A is the least common among these students.
D. Blood group in humans is controlled by four alleles.

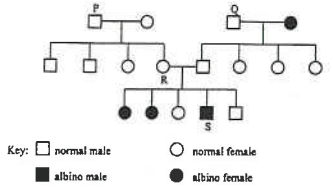
03-55
The table below lists some information about two brothers

	Tom	Andy
Blood group	A	O
Eye colour	brown	brown
Tongue rolling ability	tongue roller	tongue roller

Note : Blood group A, brown eye colour and tongue rolling are dominant characters.

What can be implied from the above information?
A. Tom can receive blood transfused from Andy.
B. They are homozygous for brown eyes.
C. Both their parents are tongue rollers.
D. Their sex chromosomes have the same genetic make-up.

04.
Directions: Questions 38-and 39 refer to the pedigree below, which shows the inheritance of albinism in a family. Albinism is a condition characterized by the lack of a dark brown pigment in the body. The ability to produce this pigment is controlled by a pair of alleles.



04-38
The information in the pedigree allows us to deduce the genotype of
A. P and Q.
B. P and R.
C. Q and S.
D. R and S.

04-39
What is the chance of R giving birth to another albino child?
A. $^1/_4$
B. $^1/_2$
C. $^3/_5$
D. $^3/_4$

04-57
Joe and Jim are twin brothers. Which of the following characteristics of Joe and Jim allows you to determine whether they are identical twins or not?

		Joe	Jim
A.	IQ	110	110
B.	Pulse rate	70	75
C.	Blood group	A	A
D.	Colour vision	Normal	Colour-blind

05-16
A gardener pollinated a purple-flowered pea plant with the pollens from a white-flowered pea plant. When the seeds obtained from this cross were germinated, he obtained 252 purple-flowered plants and 245 white-flowered plants. What conclusion can be drawn from the result of this cross?

A. Purple flower colour is dominant to white flower colour.
B. Neither purple nor white flower colour is dominant.
C. Both parent plants are heterozygous.
D. One parent plant is homozygous and the other is heterozygous.

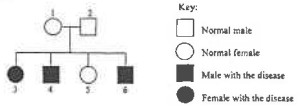
05-60
Which of the following is *not* an advantage of growing genetically modified crop plants in agriculture?

A. The crop plants are more resistant to pests.
B. Overcrowding of the crop plants can be prevented.
C. The production of the crop plants can be increased.
D. The nutritional value of the plant products is higher.

06.
06-13
Two homozygous parents with different phenotypes of the same trait are crossed to produce some offspring. Which of the following correctly describes the offspring with respect to this trait?

A. The offspring may have two different phenotypes.
B. The offspring are similar to both parents.
C. The offspring only show one phenotype.
D. The offspring are homozygous.

Directions: Questions 14 and 15 refer to the pedigree below, which shows the inheritance of a hereditary disease in a family. Whether a person has this disease is controlled by a pair of alleles.



06-14
The allele for this disease is

A. dominant because the ratio of offspring with the disease to normal offspring is 3 to 1.
B. dominant because individual 5 has the same phenotype as that of both parents.
C. recessive because both parents are normal but some offspring have the disease.
D. recessive because both parents have the same phenotype.

06-15
If individual 5 married a man with the disease, what is the probability that their first child would be a male with the disease? (Hint: There are two possible genotypes for the dominant character.)

A. 0 or ¼
B. 0 or 1
C. ¼ or ½
D. ½ or 1

06-16
Which of the following characteristics is an example of continuous variation?

A. blood group
B. iris colour
C. shape of the ear lobe
D. heartbeat rate

06-54
Peter has inherited the problem of G6PD deficiency from his parents. The allele for this character is located on the X chromosome. Which of the following family members of Peter is least likely to have this allele?

A. Peter's father
B. Peter's mother
C. father of Peter's mother
D. grandmother of Peter's mother

07-31
Which of the following statements about chromosomes are correct?

(1) It is made up of DNA and proteins.
(2) It plays a role in protein synthesis.
(3) It is capable of replication.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

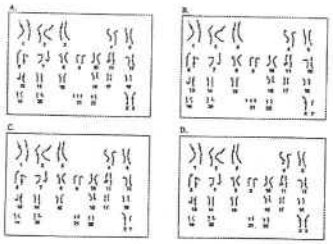
07-51
P, Q and R are triplets. The phenotypes of several traits found in them are listed below:

	Sex	Blood group	Eye colour	Weight (kg)
P	Male	O	Blue	52
Q	Male	O	Brown	52
R	Female	O	Brown	45

Which of the following conclusions is correct?

