

**Q1.**

- (a) nucleus 1
- (b) gene(s)
allow allele(s) 1
- (c) copying of chromosomes 1
- (d) mitochondria 1
- (e) 60 – 45
or
120 – 105 1
- 15 (minutes) 1
- an answer of 15 (minutes) scores 2 marks*
- (f) C 1
- (g) 8 1
- (h) to repair tissues 1

[9]**Q2.**

- (a) diffusion 1
- (b) A 1
- (c) B 1
- (d) (earthworm) can absorb more oxygen (in a given time)
or
increases / more gas exchange
allow get / obtain / take in more oxygen
ignore easier absorption of oxygen
ignore references to food 1
- (e) lipase 1
- (f) more oxygen (in soil with earthworms)



allow earthworms bring oxygen to soil

1

(for) more (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(of) bacteria / fungi / microorganisms / microbes / decomposers

1

reference to more is only needed once for the first two marking points

(g) fertilisation

ignore sexual reproduction

1

(h) asexual (reproduction)

allow cloning

1

[10]

Q3.

(a) Gregor Mendel

1

(b) DNA

1

(c) when the dominant allele is not present

1

(d) tt

allow homozygous recessive

1

(e)

	T	t
T	TT	Tt
t	Tt	tt

all 3 correct = 2 marks

2 correct = 1 mark

0 or 1 correct = 0 marks

allow tT for Tt

2

(f) circle drawn around either TT or tt on Figure 2

allow circles drawn round both

1



- (g) correct ratio from part (e) e.g. 3 : 1
allow multiples of stated ratio
allow 3 : 1 if no answer to part (e)

1

[8]

Q4.

(a)

	statement is true for		
	mitosis only	meiosis only	both mitosis and meiosis
all cells produced are genetically identical	✓		
in humans, at the end of cell division each cell contains 23 chromosomes		✓	
involves DNA replication			✓

3 correct = 2 marks
 2 correct = 1 mark
 0 or 1 correct = 0 marks

2

(b) any **two** from:*ignore references to one parent only*

- many offspring produced
- takes less time
allow asexual is faster
- (more) energy efficient
- genetically identical offspring
allow offspring are clones
- successful traits propagated / maintained / passed on (due to offspring being genetically identical)
- no transfer of gametes or seed dispersal
allow no vulnerable embryo stage
allow no need for animals
- not wasteful of flowers / pollen / seeds
- colonisation of local area
must imply local area

2

(c) genetic variation (in offspring)



- (so) better adapted survive
allow reference to natural selection or survival of the fittest 1
- (and) colonise new areas by seed dispersal
or
can escape adverse event in original area (by living in new area)
must imply new area 1
- many offspring **so** higher probability some will survive
allow bluebell example described (max 3 if not bluebell) 1

[8]

Q5.

- (a) 3.7 1
- (b) 2 1
- (c) (different combinations of alleles cause) many / 22 values
allow continuous variation
- or**
in-between values
or
large range of values
or
there are not only two values
allow there are not only 3 values if 3 is given in part (b) 1
- (d) different protein made
allow change in shape (of enzyme) or change in 3-D structure
ignore denature 1
- active site changed 1
- so substrate does not fit / bind
allow description of substrate
allow cannot form E-S complex
ignore lock and key description 1
- (e) produces (some) offspring with high-fat milk



- or**
not all offspring have low-fat milk
ignore reference to alleles 1
- (f) takes less time (to obtain results)
or
more offspring at the same time
allow other sensible suggestion – e.g. allows screening or allow cow 7 to continue to produce eggs or avoid injury to cow 7 during mating or giving birth 1
- (g) male gametes correct: d (and d) 1
- female gametes correct: D and d 1
- allow 1 mark if gametes are correct but gender not identified*
- correct derivation of offspring genotypes from given gametes
allow 2 × 2 or 2 × 1 derivation 1
- Dd identified as low-fat **and** dd identified as high-fat in offspring
if DD offspring are produced, must also identify as low-fat 1
- (h) find female with low(est) fat in milk **and** high(est) milk yield
allow choose from 7, 9, 12, 13 which has the highest yield 1
- find male whose female offspring have high(est) milk yield **and** low(est) fat in milk
allow choose from 16 or 18 whose female offspring has the highest yield 1
- or**
- find female with lowest fat in milk
or cow 13 (1)*
***or**
allow female with high(est) milk yield
- find male whose female offspring have high(est) milk yield (1)*
***or**
allow male whose female offspring have lowest fat in milk / male 16
- cross the best (for both features) female with the best male 1



select best offspring (for both features) from each generation and repeat for several generations

1
[16]

Q6.

(a) 46

1

(b) 23

allow ecf from 2.1 – ie half of answer given in 2.1

1

(c) egg

1

sperm

1

ovary

1

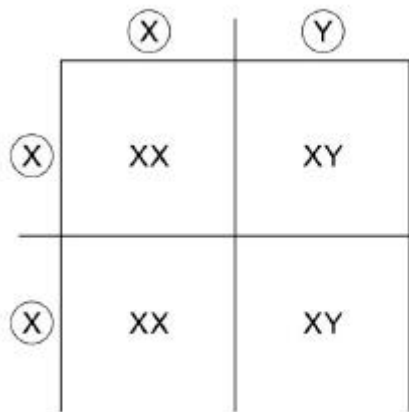
meiosis

1

fertilisation

1

*correct order only
correct spelling only*



(d)

*all 4 correct = 2 marks
2 or 3 correct = 1 mark
0 or 1 correct = 0 marks
ignore correct / incorrect identification of male and female offspring*

2

(e) 1 in 2

1

(f) any **two** from:



- multiple genes determine appearance
allow several / many genes determine appearance
- different combinations of alleles
allow description of combinations of alleles' allow genes for alleles
- different environmental effects
allow example e.g. eat different diets
- from different egg / sperm

2

[12]

Q7.

(a) red blood cell

1

(b) 44

1

(c) retina

1

(d) **7** and **8** / the parents
do not have **A** (allele)
or only have **a** (allele) **or** are **aa**

*allow converse – if parents had an **A** (allele) they would have Stickler syndrome*

1

so children cannot inherit **A**
or can only inherit **a**

or

the parents show the recessive characteristic

so must be homozygous
(recessive)

or must be **aa**
or parents cannot have **A**

1

(e) parental genotypes:
12 = Aa and 18 = aa
or parental gametes:
12 = A + a and 18 = a + a

1

derivation of offspring genotypes
allow ecf

1

identification of **Aa** offspring as Stickler

1



probability = $0.25 / \frac{1}{4} / 1 \text{ in } 4 / 25\% / 1:3$
allow ecf – e.g. 0.5 if 12 = AA
do not accept 3:1
do not accept 1:4

1

[9]

Q8.

- (a) white blood cells have the same DNA / genes / chromosomes
or
 have the gene for GH
allow have all the genes
allow all body cells (except RBCs) have all of the genes

1

- (b) enzyme has specifically-shaped active site

1

the 2 antibiotic resistance genes have different (sequence of) bases

1

only Tetracycline-resistance gene fits (active site of) enzyme

or

only Tetracycline-resistance gene is complementary to (active site of) enzyme

1

- (c)

Ampicillin	Tetracycline
✓	✗
✗	✗
✓	✓

1 mark for each correct row

if no other mark, allow 1 mark for one correct column

1

1

1

- (d) clone produced by asexual reproduction
allow by 'mitosis'

1

all DNA / all genes are copied

allow GH gene copied

allow plasmid copied

1

every cell receives a copy

or

receives every gene

or

receives GH gene

or
 receives plasmid
 or
 genetically-identical cells

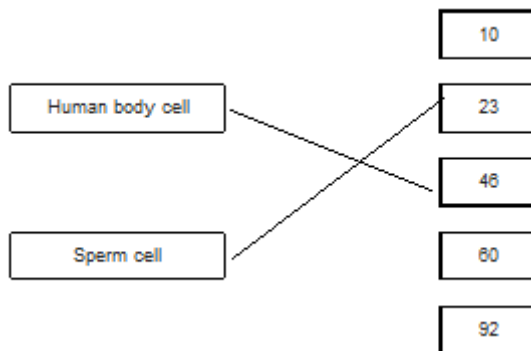
1
[10]

Q9.

(a) **A**

1

(b)



2

(c) one x circled under mother
accept if clearly indicated choice even if not circled

1

(d) XY
allow YX

1

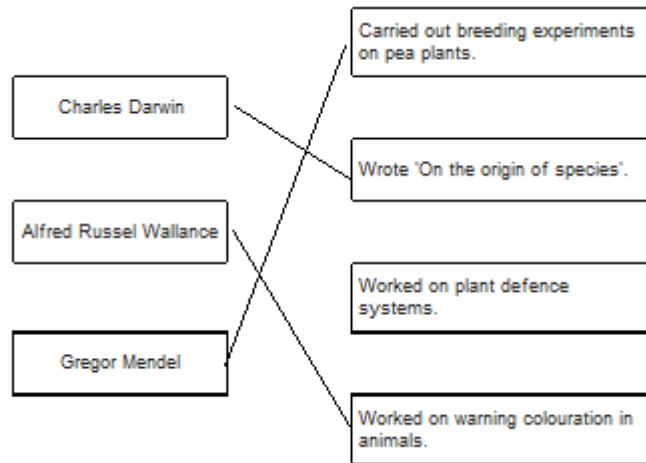
(e) 50 (%)

1

[6]

Q10.

(a)



3

(b) a gene

allow allele

1

(c) 4

1

(d) correct derivation of children's genotypes

1

identification of children with cystic fibrosis (dd)

1

0.25

allow ecf

allow ¼ / 25% / 1 in 4 / 1:3

1

do not accept 1:4

(e) heterozygous

1

[9]

Q11.

(a) phosphate

allow PO₄³⁻

1

do not allow P

(b) A / adenine and T / thymine
and

C / cytosine and G / guanine

do not allow U / uracil

1

(c) (mutation) changes from C to T DNA code

or

there is a change in the three bases / triplet from CAG to TAG

1



- (mutation) changes the amino acid 1
- (this could) change the protein 1
- (so it) forms a different shape / changed active site
accept different tertiary structure 1
- (therefore) the enzyme no longer fits the substrate / carbohydrate 1
- (d) mother / woman's gametes correct: A a 1
- father / man's gametes correct: a a 1
- correct derivation of offspring
ecf 1
- identification of child with syndrome H or genotype aa 1
- 0.5
ecf
allow 50% / 1 / 2 / 1 in 2 / 1:1 1
do not accept 1:2

[12]

Q12.

