# SL Paper 1

What is the name given to a heritable factor which controls a specific characteristic?

A. Allele
B. Chromosome
C. Gene
D. Mutation

# Markscheme

C

# Examiners report

N/A

---

What was an aim of genetic modification of organisms?

A. To provide stem cells from embryos for medical use

B. To make crop plants resistant to herbicides

C. To provide sperm cells for in vitro fertilization (IVF)

D. To produce genetically identical sheep

# Markscheme

B

# Examiners report

Although the resistance to pests is often referred to as an example of the use of genetic modification in plants, this was a very easy question and most candidates chose plant resistance to herbicides.

---

Which disease is an example of sex-linked (X-linked) inheritance?

A. AIDS
B. Down syndrome
C. Sickle-cell anemia
D. Hemophilia

# Markscheme

D

# Examiners report

N/A

---

A man has hemophilia, a condition caused by a recessive sex-linked allele carried on the X chromosome.

Which of his grandparents must be a carrier if none of them had the disease?

A. Maternal grandmother (his mother's mother)
B. Maternal grandfather (his mother's father)
C. Paternal grandmother (his father's mother)
D. Paternal grandfather (his father's father)

# Markscheme

A

# Examiners report

Three quarters of candidates gave the correct response of A. G2 feedback suggested that information about the man's parents should have been given, but this in fact formed the basis of the question.

---

If a man with blood group O and a woman with blood group AB have children, which blood group(s) could the children have?

A. Group O only

B. Groups A and B only

C. Group AB only

D. Groups O, A, B and AB

# Markscheme

B

# Examiners report

[N/A]

---

What is a possible source of the chromosomes used for pre-natal karyotype diagnosis?

A. The mother’s lymphocytes

B. The mother’s cheek cells

C. The cells from chorionic villi

D. The fetal hair root cells

# Markscheme

C

# Examiners report

[N/A]

---

Sickle-cell anemia is caused by a mutation. How many changes to the amino acid sequence are caused by this mutation?

A. 1
B. 2
C. 3
D. 4

# Markscheme

A

# Examiners report

There were some criticisms of this question on the basis that there are two types of chain in hemoglobin and that this could confuse candidates but they found this to be an easy question.

---

A man of blood group A and a woman of blood group B have a child. If both are heterozygous for the gene, what are the chances of them having a child with blood group B?

A. 0%
B. 25%
C. 50%
D. 75%

# Markscheme

B

# Examiners report

N/A

---

What makes gene transfer between species possible?

A. All species use the same genetic code.
B. All species have the same genetic material.
C. All species produce the same polypeptides.
D. All species transcribe genes using plasmids.

# Markscheme

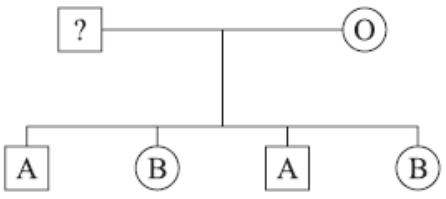
A

# Examiners report

Comments on the G2 forms suggested that the question was poorly worded, and this may be a legitimate point. Many candidates picked option B (same genetic material) rather than A (same genetic code), but it was felt that the word code is precise and often used too loosely by students. It does have a different meaning to “material”.

---

The blood groups of a mother and four children are indicated on the pedigree chart below.



What are the possible blood groups of the father?
A. Group A only
B. Group A or B only
C. Group AB only
D. Group A, B or AB only

# Markscheme

C

# Examiners report

[N/A]

---

What is produced by somatic-cell nuclear transfer?

A. Adult sheep
B. Cloned embryos
C. Rooted stem-cuttings
D. Genetically modified food

# Markscheme

B

# Examiners report

[N/A]

---

A human cell has between 20 000 and 25 000 genes whereas an *E. coli* cell has approximately 4000 genes. Which of the following statements is true?

A. The human genome is larger than the *E. coli* genome.
B. There are more genes on each human chromosome than on the *E. coli* chromosome.
C. The human cell and the *E. coli* cell produce approximately the same variety of proteins.
D. The DNA in both organisms is associated with histones (proteins).

# Markscheme

A

# Examiners report

This question was well answered by candidates though some teachers felt that they would find it difficult.

Which statement is a definition of a gene?

A. The whole of the genetic information of an organism
B. The factor that affects the phenotype in the homozygous state
C. A heritable factor that controls a specific characteristic
D. The factor that affects the phenotype in the heterozygous state

# Markscheme

C

# Examiners report

N/A

---

Which phase of cell division is photographed in order to make a karyotype?

A. Anaphase of mitosis
B. Anaphase I of meiosis
C. Metaphase of mitosis
D. Metaphase II of meiosis

# Markscheme

C

# Examiners report

Many candidates confused metaphase of mitosis with metaphase II of meiosis.

---

If the haploid number of a species is 14, how many chromatids will there be in metaphase I in a dividing diploid cell?

A. 7
B. 14
C. 28
D. 56

# Markscheme

D

# Examiners report

This question turned out to be a good discriminator. Many candidates did not consider the chromatids, but merely counted chromosomes.

---

A body cell of a goat has 60 chromosomes.  What would be produced following meiosis in the testis of a male goat?

A. 2 cells each with 60 chromosomes
B. 4 cells each with 60 chromosomes
C. 2 cells each with 30 chromosomes
D. 4 cells each with 30 chromosomes

# Markscheme

D

# Examiners report

N/A

---

What distinguishes an allele from a gene?

A. An allele is made of RNA.

B. An allele is shorter.

C. An allele is a variety of a gene.

D. An allele cannot be transferred during genetic modification.

# Markscheme

C

# Examiners report

[N/A]

What is the composition of eukaryotic chromosomes?

A. DNA only

B. DNA and ribose

C. DNA and RNA

D. DNA and proteins

# Markscheme

D

# Examiners report

The genetics questions were well answered by the vast majority of candidates.

---

In some people, hemoglobin always contains the amino acid valine in place of a glutamic acid at one position in the protein. What is the cause of this?

A. An error in transcription of the hemoglobin gene
B. An error in translation of the mRNA
C. Lack of glutamic acid in the diet
D. A base substitution in the hemoglobin gene

# Markscheme

D

# Examiners report

N/A

---

Which is a characteristic of the pairs of sister chromatids that are visible during meiosis?

A. They result from the replication of DNA before meiosis.

B. They are only present in meiosis I.

C. They split apart during metaphase I in meiosis.

D. They are only present in meiosis II.

# Markscheme

A

# Examiners report

[N/A]

---

A man has hemophilia, a condition caused by a recessive sex-linked allele carried on the X chromosome.

