**Q 2004 2**

1. The diagram shows the distribution of heights in a group of men between the ages of 18 and 23.

**Distribution of human heights**

**200**

**180**

**160**

**numbers of men**

**140**

**120**

**100**

**80**

**60**

**40**

**20**

**0**

**156**

**height/cm**

**198**

(a) What term is used by biologists to describe differences within a population with respect to features such as height?

(b) State **two** factors that could be responsible for the differences shown.

(c) Would you expect a similar distribution if the students were weighed instead of being measured for height? Explain your answer.

(d) What is a mutation?

(e)State **one** cause of mutation.

(f) Give an example of a condition, found in the human population, that results from a mutation.

**MS 2004 2**

**Q 2. 2(4) + 6(2)**

**(i.e. 4 marks for the first 2 correct points and 2marks for each subsequent correct point)**

(a) Variation

(b) Genetic **or** examples / environment or examples / age /

[NOTE – environment + food = 1 point] ***any two points***

(c) Yes **or** No **or** implied in text (on this line)

**Explanation:**

Weight is also determined by genetic **or** environmental factors [*for ‘yes’ above]* **or** valid reason e.g. reference to eating habits or exercise [*if ‘no’ given above] [Note: reason must match the Yes/No above]*

(d) Change in genetic makeup (or in DNA, in gene, in chromosome, etc.)

(e) Radiation **or** chemical **or** viruses **or** carcinogens **or** named example of any one of these [*allow smoking*]

(f) Down’s syndrome **or** other correct condition e.g. cancer or stripe in eye colour [*any spontaneous change - one incorrect does not cancel*]

**Q 2004 3**

In tomato plants the allele responsible for purple stem (**P**) is dominant to that for green stem (**p**) and the allele for cut leaf (**C**) is dominant to the allele for potato type leaf (**c**). A plant with a purple stem and cut leaves was crossed with a plant with a green stem and potato type leaves. A total of 448 seeds was obtained. When the seeds were germinated four types of progeny resulted and they had the following phenotypes;

110 purple stem and cut leaves

115 green stem and potato type leaves

114 purple stem and potato type leaves

109 green stem and cut leaves

(a) What were the genotypes of the tomato plants that gave rise to these progeny?

(b) Do the progeny of this cross illustrate the Law of Independent Assortment

(c) Explain your answer

**MS 2004 3**

PpCc ppcc **4 + 4**

Yes *[or implied in statement]* **4**

Parentals and non-parentals (i.e. all possible phenotypes)

**or** each allele can combine with either of the other pair / **4**

in 1:1:1:1: ratio (or in equal numbers or some indication of this)

**Q 2004 13**

1. (a) Copy the diagram into your answer book and then complete it to show the complementary base pairs of the DNA molecule. Label all parts not already labelled. **(9)**

**adenine**



**cytosine**

1. The genetic code incorporated into the DNA molecule finds its expression in part in the formation of protein. This formation requires the involvement of a number of RNA molecules. List these RNA molecules and briefly describe the role of each of them. **(24)**
2. Read the following passage and answer the questions that follow.

Dolly, the most famous sheep in the world, was cloned in the Roslin Institute in Scotland in 1996. When this was announced in February 1997 it caused a sensation, because until then many scientists thought that such cloning was impossible.

Such cloning is the production of one or more animals that are genetically identical to an existing animal. This cloning technique is based on the fact that, with the exception of the sperm and the egg, every cell in the body contains in its DNA all of the genetic material needed to make an exact replica of the original body. During the normal development process from embryo to fully-fledged animal, all of the cells in the body are differentiated to perform specific physiological functions.

Before Dolly, the majority view was that such differentiated cells could not be reprogrammed to be able to behave as fertilised eggs.

Dolly was produced by a process known as "adult DNA cloning", which produces a duplicate of an existing animal. The technique is also known as "cell nuclear replacement". During adult DNA cloning, the DNA is sucked out from a normal unfertilised egg cell, using a device that acts somewhat like a miniature vacuum cleaner. DNA that has already been removed from a cell of the adult to be copied is then inserted in place of the original DNA. Following this stage, the cell containing the inserted DNA is implanted in the womb of an animal of the same species, and gestation may begin.

To make Dolly, a cell was taken from the mammary tissue of a six-year-old sheep. Its DNA was added to a sheep ovum (egg) from which the nucleus had been removed. This artificially fertilised cell was then stimulated with an electric pulse and implanted in an ewe.

{Adapted from [www.biotechinfo.ie](http://www.biotechinfo.ie/)}

1. What is the difference between a nucleus of an egg cell and that of a somatic (body) cell of an animal?
2. Suggest an advantage of producing genetically identical animals.
3. Suggest a disadvantage of producing genetically identical animals.
4. “Every cell in the body contains in its DNA all of the genetic material needed to make an exact replica of the original body”. Comment on this statement.
5. What is the precise meaning of the term “implanted” in the extract above?
6. Suggest a purpose for stimulating the fused egg with an electric pulse.

What do you think is meant by the phrase “artificially fertilised cell”?

**MS 2004 13**

1. Completed **diagram** showing two additional sugar molecules and two more bases

**diagram completed correctly or** shapes of bases **or** show bonding **3, 0**

**new bases named and matched 3, 0 deoxyribose or phosphate labelled 3, 0**

1. mRNA(messenger RNA) **3**

rRNA (ribosomal RNA) **3**

tRNA (transfer RNA) **3**

**Functions:**

**mRNA:** mRNA formed to match DNA (or transcription or explained) / leaves nucleus

**or** into cytoplasm / (carries instructions) to ribosomes **or** for translation

**rRNA:** rRNA binds (holds) mRNA in place / for translation (**or** explained) / structure of ribosome

**tRNA:** tRNA carries an amino acid / complementary to mRNA / to ribosomes

|  |  |
| --- | --- |
| ***any five functions***  [***must be at least one point from each RNA type****]* | **5(3)** |

|  |  |
| --- | --- |
| **(c) (i) Difference:** egg cell is haploid **or** somatic cell is diploid **or**  quote from passage line **6 and 7** | **3** |
| 1. **Advantage:** any valid example e.g. same wool quality 2. **Disadvantage:** any valid example e.g. lack of variation **or**   consequence e.g. prone to disease | **3**  **3** |