- (a) When the dominant allele is not present. 1
- (b) (i) Bb 1

	Woman Brown hair	
	B	b
Person 3 Red hair	b	bb
	b	Bb

- (ii)
 - 3 correct = 2 marks
 - 2 correct = 1 mark
 - 1 or 0 correct = 0 marks

*allow bB for Bb*

2

(iii) 1 in 2

allow ecf from part ii

1

[5]**Q13.**

(a) ovary

1

(b) 46

1

(c) (i) does not fit the pattern

orit is higher than the 3rd value / it should be lower than the 3rd value / it should be between the 3rd and 5th values*do **not** allow use of incorrect figures*

1

(ii) As age increases % of women (having a baby) decreases

1

(d) (i) 33

 $\frac{66}{2}$ *allow 1 mark for $\frac{66}{2}$* *if no answer / wrong answer*

2

(ii) low success rate

1

more likely to have a baby with health problems / abnormalities / a faulty chromosome

1

[8]**Q14.**

(a) testis / testes

allow testicle(s)

1

(b) (i) **B** = 13.2**C** = 6.6**E** = 3.3*all 3 correct = 2 marks**2 or 1 correct = 1 mark**If no marks awarded allow ecf for **C** and **E** based on answer to **B****ie $C = \frac{1}{2} B$ and $E = \frac{1}{2} C$ for one mark*

2



- (ii) 6.6
allow twice answer for cell E in part bi
1
- (iii) mitosis
correct spelling only
1
- (c) (i) any **two** from:
• cells that are able to divide
• undifferentiated cells / not specialised
• can become other types of cells / tissues **or** become specialised /differentiated
allow pluripotent
2
- (ii) 4-day embryo is a (potential) human life
or
destroying/damaging (potential) human life
allow cord would have been discarded anyway
ignore reference to miscarriage
allow cannot give consent
1
- (iii) perfect tissue match **or** hard to find suitable donors
allow same/matching antigens
allow no danger of rejection
allow no need to take immunosuppressant drugs (for life)
*ignore genetically identical **or** same DNA*
1
- (iv) stem cells have same faulty gene / allele / DNA / chromosomes
allow genetically identical
ignore cells have the same genetic disorder
1
- [10]

Q15.

- (a) (i) man has (inherited) polydactyly (PD) allele (from mother)
1

man has (inherited) other / normal / recessive allele from father
1

because father does not have PD allele **or** if father had it father would have had PD **or** father only has normal allele **or** father is homozygous recessive
1

allow gene for allele
- (ii) 0.5 / $\frac{1}{2}$ / 1 in 2 / 1:1 / 50%
do not allow 1:2 or 50/50
allow 50:50



- (b) parental phenotypes: both brown 1
- parental genotypes: both **Bb** 1
- gametes: **B b** and **B b** 1
- allow only on gametes answer line*
allow ecf from genotypes
- offspring genotypes: **BB (2)Bb bb** 1
allow ecf from gametes
- offspring phenotypes correctly assigned to genotypes:
BB & Bb = brown bb = red 1
do not penalise confusion of 'phenotypes' & 'genotypes' here

[9]**Q16.**

- (a) salivary gland 1
- (b) liver 1
- (c) any **four** from:
 - merozoites released (from liver) and enter the red blood cells
 - (some of these) turn into schizonts
 - (which) burst the red blood cells
 - releasing (more) merozoites
 - coincides with fever attacks.*points credited must be in correct sequence* 4
- (d) (i) three bases code for one amino acid 1
- middle code of CTC is now CAC / T changed to A 1
- so will be a different amino acid (in the chain) 1
- (and so chain / protein will have a different shape) due to a different sequence of amino acids 1
- (ii) correct parental genotypes (both **Aa**)
allow ecf for 2nd and 4th marking points
or correct gametes (**A+a A+a**)
allow alternative symbols if defined

- 1
- correct derivation of offspring genotypes from gametes 1
- aa identified (homozygous for) SCA 1
- 0.25
allow 25% or 1 in 4 or 1:3 or 1 / 4 1
- (iii) **(Aa)** less likely to get malaria (than homozygous dominant / **AA**)
allow resistance or protection if correctly qualified eg some protection
do not accept 'immune' 1

[15]

Q17.

- (a) any **two** from:
- right amount of nutrients **or** different / all foods
 - right amount of energy
 - for (individual) needs
- 'right amount' only needed once for both marks to be awarded* 2
- (b) (i) ovaries / ovary
allow placenta 1
- (ii) any **one** from:
- inhibits follicle stimulating hormone / FSH production
 - inhibits maturation of eggs
- ignore ref to site of production of FSH*
*allow stimulates LH production **or** stimulates preparation of womb lining* 1
- (iii) any **one** from:
- stimulate muscle growth
 - used in (oral) contraceptives
- 1
- (c) small (rate of) decrease then bigger (rate of) decrease 1
- idea that change of rate (of decrease) at 900 (mg per day)
If no other mark awarded allow 1 mark for decrease 1
- (d) (i) gene(s) / nucleus / chromosome(s) / DNA



allow ribosome

1

- (ii) reduces production of cholesterol (by liver)

allow idea of switching off gene for reductase (production)

allow switch off / reduce / inhibit reductase (production)

allow reduces absorption of cholesterol (by intestine)

allow statins (might) breakdown / destroy cholesterol

1

[9]

Q18.

- (a) (i) (female) has XX / only X's / no Y

allow has X chromosomes

ignore ref to genes / cells

1

- (ii) extra chromosome / has 47 chromosomes / one set has 3 copies

ignore reference to chromosome numbers other than 47 or no. 18

1

no. 18

1

- (b) (i) 14

allow in range of 13.5 to 14.5

1

- (ii) 7

allow in range of 6.75 to 7.25

accept ecf from 5bi

1

- (c) Advantages:
any **two** from:

- more than 1 embryo (so more chance of success)
allow method 2 may cause a miscarriage
- tested at 3 days cf 10 weeks **or** tested earlier
tested when only 3 days old
- tested before pregnancy
- no termination / abortion
- spare embryos have a potential use.

2

- Disadvantages:
any **one** from:

- needs an operation
accept described hazard of operation
- (spare) embryos / human life destroyed / harmed
must be comparative
- higher cost
- embryos might not implant / might not develop.

1

Q19.

- (a) (i) in the chromosome(s)
ignore genes / alleles 1
- in the nucleus
allow nuclei
allow mitochondria 1
- (ii) the DNA / chromosomes / genes are replicated / copied / multiplied / doubled / duplicated
allow DNA is cloned
ignore same DNA / chromosomes / genes if unqualified 1
- (b) (i) 1 / one 1
- (ii) 2 / two 1
- (c) **B** 1

[6]

Q20.

- (a) (i) 3.15 : 1
accept 3.147:1 or 3.1 : 1 or 3 : 1
do not accept 3.14 : 1
Ignore 705:224 1
- (ii) any **two** from:
- fertilisation is random **or** ref. to chance combinations (of alleles / genes / chromosomes)
 - more likely to get theoretical ratios **or** see (correct) pattern **or** get valid results if large number
allow ref. to more representative / reliable
do not allow more accurate or precise
ignore fair / repeatable
 - anomalies have limited effect / anomalies can be identified
accept example of an anomaly 2
- (b) (i) in sequence:
- Homozygous
Homozygous
Heterozygous



All 3 correct = 2 marks
2 correct = 1 mark
1 or 0 correct = 0 marks

2

(ii) genetic diagram including:

Parental genotypes: **Nn** and **Nn**

allow other characters / symbols only if clearly defined

1

or

Gametes: **N** and **n** + **N** and **n** derivation of offspring genotypes:

NN Nn Nn nn

allow genotypes correctly derived from candidate's P gametes

1

identification: **NN** and **Nn** as purple **and nn** as white

allow correct identification of candidate's offspring genotypes but only if some F₂ are purple and some are white

1

(c) any **two** from:

- did not know about chromosomes / genes / DNA
or did not know chromosomes occurred in pairs
ignore genetics
- had pre-conceived theories
eg blending of inherited characters
ignore religious ideas unless qualified
- Mendel's (mathematical) approach was novel concept
allow his work was not understood or no other scientist had similar ideas
- Mendel was not part of academic establishment
allow he was not considered to be a scientist / not well known / he was only a monk
- work published in obscure journal / work lost for many years
- peas gave unusual results of other species
allow he only worked on pea plants
- Mendel's results were not corroborated until later / 1900

2

[10]

Q21.

(a) (different / alternative) forms of a gene
*do **not** accept types of genes*

1

(b) DNA isolated from embryo

1

(fluorescent) probe mixed with embryo DNA

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		1
	probe (then) <u>binds</u> with embryo DNA	1
	(UV light) <u>to show</u> alleles / gene for disorder	1
(c)	genotypes of parents and gametes correct (Man D and d , Wife d and d) <i>allow half-size genetic diagram with only one d from wife</i>	1
	offspring genotypes correct ($\frac{1}{2}$ = Dd and $\frac{1}{2}$ = dd) <i>allow ecf if parental genotypes are wrong</i>	1
	offspring phenotypes correctly assigned to genotypes	1
(d)	genotypes of parents and gametes correct (N and n) <i>allow ecf if parental genotypes are wrong</i>	1
	offspring genotypes correct (NN , 2 × Nn , and nn)	1
	offspring phenotypes correctly assigned to genotypes;	1
	correct probability = 0.25 / $\frac{1}{4}$ / 25% / 1 in 4 / 1:3, <u>only</u> ; <i>do not allow '3:1' / '1:4'</i>	1

[12]

Q22.

(a)	(i)	nucleus <i>correct spelling only</i> <i>accept mitochondrion</i> <i>ignore genes / genetic material / chromosomes</i>	1
	(ii)	base(s) <i>Accept all four correct names of bases</i> <i>ignore nucleotides and refs to organic / N-containing</i>	1
	(iii)	4	1
	(iv)	codes for sequence / order of amino acids <i>ignore references to characteristics</i>	1
		codes for a (specific) protein / enzyme	

or



the sequence / order of three bases / compounds / letters

codes for a specific amino acid

or

the sequence / order of 3 bases / compounds / letters

codes for the order / sequence of amino acids

1

(b) (i) DNA

1

circular / a ring **or** a vector / described

1

(ii) kills any cells not having **kan^r** gene / so only cells with **kan^r** gene survive

1

hence surviving cells will also contain **Bt** gene / plasmid

1

(iii) cells divide by mitosis

ignore ref to asexual reproduction

correct spelling only

1

genetic information is copied / each cell receives a copy of (all) the gene(s) / all cells produced are genetically identical / form a clone

1

(iv) any **two** from:

- gene may be passed to pathogenic bacteria
- cannot then kill these pathogens with kanamycin

or

- cannot treat disease with kanamycin
- may need to develop new antibiotics
- gene may get into other organisms
- outcome unpredictable

2

[13]

Q23.