His wife does not carry the hemophilia allele. What would be expected in their children?

| | Sons | Daughters |
|---|---|---|
| A. | all normal | all carriers |
| B. | half hemophiliac | all carriers |
| C. | all normal | half carriers |
| D. | half hemophiliac | all normal |

# Markscheme

A

# Examiners report

N/A

---

A parent organism of unknown genotype is mated in a test cross. Half of the offspring have the same phenotype as the parent. What can be

concluded from this result?

A. The parent of unknown genotype is heterozygous.
B. The parent of unknown genotype is homozygous dominant.
C. The parent of unknown genotype is homozygous recessive.
D. The parent of known genotype is heterozygous.

# Markscheme

A

# Examiners report

N/A

---

Which individuals are colour blind in this Punnett grid?

| | $X^B$ | Y |
|---|---|---|
| $X^B$ | $X^B X^B$ | $X^B Y$ |
| $X^b$ | $X^B X^b$ | $X^b Y$ |

A. $X^B Y$
B. $X^B X^B$
C. $X^b Y$
D. $X^B X^b$

# Markscheme

C

# Examiners report

This was one of the easiest questions in the paper.

---

A woman who is a carrier for hemophilia and a man who does not have hemophilia have a child. What is the probability that the child will have hemophilia?

| | If it is a girl | If it is a boy |
|---|---|---|
| A. | 0% | 50% |
| B. | 0% | 0% |
| C. | 50% | 50% |
| D. | 50% | 0% |

# Markscheme

A

# Examiners report

N/A

---

Rhesus factor is an antigen present on the surface of red blood cells of Rhesus positive individuals. Rhesus positive ($Rh^+$) is dominant to Rhesus negative ($Rh^-$). A mother with Rhesus negative blood gives birth to a baby with Rhesus positive blood and there are concerns that subsequent pregnancies will trigger an immune response.

What is a possible explanation for why subsequent pregnancies could trigger an immune response?

A. Exposure to the $Rh^+$ antigen in the first pregnancy triggered the development of antibodies that could attack the blood of a future $Rh^+$ baby.
B. Exposure to the $Rh^+$ antigen in the first pregnancy triggered the development of specific phagocytes that could attack the blood of a future $Rh^+$ baby.
C. The mother has developed passive immunity to the $Rh^+$ factor.
D. The mother's immune system has been weakened by pregnancy.

# Markscheme

A

# Examiners report

N/A

---

Boys can inherit the recessive allele (*c*) that causes red-green colour blindness from their mother, not from their father. The allele for normal red and green vision is *C*. Which of the following genotypes are possible in men?

A. *c* only

B. C or *c* only

C. *CC* or *cc* only

D. *CC, Cc* or *cc* only

# Markscheme

B

# Examiners report

The notation in this question was not the usual sex linked notation. It would have been difficult to write it in this way as this would have made the question too easy. Nevertheless, the question turned out to be a good discriminator while still not proving too difficult.

---

In a human with type A blood, what determines the blood group?

A. Sex chromosomes

B. One or two alleles

C. Multiple alleles

D. Codominant alleles

# Markscheme

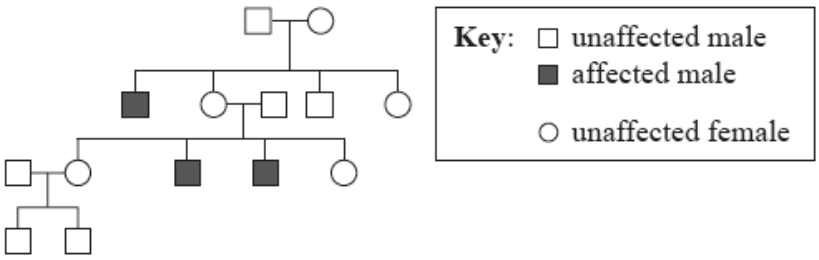
B

# Examiners report

Many candidates failed to read that the question was referring only to type A blood. In the guide, in section 4.3.3 it says: State that some genes have more than two alleles (multiple alleles). We can say that multiple alleles refers to more than 2 alleles, therefore answer C is incorrect.

---

The following shows a pedigree chart.




What type of inheritance is shown in this pedigree chart?
A. X-linked recessive
B. Y-linked dominant
C. X-linked dominant
D. Y-linked recessive

# Markscheme

A

# Examiners report

This question was a good discriminator with the majority of those getting this wrong incorrectly choosing D. Almost all were able to determine that the type of inheritance was recessive but the weaker candidates were not able to see whether it was X- or Y-linked.

---

What would be the expected result if a woman carrier for colour blindness and a colour blind man had many children?

A. All offspring will be colour blind.
B. All male offspring will be colour blind and all females normal.
C. All males will be normal and all females will be colour blind.
D. All females will be carriers of colour blindness or colour blind

# Markscheme

D

# Examiners report

This question had a very good discrimination index and did not prove to be too hard for candidates, who seem to perform well at this type of simple sex-linked cross.

---

It is possible for two parents to have children with each of the four ABO blood groups. What blood groups would the parents have?

| | Mother | Father |
|---|---|---|
| A. | O | O |
| B. | AB | O |
| C. | AB | AB |
| D. | A | B |

# Markscheme

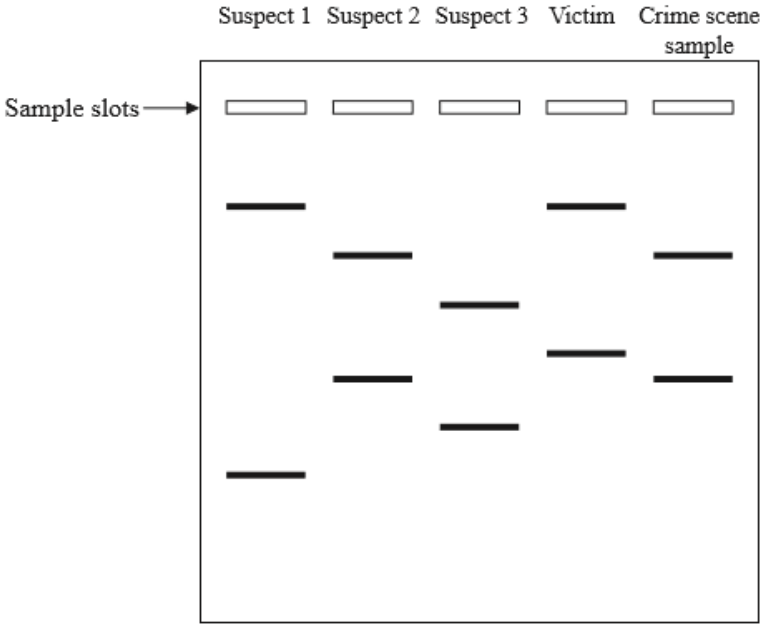
D

# Examiners report

This was the most successful question, as good candidates were able to find the parents that could give all blood groups. Weaker candidates went for answer B.