A. P, Q and R are non-identical triplets.
B. P and Q are identical twins but R is not.
C. P and R are identical twins but Q is not.
D. Q and R are identical twins but P is not.

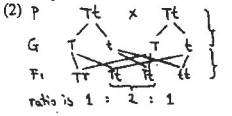
07-58
Which of the following photomicrographs shows the full set of chromosomes in a body cell of a boy with abnormalities in his chromosomes?



Past HKCEE Questions
Genetics
Suggested Answers

Paper I

1. (i) (1) the genotype of the parent is Tt / heterozygous 1 1
because dwarf plants (tt) are produced 1

(2) 

1 or 0
1 or 0
1

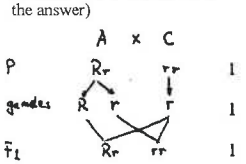
(3) dwarf plants: 53 1
tall plants: 150 1

(ii) due to environmental effect

(iii) test-cross with dwarf plant (tt) 1
the individual producing only tall plants is homozygous (TT) 1

2. (i) Cross (I) 1
grey 1

(ii) (1) A - Rr # 1
B - RR# 1
C - rr# 1
(# No mark if a wrong genotype is also mentioned in the answer)

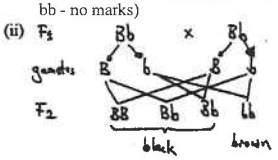
(2) 

1
1
1
If symbols other than R and r are used but symbols defined, deduct 1 mark from scores obtained in (ii) but symbols not defined, no marks to be awarded for (ii).

(iii) cross the fruitfly with a black fly / a fly with recessive character 1
if all the offspring were grey / showed the dominant character, then the fruitfly is homozygous
(if some of the offsprings were black / showed the recessive character, then the fruitfly is heterozygous) 1

3. If symbols other than B and b are used but symbols defined, deduct 1 mark from this section, i.e. max. 9 marks but symbols not defined, no marks to be awarded for answers using the undefined symbols.

(i) Some F_1 were homozygously black / BB 1
and some were heterozygously black / Bb 1
(Answers giving 3 genotypes BB, Bb, bb - no marks)

(ii) 

1
1
1
matching lines absent- deduct 1 mark
wrong matching lines - deduct 1 mark

(iii) Bb, 1
BB 1

(iv) cross each parent with a brown mouse / perform a test-cross for each parent 1
for the parent with BB, all offspring will be black 1
for the parent with Bb, some offspring will be brown 1

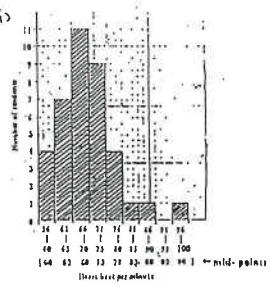
4. (i) white flower 1
this trait appears in the offspring but not in parents in cross II 1
(also accept: about 1/4, of the offspring in cross II produce white flowers)

(ii) (1) Ff 1
(2) FF and Ff 1
or 0

N.B. No marks to be awarded for answers using other symbols.

(iii) (1) a pair of genes which controls a certain character / different forms of a gene 1
(2) appearance / expression of a character 1
(3) an individual which results from crossing 2 individuals (homozygous) which are genetically unlike 1

(iv) 2N 1

5. (i) 

correct choice of axes 1
correct labels 1
correct plotting of all data 2
(5 data correct - 1 mark only)

(ii) continuous variation 1
characteristics show gradation + 1
(from one extreme to the other)
OR
variation shows a normal distribution

(iii) (1) height / weight / I.Q. / skin colour / etc. (any 1) 1
(2) eye colour / tongue-rolling ability / characteristics of ear lobe / etc. (any 1) 1

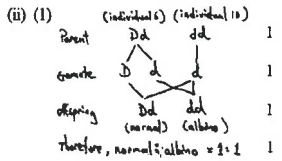
6. (i) (1) yellow (18±2); purple (53±2) 1
(2) 1:3 1

(ii) since the purple and yellow grains occur in a 3:1 ratio 1
both parents must be heterozygous 1
purple grain colour is the dominant character 1
therefore the phenotype of both parents must be purple grain colour 1

(iii) all grains will be yellow 1
because both parents are homozygous for yellow grain colour 1

7. (i)
- Albino
- This character is shown in individual 10 but not in their parents (individuals 3 and 4))
- Individual 10 must have received one albino allele from either parent
- who must be heterozygous
- In heterozygous condition, only the dominant allele is expressed OR the recessive allele is masked.