(a) (i) alternative / different / one form of a gene

or

a mutation of a gene

do not allow a type of gene

(For info: CRAM = Childhood Recurrent Acute Myoglobinuria)

1

(ii) not expressed if dominant / other allele is present or it is heterozygous

or

only expressed if dominant allele not present / no other allele present or it is homozygous

need two copies to be expressed / not expressed if only one copy

allow 'gene' for allele

1

(iii) unaffected parents have an affected child

allow 7 and 8 have 10

allow skips a generation

1

(b) (i) has two alleles that are the same

*accept (person is) **nn** / **NN** or has two recessive / dominant alleles*

1

(ii) (all) inherit **N** / normal / dominant allele from 1 / from father

ignore they are carriers

1

all are **Nn** / none are **nn** / all are heterozygous

1

(c) (i) genetic diagram including:

1 gametes correct **or** parental genotypes correct:

N and **n** + **N** and **n** **or** **Nn** + **Nn**

accept alternative symbols, if defined

1

2 derivation of offspring genotypes:

NN + **Nn** + **Nn** + **nn**

allow alternative if correct for parental gametes

1

3 **nn** identified as CRAM

accept ¼ / 25% / 1 in 4 / 1 out of 4 / 1:3

1

4 correct probability: 0.25

*do **not** accept 3:1 / 1:4*

1

(ii) any **four** points + conclusion:

pro PGD:

detected at earlier stage / at 3 days c.f. several weeks / before becoming pregnant

no / less chance of miscarriage c.f. CVS



does not involve abortion / less trauma / less pain / ethical comparison

higher chance of having unaffected child – eg ref to use of spare embryos

provides embryos for research

4

pro CVS:

PGD may destroy some embryos

ethical implications of research on embryos (with PGD)

lower incidence of false positives / false results

low(er) financial cost

conclusion:

must relate to candidate's argument

must have at least one point from each technique for max marks

1

[15]

Q24.

(a) (i) Chromosomes

1

(ii) Characteristics

1

(iii) Classify

1

(b) Plants

ignore algae

1

[4]

Q25.

(a) (i) gamete(s)

ignore reproductive cells

1

(ii) womb / uterus

allow phonetic spellings

1

(b) (i) are formed from the same original embryo

1

(ii) embryo transplantation

1



(iii) any **one** from:

- (calves will have some) genes / DNA from bull / sperm
allow not all genes from the cow
- idea that sexual reproduction produces variation
allow may be male
allow idea that gene for low fat milk may not be passed on

1

[5]

Q26.

(a) any **three** from:

- (gene) cut out
- (gene / cut out) from (bacterial) chromosome / DNA
accept (gene / cut out) from (bacterial) plasmid
- ref to enzymes (at any point)
- (gene spliced) into maize chromosome / DNA
- (gene added) at an early stage of development

3

(b) any **four** from:

- justification based on comparison of the relative merits of at least one advantage and one disadvantage
max 3 marks if only advantages or disadvantages given

Advantages:

- less effort for farmer **or** less likely to harm farmer
ignore ref to cost
- (pesticide) always there **or** doesn't wash away
allow examples eg no need to spray
- less insects to eat crop / maize **or** carry disease
allow pesticide doesn't contaminate water courses
- so greater crop production / yield

Disadvantages:

- (toxin) kills other insects
ignore ref to cost
- so (some) crops don't get pollinated / (sexually) reproduce
allow maize not pollinated
- possible harm when eaten by humans / animals
allow may have unpleasant taste
- damage to food chains
allow reduced biodiversity
- gene may spread to other species

4

[7]

Q27.



- (a) (i) fertilisation 1
- (ii) in sequence:
accept 1 next to gene, 2 next to chromosome and 3 next to nucleus in box
- 1 gene
2 chromosome
3 nucleus
*allow 1 mark for smallest **or** largest in correct position* 2
- (iii) DNA 1
- (b) (i) On diagram:
tick drawn next to **X** and / or **Y** from Parent 1
tick(s) must be totally outside grid squares
allow ticks around "parent"
extra ticks elsewhere cancel 1
- (ii) 0.5 / $\frac{1}{2}$ / 50% / 1:1 / 50:50 / 1 in 2
allow 2/4 / 2 in 4 / 2 out of 4 / 'even(s)' / 'fifty – fifty'
*do **not** allow 1:2 or '50 / 50' or '50 – 50'* 1
- 2 (out of 4) boxes are **XX**
- or**
- half of the sperm contain an **X**-chromosome
*allow **XY** is male and 2 (out of 4) boxes are **XY*** 1
- [7]**

Q28.

- (a) (i) one form of a / one gene
*do **not** allow 'a type of gene'*
allow a mutation of a gene 1
- (ii) not expressed if dominant / other allele is present / if heterozygous
- or**
- only expressed if dominant allele not present / or no other allele present
allow need two copies to be expressed / not expressed if only one copy / only expressed if homozygous 1
- (b) (i) two parents without PKU produce a child with PKU / **6** and **7** → **10**



allow 'it skips a generation'

1

- (ii) genetic diagram including:
accept alternative symbols if defined

Parental gametes:

6: **N** and **n**
and 7: **N** and **n**

1

derivation of offspring genotypes:

NN Nn Nn nn

allow genotypes correctly derived from student's parental gametes

1

identification: **NN** and **Nn** as non-PKU

OR nn as PKU

allow correct identification of student's offspring genotypes

1

correct probability only: 0.25 / $\frac{1}{4}$ / 1 in 4 / 25% / 1 : 3

*do **not** allow 3 : 1 / 1 : 4*

*do **not** allow if extra incorrect probabilities given*

1

- (c) (i) mitosis
correct spelling only

1

- (ii) 8

1

- (iii) DNA
allow deoxyribonucleic acid
*do **not** allow RNA / ribonucleic acid*

1

- (d) (i) may lead to damage to embryo / may destroy embryos / embryo cannot give consent

allow avoid abortion

allow emotive terms – eg murder religious argument must be qualified

allow ref to miscarriage

allow idea of avoiding prejudice against disabled people

allow idea of not producing designer babies

1

- (ii) any **one** from:

- prevent having child with the disorder / prevent future suffering / reduce incidence of the disease



ignore ref to having a healthy child

ignore ref to selection of gender

- embryo cells could be used in stem cell treatment
- allow ref to long term cost of treating a child (with a disorder)*
- allow ref to time for parents to become prepared*

1

[12]

Q29.

(a) DNA

1

(b) X and Y

1

(c) (i) 46 chromosomes

1

(ii) half the number

1

(d) meiosis

1

[5]

Q30.

(a) Mendel

1

(b) (i) **TT**

1

(ii) a dominant allele

1

(c) 1 : 1

1

(d) 100 short plants

1

[5]

Q31.

(a) (i) mitochondrion / mitochondria
must be phonetically correct

1

(ii) carbon dioxide / CO₂

1

water / H₂O

1

in either order

*accept CO₂ but **not** CO²*



accept H_2O **or** HOH but not H^2O

- (iii) diffusion 1
- high to low concentration
allow down a concentration gradient 1
- through (cell) membrane **or** through cytoplasm
do not accept cell wall 1
- (b) ribosomes make proteins / enzymes 1
- using amino acids 1
- part A / mitochondria provide the energy for the process
allow ATP
do not accept produce or make energy 1
- [9]

Q32.

- (a) (i) meiosis
allow mieosis 1
- (ii) testis / testes
allow testicle 1
- (b) (i) 23 1
- (ii) fuses / joins with cell D / with egg cell **or** used in fertilisation
allow fuse with another cell 1
- prevents doubling of chromosome number / restores original no. / 46 /
diploid no. / normal no. / full no.
accept 23 from each parent / from each gamete 1

[5]

Q33.

- (a) (i) allele expressed even when other allele present **or** expressed if just one copy
of allele is present **or** expressed if heterozygous
if present other allele not expressed 1
- (ii) 2 affected parents have unaffected child **or** 1 and 2 → **5 / 6**



- or** if recessive all of **1** and **2**'s children would have CADASIL 1
- (iii) heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL 1
- (b) genetic diagram including:
accept alternative symbols, if defined 1
- correct gametes:
D and **d**
and d (and **d**)
ignore 7 / 8 or male / female 1
- derivation of offspring genotypes:
Dd Dd dd dd
*allow just **Dd dd** if ½-diagram*
allow ecf if correct for student's gametes 1
- identification of **Dd** as CADASIL
or dd as unaffected
allow ecf if correct for student's gametes 1
- correct probability: 0.5 / ½ / 1 in 2 / 50% / 1 : 1 1
- (c) (i) stem cells can differentiate **or** are undifferentiated / unspecialised 1
- can form blood vessel cells / brain cells
or
stem cells can divide 1
- (ii) ethical argument - eg no risk of damage to embryo or adult can give consent for removal of cells **or** adult can re-grow skin
more ethical qualified
ignore religion unqualified
or
if from a relative then less chance of rejection **or** if from self then no chance of rejection
or
skin cells more accessible 1

[10]

**Q34.**

- (a) (use of) enzymes 1
- (b) asexual reproduction / no gametes / no fusion / only one parent
ignore clones 1
- cells all contain same genetic information / same genes (as parent) / same DNA 1
- (c) can spray crop with herbicide – only weeds killed
crop survives herbicide insufficient 1
- (d) any **one** from:
allow 'think that GM food is bad for health'
- fears / lack of knowledge about effects of GM food on health
ignore not natural or against religion
 - crop plants may pass on gene to wild plants
 - encourages use of herbicides 1

[5]**Q35.**

- (a) (i) gametes
apply list principle 1
- (ii) chromosomes
apply list principle 1
- (b) (i) The allele is recessive
no mark if more than one box is ticked 1
- (ii) two
apply list principle 1
- (c) (i) **A**
apply list principle 1
- (ii) **B**
apply list principle 1

[6]

Q1.(a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols with a key*

allow as gametes shown in Punnett square

1

aa in offspring correctly derived from parents**or****aa** correctly derived from the parents given

ignore other offspring / gametes

for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

accept converse if clear, eg if you (only) took one it might have cystic fibrosis / might not be fertilised