---

The diagram below represents the results obtained in a DNA profile from a crime scene.




Suspect 2 is most likely to be the criminal because the band pattern coincides with that of the crime scene sample. What do these bands represent?

A. DNA fragments
B. Genes
C. Chromosomes
D. Chromatids

# Markscheme

A

# Examiners report

N/A

---

Which enzymes are needed to produce recombinant plasmids to be used in gene transfer?

A. DNA polymerase and DNA ligase
B. DNA polymerase and restriction enzyme (endonuclease)
C. Transcriptase and RNA polymerase
D. Restriction enzyme (endonuclease) and DNA ligase

# Markscheme

D

# Examiners report

Although this question discriminated well, many candidates chose responses A and B instead of the correct D. It would imply that perhaps many are confusing DNA replication with DNA recombination.

---

If an organism that is homozygous recessive for a trait is crossed with a heterozygote, what is the chance of getting a homozygous recessive phenotype in the first generation?

A. 0%
B. 25%
C. 50%
D. 100%

# Markscheme

C

# Examiners report

N/A

---

Which of the following involves meiosis?

A. Tissue repair
B. Production of gametes
C. Asexual reproduction
D. Growth

# Markscheme

B

# Examiners report

N/A

Which of the following statements relate(s) to Down syndrome (trisomy 21)?

I. It can be detected in chorionic villus samples.
II. It results from non-disjunction in meiosis.
III. It is caused by gene mutation.

A. I and II only
B. I and III only
C. II only
D. III only

# Markscheme

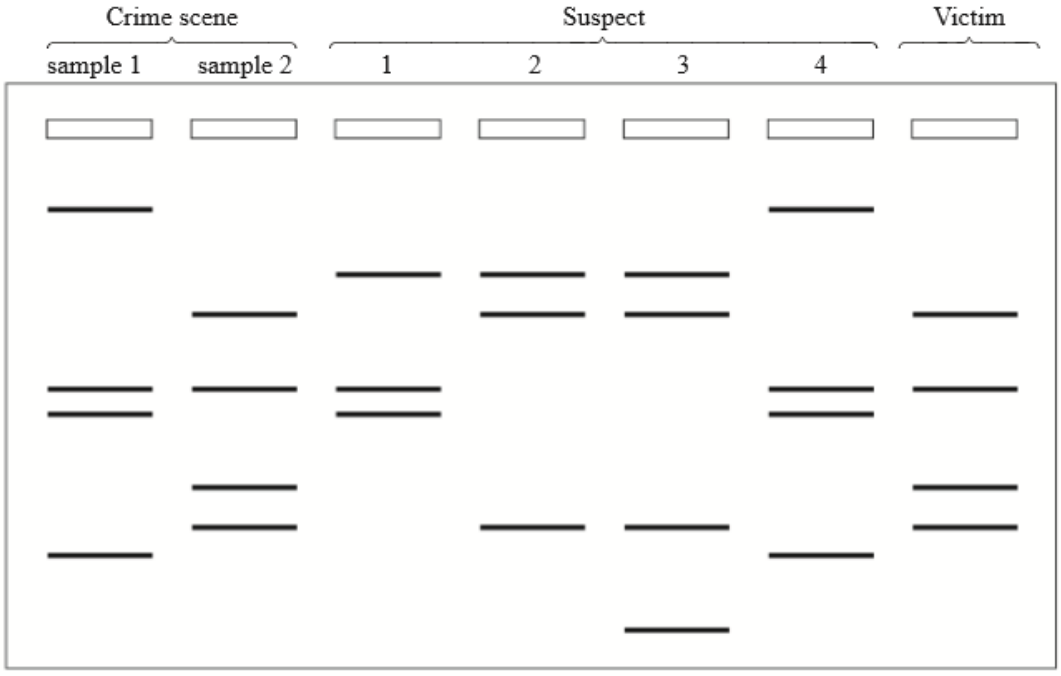
A

# Examiners report

N/A

---

The diagram shows results of electrophoresis of DNA from a crime scene.




Which suspect could be implicated as the criminal, according to the gel of DNA shown?

A. Suspect 1
B. Suspect 2
C. Suspect 3
D. Suspect 4

# Markscheme

D

# Examiners report

N/A

---

*Hind*III is an endonuclease that recognizes the sequence A A G C T T, cutting between the two adenines.


Into how many DNA fragments would the strand shown be cut by *Hind*III?

A. 2

B. 3

C. 4

D. 5

# Markscheme

B

# Examiners report

[N/A]

---

What is the cause of sickle-cell anemia?

A. A change to the base sequence of a hemoglobin gene

B. Mosquitoes acting as the vector for malaria

C. Iron deficiency due to the malaria parasite

D. Production of more white blood cells than red blood cells by bone marrow

# Markscheme

A

# Examiners report

[N/A]

---

Which genotypes are possible when a male with blood group AB and a female with blood group O have offspring?

A. $I^Ai$ only

B. $I^Ai$ and $I^Bi$

C. $I^Ai$ and ii

D. $I^Ai$, $I^Bi$ and ii

# Markscheme

B

# Examiners report

The genetics questions were well answered by the vast majority of candidates.

---

Laboratory analysis of DNA from a 40 000 year old woolly mammoth used the polymerase chain reaction (PCR). What role did the PCR have in the analysis?

A. DNA denaturation

B. DNA comparison

C. DNA separation

D. DNA amplification

# Markscheme

D

# Examiners report

[N/A]

---

A small amount of a suspect's DNA is obtained from a crime scene. What techniques would be used to carry out DNA profiling?

A. Gel electrophoresis and paternity testing

B. Paternity testing and the polymerase chain reaction (PCR)

C. Polymerase chain reaction (PCR) and gel electrophoresis

D. Test crossing and pedigree analysis

# Markscheme

C

# Examiners report

[N/A]

---

Which technique separates proteins according to size?

A. Treatment with restriction endonucleases
B. PCR
C. Gel electrophoresis
D. DNA profiling

# Markscheme

C

# Examiners report

Despite some complaints, this question was well answered by good candidates. In general, proteins are separated using a polyacrylamide gel. The SDS-page method is one of the most popular in molecular biology procedures. In this case, proteins are previously denatured. SDS molecules bind to unfolded proteins in large excess, providing extra negative charges to the molecules. Therefore, upon SDS-treatment, the specific charge (the charge-to-mass ratio) of different proteins will become roughly identical.