(any 3) 3

(ii) (1) 

1
1
1
1

(2) 1/2 1

8. (i) * testis 1

(ii) (1) * meiosis
(2) the chromosome number of the egg is half of that of the parent cell 1
so that the normal chromosome number is restored after fertilization / in the zygote 1

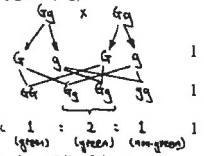
(iii) oviduct / fallopian tube 1

(iv) * mitosis 1

(v) (1) * umbilical cord 1
(2) carries oxygen / nutrients to the foetus 1

(vi) (1) any discontinuous variation of man, e.g. tongue rolling ability, eye colour, blood group, etc. 1
(2) any continuous variation of man, e.g. height, weight, etc. 1

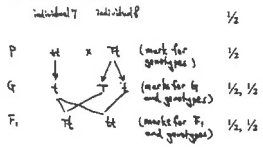
9. (i) the non-green offspring must be homozygous recessive (gg) 1
therefore, they must receive one recessive gene (g) from each parent 1
since both of the parents should have a dominant gene for being green in colour 1
their genotypes must be heterozygous (Gg) 1
OR
According to Mender's Law / Law of Inheritance
If a cross between two green parents gives rise to green and non-green offspring in a 3:1 ratio
(Working of the 3:1 ratio)
Then both parents must be heterozygous (Gg)

(ii) 

1
1
1
That is, about 2/3 of the green seedlings have a heterozygous genotype (Gg) for chlorophyll production, i.e. 705 x 2/3 1 1
= 470 1

(iii) seeds make use of their food reserve for germination 1

10. (i) The six-toed allele is dominant 1
individuals 1 and 2 are six-toed / of the same phenotype and 1
produce offspring who are of two phenotypes 1
indicating both parents are heterozygous 1
only the dominant allele expresses itself / recessive allele is masked in heterozygous state 1
OR
Both individuals 1 and 2 are six-toed therefore each of them must possess at least one six toed allele
some of their children (individuals 3 and 6) are five-toed that means at least one of the parents must also possess at least one five-toed allele
at least one of the parents is heterozygous in a heterozygous condition, the dominant allele will be expressed
therefore the six-toed allele is the dominant allele

(ii)  ½
P ½
G ½, ½
F₁ ½, ½
∴ the chance of individual being six-toed = 1/2 1
N.B. Deduct 2 marks for undefined symbols.
Deduct 1 mark for defined symbols.
Marks deducted should not exceed marks gained in genetic diagram.

(iii) Her idea cannot work 1
It is because the gene cannot be removed by this surgical operation / six-toed character is inheritable 1

11. (i) Discontinuous variation 1
as the character (seed colour) can + be grouped into a few distinct classes 1

(ii) (1) Environmental factors:
- light supply
- carbon dioxide supply
- water supply
- nutrients supply

(any 1) 1

(ii) (2) Genetic variation may be caused by:
- random fertilization 1
- independent assortment of chromosomes in meiosis 1

(iii) The ratio of the number of yellow seeds to green seeds among the offspring is 143:46; 1
which is approximately 3:1 1
According to the Mendel Law, the parent is thus heterozygous for the seed colour 1
OR
The. parent plant, which set germinated from a yellow seed, 1
should contain alleles for yellow seed
It produces some green seeds which must have received alleles for green seeds from the parent 1
Therefore the parent plant is heterozygous for the seed colour 1

(iv) (1) Mutation is a sudden and inheritable change of genetic material (gene / chromosome) 1
(2) anther / pollen grain / ovary / ovule 1

12. (i) Blood group A is dominant 1

Reasons:
Both individual 3 and 4 have blood group A therefore each of them must posses at least one allele for blood group A 1
One of their children (individual 12) has blood group O, that means at least one of the parents must also possess one allele for blood group O 1
At least one of the parents is heterozygous 1
In a heterozygous condition, only the dominant allele will be expressed 1
OR
Both individuals 3 and 4 have blood group A / are of the same phenotype 1
and produce offspring who are of two phenotypes 1
indicating that both parents are heterozygous 1
Only the dominant allele expresses itself / recessive allele is masked in heterozygous state 1

Communication skill (C) 1

(ii) Defined symbols,
e.g. A = allele for blood group A
a = allele for blood group O 1

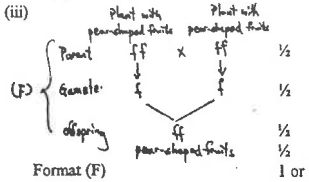
No mark for defining symbols if not using capital letter for dominant allele and small letter for recessive allele.