- (more) sure / greater chance of healthy / non-cystic fibrosis egg / embryo / child

accept some may have the allele

reference to 'suitable / good embryo' is insufficient

- greater chance of fertilisation

1

(ii) **advantages**

to gain 3 marks both advantage(s) and disadvantage(s) must be given

max 3

any **two** from:

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

disadvantagesany **two** from:

- operation dangers / named eg infection
- ignore risk unqualified*



- ethical or religious issues linked with killing embryos
*accept wrong / cruel to embryos accept right to life argument
ignore embryos are destroyed*
- (high) cost of procedure
- possible damage to embryo (during testing for cystic fibrosis / operation)

plus

conclusion

a statement that implies a qualified value judgement
eg it is right because the child will (probably) not have cystic fibrosis
even though it is expensive

or

eg it is wrong because embryos are killed despite a greater chance of
having a healthy baby

note: *the conclusion mark cannot be given unless a
reasonable attempt to give both an advantage and a
disadvantage is made*

*do **not** award the mark if the conclusion only states that
advantages outweigh the disadvantages*

1

(c) any **three** from:

- osmosis / diffusion
*do **not** accept movement of ions / solution by osmosis /
diffusion*
- more concentrated solution outside cell / in mucus
*assume concentration is concentration of solute unless
answer indicates otherwise or accept correct description of
'water concentration'*
- water moves from dilute to more concentrated solution
*allow correct references to movement of water in relation to
concentration gradient*
- partially permeable membrane (of cell)
allow semi / selectively permeable

3

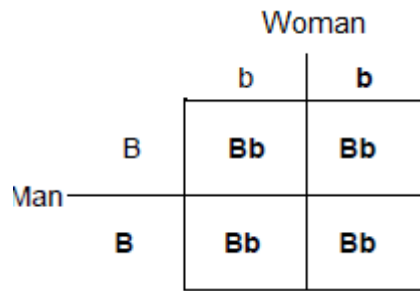
[11]

Q2.

(a) (i) correct parental genotypes (man BB and woman bb)

1

all offspring Bb



ignore 'brown' or 'brown eyes' on diagram

1

- (ii) they have one B / dominant allele / heterozygous

or

B / brown allele / dominant allele is expressed even if only on one chromosome

1

- (b) correct parental genotypes (both Bb)
can be shown in a diagram
can be shown as gametes

1

correct derivation of offspring genotypes from gametes
allow correct derivation from wrong gametes

1

bb identified as blue-eyed

1

[6]

Q3.

- (a) sexual reproduction

1

- (b) (i) genes

1

- (ii) gametes

1

- (c) (i) any **two** from:
answers must be comparative

- more meat (per cow)
ignore bigger unqualified
- more milk each day
- can be milked for more time after giving birth / greater proportion of time
accept '(produce) more milk', for 1 mark, if neither more milk each day nor can be milked for more time after giving birth



are given

2

- (ii) (milk contains) more protein
answers must be comparative

1

less time before having a calf when no milk produced

1

- (d) (i) genes from one organism are transferred to a different organism

1

- (ii) (possible) harm to babies' long term health
allow don't know long-term / side effects (on baby)
accept idea that there may be other things in (genetically engineered) cow's milk that might harm babies' health e.g. bacteria
ignore ethical / religious arguments

1

[9]

Q4.

- (a) auxin

accept other named plant hormones

1

- (b) (i) any **three** from:

- no (fusion of) gametes / fertilisation
allow no meiosis or new cells only produced by mitosis
- only one parent
allow not two parents
- no mixing of genetic material
- no genetic variation or genetically identical offspring
allow clones

3

- (ii) more / many offspring / plants (produced from one parent plant)
allow less damage to parent plant
ignore speed / cost

1

[5]

Q5.

- (a) (i)

Feature	Mitosis only	Meiosis only



Produces new cells during growth and repair	✓	
Produces gametes (sex cells)		✓
Produces genetically identical cells	✓	

All 3 correct = **2** marks

2 correct = **1** mark

0 or 1 correct = **0** marks

2

(ii) (a man) testis / testes
accept testicle(s)

1

(a woman) ovary / ovaries
*do **not** accept 'ova' / ovule*

1

(b) (i) XY / YX
or
X and Y

1

(ii) XX
or
X and X or 2 X's
accept X

1

(c) $\frac{1}{2}$ / 0.5 / 50% / 1:1 / 1 in 2
*do **not** accept 1:2 / 50/50*
allow 50:50
allow 2 in 4

1

[7]

Q6.

(a) (i) 1

1

fertilisation / fusion
allow sexual reproduction
allow fertilise / fuse
ignore joining

1

(b) (i) **Dd**

1



- (ii) **dd** 1
- (c) (i) 1 in 2 1
- (ii) 0 1

[6]

Q7.

- (a) changes code /sequences of bases
or
sequence of amino acids is different 1
- the enzyme has different / wrong shape / structure
allow the active site is changed 1
- so substrate will not fit into enzyme / will not join to enzyme 1
- (b) (i) 46
allow 23 pairs 1
- (ii) also inherited (from mother) normal chromosome 15 / normal allele /
normal gene / boy is heterozygous / **Hh**
allow the boy is a carrier 1
- (allele for) this disorder is recessive
or
the normal allele would give a working enzyme
ignore converse 1
- (iii) genetic diagram including:
Parental gametes:
H and **h** from both parents
accept alternative symbols, if defined 1
- derivation of offspring genotypes:
HH Hh Hh hh
*allow alternative if correct for student's parental genotypes /
gametes* 1
- identification of **hh** (having the disorder) if 1 in 4 1

[9]

**Q8.**

- (a) (i) DNA replication / copies of genetic material were made
'it' = a chromosome
allow chromosomes replicate / duplicate / are copied
ignore chromosomes divide / split / double 1
- (ii) one copy of each (chromosome / chromatid / strand) to each offspring cell
ignore ref. to gametes and fertilisation 1
- each offspring cell receives a complete set of / the same genetic material
allow 'so offspring (cells) are identical' 1
- (b) (i) meiosis
allow mieosis as the only alternative spelling 1
- (ii) Species A = 4 **and** Species B = 8 1
- (iii) sum of A + B from (b)(ii) e.g. 12 1
- (c) (i) similarities between chromosomes
or
similarities between flowers described
e.g. shape of petals / pattern on petals / colour / stamens 1
- can breed / can sexually reproduce
allow can reproduce with each other / they can produce offspring 1
- (ii) any **two** from:
- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
 - some chromosomes unable to pair (in meiosis)
 - (viable) gametes not formed / some gametes with extra / too many genes / chromosomes
- or**
some gametes with missing genes / chromosomes 2

[10]**Q9.**



- (a) (i) fusion / joining / combining of gametes / egg **and** sperm / sex cells
accept fertilisation
allow fusion / joining / combining DNA from two parents
ignore meeting / coming together / mixing of gametes etc 1
- (ii) (mixture of) genes / DNA / genetic information / chromosomes
ignore nucleus / inherited information but allow second mark if given 1
- from both parents / horse **and** zebra
dependent on sensible attempt at 1st mark 1
- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.
- 0 marks**
No relevant content
- Level 1 (1-2 marks)**
There is simple description of the early stages of adult cell cloning. However there is little other detail and the description may be confused or inaccurate.
- Level 2 (3-4 marks)**
There is an almost complete description of the early stages of the process and description of some aspects of the later stages. The description may show some confusion or inaccuracies.
- Level 3 (5-6 marks)**
There is a clear, detailed and accurate description of all the major points of how adult cell cloning is carried out.
- Examples of Biology points made in the response could include:**
- skin cell from zorse
 - (unfertilised) egg cell from horse
 - remove nucleus from egg cell
 - take nucleus from skin cell
 - put into (empty) egg cell
 - (then give) electric shock
 - (causes) egg cell divides / embryo formed
 - (then) place (embryo) in womb / uterus

6

[9]

**Q10.**(a) mutation*correct spelling only**ignore other adjectives eg random / spontaneous*

1

(b)

*ignore references to X / Y chromosomes*idea of mutant gene / new form / this allows hatching (of males)

1

(individual with advantage) (more) survive / (more) live / (more) don't die

allow immunity rather than resistance throughout

1

(so survivors) breed / reproduce

1

mutation / gene passed (from survivors) to offspring / next generation

*allow resistance / characteristic for gene**'gene passed on' is insufficient*

1

[5]**Q11.**

(a) sexual

1

characteristic

1

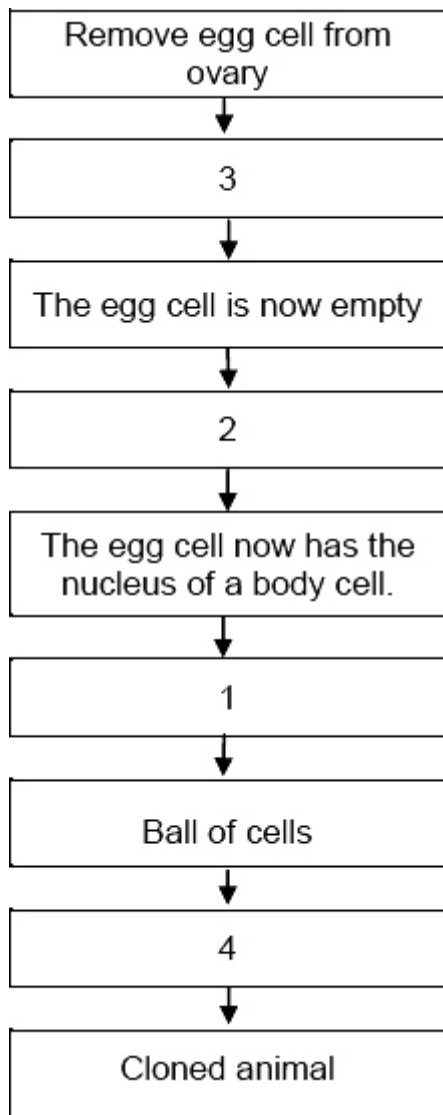
mutation

1

chromosome

this order only

1



(b)

four correct gains 3 marks
two or three correct gains 2 marks
one correct gains 1 mark
accept correct connection between statement and box

3

[7]

Q12.