---

The diploid number of chromosomes in humans (*Homo sapiens*) is 46 and the diploid number of chromosomes in rice (*Oryza sativa*) is 24. What does this indicate about diploid chromosome numbers?

A. Plant species have a lower diploid number of chromosomes than animals.
B. Members of a species have the same diploid number of chromosomes.
C. The evolutionary progress of species is determined by the diploid number of chromosomes.
D. The complexity of the organisms is correlated to the diploid number of chromosomes.

# Markscheme

B

# Examiners report

[N/A]

---

What are homologous chromosomes?

A. Identical chromosomes
B. Non-identical chromosomes with different genes
C. Non-identical chromosomes with the same genes in the same sequence but not necessarily the same alleles
D. Non-identical chromosomes with the same genes in a different sequence and not necessarily the same alleles

# Markscheme

C

# Examiners report

There was a complaint in the G2 that this question was tricky and confusing. This is not the intention. As a matter of fact, this question turned out to be a very good discriminator and most good candidates chose the correct answer C. Many other candidates went for answer A, showing they did not quite understand the concept of homologous chromosomes

---

The Human Genome Project allowed the first accurate estimates of the number of different genes in the human genome. What was a typical estimate, based on the results of the Human Genome Project?

A. 46

B. 64

C. 25 000

D. 1 000 000

# Markscheme

C

# Examiners report

Most candidates answered this question correctly. There were some complaints on the G2 reports submitted about the fact that there are different quotes in different text books about the number of genes in the human genome. What most books state is that it was originally believed there would be millions of genes and eventually only about 25 000 were discovered. All the other numbers in the distractors were a long way from this number.

What is the chromosome number in a human gamete with non-disjunction?

A. 46

B. 45

C. 24

D. 23

# Markscheme

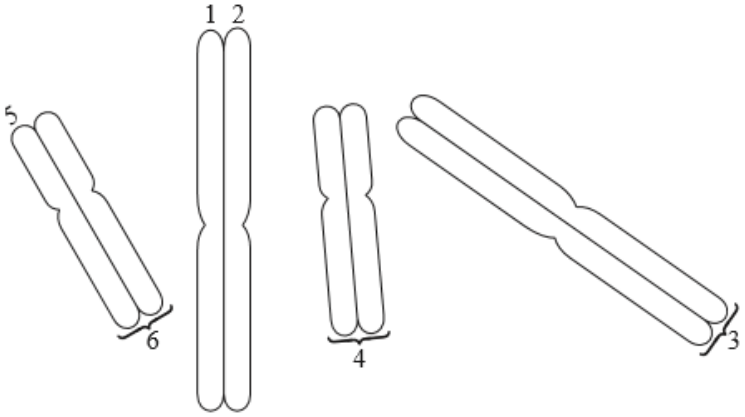
C

# Examiners report

Although most good candidates answered this question well, some candidates had different number of chromosomes in a disjunction. Unlike what happens in plants, the probability to have more than one chromosome suffering non-disjunction in humans is very low, let alone the whole set of chromosomes.

---

In the following diagram, which pair represents homologous chromosomes?




A. 1 and 2
B. 3 and 4
C. 2 and 5
D. 4 and 6

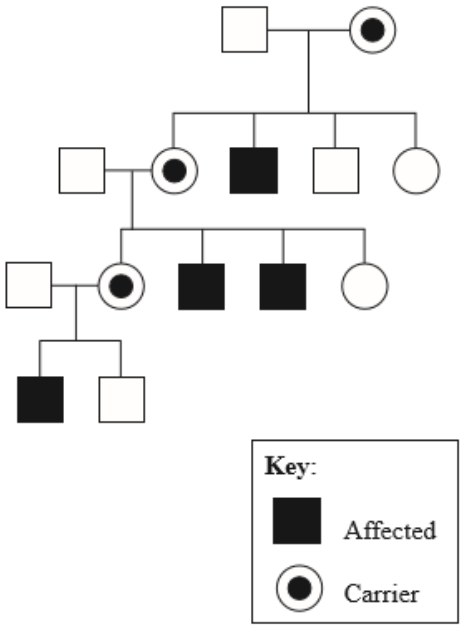
# Markscheme

D

# Examiners report

N/A

What type of inheritance is shown in this pedigree chart?




A. X-linked dominant
B. Y-linked dominant
C. X-linked recessive
D. Y-linked recessive

# Markscheme

C

# Examiners report

Although one teacher complained about the use of a non-standard carrier notation, this question was in general well answered by the most capable candidates.

---

A colour blind man and a woman carrier for colour blindness have a son. What is the probability that their son will be colour blind?

A. 25 %

B. 50 %

C. 75 %

D. 100 %

# Markscheme

B

# Examiners report

[N/A]

---

If there are 16 chromosomes in a cell that is about to divide, what will be the number of chromosomes in a daughter cell after division by mitosis or meiosis?

| | Mitosis | Meiosis |
|---|---|---|
| A. | 16 | 16 |
| B. | 16 | 8 |
| C. | 8 | 16 |
| D. | 8 | 8 |

# Markscheme

B

# Examiners report

N/A

---

Which process is used in polymerase chain reaction (PCR)?

A. Transcription
B. Translation
C. Replication
D. Mutation

# Markscheme

C

# Examiners report

N/A

How is the polymerase chain reaction (PCR) used?

A. To make many copies of a DNA molecule
B. To cut DNA at specific sequences
C. To splice fragments of DNA together into a plasmid
D. To separate fragmented pieces of DNA based on their charge and size

# Markscheme

A

# Examiners report

N/A

---

The sequence of the first six amino acids of the normal β hemoglobin ($Hb^A$) chain are listed.

valine – histidine – leucine – threonine – proline – glutamic acid

Which sequence of amino acids could there be in the first six amino acids of the sickle-cell β hemoglobin ($Hb^S$) chain?

A. glutamic acid – histidine – leucine – threonine – proline – valine
B. valine – valine – histidine – leucine – threonine – proline
C. glutamic acid – histidine – leucine – threonine – proline – glutamic acid
D. valine – histidine – leucine – threonine – proline – valine

# Markscheme

D

# Examiners report

This question was perhaps not as fair as it could have been, as it did require candidates to remember difficult details about specific amino acid sequences. However, it was the fourth most difficult question on the paper, and it did discriminate well.

---

During reproduction in flowering plants an embryo sac is produced, containing one haploid nucleus. This haploid nucleus divides by mitosis three times. What is produced?

A. One diploid nucleus

B. Four diploid nuclei

C. Four haploid nuclei

D. Eight haploid nuclei

# Markscheme

D

# Examiners report

Although some teachers complained about the testing on plant reproduction in this question, it turned out to be a very good discriminator. There was no need to understand how a plant carries out mitosis, just the process of mitosis itself.