(1) Individual 7 : Aa 1
(2) Individual 13 : AA, 1
Aa 1

(iii) (1) 5 and 6 1
(2) 4, 5, 6 and 7 1

13. (i) Spherical fruits 1
In cross B, some offspring must have received an allele for spherical Fruits and an allele for pear-shaped fruits from their parents / heterozygous 1
All daughter plants have spherical fruits 1
Therefore, the allele for pear-shaped fruits must be masked by the allele for spherical fruits 1
Communication skill (C) 1

(ii) Let F represents the allele for spherical fruits
f represents the allele for pear-shaped fruits
(1) Ff 1
(2) FF 1

(iii) 
Plant with pear-shaped fruits
Plant with pear-shaped fruits
(F) Parent ff × ff ½
Gamete f f ½
offspring Ff ½
pear-shaped fruits ½
Format (F) 1 or 0

(iv) Sexual reproduction 1
because the self-cross involves + 1
As fusion of two gametes / fertilization 1

14. (i) The cells of A and the cells of the foetus are formed by mitosis of the 1
zygote 1

(ii) (1) female 1
(2) A sperm carrying an X chromosome 1
fused with an egg, which always contains an X chromosome 1
to form a zygote / offspring with two X chromosomes, 1
thus resulting in a female foetus

(iii) There are 3 chromosomes 21 / an extra chromosome is present 1

(iv) The foetus may be expelled out of the uterus / miscarriage. 1

(v) any two (1,1) 2
Blood from A to the foetus has
higher oxygen content
higher nutrient content
lower carbon dioxide content

lower urea content
(accept other correct answers)

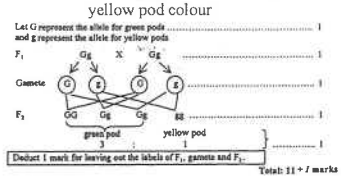
15. (i) Advantage: any one 1
- The chance of pollination / fertilization is higher
- Less wastage of pollen grains
- Desirable characters of the parent are more likely to be transmitted to the offspring

Disadvantage:
Less genetic variation (accept other correct answers) 1

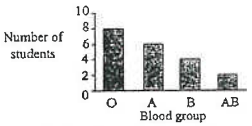
(ii) Remove the anthers from the flower before they are mature 1
Use a brush to dust pollen grains of another pea flower onto the stigma of this flower 1
Cover the flower with a plastic bag to prevent further pollination 1
Effective communication (C) 1

(iii) (1) Any one below: 1
Green pod colour is dominant to yellow pod colour

or
The allele for green pod colour is dominant to the allele for yellow pod colour

(2) 
Let G represent the allele for green pods 1
and g represent the allele for yellow pods
F₁ Gg × Gg 1
Gamete G g G g 1
F₂ GG Gg Gg gg 1
green pod yellow pod
3 : 1 1
Deduct 1 mark for leaving out the labels of F₁, gamete and F₂.
Total: 11 + / marks

16. (i) (1) Title (T) 0.5
Correct labelling of axis (L) 1
Correct plotting of the bars (P): 2 bars correct, 0.5 marks, 3 bars, 1 mark; all 4 bars, 1.5mark 1.5
No mark if data are not resented in the form of bar chart.
Distribution of students wills different blood groups



(2) Discontinuous variation 1

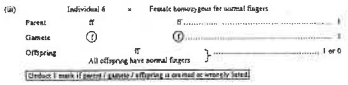
(ii) The parents of students 1 and 2 are tongue-rollers, so each of them must carry at least one allele for tongue rolling 1
Student 2 is a non-roller, so she must have received at least one allele for non-tongue rolling from either of her parents 1
Thus at least one of the parents is heterozygous 1
In a heterozygous condition, only the dominant allele is expressed 1
Thus the allele for tongue rolling is dominant 1

(iii) They are non-identical twins because their blood groups are different, implying that they are genetically different 1