(a) fusion of gametes / named gametes
allow meet / join / fertilise

1

results in mixing of genetic information / DNA / chromosomes
accept genetic information / DNA / chromosomes from two parents

1

(b) (i) use enzyme

1

to cut gene from pout chromosome / DNA



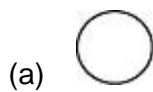
1

insert gene into salmon chromosome / DNA / egg / embryo / nucleus
accept use of plasmid as carrier
ignore salmon / cell

1

- (ii) eg fear of gene transfer to wild salmon / extinction of wild salmon /
 fear of harmful effect on consumers / unsure of long term effects
*ignore cruel / ethics / morals / religion / unnatural /
 economics*

1

[6]**Q13.**

*the shape must be (roughly) circular **and** not shaded, for the mark*

accept the shape drawn in the key if it is not contradictory

1

- (b) dominant

1

- (c) (i) a half (50%)

1

- (ii) Some of B's sperm cells have an X chromosome

1

[4]**Q14.**

- (a) gene / allele

1

- (b) (in / on) ribosome(s)

1

- (c) any **three** from:

- amino acids make up a protein
- (protein is) particular combination / sequence (of amino acids)
- bases form a code
- the bases work in threes or description
accept bases work in triplet
- (code / three bases) for one amino acid
accept eg (bases) WXZ for amino acid J for 2 marks

3



- (d) (i) different / wrong amino acid (coded for) **or** different / wrong shape
ignore reference to amino acid 'made'
ignore change unqualified
ignore different protein 1
- (ii) different / example of different eye colour
allow protein may / would not be made / function (normally) 1

[7]

Q15.

- (a) (i) 23 1
- (ii) nucleus / 'the head'
allow phonetic spelling 1
- (b) (i) **X and X** 1
- (ii) **X and Y** 1
- (c) 150 million / 150,000,000 / half (of them) / 50% / 1 in 2 1

[5]

Q16.

- (a) (i) recessive allele 1
- (ii) carriers 1
- (b) (i) 6
allow nn 1
- (ii) 1 in 4 / 0.25 / $\frac{1}{4}$ / 25 % / 1:3
do not accept '3:1' / 1:4 / 1 in 3 / 25 1

(c) **advantage:**

detect CF qualified – eg at early stage / before becoming pregnant **or** (only) healthy children produced

allow 'after only 3 days'

allow reduces health care costs

1

disadvantage:



some embryos are destroyed / may damage embryo
allow increased risk of miscarriage
ignore not natural
ignore cost

1

[6]**Q17.**

(a) (i) mitosis

correct spelling only

1

(ii) replicates / doubles / is copied / duplicates

accept cloned
ignore multiplied / reproduced

1

(b) fertilisation occurs / fusion (of gametes)

accept converse for asexual, eg none in asexual / just division in asexual

1

so leading to mixing of genetic information / genes / DNA / chromosomes

genes / DNA / chromosomes / genetic information comes from 1 parent in asexual
ignore characteristics

1

one copy (of each allele / gene / chromosome) from each parent

or

gametes produced by meiosis

or

meiosis causes variation

meiosis must be spelt correctly

1

[5]**Q18.**

(a) (i) (alternative) forms / types of a / the same gene

1

(ii) only expressed if 2 copies inherited

or not expressed if other allele present

allow over ruled / over powered by the other allele

1

(b) (i) **Nn**

ignore heterozygous

1

(ii) genetic diagram including:

accept alternative symbols, if defined



gametes: **N** and **n** from both parents

accept alternative symbols if correct for answer to (b)(i)

1

correct derivation of offspring genotypes:

NN Nn Nn nn

allow if correct for candidate's parental genotypes / gametes

1

identification of **nn** as having cystic fibrosis

1

(c) **Argued evaluation**

any **four** from:

- PGD higher financial cost
accept CVS only costs £600
- PGD occurs before pregnancy / implantation
accept detected at earlier stage so less unethical / less trauma
- PGD does not involve abortion so less trauma / less pain / ethical

**Q1.**

- (a) (i) characteristic 1
- (ii) gene 1
- (iii) gamete 1
- (b) sexual 1
- asexual 1
- clones 1

[6]**Q2.**

- (a) (i) circle 1
mark independently
- unshaded 1
could be in body of script
- (ii) (Harriet) dd 1
in first box
- DD 1
if another letter is chosen it must be used throughout and upper or lower case must be clear
- Dd 1
- (b) (i) to check for the D allele. 1
- (ii) any **one** from:
- may harm / kill foetus / embryo / baby / mother
allow could affect the baby
 - immoral / unethical / religion
ignore playing God
ignore references to unnatural
ignore wrong unqualified



ignore expense / prejudice unqualified
ignore lack of permission
ignore results are unreliable

1

[7]

Q3.(a) any **one** from

- chromosomes in pairs
- inherited one of each pair from each parent
- one of each pair in egg **and** one of each pair in sperm
- so sex cells / gametes can have half the number
allow need to pair during cell division / meiosis

1

(b) any **two** from:

- code
- combination / sequence of amino acids
- forming specific / particular proteins / examples
*If **no other mark** gained allow reference to controlling characteristics / appearance for **1** mark*

2

(c) (i) C

1

(ii) 30

1

(d) (i) for growth / repair / replacement / asexual reproduction
*do **not** accept incorrect qualification, eg growth of cells **or** repair of cells*
they equals cells therefore do not accept they grow etc

1

(ii) 44 **or** 22 pairs

1

[7]

Q4.

(a) sexual reproduction

1

(b) any **three** from:

- coat colour inherited / controlled by genes



- it has horse and zebra features
- gets gametes from both parents
- genes / DNA / chromosomes / genetic information in gametes
- zorse receives genes / DNA / chromosomes / genetic information from parents

3

[4]

Q5.

(a) 2 and 3

1

(b) cell **P** has an X chromosome; cell **R** has a Y chromosome

1

(c) any **two** from:

- (formed from) different egg / 2 eggs
- (formed from) different sperm / 2 sperm
- have different genes / alleles / chromosomes / DNA
allow genetics

2

(d) (i) stem cells

1

(ii) the cells divide

1

the cells differentiate

1

(iii) (medical) research / named eg growing organs
or

medical / patient treatment

*allow (embryo) cloning**do **not** allow designer babies / more babies*

1

(iv) any **one** from:

- ethical / moral / religious objections
ignore cruel / not natural / playing God
- potential harm to embryo
allow deformed
ignore harm to mother

1

Q6.

- (a) 1 in 4 / 1/4 / 1: 3 / 25% / 0.25
do **not** accept 3:1 / 1:4 / 2:6

1

- (b) **either** from C **and** D
*accept synonyms for dominant / recessive eg
Normal / faulty
accept genetic diagram if clearly referring to correct
individuals or genotypes on family tree
allow 'gene' for 'allele'*

any **three** from:

- C **and** D have disorder
ignore 'C & D are carriers'
- I/J don't have disorder
- C **and** D have dominant **and** recessive alleles
- recessive alleles from C **and** D passed to I/J
or I/J have two recessive alleles
*NB if allele was recessive then all offspring of C **and** D would have the disorder = 3 marks*

or from A **and** B

assume response refers to A + B unless contradicted

- A is homozygous recessive / rr, **and** B is heterozygous / Rr can be shown in words or symbols
allow any symbol
- offspring can be rr **or** Rr described
allow without key

3

- (c) (i) (embryos) checked for inherited / genetic disorders / conditions
accept diseases for disorders

1

(ii) any **three** from:

- C/D have disorder / have dominant allele
*accept disease / condition
accept 'gene' for 'allele'
ignore reference to 'carriers'*



- chance of embryo / foetus / child having disorder
or may pass on alleles for disorder to their offspring
- C/D might want to decide on termination **or** prepare for child with disorder
- G **and** H don.t have disorder / both homozygous recessive / have no dominant alleles (for this disorder)
- so offspring (of G **and** H) cannot / don.t have disorder

3

[8]**Q7.**

- (a) characteristics
- (b) genes
- (c) chromosomes
- (d) mitosis
- (e) asexual

1

1

1

1

1

[5]**Q8.**

- (a) cell membranes
- (b) (i) two recessive / cystic fibrosis / faulty / diseased / the allele(s) / genes
two can be implied by second marking point
ignore chromosomes
from Bob **and** Carol / both parents / the parents
if no other marks awarded 'Carol is a carrier' gains 1 mark
(ii) (inherited) dominant / normal allele / gene
from Carol / mother
ignore references to recessive allele / gene from father / Bob
if no other marks awarded he has just / only one recessive allele gains 1 mark
(c) (i) reduce number of people with cystic fibrosis (in population)

1

1

1

1

1

or

reduce health-care costs

or

expensive to have baby with cystic fibrosis

*accept to allow decision / emotional argument qualified
eg allows abortion*

or

allows people to make choices about termination

or

help to prepare financially / emotionally etc

1

(ii) any **one** from:

- possible damage / risk to embryo / fetus / baby
allow possible harm / risk to mother
- screening / it is expensive
- (may) have to make ethical / moral / religious decisions
ignore not natural / playing God / unethical / immoral / religious unqualified
- right to life

1

[7]

Q9.

(a) any **two** from:

- to combine / use amino acids
*do **not** allow to make amino acids*
- in specific / particular / correct / right order
- to manufacture protein / enzymes / hormones
allow examples of proteins / enzymes / hormones

2

(b) (i) (man) B

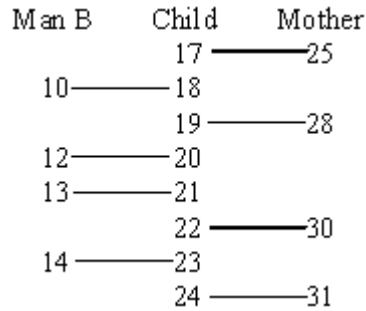
*no mark for this **but** max 2 marks if A given*

any **three** from:

- child gets DNA / bars / lines from mother and father / parents
ignore genes / chromosomes
- (child has) mother's 25 / 28 / 30 / 31
or child gets 17 / 19 / 22 / 24 from mother



- (child has) man B's 10 / 12 / 13 / 14
or child gets 18 / 20 / 21 / 23 from B



*contradictions disqualify 2nd and / or 3rd marking points
ignore genes / chromosomes*

- no bars / DNA / lines from man A correspond to child

3

(ii) any **two** from:

- gametes / eggs / sperm
- contain only half of (mother's / father's) DNA / chromosomes / genes / genetic information
- due to meiosis

2

[7]

Q10.