1. **Comment:** valid / mitosis yields genetically identical nuclei / not all

genes switched on / genetic potential to produce new organism or explained / comment on significance e.g. forensics

[*If ‘not valid’ stated for one point, second point got from a reason why not e.g. not sex cells]*

***any two* 2(3)**

1. **Implanted:** attached (embedded) *[allow inserted, placed or put]* to the endometrium [*allow uterus or womb*] **or** explained **3**
2. **Why electric pulse:** any reasonable suggestion e.g**.** to initiate

cell division, keep alive, boost viability, energise. **3**

1. **Artificially fertilised: (**diploid) nucleus / into ovum without nucleus / rather than from fusion of haploid nuclei (**or** gametes)

**[***These 2 points will be got by quoting from last paragraph]*

***any two* 2(3)**

**Q 2005 8**

(a) Explain each of the following terms in relation to DNA.

(i) Replication

(ii) Transcription

(b) As part of your practical activities you extracted DNA from a plant tissue. Answer the following questions in relation to this experiment.

(i) What plant did you use?

1. It is usual to chop the tissue and place it in a blender. Suggest a reason for this.

For how long should the blender be allowed to run?

1. Washing-up liquid is normally used in this experiment. What is its function?
2. Sodium chloride (salt) is also used. Explain why.

(vi) What is a protease enzyme?

1. Why is a protease enzyme used in this experiment?
2. The final separation of the DNA involves the use of alcohol (ethanol). Under what condition is the alcohol used?

**MS 2005 8**

|  |  |  |  |
| --- | --- | --- | --- |
| **8.** (a) | (i)  (ii) | Making a copy  (Matching) RNA production | **3** |
| (notion of both DNA and RNA must be given) **3** | | | |
| (b) | (i) | Name of plant | **3** |
|  | (ii) | Break up of cell (walls) or release of cytoplasm | **3** |
|  | (iii) | A few seconds only (max 6 secs) | **3** |
|  | (iv)  (v) | To break down membrane(s) or membrane components Clumps (protects) DNA / to remove protein / separates DNA / separates protein | **3**  **3** |
|  | (vi) | Breaks down (acts on) protein | **3** |
|  | (vii) | Proteins are associated with DNA (histones or chromosomes) | **3** |
|  | (viii) | (Ice) cold | **3** |

**Q 2005 10**

|  |  |  |
| --- | --- | --- |
| **10.** (a) | (i) | What is meant by genetic engineering? |
|  | (ii) | State **two** applications of genetic engineering, **one** involving a micro-organism and |
|  |  | **one** involving a plant. **(9)** |

1. Cystic fibrosis is a serious condition that affects the lungs and digestive system. The condition results from the inheritance of a single pair of recessive alleles.
   1. Explain each of the underlined terms.
   2. Suggest why a person with an heterozygous allele pair does not suffer from the condition.
   3. If both parents are heterozygous what is the percentage chance that one of their children may inherit the condition? Explain how you obtained your answer.
   4. What is meant by genetic screening?
   5. Parents who are suspected of being carriers of disease-causing alleles may be advised to consider a genetic test. Suggest a role for such a test after *in-vitro* fertilisation.

#### (27)

1. (i) Define the following terms as used in genetics; linkage, sex linkage.
2. Explain why linked genes do not assort independently.
3. Red-green colour blindness is a sex (X)-linked condition. Normal red-green vision results from the possession of a dominant allele (**C**). In each of the following cases give the genotypes of the mother and of the father.
   1. A family in which one daughter is red-green colour blind and one daughter has normal colour vision.
   2. A family in which all the sons are red-green colour blind and all the daughters are carriers (heterozygous). **(24)**

**MS 2005 10**

|  |  |  |  |
| --- | --- | --- | --- |
| **10.** (a) | (i)  (ii) | Manipulation of genes or explained  Micro-organism - production of hormone or enzymes or named or interferon or other  Plant - slow ripening tomatoes / herbicide resistant plants/ freeze-resistant plants / other | **3**  **3**  **3** |
| (b) | (i) | Recessive – its expression is masked by dominant (allele) / expressed when homozygous only | **3** |
|  | (ii) | Allele – form of a gene or explained  Dominant allele masks the expression of the recessive allele or explained | **3**  **3** |
|  | (iii) | 25% | **3** |

(Offspring Phenotypes) (Normal Normal Normal) Abnormal **3**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (Gametes) | N | n |  | X |  | N | n | **3** |
| (Offspring Genotypes) | NN |  | Nn |  | Nn | nn |  | **3** |

(or cross explained 3(3))

|  |  |  |  |
| --- | --- | --- | --- |
|  | (iv) | Testing (people) for the presence of a (specific) gene | **3** |
| (v) | Selection of embryo or any valid role | **3** |
| (c) | (i) | (Genes) on the same chromosome | **3** |
|  | (ii) | Gene located on a sex (or X) chromosome  They are transmitted/ on the same chromosome or together | **3**  **2(3)** |
|  | (iii) | 1. XXCc and XY c - | **2(3)** |
|  |  | 2. XXcc and XY C -  [In 1. and 2. if genes are correct in both parents – 3 marks  If genes and chromosomes are correct in both parents – 6 marks] | **2(3)** |

**Q 2006 12**

(a) (i) Explain the following terms as used in genetics: species, variation.