---

What is the set of alleles that an individual possesses?

A. A gene
B. A genotype
C. A genome
D. A genus

# Markscheme

B

# Examiners report

The wording of the stem in this question seemed confusing, as a set of alleles could have been interpreted as all of the alleles of an organism and not just the pair of alleles. Nevertheless, the question turned out to have a good discrimination index.

---

Which of the following types of information are needed to construct a karyotype?

I. Size of the chromosomes
II. Gene mutations of the chromosomes
III. Age of the individual

A. I only
B. II only
C. I and II only
D. I, II and III

# Markscheme

A

# Examiners report

More candidates chose response C instead of A, the correct answer, so the question discriminated well. A comment on the G2 forms suggested that shape was also a property that students would be expected to know, and this was not an option in the responses. It was felt that often not all possible information is included in questions, and that it was a fair set of options.

---

What is a plasmid?

A. Chloroplast DNA
B. Mitochondrial DNA
C. Small circle of DNA that can transfer genes to or from a prokaryote
D. The bacterial chromosome

# Markscheme

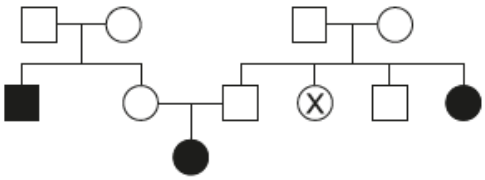
C

# Examiners report

N/A

---

The diagram shows a pedigree of cystic fibrosis, in which the black colour indicates the presence of cystic fibrosis.



What is the probability that the individual labelled X is a carrier of cystic fibrosis?

A. 1.00

B. 0.50

C. 0.25

D. 0.00

# Markscheme

B

# Examiners report

[N/A]

---

In guinea pigs black coat colour is dominant to white. In a test cross between a black and a white guinea pig both black and white offspring were produced. What percentage of the offspring would be expected to be white?

A. 75 %
B. 50 %
C. 33.3 %
D. 25 %

# Markscheme

B

# Examiners report

N/A

---

Which of the following statements about homologous chromosomes is correct?

A. Each gene is at the same locus on both chromosomes.
B. They are two identical copies of a parent chromosome which are attached to one another at the centromere.
C. They always produce identical phenotypes.
D. They are chromosomes that have identical genes and alleles.

# Markscheme

A

# Examiners report

N/A

---

What is a gene mutation?

A. Failure of chromosome pairs to separate properly during cell division
B. Changes to genes caused by natural selection
C. Changes to the nucleotide sequence of the genetic material
D. Changes in karyotypes

# Markscheme

C

# Examiners report

N/A

---

Which is a feature of sex-linked genes in humans?

A. Males can only be heterozygous for the gene.
B. Females can only be homozygous for the gene.
C. Males can be either heterozygous or homozygous for the gene.
D. Females can be either heterozygous or homozygous for the gene.

# Markscheme

D

# Examiners report

Quite a few candidates picked option A instead of D, but this statement is invalid when dealing with sex-linked genes. The question had a high discrimination index.

---

In peas, tall is dominant to dwarf. In a cross between a dwarf plant and a heterozygous tall plant what percentage of the offspring will be dwarf?

A. 0 %
B. 25 %
C. 50 %
D. 100 %

# Markscheme

C

# Examiners report

Here is another example of a well-answered question, showing that monohybrid crosses seem well studied by candidates.

---

What is amplified using the polymerase chain reaction (PCR)?

A. Large amounts of RNA
B. Small amounts of DNA
C. Small amounts of protein
D. Large amounts of polymers

# Markscheme

B

# Examiners report

Quite a few candidates picked option A instead of D, but this statement is invalid when dealing with sex-linked genes. The question had a high discrimination index.

---

Rhesus factor is an antigen present on the surface of red blood cells of Rhesus positive individuals. Rhesus positive ($Rh^+$) is dominant to Rhesus negative ($Rh^-$). A mother with Rhesus negative blood gives birth to a baby with Rhesus positive blood and there are concerns that subsequent pregnancies will trigger an immune response.

What are the genotypes of the mother and her first baby?

| | Genotype of mother | Genotype of first baby |
|---|---|---|
| A. | $Rh^- Rh^-$ | $Rh^- Rh^-$ |
| B. | $Rh^- Rh^-$ | $Rh^+ Rh^-$ |
| C. | $Rh^- Rh^-$ | $Rh^+ Rh^+$ |
| D. | $Rh^+ Rh^-$ | $Rh^+ Rh^+$ |

# Markscheme

B

# Examiners report

This was a good discriminator. There was some criticism that the question was not on the syllabus, but it tested their understanding of inheritance rather than a specific example in the syllabus. It was well answered by candidates.

What happens to DNA fragments in electrophoresis?

A. They move in a magnetic field and are separated according to their size.

B. They move in an electric field and are separated according to their size.

C. They move in a magnetic field and are separated according to their bases.

D. They move in an electric field and are separated according to their bases.

# Markscheme

B

# Examiners report

This question was a good discriminator with the majority of those getting this wrong incorrectly choosing D. Almost all understood that fragments of DNA moved in an electric field (B and D) during electrophoresis but the weaker candidates did not know what was the basis for their separation, which is size.

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Which of the following is the cause of sickle-cell anemia?

A. Tryptophan is replaced by leucine.
B. Leucine is replaced by valine.
C. Glutamic acid is replaced by valine.
D. Lysine is replaced by glutamic acid.

# Markscheme

C

# Examiners report

This question turned out to be a good discriminator. Some teachers complained in the G2s that there was too much detail expected in this question.

This exact statement is present however in the teacher notes of the guide.

---

What causes the presence of three chromosomes 21 in Down syndrome?

A. Crossing over

B. Allele change

C. Non-disjunction

D. Gene mutation

# Markscheme

C

# Examiners report

In assessment statement 4.2.3 candidates are expected to study crossing over.

---

Which is a source of chromosomes for pre-natal diagnosis of abnormalities by karyotyping?

A. Sperm
B. Ovaries
C. Erythrocytes
D. Chorionic villi

# Markscheme

D

# Examiners report

N/A

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The Punnett grid shows the inheritance of blood groups.

| | $I^A$ | $I^B$ |
|---|---|---|
| $I^A$ | $I^AI^A$ | $I^AI^B$ |
| i | $I^Ai$ | $I^Bi$ |

What is the ratio of phenotypes of the offspring?