- (a) have identical genes / chromosomes / genetic material

1

since asexual reproduction

accept mitosis

1

- (b) mixture of genes / chromosomes / genetic material from two parents

accept meiosis

1

sexual reproduction / fusion of gametes

1

- (c) public misunderstand technique as cloning **or** worried about large numbers of clones **or** moral / ethical / religious issues **or** unnatural process **or** scientists must not play god **or** technique may lead to embryo death

*do **not** allow mark for embryos lost*

1

[5]

Q11.

joining

1



Biology

Mark scheme

sexual

1

identical

1

asexual

1

clones

1

[5]

Q12.

in the correct order

DNA

1

23

1

XX

1

XY

1

recessive

1

dominant

1

[6]

Q13.

(a) A = meiosis

accept 'mieosis'

do not accept 'miosis'

1

B = mitosis

do not accept 'meitosis' etc

1

(b) fertilisation allow conception

1

(c) (i) 23

1

(ii) 46

1

[5]



Q14.

(a) chromosome

accept chromosomes

1

(b) drawing shows:

1

just 2 chromosomes

one long + one short

1

[3]

Q15.

(a)

Ampicillin

Tetracycline

✓
—
✓

—
—
✓

accept blank or cross or –

1st: mark by rows to maximum 3 marks

2nd: if no marks by rows, mark by columns to maximum 1 mark

table completely blank = 0 marks

3

(b) 1st: Yes (no mark)

if 'no' - read on for logical argument e.g. loss of plasmid or gene mutation

2nd: all formed from same original cell

must be one cell i.e. bacterium

1

by asexual reproduction / no fusion / not sexual

allow reference to 'mitosis'

1

offspring cells are genetically identical **or**
all have a copy of the insulin gene / of the plasmid

1

[6]

Q16.

(i) clones

accept other positive indications

1

(ii) same genes / alleles / DNA



*accept same genetics / genetic information do **not** accept same chromosomes*

1

grown in same (environmental) conditions **or** correct eg – same amount of water / same temperature / same amount of light

1

[3]

Q17.

(a) one from each parent / one from egg and one from sperm
*do **not** accept egg and sperm join / fertilisation unqualified*

1

(b) (i) nn
accept a ring around printed nn

1

(ii) Nn Nn

1

[3]

Q18.

(a) (i) **Aa** or aA

1

(ii) allele / gene for vestigial wings / **a** is recessive **or** vestigial is recessive **or A** is dominant **or A** would override the effect of **a or A** present gives long wings

1

(b) parental genotypes correct – both **Aa**
NB can pick up chain of logic at any point correctly derived from candidate's previous point

1

gametes correctly derived from **P** genotypes

1

offspring genotypes correctly derived from gametes

1

3:1 ratio recognised
wrong cross and not 3:1 ratio = max 2

1

[6]

Q19.

eggs

accept gamete once

1

ovaries




		1
sperms	<i>accept gamete once</i>	1
testes		1
sexual		1
gametes	<i>allow egg and sperm once</i>	1
fertilisation		1
asexual		1

[8]

Q20.

(a)	genes/DNA	1
-----	-----------	---

female/girl/woman/ 
*both required **in** the correct place for this last mark*

male/boy/man/ 
*do **not** accept homo/heterogametic, homo/heterozygous*

1

(b)	parents correct <i>n.b if parents are wrong, candidates can score a maximum of 3 marks</i>	1
-----	---	---

gametes correct
allow just 1 mark for female

1

combinations correct

1

correct analysis of the 50:50 ratio of what is written

1

[6]

Q21.

(a)	(i) gametes i.e. B b and B b	1
-----	------------------------------	---



- correct combination of genotypes i.e. BB, Bb, Bb, bb
1
- correct analysis of phenotypes i.e. 3 black fur 1 with brown fur
1
- (ii) award one mark for the recognition that it is down to chance (which two gametes fuse) and not simply 'because it's a prediction'
do not accept mutation
1
- (b) (i) **B** is dominant/ an allele is dominant if it is expressed in the heterozygous phenotype
candidates are likely to use a variety of ways of expressing their ideas
1
- b is recessive/ a recessive allele is not expressed in the presence of its contrasting allele
do not accept powerful
do not accept stronger
1
- (ii) alleles are different forms of a gene controlling a characteristic and occupying the same site on homologous chromosomes (e.g. B or b)
1
- genes are the units of DNA/sites on chromosomes carrying the information that determines characteristics (e.g. bB)
1
- (c) homozygous: BB / bb / possessing a pair of identical alleles for a character/true breeding
give credit to an explanation using a diagram
1
- heterozygous: Bb / carrying a pair of contrasting/different alleles for a characteristic
do not accept references to xx, xy
do not accept gene by itself
1
- [10]

Q22.

- (i) (sweet) peas
1
- (ii) homozygous parents crossed [1]
heterozygous (F1) offspring crossed [1]
recognition of yellow dominant over green [1]
recognition that results support 3:1 or 0.75 to 0.25 ratio



up to **4** marks awarded for an understanding of the monohybrid cross and the expected outcome

4

[5]

Q23.

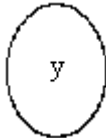
one mark for each of the following comparisons to a maximum of **6**

*candidates **must** make a clear comparison*

meiosis	mitosis
sexual	asexual
gametes	growth
ovary or testes or gonads	all other cells
half number of chromosomes	same number of chromosomes
haploid or 23 chromosomes	diploid or 46 chromosomes
reassortment or variation possible or not identical	no reassortment or no variation or identical
4 cells produced	2 cells produced
2 divisions	1 division

[6]

Q24.

(a)  clearly labelled 'y'

1

mark the offspring in two horizontal rows

1 mark for each fully correct row

allow transferred error if parent 2 is incorrect

XX XX

1

XY XY

accept YX

1



- (b) parent 1
accept XX
1
- (c) 50:50
or
equal **or** even
or
1:1 **or** 50%
*accept 1/2 **or** 2/4*
1

[5]

Q25.

- (a) **award one mark for each key idea**
- energy released **or** energy transferred **or** respiration
*allow provides **or** gives*
*do **not** allow produces **or** makes*
3
- near to the site of movement **or**
energy available quickly **or** more
energy
accept allows more mitochondria to fit in
- (mitochondria) packed (around
filament) **or** efficient arrangement **or**
spiral arrangement
- (b) contains chromosomes **or** genes **or**
DNA
***not** genetic material*
1
- (which) contribute half (the genes) to
the fetus **or** offspring
*23 chromosomes **or** half the genes*
***or** reference to X,Y chromosome determining sex (if the*
notion of halfness is there)
nucleus contains half genes for the offspring = 2 marks
1

[5]

Q26.

- (a) breed (together)
accept have same number of chromosomes
*do **not** accept have the same number of genes*
1
- to produce fertile offspring
1



- (b) male **or** testes
accept dog 1
- testes **or** male
accept testis
do not accept testicles 1
- ovary **or** ovaries 1
- gametes 1
- fertilisation
do not accept conception 1
- fetus **or** zygote **or** embryo
do not accept baby or puppy 1
- (c) genetic information **or** genes **or**
chromosomes **or** DNA
do not accept characteristics by itself 1
- (comes) **from** two parents
accept from both parents 1

[10]

Q27.

- (a) (i)
if two nuclei drawn then maximum two marks 1
- 6 chromosomes 1
- same 3 homologous pairs 1
- nuclear membrane drawn 1
- (ii) 3 chromosomes 1
- 1 from each homologous pair 1
- (b) (i)
parent line must be separate



heterozygous parents $Tt \times Tt$

maximum of 2 marks if parental genotype is wrong

gametes correct $T \ t \ T \ t$

1

genotypes $TT \ Tt \ Tt \ tt$

1

(ii) correct analysis of chance i.e. 1 in 4
or 25%

1

(iii) 50% **or** 1 in 2

1

[10]

Q28.

(a) (i) gametes correct
*allow by implication from line diagram
only need on X from female*

1

offspring genotype correctly derived
on suitable diagram

	X	X
X	XX	XX
Y	XY	XY

or

	X
X	XX
Y	XY

1

(ii) 1:1 **or** 50% **or** $\frac{1}{2}$ **or** 0.5 **or** 1 in 2
or 1 out of 2 **or** 50 : 50
*do **not** accept 50/50
accept 'equal' (probability)*

1

(b) Y chromosome needed for male child

1

only male has the Y **or** males had only X (chromosomes)
or sex determined by the sperm

1

[5]

**Q29.**

- (a) on chromosomes/DNA within the nucleus
each for 1 mark 2
- (b) parental genotypes correct i.e. Aa Aa;
gamete genotypes correct i.e. A or a A or a/correct lines;
F1 genotypes correct i.e. AA Aa Aa aa;
aa recognised as child with cystic fibrosis
each for 1 mark 4
- (d) (i) molecule has two long strands/double helix;
idea of held together by (weak) bonds;
each strand has 4 different types of base;)
which pair with specific bases in opposite strand;)
when strands separate;) OWTTE
each strand acts as a 'complementary' template;)
makes 2 identical strands)
each for 1 mark 6
- (ii) order of bases acts as a code;
which controls the order;
in which amino acids are assembled into protein;
read in triplet
each for 1 mark 3

[15]**Q30.**

- (a) select for breeding;
the plants with the sweetest taste
each for 1 mark 2
- (b) natural population has a wide range of variations;
because it has a large number of alleles;
selective breeding reduces the number of alleles;
cloning perpetuates this reduced number of alleles
each for 1 mark 4
- (c) 3 of:
reference to cuttings;
reference to tissue culture;
reference to hormones;
cloning
each for 1 mark 3
- (d) 4 of:



cut genes for disease resistance;
from chromosomes of 'cooking banana';
introduce into chromosomes of 'ordinary banana';
tissue culture to produce disease resistant plants/clone;
enzymes cut chromosomes

each for 1 mark

4

[13]**Q31.**

(a) Stan BB
Sharon bb
all offspring Bb

3

(b) Tom Bb
black offspring Bb
white offspring bb

3

[6]**Q32.**

(a) (i) e.g. B and b
for 1 mark

1

(ii) e.g. bb
for 1 mark

1

(b) no black genes in flock
all double recessive
for 1 mark each

2

[4]**Q33.**

(a) grow from parents,
by vegetative reproduction/asexual reproduction/
no sexual reproduction
for 1 mark each

2

(b) e.g. different environmental conditions/named condition
for 1 mark

1

[3]**Q34.**

(a) mutation



for 1 mark

1

- (b) fall,
idea that resistant beetles more likely to survive to breed,
∴ their offspring more likely to appear in the next generation

for 1 mark each

3

- (c) inbreeding between resistant brothers and sister,
will produce some individuals with 2 copies of the resistance allele,
if 2 of these individuals breed all their offspring will be resistant

for 1 mark each

3

[7]

Q35.