(ii) Give **one** cause of genetic variation. **(9)**

1. The diagram shows some of the chromosomes in the nucleus of a cell taken from a small mammal.



1. **a**
2. **b**

**X X**

**D d**

**C c**

* 1. What is the sex of this individual?
  2. How many loci are marked in the diagram?
  3. “A is linked to B but not to C”. Is this statement correct? Explain your answer.
  4. Is D linked to d? Explain your answer.
  5. What term is used to describe the allele pair Dd?
  6. Draw a diagram, similar to the one above, but in which A, B, and C are homozygous and the cell is taken from an individual of the opposite sex. **(27)**

1. Give an account of the Theory of Natural Selection. Name the scientists who are associated with the theory and refer to any **one** observation that prompted its development. **(24)**

**Q 2006 12**

|  |  |  |  |
| --- | --- | --- | --- |
| **12.** (a) | (i) | *species*: interbreeding results in fertile offspring | **3** |
|  |  | *variation*: difference between members of species **or** population | **3** |
|  | (ii) | sexual reproduction / meiosis / mutation **or** agent / | **3** |
| (b) | (i) | female | **3** |
|  | (ii) | 4 [*accept 8*] | **3** |
|  | (iii) | Yes (*stated or implied*)  A and B on the same chromosome  **or** A and C not on same chromosome | **3**  **3** |
|  | (iv) | No (*stated or implied*) | **3** |
|  |  | explained | **3** |
|  | (v)  (vi) | heterozygous  *diagram:*  XY chromosomes | **3**  **3** |
|  |  | AA, BB, CC, | **3** |

(c) *account:* high reproductive rate / variation / example / competition / survival / of the fittest / breeding / offspring survive/ traits passed on /

those without advantage die out *any five* **5(3)**

Darwin **3**

Wallace **3**

*one observation:* large numbers of offspring / low survival /

populations constant / variation in offspring / specific example **3**

**Q 2007 5**

(a) In genetics, what is meant by sex linkage?

(b) In humans a sex-linked recessive allele **c** is responsible for red-green colour blindness. Complete the blank spaces above the lines in the following cross.

# X X

#### Parents c X c C

**Gametes**

#### F1 c c c C

#### Phenotypes:

**Sex**

**Vision**

X

**MS 2007 5**

**(a)** Gene on sex chromosome **or** on X **or** on Y **2**

## (b)

***Parents****:* **X Y 2**

### *Gametes:*

**c**

**X**

**c C**

F1 **2 + 2**

## c C

## 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Phenotype:*** |  | | | |
| *Sex:* | Female | Female | Male | Male |
| *Vision*: | Colour blind | Normal [accept carrier] | Colour blind | Normal  **4(2)** |

**Q 2007 10**

|  |  |  |  |
| --- | --- | --- | --- |
| **10.** (a) | (i)  (ii) | The DNA molecule is composed of two strands held together by paired bases.   1. Which base can link only to thymine? 2. Which base can link only to cytosine?   Name the type of bonding which occurs between members of a base pair. | **(9)** |
| (b) | (i)  (ii)  (iii)  (iv) | Explain what is meant by the term DNA profiling.  Give a brief account of the stages involved in DNA profiling. Give **two** applications of DNA profiling.  What is genetic screening? | **(27)** |

1. “The same amount of DNA is present in nuclei of cells taken from the liver, heart, pancreas and muscle of a rat.”
   1. Use your knowledge of DNA and mitosis to explain this statement.
   2. Name a cell produced by the rat which will contain a different amount of DNA in its nucleus to those mentioned above.
   3. Briefly outline how you isolated DNA from a plant tissue.

**MS 2007 10**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q 10.** | **(a)** | **(i)** | 1. adenine\* 2. guanine\* | **2(3)** |
|  |  | **(ii)** | hydrogen (bonding) | **3** |
|  | **(b)** | **(i)**  **(ii)**  **(iii)** | examining DNA / for a pattern or band / to compare  DNA extracted **or** explained / DNA cut into fragments / using enzymes / fragments separated / on basis of size / pattern analysed  forensic science or explained / relationships or explained / medical or explained | **2(3)**  **4(3)**  **2(3)** |
|  |  | **(iv)** | to establish presence **or** absence of gene(s) | **3** |
|  | **(c)** | **(i)** | chromosome contains DNA  mitosis maintains same chromosome number **or** cells derived from mitotic | **3** |
|  |  |  | division | **3** |
|  |  | **(ii)**  **(iii)** | gamete **or** sex cell or named  chop plant into small pieces / add salt / add detergent / warm to 50 – 60 degrees / then cool / blend / any one correct time point / filter / add protease | **3** |
|  |  |  | / add cold ethanol | **5(3)** |

**Q 2008 11**

(a) Explain the following terms which are used in genetics: homozygous, recessive, phenotype. **(9)**

1. In the fruit fly, *Drosophila*, the allele for grey body (**G**) is dominant to the allele for ebony body (**g**) and the allele for long wings (**L**) is dominant to the allele for vestigial wings (**l**). These two pairs of alleles are located on different chromosome pairs.
   1. Determine all the possible genotypes and phenotypes of the progeny of the following cross: grey body, long wings (heterozygous for both) X ebony body, vestigial wings.
   2. What is the significance of the fact that the two allele pairs are located on different chromosome pairs? **(27)**
2. Haemophilia in humans is governed by a sex-linked allele. The allele for normal blood clotting (**N**) is dominant to the allele for haemophilia (**n**).
   1. What is meant by sex-linked?
   2. Determine the possible genotypes and phenotypes of the progeny of the following cross: haemophilic male X heterozygous normal female. **(24)**

**MS 2008 11**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **11.** | (a) |  | homozygous**:** identical alleles [*accept* identical genes]  recessive: allele whose expression is masked by dominant allele phenotype: physical appearance **or** expression of genotype  **or** result of genotype + environment |  |
|  |  | **3** |
|  |  | **3** |
|  |  | **3** |
|  |  |  |  |  |
|  | (b) | (i) | \* GgLl / Ggll / ggLl / ggll | **4(3)** |
|  |  | grey, long / grey, vestigial / ebony, long /ebony, vestigial | **4(3)** |
|  |  | (ii) | they assort independently **or** greater variation | **3** |
|  |  |  |  |  |
|  | (c) | (i) | located on sex- chromosome **or** on X- chromosome **or** on Y-chromosome | **4** |
|  |  | (ii) | \* XNXn / XnXn / XNY / XnY | **4(3)** |
|  | normal (carrier) female/haemophilic female/ normal male/haemophilic male | **4(2)** |

**2008 Q 14 B**

* 1. (i) DNA is made of units called nucleotides. Draw a labelled diagram of a nucleotide to show its three constituent parts.