A. 1 : 1 ratio of blood groups A : B
B. 1 : 2 : 1 ratio of blood groups A : AB: B
C. 1 : 1 : 1 ratio of blood groups A : AB: B
D. 2 : 1 : 1 ratio of blood groups A : AB : B

# Markscheme

D

# Examiners report

N/A

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In a person who is heterozygous for sickle-cell anemia, where is the mutation found?

A. In every gamete produced

B. Only in gametes carrying an X chromosome

C. In all brain cells

D. In blood plasma

# Markscheme

C

# Examiners report

This question proved to be too hard for all candidates. Most candidates answered that the mutation for sickle-cell anemia is found in blood plasma. This is probably because they know anemia is related to blood, but failed to realize that plasma has no cells, therefore no DNA (6.2.6 in guide). Many candidates also went for gametes with X chromosome; probably wrongly believing this is a sex-linked disease. Others believed every gamete has the mutation, forgetting that gametes only have half the genetic information, so in a heterozygous individual, not all gametes receive the mutation. All nucleated cells in the body (except half of the gametes) have the mutation; therefore the only possible answer was brain cells.

---

A child has blood group A. The father of the child has blood group B. What are the possible genotypes of the mother?

I. $I^AI^A$

II. $I^AI^B$

III. $I^Ai$

A. I only

B. I and II only

C. II and III only

D. I, II and III

# Markscheme

D

# Examiners report

[N/A]

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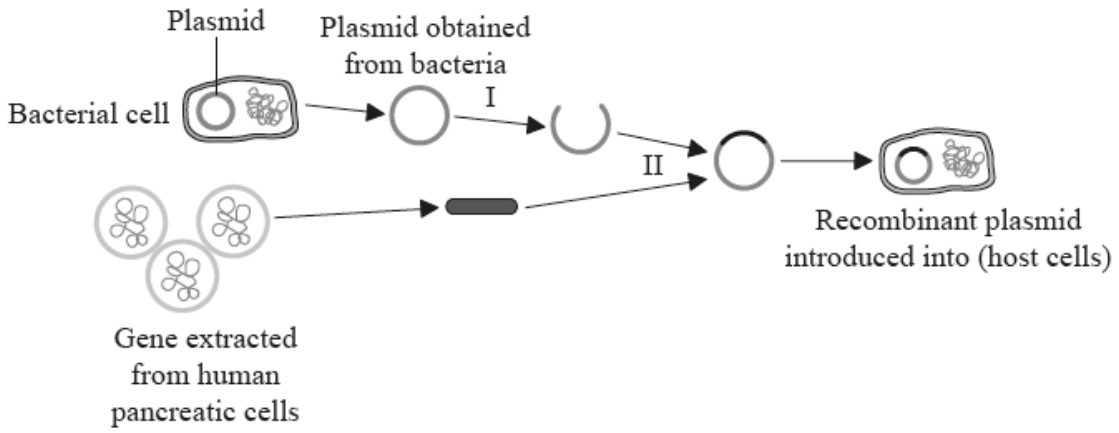
The flow chart summarizes methods of gene transfer.




[Source: © International Baccalaureate Organization 2014]

Which enzymes are used in steps I and II?

| | I | II |
|---|---|---|
| A. | DNA ligase | restriction enzyme |
| B. | restriction enzyme | DNA ligase |
| C. | DNA polymerase | DNA ligase |
| D. | restriction enzyme | DNA polymerase |

# Markscheme

B

# Examiners report

This question on gene transfer was also a good discriminator as the stronger candidates correctly choose B, indicating that they knew both enzymes involved in the steps indicated while the weaker candidates were split between C and D showing that they knew one, but not both of the enzymes.

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What is the difference between dominant, recessive and codominant alleles?

| | Dominant allele | Recessive allele | Codominant allele |
|---|---|---|---|
| A. | only affecting the phenotype when in a homozygous state | always affecting the phenotype | both alleles affect the phenotype |
| B. | always affecting the phenotype | both alleles affect the phenotype | only affecting the phenotype when in a homozygous state |
| C. | always affecting the phenotype | only affecting the phenotype when in a homozygous state | both alleles affect the phenotype |
| D. | both alleles affect the phenotype | only affecting the phenotype when in a heterozygous state | always affecting the phenotype when in a heterozygous state |

# Markscheme

C

# Examiners report

The genetics questions were well answered by the vast majority of candidates.

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During which phase of the first division of meiosis can non-disjunction take place and what structure is affected by the non-disjunction?

| | Meiotic phase | Structure |
|---|---|---|
| A. | Anaphase | chromosomes |
| B. | Anaphase | chromatids |
| C. | Metaphase | chromosomes |
| D. | Metaphase | chromatids |

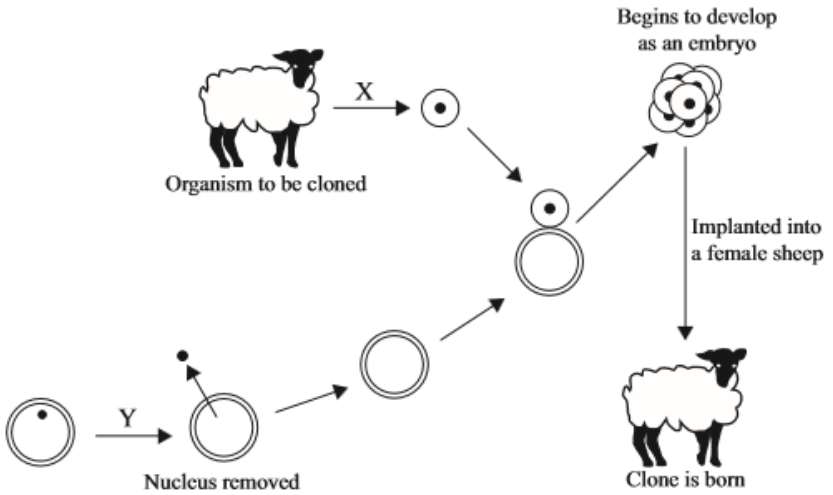
# Markscheme

A

# Examiners report

[N/A]

Which processes involved in cloning an animal are indicated by the letters X and Y?