17. (i) (1) Mutation is a sudden change in the genetic materials 1

(2) A mutation may lead to the synthesis of a new protein / failure to synthesize a certain protein 1
Since proteins may be enzymes or may have other functions in the cell 1
absence/change of the original protein will result in a change in the metabolic activities of cells

(ii) Individual 3 / 6 is normal, so she / he must have received at least one allele for normal fingers from either of her/his parents (individual 1 or 2) 1
Individuals 1 and 2 have short fingers, so each of them must carry at least one allele for short fingers 1
Thus at least one of individuals and 2 is heterozygous 1
In the heterozygous condition, only the dominant character is shown 1
Thus short fingers is the dominant character 1
Effective communication (C) 1



18. (i)
- The offspring in cross 1 have white flowers, 1
- so they must have received at least one allele for white flower from either of the parents. 1
- Since both parents have purple flowers, each of them must carry at least one allele for purple flower. 1
- Thus at least one of the parents is heterozygous. 1
- In the heterozygous condition, only the dominant character is shown. Thus purple flower is the dominant character. 1

(ii) F represents the allele for purple flower; f represents the allele for white flower. 1
(or other sets of symbols)
The possible genotypes of the purple-flower parent are FF or Ff and 1
that of the white-flower parent is ff. 1

(iii) If the genotype of purple-flower parent is FF, all offspring will produce purple flowers. 1
If the genotype is Ff, purple-flower offspring and white-flower offspring will be formed 1
and they would be in the ratio of 3:1. 1

19. (i) Plant A is homozygous for the green-leaf allele. 1
Plant B is homozygous for the variegated-leaf allele. 1
This is because all the offspring of each plant have the same phenotype as the parent. 1

(ii) Both plants A and B are homozygous, but of different phenotypes. 1
When they are crossed, all their offspring will be heterozygous. 1
In heterozygous condition, the phenotype shown by the offspring is the dominant phenotype. 1

(iii) Any one set (1 + 1) 2
- Magnesium
- For the formation of chlorophyll

or
- Nitrate
- For the formation of chlorophyll / protein

20. (a) *Chromosome 0.5
(b) *Heterozygote 0.5
(c) *Dominant 0.5
(d) *Meiotic cell division 0.5
(e) *Gamete 0.5
(f) *diploid 0.5

21. (i) Any 2 below 2
- Four daughter cells are formed from a single parent cell
- The two members of a pair of homologous chromosomes are separated; each goes to a different daughter cell
- Each daughter cell contains the haploid number of chromosomes

(ii) (1) Type A gamete has both members the homologous pair, while type B gamete has none 1

(2) *Down / Down's syndrome (Accept other correct answers) 1

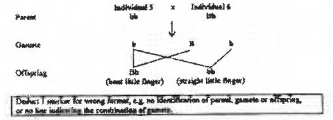
(3) (any 1 set below) 3
- The X chromosome carries some vital genes
- that are essential to the survival of the zygote and it subsequent development
- These genes are absent in the Y chromosome

or
- The X chromosome carries more genes than the Y chromosome
- Absence of the X chromosome will result in the loss of some genes
- that may be essential to the survival of the zygote and its subsequent development

22. (a) Yes.
To produce offspring with different phenotypes 1
there must be two different combinations of gametes
Therefore, either one of the parents must be heterozygous, producing two types of gametes carrying 1
different alleles
or
The parents are of different phenotypes, hence, one of the parents must be homozygous recessive. 1
To produce offspring with different phenotypes 1
the other parent must be heterozygous, producing two types of gametes carrying 1
different alleles

(b) Individual I possesses straight little fingers, she must be homozygous recessive 1
and pass an allele for straight little fingers to individual 4 1
Individual 4 possesses bent little fingers, she must have at least one allele for bent little fingers 1
Hence, individual 4 is heterozygous 1
Effective Communication 1C

(c) Define symbols 1
Let B be the allele for bent little fingers and b be the allele for straight little fingers



The probability for their child to have straight little finger is 50% 1

Paper II

99-50	A
99-51	B
99-52	C
00-40	B
00-41	D
00-42	D
01-39	A
01-42	B
01-55	B
02-9	A
02-51	C
03-55	A
04-38	D
04-39	A
04-57	D
05-16	D

05-60	B
06-13	C
06-14	C
06-15	A
06-16	D
06-54	Deleted
07-31	D
07-51	A
07-58	B