1. Which of the labelled parts in your diagram in (i) may vary from nucleotide to nucleotide?
2. The genetic code is contained within the DNA of chromosomes. Briefly describe the nature of this code.
3. What is meant by non-coding DNA?
4. Give **one** structural difference between DNA and RNA.
5. Name a cell organelle, apart from the nucleus, in which DNA is found.

**MS 2008 14 B**

|  |  |  |  |
| --- | --- | --- | --- |
| (b) | (i) | Diagram | **3** |
|  |  | labels: deoxyribose **or** ribose, phosphate, base **or** named base | **3(2)** |
|  | (ii) | Base **or** named base | **3** |
|  | (iii) | three bases (triplet **or** codon) / in sequence / (codes for) one amino acid /(base or triplet or codon) sequence / codes for protein | **3(3)** |
|  | (iv) | does not code for a protein **or** for RNA  [*allow* not part of the genetic code **or** explained] | **3** |
|  | (v) | (DNA) contains thymine **or** RNA contains uracil | **3** |
|  | (vi) | Mitochondrion **or** chloroplast | **3** |

**Q 2009 6**

(a) What is *genetic engineering*?

1. Name **three** processes involved in genetic engineering.
2. Give an example of an application of genetic engineering in each of the following cases:
   1. A micro-organism.
   2. An animal.
   3. A plant.

**MS 2009 6**

|  |  |  |  |
| --- | --- | --- | --- |
| **6.** |  | **6(3) + 2** |  |
|  | (a) | Manipulation **or** alteration of genes **or** of genotypes |  |
|  | (b) | Isolation / cutting (or restriction) / transformation (or ligation) / introduction of base sequence (changes) / expression | ***Any three*** |
|  | (c) | 1. Micro-organism example: 2. Animal example: 3. Plant example: |  |

**Q 2009 10**

1. (a) (i) State Mendel’s Law of Segregation.

(ii) Name two cell organelles, other than the nucleus, that contain DNA. **( 9)**

1. In guinea pigs the allele for black hair (B) is dominant to the allele for brown hair (b) and the allele for short hair (S) is dominant to the allele for long hair (s). The alleles governing hair colour are located on a different chromosome pair to those governing hair length.
   1. Explain the terms *alleles* and *dominant*.
   2. What term is used to describe alleles that lie on the same chromosome?
   3. Why is it significant that the two pairs of alleles, mentioned above in relation to guinea pigs, are located on different chromosome pairs?
   4. Determine all the possible genotypes and phenotypes of the offspring of a cross between the following guinea pigs:

Brown hair, heterozygous short hair X Heterozygous black hair, long hair

1. (i) Explain the term *species*.
2. Within a species a considerable degree of variation is usually seen.
   1. What is meant by *variation*?
   2. State **two** causes of variation.
3. What is the significance of inherited variation in the evolution of species
4. State **two** types of evidence used to support the theory of evolution. **(24)**

#### (27)

**MS 2009 10**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **10.** | (a) | (i) | Two factors that separate at gamete formation (each gamete receiving one factor) | **3** |
|  |  | (ii) | Mitochondrion / chloroplast | **2(3)** |
|  |  |  |  |  |
|  | (b) | (i) | *Alleles* = Different forms of a gene  *Dominant =* An allele that masks its (recessive) partner **or** an allele that is always expressed | **3** |
|  |  | **3** |
|  |  | (ii) | Linked | **3** |
|  |  | (iii) | Independent assortment (or described) can occur **or** more variation (in offspring) | **6** |
|  |  | (iv) | BbSs Bbss bbSs bbss | **4(2)** |
|  |  |  | black + long black+ short brown + short brown + long | **4(1)** |
|  |  |  | Each excess incorrect cancels a correct answer |  |
|  |  |  |  |  |
|  | (c) | (i) | Interbreeding organisms **/** producing fertile offspring | **2(3)** |
|  |  | (ii) | 1. Differences (between individuals) | **3** |
|  | 2. Sexual reproduction / mutation / environment / meiosis | **2(3)** |
|  |  | (iii) | Produces new genotypes **or** allows natural selection (or explained) | **6** |
|  |  | (iv) | Fossils **or** embryos **or** anatomy **or** genetics **or** example **Any ONE** | **3** |

**Q 2010 2**

1. In each of the following cases read the information provided and then, **from the list below**, choose the correct percentage chance of obtaining the indicated offspring in each case.

##### 0% 10% 25% 50% 75% 100%

* 1. In the fruit fly *Drosophila* the allele for full wing is dominant to the allele for vestigial wing. One parent was homozygous in respect of full wing and the other parent was heterozygous.

What is the % chance of obtaining offspring with **full** wing?

##### % =

* 1. In roses there is incomplete dominance between the allele governing red petals and the allele governing white petals. Heterozygous individuals have pink petals. A plant with pink petals was crossed with a plant with white petals.

What is the % chance of obtaining offspring with **white** petals? **% =**

* 1. In Dalmatian dogs the allele for brown spots is recessive to the allele for black spots. The two parents were heterozygous in respect of spot colour.

What is the % chance of obtaining offspring with **black** spots? **% =**

* 1. Red hair in humans is recessive to all other hair colours. A red-haired woman and a black-haired man, whose own father was red-haired, started a family.

What is the % chance of obtaining offspring with **red** hair? **% =**

**MS 2010 2**

|  |  |  |  |
| --- | --- | --- | --- |
| **2.** |  | **4(5)** |  |
|  | (a) | 100% |  |
|  | (b) | 50% |  |
|  | (c) | 75% |  |
|  | (d) | 50% |  |

**Q 2010 10**

1. Part (a) deals with DNA structure and replication.
   1. (i) Name the base in DNA that pairs with cytosine.

(ii) What are the two main events in the replication of DNA? **(9)**

Part (b) deals with protein synthesis.

* 1. (i) Explain the terms *transcription* and *translation*.