[Source: adapted from http://www.sciencecases.org/dog_cloning/cloning.gif]

| | X | Y |
|---|---|---|
| A. | differentiated cell removed from animal | nucleus removed from unfertilized egg cell |
| B. | sex cell removed from animal | nucleus removed from differentiated animal cell |
| C. | sex cell removed from animal | nucleus removed from unfertilized egg cell |
| D. | differentiated cell removed from animal | nucleus removed from differentiated animal cell |

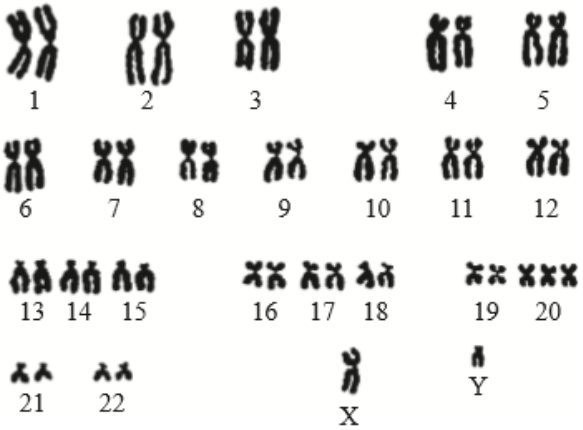
# Markscheme

A

# Examiners report

N/A

The image shows a human karyotype.





According to the image, what conditions can be determined?

A. Non-disjunction has occurred and the individual is male.
B. Non-disjunction has occurred and the individual is female.
C. The individual is female and has Down syndrome.
D. The individual is male and has Down syndrome.

# Markscheme

A

# Examiners report

N/A

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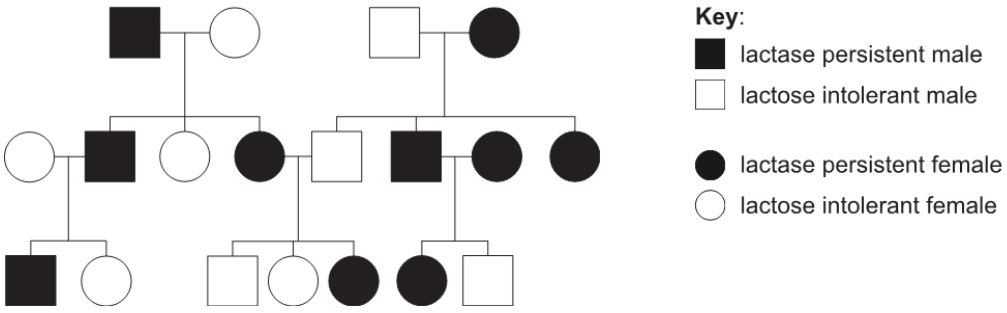
An allele for lactase persistence allows humans to digest milk as adults. People who lack this allele are lactose intolerant in adulthood.




What is the pattern of inheritance?

A. Lactase persistence is sex-linked recessive.

B. Lactase persistence is autosomal recessive.

C. Lactase persistence is sex-linked dominant.

D. Lactase persistence is autosomal dominant.

# Markscheme

D

# Examiners report

[N/A]

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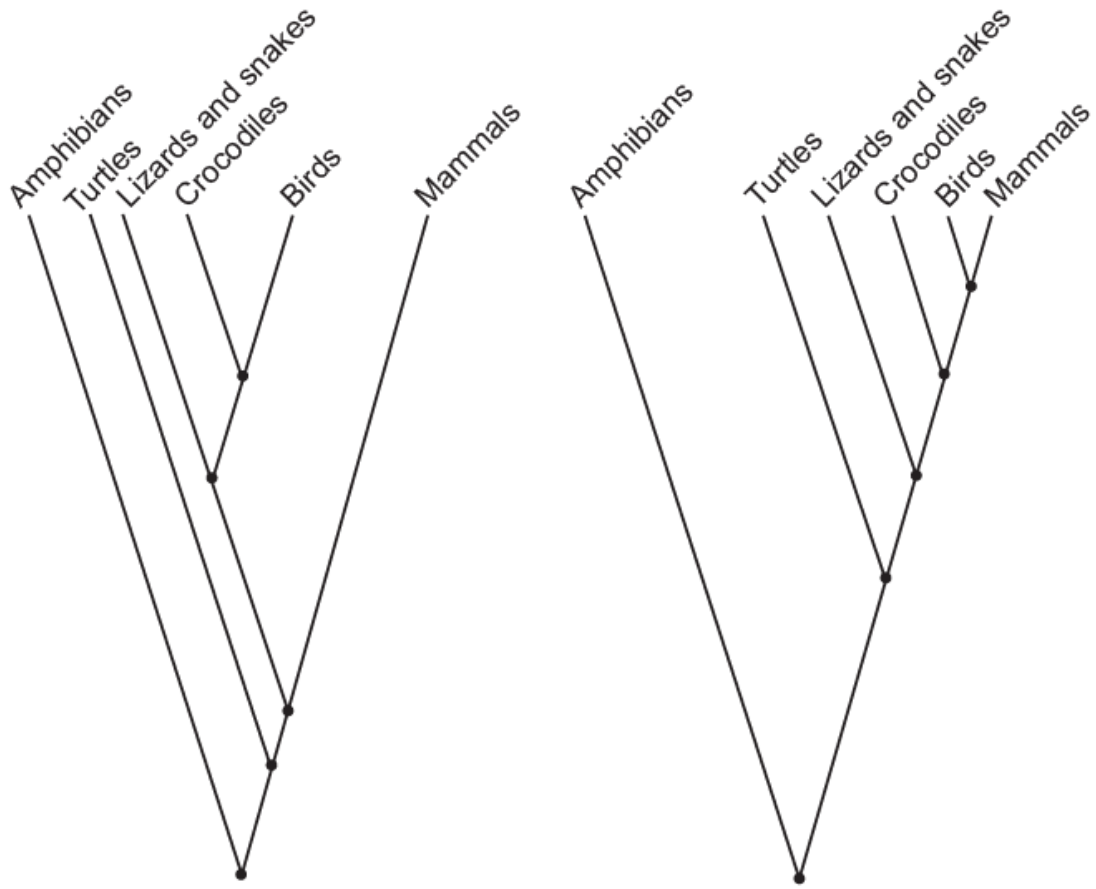
Cladograms can be created by comparing DNA or protein sequences. The cladogram on the left is based on DNA sequences and the cladogram on the right is based on comparing protein sequences.




What is the reason that cladograms based on DNA sequences are more reliable predictors of the phylogenetic relationship of species than cladograms based on protein sequences?