- (i) DNA

for 1 mark

1

- (ii) contains the code for manufacturing the protein,
as order of bases,
which determine the order in which amino acids are
assembled into protein

for 1 mark each

3

[4]

Q1.

D

*idea that twins have come from one (fertilised) egg**idea that Y sperm / Y chromosome produces boys**each for 1 mark**allow 1 mark if candidate selects **A and** states that Y sperm / Y chromosome produce boys (reject Y gene unqualified) OR**allow 1 mark if candidate selects **C and** states that twins must have come from one (fertilised) egg***[3]****Q2.**

(a) (i) mitosis

for 1 mark

1

(ii) 1

*fertilised egg cell has 1 albino gene from father splits to produce identical cells / produced by mitosis**each for 1 mark*

3

(b) (i) less protection from UV light / UV radiation

for 1 mark

1

(ii) *ideas of uncontrolled multiplication of mutated cells reject fast / rapid cell division cells invade of other parts / cells transported in blood**each for 1 mark*

2

[7]**Q3.**(a) *ideas that**embryos develop from cells with sheep nuclei / chromosomes / DNA which contains genetic information / information for development**OR placental cells (from goat) provide only e.g. nutrition**any two for mark each*

2

(b) *Max. 3 pros e.g. ideas that avoids extinction of rare breeds rapid method for plants large numbers with same features can be produced preserves features produced by genetic engineering e.g. Tracey maintains particular genetic strains e.g. produced by extensive selective breeding****reject simple idea of identical offspring unless qualified as above****any three each for one mark*

3

Max. 3 cons e.g. ideas that moral / ethical objections animal 'rights' identical individuals less adaptable to change or changing needs



reduced gene pool
any three each for one mark

3

[8]**Q4.**

- (a) chromosomes
 genes (*reject* alleles)
 alleles

for 1 mark each

3

- (b) (i) sexual / sex
for one mark

1

- (ii) egg / gamete / sex cell / ovum (*reject* ovule)
for one mark

1

- (c) (i) information / genes / DNA passed from parents (*reject* chromosomes)
for one mark

1

- (ii) genes / genetic information / chromosomes from two parents
 alleles may be different
 environmental effect / named may have been mutation
any two for 1 mark each

2

[8]**Q5.**

- (a) woman XX
 man XY

for 1 mark each

2

- (b) 50% / 1 in 2 / evens / 0.5 / 50:50
for 1 mark

mark scheme for genetic diagram

gametes all correct
 genotypes of offspring all correct in relation to gametes
for 1 mark each

1

mark scheme for written explanation

half sperm have X chromosome, half have Y
 and
 all eggs have X chromosome



50% / 1 in 2 / evens / 0.5 chance of egg being fertilised
by X or Y sperm

for 1 mark each

2

[5]**Q6.**

(a) (i) sexual / sex

(ii) egg / gamete / sex cell / ovum (*reject ovule*)

for 1 mark each

2

(b) (i) meiosis / reduction

(ii) mitosis / somatic

for 1 mark each

2

(c) twice as many (*reject answers based on 23 / 46 chromosomes*)

for one mark

1

(d) (i) information / genes / DNA passed from parents
(chromosomes neutral)

for one mark

1

(ii) genes / genetic information / chromosomes from two parents
alleles may be different
environmental effect / named may have been mutation

any two for 1 mark each

2

[8]**Q7.**

parental genotypes both correct – both Bb
gamete genotypes all correct B and b B and b
genotype of bb offspring correctly related to gametes
bb offspring identified as small bolls

for 1 mark each

[4]**Q8.**

(i) DNA (*accept RNA*)

for one mark

1

(ii) DNA carries coded information
which controls the order of amino acids
in proteins



for 1 mark each

3

[4]

Q9.

dominant

1

recessive

1

genes

1

gametes

1

environmental

1

[5]

Q10.

(a) asexual

mitosis is neutral

1

(b) (body cell)
nucleus *is* from body cell*no mark for just body cell – mark the explanation
allow converse nucleus from egg cell is removed*

1

nucleus contains (genetic) information / instructions / chromosomes / genes /
DNA / allele*do not credit 'contains characteristics'*

1

(c) splitting apart (cells from clonal) embryo
do not credit 'repeat process'

1

[4]

Q11.(a) gametes A **or** a A **or** a

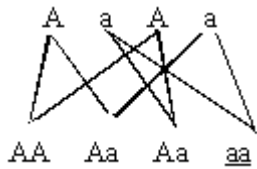
1

F₁ genotypes correctly derived

1

albino identified

OR



gametes – 1
 F1 genotypes corresponding to 'lines' – 1
 lines must be correct
 Albino (aa) identified – 1 (lower case)

1

OR

	A	a
A	AA	Aa
a	Aa	aa

gametes – 1
 boxes all correct – 1
 albino (aa) identified – 1

(b) $\frac{1}{2}$ / half / 50% evens / 1 in 2

do **not** credit 1 to 2 or 50/50

1

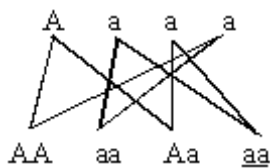
gametes A **or** a a **or** a or one
 parent heterozygous, one parent
 homozygous recessive

1

F₁ genotypes correctly derived

OR

(R) (S)



gametes correctly identified – 1
 F₁ genotypes correctly derived – 1

OR

(R)

(S)

	A	a
a	Aa	aa
a	Aa	aa

gametes correctly derived – 1
 F₁ genotypes correctly derived – 1

**Q12.**

man XY

allow (chromosomes) different

1

[6]

woman XX

*allow (chromosomes) same
genes and alleles are neutral
allow 1 mark for one is XX and one is XY*

1

1

[2]**Q13.**(a) any **two** from

- copies of chromosomes made
- cell divides twice **or** 4 cells formed
- each gamete / cell now has single set of chromosomes
*allow chromosome number halved /
cells haploid / cells n*

2

(b) any **two** from

- sex cells / gametes fuse / fertilisation
- offspring receive genes or chromosomes or alleles from both parents / DNA
- alleles in a pair may vary

2

(c) (i) new form of gene

*allow change in genetic material / DNA / chromosomes /
gene*

1

(ii) (no)

any **two** from

- some neutral
- exemplified
e.g. extra digit
- some increase chances of survival / reference to natural selection or evolution



- exemplified
e.g. example of disease resistance

2

[7]

Q14.

- (a) any **three** from:

factor for colour has two forms

accept gene for factor and allele for form

yellow dominant since all first generation yellow

accept F1 for first generation

green recessive since reappears in second generation

accept F2 for second generation

3

- (b) (i) genes

accept alleles / genetic

1

- (ii) nucleus

accept chromosomes / DNA

1

[5]

Q15.

- (a) (i) meiosis

1

- (ii) mitosis

1

- (c) (i) **X** pituitary

1

Y FSH

1

- (ii) stimulates LH production

1

inhibits FSH production / production of **Y**

1

[6]

Q16.

- (a) (i) testis

1

ovary

1



- (b) fertilisation **or** fertilise(d) / (ing)
accept fusion
*do not credit conception **or** intercourse* 1
- (c) (i) the same, identical
do not credit very similar make clear their genetic material is the same
do not credit the same number of chromosomes or genes 1
- (ii) the same, identical
make clear their genetic material is the same
do not credit the same number of chromosomes or genes 1
- [5]

Q17.

- (a) (i) XX XY XY XX
female male male female
the four correct genotypes and sex are required they may be in any order 1
- (ii) meiosis
correct spelling required but accept meisosis not miosis or meosis 1
- (iii) 23 1
- (iv) 23 1
- (b) (i) any **two** from
(introduces) variation
*accept can crossbreed **or** offspring may gain beneficial characteristics*

prevents the risk of all being the same
and a disease wiping out population
or prevent monoculture

two parents to raise offspring 2
- (ii) both parents carry a recessive allele
or gene **or** are heterozygous
accept both parents are carriers 1

[7]



Q18.

- (a) **A A a a**
Aa allele correctly separated 1
- B b B b**
*Bb allele arranged to form four different pairings
all four pairings must be correct for the second mark* 1
- (b) **A A**
the two cells the same as the parent cell
- a a**
- B B**
- b b**
1 mark for each cell 2
- (c) (i) 46
accept 23 pairs 1
- (ii) 23
accept half if c(i) 1
- (iii) 46
accept save as c(i) 1

[7]

Q19.

- (i)
- | | | |
|---|----|----|
| R | r | |
| | | |
| R | RR | Rr |
| | | |
| r | rR | rr |
- a cross over diagram is also acceptable 1 mark for the separation of alleles to form the two axes (gametes)
1 mark for the four combinations* 2
- (ii) 25 or 1 in 4 or 1:3
accept ¼ do not credit 1 to 4 1

[3]

**Q20.**

- (a) (i) to go under teeth **or** mower
accept not damaged by grazing animals
accept do not get cut or bitten
accept reduces competition by other plants
do not credit maximum surface of leaves facing Sun 1
- (ii) any **one** from
it can force its way through grass roots
accept in competition with grass roots
it is a store of food (to help the plant recover)
do not credit a good store of water
to reach down to water
to give good anchorage
accept it is hard to pull up 1
- (iii) any **one** from
to reach more light
accept to get out of the shadow of the hedge or tall grass
to let seeds be caught on animals' coats (more easily)
accept improves access or visibility or ease for pollination
do not credit to help it grow up the hedge 1
- (iv) any one from
(they reach out from hedge) to find water
accept increase surface area
accept to find nutrients or minerals
do not award mark if food mentioned
to give good anchorage 1
- (b) (i) gene **or** allele
do not credit chromosome 1
- (ii) any **one** from
they do not crossbreed **or** interbreed



*accept different species do not breed together **or** do not fertilise each other*

do not produce fertile offspring

have different numbers or types of chromosomes

accept genes are incompatible

*do not credit have different genes **or** are genetically different*

do not credit do not pollinate each other

1

- (c) one mark is for the adaptation and one is for an appropriate reason

have white fur

for camouflage

are huge

for large volume to surface area

thick layer of fat

*for insulation or to reduce heat loss **or** retain heat*

*do not credit to stop it losing heat **or** withstand the cold **or***

keep it warm

have thick fur

*for insulation **or** to reduce heat loss **or** retain heat*

hibernate

to avoid the coldest part of year

is a carnivore

because animals provide high energy food

has big paws **or** claws

to be able to walk on snow

have small ears

to reduce heat loss

have furry feet

for insulation from the snow

2

[8]

Q21.