1. In which structures in the cell does translation occur?
2. How many bases in sequence make up a codon in mRNA?
3. Each mRNA codon specifies one of three possible outcomes during protein synthesis. Name these **three** possible outcomes.
4. What does the letter ‘t’ stand for in tRNA?
5. During translation one end of a tRNA molecule attaches to an mRNA codon.

What is usually attached to the other end of the tRNA molecule? **(27**

* 1. Distinguish between the terms in the following pairs by writing **one** sentence about **each**

member of **each** pair.

* + 1. *Haploid* and *diploid*
    2. *Homozygous* and *heterozygous*
    3. *Genotype* and *phenotype*
    4. *Segregation* and *independent assortment*. **(24)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **10.** | (a) | (i) | \*Guanine | **3** |
|  |  | (ii) | (DNA) opens (or unzips) / new strands (made) | **2(3)** |
|  |  |  |  |  |
|  | (b) | (i) | *Transcription*: making of (m)RNA using DNA (template) | **3** |
|  |  | *Translation*: making a protein using (m)RNA (code) | **3** |
|  |  | (ii) | \*Ribosome(s) | **3** |
|  |  | (iii) | \*Three | **3** |
|  |  | (iv) | Start; | **3** |
|  | Adding an amino acid; | **3** |
|  | Stop | **3** |
|  |  | (v) | \*Transfer | **3** |
|  |  | (vi) | \*An amino acid | **3** |
|  |  |  |  |  |
|  | (c) | (i) | *Haploid:* (A nucleus having) one set of chromosomes (or one copy of each chromosome)  *Diploid:* (A nucleus having) Two sets of chromosomes (or two copies of each chromosome) | **3** |
|  |  | **3** |
|  |  | (ii) | *Homozygous:* alleles the same | **3** |
|  | *Heterozygous*: alleles different | **3** |
|  |  | (iii) | *Genotype*: genetic make-up **or** genes (alleles) present  *Phenotype:* expression of genotype (and environment)  **or** physical make up | **3** |
|  | **3** |
|  |  | (iv) | *Segregation*: only one (member) of a pair of alleles (or chromosomes) enters a gamete  *Independent* Either member of a pair of alleles (or chromosomes) can  *assortment:* combine (or transmit) with either member of another pair (in gamete formation) | **3** |
|  | **3** |

**MS 2010 10**

**2011 Q 9**

(a) (i) How are the two strands of a DNA molecule joined together?

(ii) What is ‘junk’ DNA?

1. Answer the following questions by referring to the procedures that you used to isolate DNA from a plant tissue.
   1. Having obtained a plant tissue e.g. onion,
      1. What was the first procedure that you followed?
      2. What was the reason for that procedure?
   2. Washing-up liquid is then used in the isolation. Give a reason for its use.
   3. Salt (sodium chloride) is also used in the isolation. Give a reason for its use.
   4. 1. What is a protease?

2. Why is a protease necessary when isolating DNA?

* 1. The final stage of the isolation involves the use of freezer-cold ethanol.
     1. Describe how it is used.
     2. For what purpose is it used?

**MS 2011 9**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **9.** | (a) | (i) | Hydrogen bonds | **3** |
|  |  | (ii) | Non-coding (or described) | **3** |
|  | (b) | (i) | 1. Chop 2. To disrupt structure (or described) **or** to increase surface area | **3**  **3** |
|  |  | (ii) | To disrupt membranes | **3** |
|  |  | (iii) | To clump the DNA (or described) **or** to protect DNA from other positive ions | **3** |
|  |  | (iv) | 1. An enzyme that digests protein 2. Because DNA is combined with protein | **3**  **3** |
|  |  | (v) | 1. Added down the side of the test tube **or** added slowly 2. To bring the DNA out of solution | **3**  **3** |

**Q 2011 13**

1. (a) (i) What is meant by the term *evolution*?

(ii) Name either of the scientists responsible for the Theory of Natural Selection. **(9)**

1. In the antirrhinum (snapdragon) there is no dominance between the allele for red flower and the allele for white flower. Heterozygous individuals have pink flowers.

The allele for tall stem is dominant to the allele for short stem. These pairs of alleles are located on different chromosome pairs.

* 1. What is the significance of the fact that the two allele pairs are located on different chromosome pairs?
  2. A plant which had pink flowers and was heterozygous in respect of stem height was crossed with one which had white flowers and a short stem.
     1. Using suitable symbols determine the genotypes of all the possible offspring of this cross.
     2. For each of your answers, state the phenotype that would result. **(27)**

1. Distinguish between the members of each of the following pairs of terms, by writing a sentence about **each** member of each pair.
   1. Gene and allele.
   2. Homozygous and heterozygous.
   3. Genotype and phenotype.
   4. Linkage and sex linkage.

**MS 2011 13**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **13.** | (a) | (i) | Inheritable change within a population (or species) / in response to change in the environment / by natural selection / over time ***Any 2*** | | | | **2(3)** |
|  |  | (ii) | Darwin **or** Wallace | | | | **3** |
|  |  |  |  | | | |  |
|  | (b) | (i) | Independent assortment (or described) can occur **or** more variation (in offspring) | | | | **3** |
|  |  | (ii) | RrTt | Rrtt | rrTt | rrtt |  |
|  |  |  | **OR** | | | |  |
|  |  |  | RWTt | RWtt | WWTt | WWtt | **4(3)** |
|  |  |  |  | | | |  |
|  |  |  | pink + tall | pink + short | white + tall | white + short | **4(3)** |
|  |  |  | **Phenotype must match a correct genotype** | | | |  |
|  |  |  | **Each excess incorrect cancels a correct answer** | | | |  |
|  |  |  |  | | | |  |
|  | (c) | (i) | *Gene:*  *Allele:* | a section of DNA that codes for one polypeptide (or protein or trait) **or** unit of heredity  (an alternative) form of a gene | | |  |
|  |  | **3** |
|  |  | **3** |
|  |  | (ii) | *Homozygous:* | identical alleles | | | **3** |
|  | *Heterozygous:* | different alleles (of a gene) | | | **3** |
|  |  | (iii) | *Genotype*: *Phenotype*: | genetic makeup **or** genes (alleles) present  the expression of the genotype (and environment) **or**  physical makeup (or appearance) | | | **3** |
|  | **3** |
|  |  | (iv) | *Linkage*: *Sex-linkage:* | genes on the same chromosome  (located) on sex-chromosome **or** on X- chromosome **or**  on Y-chromosome | | | **3** |
|  | **3** |

**Q 2012 6**

(a) In genetics, what is meant by the term *variation*?