A. Amino acids are not as chemically stable as DNA nucleotides.

B. DNA mutates but amino acids do not.

C. Several different triplets of bases can code for the same amino acid.

D. There are 20 different amino acids but only 4 nucleotides.

# Markscheme

C

# Examiners report

[N/A]

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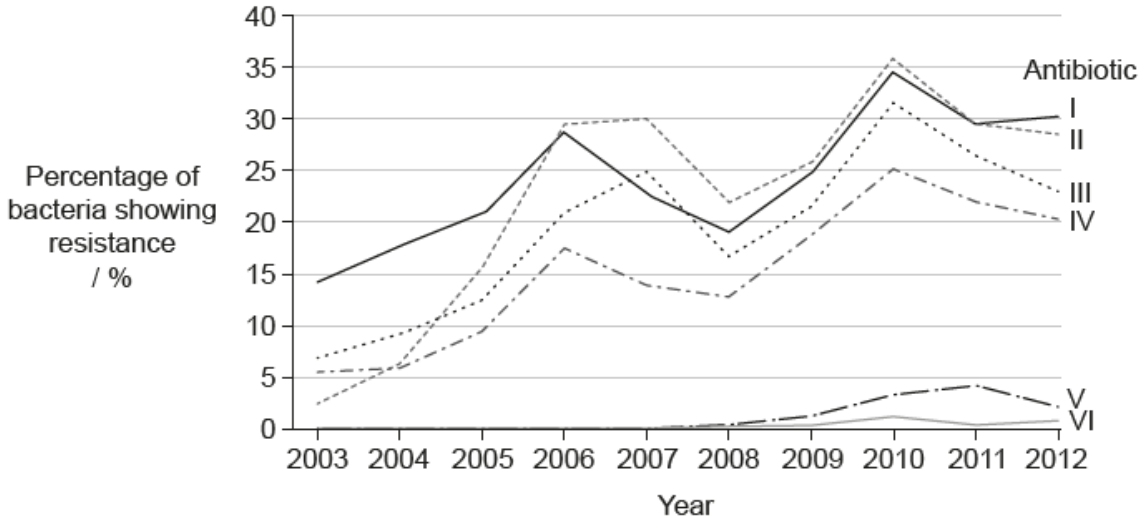
The bacterium *Neisseria gonorrhoeae* causes infections related to the human reproductive system. The graph shows the percentage of samples in which this bacterium showed resistance to six antibiotics over a period of ten years.




[Source: © All rights reserved. National Surveillance of Antimicrobial Susceptibilities of *Neisseria gonorrhoeae* Annual Summary 2012. Public Health Agency of Canada, 2012. Translated, adapted and reproduced with permission from the Minister of Health, 2017.]

What is a possible explanation for the total percentage resistance being larger than 100% in 2010?

A. People do not take the antibiotics as prescribed.

B. More people have been sampled in that year.

C. There was an epidemic of *Neisseria gonorrhoeae* in that year.

D. Some bacteria are resistant to more than one antibiotic.

# Markscheme

D

# Examiners report

[N/A]

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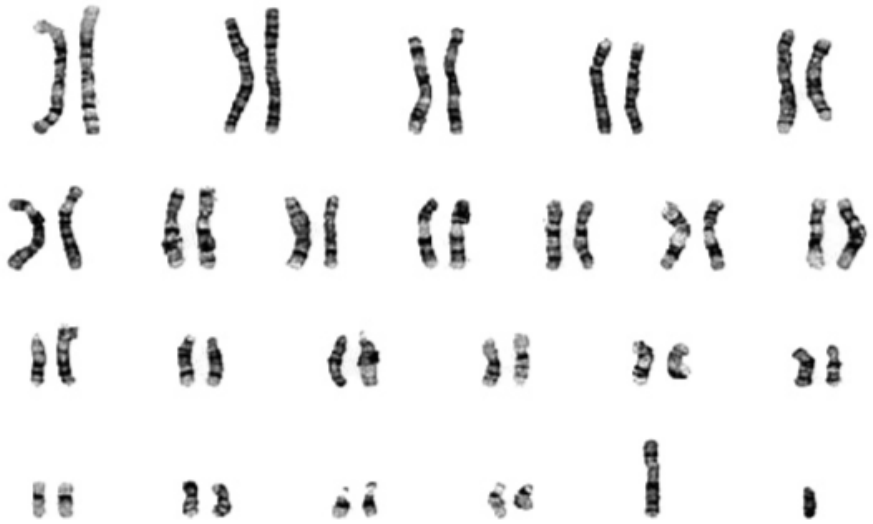
What does the karyogram below correspond to?



A. A normal male
B. A normal female
C. A female with Down syndrome
D. A male with Down syndrome

# Markscheme

A

# Examiners report

N/A

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Some breeds of dogs are characterized by the presence of a melanistic mask, which is a darkening of the fur near the nose, as shown by the arrow in this photograph.


[Source: https://commons.wikimedia.org/wiki/File:French_bulldog_on_the_grass.jpg]

Which outcome is matched with a valid conclusion if dogs that were pure breeding for melanistic masks were crossed with dogs without melanistic masks?

A. If 0 % of the puppies have a mask, the character is recessive.

B. If 25 % of the puppies have a mask, the character is dominant.

C. If 75 % of the puppies have a mask, the character is dominant.

D. If 100 % of the puppies have a mask, the character is recessive.

# Markscheme

A

# Examiners report

[N/A]

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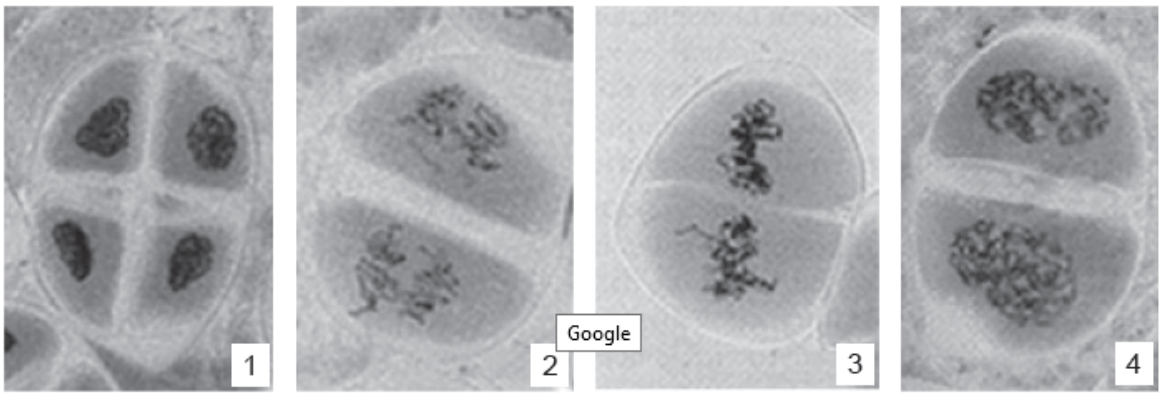
The micrographs show four different phases from meiosis II. What is the correct order?




[Source: http://biologyforhighschool.net]

A. 3-4-2-1

B. 2-3-4-1

C. 4-3-2-1

D. 4-2-3-1

# Markscheme

C

# Examiners report

[N/A]

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