1. Variation can result from mutation. Name **one** other cause of variation.
2. Name **two** types of mutation.
3. Name **two** agents responsible for increased rates of mutation.
4. Briefly explain the significance of mutation in relation to natural selection.

**MS 2012 6**

2012 Q 10

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **6.** |  |  |  | **2(7) + 6(1)** |
| (a) Differences (within a population or within a species or between individuals) | | | | |
| (b) Sexual reproduction **or** meiosis **or** independent assortment **or** environmental | | | | |
|  | (c) | (i) | Gene (mutation) |  |
| (ii) Chromosome (mutation) | | | | |
|  | (d) | (i)  (ii) | Example 1  Example 2 |  |
| (e) New phenotypes **or** new types **or** new features /  Better adapted **or** survival of the fittest (or advantageous)  **or** less well adapted (or disadvantageous) | | | | |

**Q 2012 10**

1. (a) (i) Nucleic acids are composed of subunits called nucleotides. Each nucleotide is formed from a sugar, a phosphate group and a nitrogenous base.

Name the two **types** of nitrogenous base found in DNA.

(ii) Give **both** of the specific base pairs in DNA structure. **(9)**

1. In the sweet pea plant the texture and colour of the testa (seed coat) are governed by two pairs of alleles, which are not linked. The allele for smooth (S) is dominant to the allele for wrinkled (s) and the allele for yellow (Y) is dominant to the allele for green (y).
   1. State the Law of Segregation **and** the Law of Independent Assortment.
   2. Using the above symbols, and taking particular care to differentiate between upper case and lower case letters:
      1. give the genotype of a pea plant that is homozygous in respect of seed texture and heterozygous in respect of seed colour.
      2. state the phenotype that will result from the genotype referred to in 1.
   3. What phenotype will be produced by the genotype SsYy?

Give another genotype that will produce the same phenotype. Do not use a genotype that you have already given in response to part (ii) 1.

* 1. If the allele for smooth were linked to the allele for green and the allele for wrinkled were linked to the allele for yellow, give the genotypes of the **two** gametes that parent SsYy would produce **in the greatest numbers**.

#### (27)

1. (i) What is meant by the term *genetic engineering*?
2. In genetic engineering all or some of the following procedures may be involved.

Isolation;

Cutting (restriction); Transformation (ligation);

Introduction of base sequence changes; Expression.

**Briefly** explain **each** of the above terms in the context of genetic engineering.

1. Give **one** application of genetic engineering in **any two** of the following:
2. a plant
3. an animal
4. a microorganism

|  |  |
| --- | --- |
| **10.** (a) (i) \*Purines | **3** |
| \*Pyrimidines | **3** |
| (ii) \*A + T and \*G + C | **3** |
| (b) (i) *Segregation:* Traits are governed by pairs of factors (or alleles or genes) /  that separate at gamete formation (each gamete receiving one factor)  *Assortment:* Either member of a pair of alleles (or factors or genes or chromosomes) can combine (or transmit) with either member of another pair (in gamete formation) | **2(3)** |
| **3** |
| (ii) 1. \*SSYy **or** \*ssYy  2. (SSYy) → Smooth + yellow  **or**  (ssYy) → Wrinkled + yellow | **3** |
| **3** |
| (iii) \*Smooth + yellow | **3** |
| \*SSYY **or** \*SsYY **or** \*SSYy if not used above b(ii) 1. | **3** |
| (iv) \*Sy | **3** |
| \*sY | **3** |
|  |  |
| (c) (i) Manipulation of genes **or** alteration of genes **or** alteration of genotypes | **3** |
| (ii) *Isolation:* Locating **or** identififying **or** removal of a gene (or a  piece of DNA or a plasmid) | **3** |
| *Cutting* (Cutting) the DNA (or plasmid) with an (restriction)  *(restriction):* enzyme | **3** |
| *Transformation :* uptake of DNA (or plasmid or gene)  **OR**  *Ligation:* the joining of DNA (or plasmid or gene) | **3** |
| *Introduction of base* (the order of bases in) the host DNA is now different  *sequence changes:* | **3** |
| *Expression:* the activation of the inserted gene (in its new position)  **or** production of product | **3** |
| (iii) 1. Animal example. 2. Plant example. 3. Micro-organism example. ***Any two*** | **2(3)** |

**Q 2013 6**

(a) (i) In DNA, nitrogenous bases occur in complementary pairs. Explain the term *complementary* as used here.

1. In each case, name the complementary base **in RNA** for:
   1. Adenine
   2. Cytosine
2. Name a carbohydrate that is a component of nucleotides.
3. Name a component of a nucleotide that is neither a carbohydrate nor a nitrogenous base.

(b) (i) What does the ‘m’ stand for in mRNA?

1. Give **one** difference between RNA and DNA, other than the nitrogenous bases.
2. Give the role of the enzyme RNA polymerase.

**MS 2013 6**

|  |  |  |  |
| --- | --- | --- | --- |
| **6.** | **1 + 1 + 8 + 6 + 4(1)** | |  |
| (a) | (i) Each base has a (different) corresponding (or matching) (base) | |  |
|  | (ii) 1. Uracil **or** U | |  |
|  | 2. Guanine **or** G | |  |
| 1. Ribose **or** deoxyribose 2. Phosphate (group) **or** P | | | |
| (b) | (i) | Messenger | |
|  | (ii) | RNA has ribose **or** RNA is single stranded | |
|  |  | **or** DNA has deoxyribose **or** DNA is double stranded | |
|  | (iii) | Joins nucleotides together (to give mRNA product) **or** to make RNA | |

**Q 2013 11**

|  |  |  |
| --- | --- | --- |
| **11.** (a) | (i)  (ii) | Give a source of evidence for evolution.  Briefly outline the evidence from the source referred to in (i). |
| (b) | (i) | Human males and females differ in one of their twenty three pairs of chromosomes. What name is given to this pair of chromosomes? |
|  | (ii) | Draw this pair of chromosomes for a human male **and** for a human female and label them appropriately. |
|  | (iii) | Using the chromosomes referred to in part (b) (ii), show, using a Punnett square or otherwise, that a child stands an equal chance of being male or female. |
|  | (iv) | 1. What is meant in genetics by the term *sex linkage*? |
|  |  | 2. Name **two** common sex-linked traits. |

**MS 2013 11**

|  |  |  |
| --- | --- | --- |
| **11.** (a) (i) Fossils **or** embryology **or** anatomy **or** adaptation of plant or animal  **or** genetics  (ii) Any two points from evidence selected above:  *e.g. Fossils*: structure / changing / over time / related to environment  *e.g. Embryology:* different organisms / similar embryo / similar development pathways  *e.g. Anatomy:* Named structure / expansion point | | **3**  **2(3)** |
| 1. (i) Heterosomes **or** sex chromosomes    1. Female Male   XX XY   * 1. Gametes shown   Cross shown  F1 genotypes shown   * 1. 1. Gene(s) on sex **or** on X **or** on Y chromosome   2. Haemophilia / colour blindness | Male Female | **3** |
| **3, 0** |
| **3, 0** |
| **3** |
| **3** |
| **3** |
| **3** |
| **2(3)** |

**Q 2014 10**

(a) (i) Explain the term *species*.

(ii) What is meant by the term *gene expression*? **(9)**

1. Last year it was discovered, by DNA analysis, that meat products labelled as beef contained meat from other animals, particularly horses and pigs.
   1. Name the biomolecule that is the major component of meat.
   2. Where in a cell are these biomolecules manufactured?
   3. Name the molecule, formed from DNA, which carries the instruction to manufacture these biomolecules.
   4. Name **and** outline the procedure used for analysing the DNA samples that revealed the presence of horse meat in products labelled as beef.
   5. Would the result obtained from the procedure referred to in (iv) be the same if the beef were contaminated with pig meat? Explain your answer.

#### (27)

1. The diagram shows part of the genotype of an individual of the Aberdeen Angus cattle breed.

This breed is unusual in that the allele for the polled (hornless) condition is dominant to the one for the horned condition.



**P**

**p**

X Y

* 1. What term is used to describe the allele pair Pp?
  2. Is this a sex-linked condition? Explain your answer.
  3. What is the phenotype **and** sex of the animal whose partial genotype is shown above?
  4. Draw a diagram, similar to the one shown, to describe an Aberdeen Angus which, when crossed with the one above, would **ensure** the production of a polled calf.
  5. Name a group of organisms in which the XY chromosome pair gives rise to a different sex than in cattle.

#### (24)

**MS 2014 10**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **10.** | (a) | (i) | Interbreeding (population) / producing fertile offspring | **2(3)** |
|  |  | (ii) | The production of a (particular) protein (using the gene’s code) | **3** |
|  | (b) | (i) | \*Protein | **3** |
|  |  | (ii) | Ribosomes | **3** |
|  |  | (iii) | \*mRNA | **3** |
|  |  | (iv) | (DNA) profiling | **3** |
|  |  |  | Cut (DNA into fragments) / with (restriction) enzymes / |  |
|  |  |  | separate fragments / on basis of size / analyse results (or explained) | **3(3)** |
|  |  | (v) | No, because pig DNA is not the same as horse DNA |  |
|  |  |  | **OR** | **6, 3, 0** |
|  |  |  | Yes, because not all the DNA is beef DNA |  |
|  | (c) | (i) | \*Heterozygous | **3** |
|  |  | (ii) | No | **3** |
|  |  |  | Because they (‘P’ genes) are not on the X (or Y or sex) chromosome | **3** |
|  |  | (iii) | Hornless (or polled) | **3** |
|  |  |  | Male | **3** |
|  |  | (iv) | PP properly located on chromosome pair | **3** |
|  |  |  | XX properly labelled as chromosome pair | **3** |
|  |  |  | [genotype *alone gets 3 marks*] |  |
|  |  | (v) | Birds **or** butterflies **or** moths | **3** |

**Q 2015 7**

(a) (i) What is the chemical composition of a chromosome?

(ii) What is meant by the term *junk DNA*?

1. (i) In relation to the isolation of DNA from a plant tissue, explain why you used each of the following:
   1. Washing-up or similar liquid.
   2. Sodium chloride.
   3. Protease.
   4. Freezer-cold ethanol.

**MS 2015 7**

1. (i) 1. To breakdown the (cell) membrane(s)
   1. To cause the DNA to clump
   2. To breakdown (or remove or digest) the protein in the chromosomes
   3. To bring the DNA out of solution **or** to make the DNA visible

**or** to separate the DNA

**Q 2015 10**

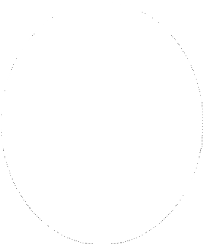
20

(a) (i) Which famous 19th century biologist is regarded as ‘the father of genetics’?

1. In genetics, what is meant by segregation?
2. Give an example of a sex-linked characteristic in humans. **(9)**
3. Write notes on each of the following topics in relation to nucleic acids. In each case your notes should contain three points. Do not give diagrams in your answers.
   1. Complementary base pairs.
   2. Codons.
   3. Transcription. **(27)**
4. Unlike the situation in humans, maleness in birds results from the presence of the XX chromosome pair in the fertilised egg and femaleness results from the XY pair. In a particular bird species, green plumage (G) is dominant to yellow plumage (g) and long tail (L) is dominant to short tail (l). The gene for plumage colour is linked to the gene for tail lengt

Study the genotypes of the above bird species shown in the diagrams below and **in your answer book** match the correct genotype to each of the descriptions (i) to (vi).

A diagram may match more than one of the descriptions.



A

G g X X

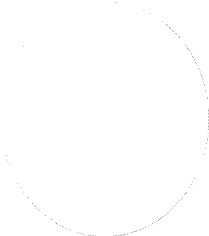
B C D E

G G X X

L l

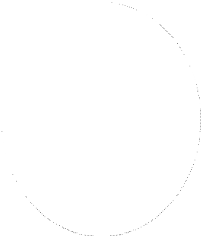
L L

1. A female that is heterozygous in respect of plumage colour and tail length.



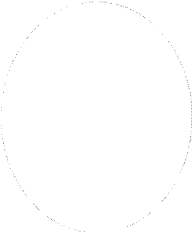
G G X Y

L L



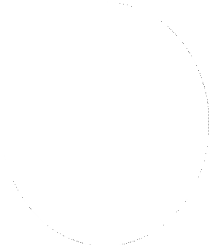
g g X Y

l l



G g X Y

L l



1. A male that can produce only one type of gamete.
2. The individual that can produce the greatest number of different gametes.
3. A male, **all** of whose offspring will have long tails.
4. A female, **all** of whose offspring will have green plumage.
5. A male that is homozygous in respect of plumage colour and tail length.
6. **In your answer book**, write out the genotypes of the gametes that bird D can produce.

#### (24)

**MS 2015 10**

|  |  |  |  |
| --- | --- | --- | --- |
| **10.** (a) | (i) | Mendel | **3** |
|  | (ii) | Separation of homologous chromosomes |  |
|  |  | **or** separation of alleles | **3** |
|  | (iii) | Haemophilia **or** (red-green) colour-blindness | **3** |
| 1. (i) (Two bases joined by) hydrogen bonds / purine with pyrimidine / Cytosine with Guanine / Adenine with Thymine in DNA /   Adenine with Uracil in RNA **or** Thymine replaced by Uracil in RNA **3(3)**   * 1. Sequence(s) of three bases / on DNA / on mRNA **or** on tRNA / (each   codon) codes for one amino acid / that codes for a start (or stop) **3(3)**   * 1. mRNA is formed / using a (single) strand of DNA / (DNA acts) as a   template (or described) / in nucleus / (catalysed by) RNA polymerase **3(3)** | | | |
| (c) | (i) | \*E | **3** |
|  | (ii) | \*C | **3** |
|  | (iii) | \*E | **3** |
|  | (iv) | \*C | **3** |
|  | (v) | \*B | **3** |
|  | (vi) | \*C | **3** |
|  | (vii) | glX / glY | **2(3)** |

**Q 2016 4**

1. (a) In a certain breed of cattle there is incomplete dominance between the allele for red coat and the allele for white coat. Heterozygous individuals are roan.

In each of the following three crosses state, in the space provided, the percentage chance that a calf of the cross will have a red coat.

|  |  |  |
| --- | --- | --- |
| (i) | roan × white | % |
| (ii) | roan × red | % |
| (iii) | roan × roan | % |

1. (i) In genetics, what is meant by the term *sex-linkage*?
   1. Would human females or human males be more likely to suffer from sex-linked diseases such as haemophilia?
   2. Explain your answer to part (ii) by referring below to possible genotypes and their corresponding phenotypes.

Male:

Female:

**MS 2016 4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **4.** |  |  | **5(3** | **) + 5(1)** |  |
| (a) | (i) | *Chance roan × white → red:* 0% | |  |  |
|  | (ii) | *Chance roan × red → red:* 50% | |  |  |
|  | (iii) | *Chance roan × roan → red:* 25% | |  |  |
| (b) | (i) | *Sex-linkage:* When genes are carried on the sex (or X or Y) chromosome(s) | | | |
|  | (ii) | *More likely:* Males | |  |  |
|  | (iii) | *Male genotypes and phenotypes:* | |  |  |
|  |  | Genotype: XnY– | |  |  |
|  |  | Phenotype: Sufferer | |  |  |
|  |  | *Female genotypes and phenotypes:* | |  |  |
|  |  | Genotype: XnXn | |  | Genotype: XNXn |
|  |  | Phenotype: Sufferer | | **OR** | Phenotype: Normal |
|  |  |  | (or lethal for haemophilia) | |  |
|  |  | *Explain:* | Male only needs to inherit the recessive allele (from mother) | | |
|  |  |  | **or** female must inherit the recessive allele from each parent. | | |
|  |  |  | **or** female may be a carrier | |  |
|  |  |  | **or** female recessive homozygote is a sufferer (or lethal for haemophilia) | | |

**Q 2016 14 A**

* 1. (i) Explain the term *species*.

1. What term is used to describe the differences which exist between individuals of a species?
2. The differences referred to in (ii) form the basis of evolution by natural selection.
   1. Explain the term *evolution*.
   2. Outline the role of natural selection in evolution.
3. Explain the term *mutation*.
4. Give **one** example **each** of a disorder caused by:
   1. Gene mutation.
   2. Chromosome mutation.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **14.** | (a) | (i) | *Species:* A group of organisms capable of interbreeding to produce fertile offspring. | | **3** |
|  |  | (ii) | *Intraspecific differences:* \*Variation | | **3** |
|  |  | (iii) | 1. | *Evolution:* Genetic changes (in populations)/ in response to environment/ |  |
|  |  |  |  | over time/ giving rise to new species | **2(3)** |
|  |  |  | 2. | *Role of natural selection:* |  |
|  |  |  |  | Better adapted survive/ reproduce/ adaptation is inherited/ adaptation (becomes) more common | **2(3)** |
|  |  | (iv) | *Mutation:* A change in DNA (or gene or chromosome or genetic material) | | **3** |
|  |  | (v) | 1. | *Gene mutation disorder*: Sickle cell anaemia **or** any valid example | **3** |
|  |  |  | 2. | *Chromosome mutation disorder:* Down syndrome **or** any valid example | **3** |
|  |  | (vi) | *Cause of variation:* Sexual reproduction **or** meiosis **or** formation of gametes | |  |
|  |  |  |  | **or** fertilisation of gametes **or** independent assortment | **3** |

1. Give **one** cause oft he differences referred to in (ii) above, other than mutation.

**MS 2016 14 A**