- (a) fertilisation

credit conception

1

- (b) (i) sperm

*do not accept offensive answers **or** those in the vernacular*



testes **or** testicles

1

(ii) ovum **or** ova **or** eggs
do not accept ovules

1

ovary

1

1

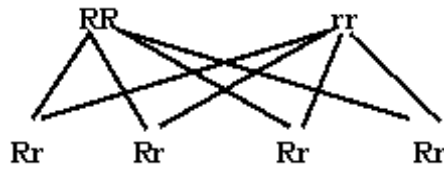
[5]

Q22.

(a) white

1

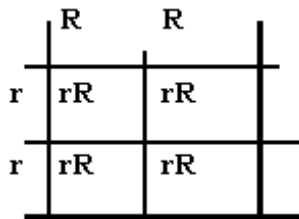
(b)



or a Punnett square

*1 mark for parents and separation of genes
1 mark correct set of four pairs, **rR***

1



1

all are red **or** R is red **or** Rr are red
1 mark for explanation of colour

1

(c) any **two** from
accept allele for gene

to stop cross pollination
*credit so they could not breed with other flowers **or** colours*



to control the gene pool **or** prevent other genes getting in
credit characteristics or factors
do not accept to use the same genes again

to see which genes were present
credit factors

to test if F₁ **or** they contained any genes for white **or** recessive genes
credit a suitable Punnett square
referenced to white
credit to see if there was variation in the
genes or to see if he got any white flowers
do not accept for a fair test

2

(d) white

1

(e)

the term gene may be in place of allele

the situation mark

red is dominant so masks any white
 alleles **or** could be heterozygous
credit some (may) have both alleles
credit you do not know if a white allele is there

the consequence marks

1

EITHER

if a recessive **or** white allele is present
 there is a chance of a white flower
credit if white alleles are there the recessive can show

OR

chance of white flower could be 1 in 4
 if all red flowers contain a dominant and a recessive allele

1

[9]

Q23.

(a) circles round right hand **X** and **Y** gametes
put two ticks or crosses by the circles

2

(b) 50:50 **or** 1:1 **or** 50% **or** 0.5 **or** ½ equal **or** evens
credit even
do not accept 2:1 or 50 / 50

1



Biology

Mark scheme

- (c) (i) 23
1
- (ii) 23
credit the same as the one above to be marked consequential
1
- (d) DNA
do not accept nucleic acid
1
- (e) same
1

[7]

Q24.

- (a) (i) any **one** from
mutations
discontinuous variation
1
- (ii) gene
accept any clear indication such as a tick
1
- (b) any **one** from
gamma radiation
accept radiation
X-rays
ultra violet rays
chemicals
accept mutagens
chance
1
- (c) zebras breed (to produce)
1
fertile offspring
do not accept mating
1

[5]

Q25.

- (a) 23
1



- (b) chromosome 2 nucleus 3 gene 1 cell 4
- 1
- (c) (i) any **one** from
- (cells which are bigger) take up more space
- (cells) have to get bigger **or** mature to divide
- 1
- (ii) chromosomes duplicate **or** make exact copies of self
- accept forms pairs of chromatids*
- 1
- nuclei divide
- accept chromatids **or** chromosomes separate*
- 1
- identical (daughter) cells formed
- accept for example, skin cells make more skin cells **or** cells are clones*
- 1
- (d) any **two** from
- Differentiation mark*
- babies need **or** are made of different types of cells **or** cells that have different functions
- accept different cells are needed for different organs*
- Division or specialisation mark*
- as fertilised egg starts to divide each cell specialises to form a part of the body
- accept specialised cells make different parts of the body*
- Growth mark*
- specialised cells undergo mitosis to grow further cells
- accept cells divide **or** reproduce to form identical cells*
- 2

[8]**Q26.**

- (i) vegetative/asexual/cloning
for 1 mark
- (ii) clones/identical copies/all same
for 1 mark

not clones if cloning in b(i)

[2]

Q27.

(a) *idea that*
thicker/sticky/viscous mucus;
difficult breathing/trachea blocked;
digestion difficult/glands blocked
each for 1 mark

3

(b) *idea*
'normal' gene/allele dominant
or
cystic fibrosis gene/allele recessive;

idea that
parents heterozygous/carrier;
children heterozygous, homozygous dominant,
homozygous recessive (clearly implied by diagram);
idea one in four chance of cystic fibrosis
each for 1 mark

4

[7]

Q28.

(a) *ideas:*
frog 2
nucleus comes from this frog
DNA/genes/information in nucleus
this controls development
for 1 mark each

4

(b) *advantages:*
large number of identical offspring
guaranteed desired features
quick
economic

disadvantages:
may all succumb to unexpected disease/change in conditions
cut adaptation/reduce gene pool/limits variation
any 5 for 1 mark each

5

[9]

Q29.

(a) *idea*



- unbanded dominant/plain **or** banded recessive
- because banded appears in young/
- parents heterozygous/Bb
- offspring

BB	}	credit response consistent with parents even if not both heterozygous
Bb	}	
Bb	}	
bb	}	

Accept any clear and consistently used notation

- identify BB, Bb as plain
 - identify bb as banded
 - ratio 3:1 unbanded/banded (stated or clearly implied)
 - matches 35:12 results e.g. all the outcomes clearly identified as banded/unbanded)
- for 1 mark each*

7

(b) *idea*

- many genes control [accept “continuous variation”]
- many alleles for a gene/large genepool
- snails can inherit lots of different combinations
- mutation (gives rise to many alleles)
allow selection allows alleles to be passed on unless [very]disadvantageous or if advantageous

any 4 for 1 mark each

[Also credit, for 1 mark each, up to 2 causes of mutation, e.g. mistakes in cell division, radiation]

4

[11]

Q30.

(a) *idea*
advantages

- large scale
- cheaper
- easy to grow/produce or quick to produce
- non-seasonal

disadvantages



- loss of farmers' income
 - loss of foreign exchange
 - less work in Kenya/developing country
 - mass use of a of particular pyrethrin
 - can allow insect populations to become resistant
- any 6 for 1 mark each
maximum of 4 in
advantages/disadvantages*

6

- (b) *idea*
chromosomes /DNA carry genes
cut off gene/part of chromosome/DNA
insert into yeast chromosome/DNA/plasmid/nuclear
Accept DNA answers
for 1 mark each

3

[9]

Q31.

- (a) alleles in parents Bb Bb
- alleles in sperms/eggs (*) B b B b
- alleles in children (*) BB Bb bB bb
- hair colour black black black red

(*) NB ecf
Allow other letters if a clear key
each line correct for 1 mark each

4

- (b) evens/50:50/equal/half (e.c.f. from cross below)
for 1 mark

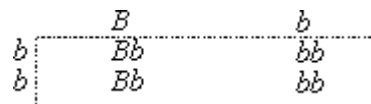
parents	J Smart Bb	M Jones bb	
children	Bb Bb black	bb bb red	*(ecf)

each line correct for 1 mark each

3

J Smart must be BB or Bb
M Jones must be bb or from (a)

Credit cross shown in a matrix:



for 2 marks

Bb identified as black hair

bb identified as red hair

or

2 red : 2 black

for 1 mark

1

[8]

Q32.

(a) *idea*

identical (do not allow simply "the same number")

for 1 mark

1

(b) *idea*

chromosomes double/duplicate/copies made

for 1 mark

separate into 2 sets/divide*

gains 1 mark

but

separate into 4 sets/divide twice*

gains 2 marks

number halved compared to bodycell

or

single set (only) 16

accept in terms of cells but only if chromosomes referred to in first and/or last items)

for 1 mark

4

[5]

Q33.

idea

- (gene) in DNA (i.e. mention of DNA)
- (DNA) contains bases
- (bases) code for amino acids (in protein)
- (amino acids) in correct order
- to make the (spider) protein



any four for 1 mark each

(No credit for double helix, **pairs** of bases - but no penalty)

[4]

Q34.

(a) (i) nucleus

(ii) chromosome

(iii) gene

each for 1 mark

3

(b) a body cell

for 1 mark

1

[4]

Q35.

(a) (i) asexual / non-sexual / cloning *[not artificial]*
for 1 mark

1

(ii) gene / allele / chromosome / DNA
for 1 mark

1

(iii) A) same / look alike / similar
gains 1 mark

but same sex / all female / all black / identical / clones
gains 2 marks

B) same as the black (female)
for 1 mark

3

(b) (i) ovaries [not reproductive organs]
for 1 mark

1

(ii) hormones / fertility drugs / FSH
for 1 mark

Allow LH

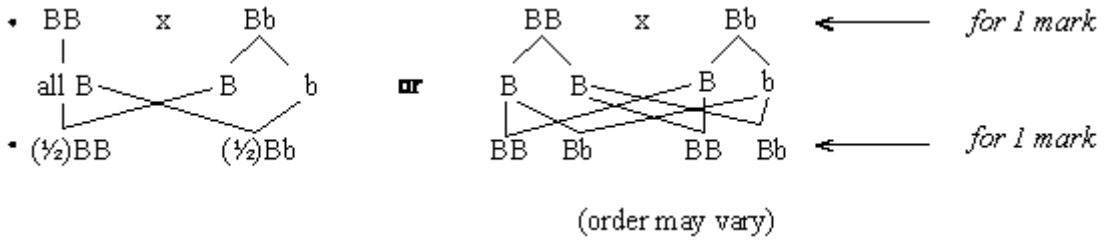
[Do not allow oestrogen / fertility treatment]

1

[7]

Q1.

(a) First Generation



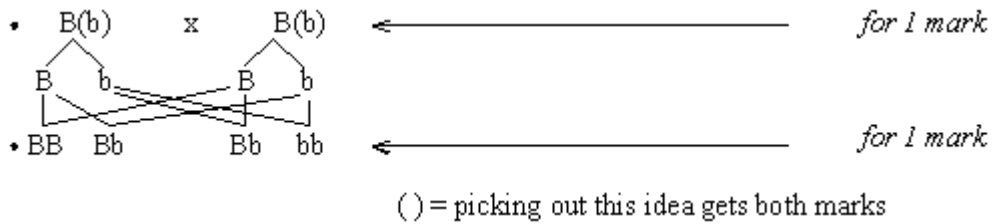
or as matrix

	B	B
B	BB	BB
b	Bb	Bb

1 mark for correct column and row headings
 1 mark for correct outcomes

allow one mark for being able to produce a correct genetic cross (even if from an incorrect starting point)

Second generation



or as a matrix

	B	b
B	BB	Bb
b	Bb	bb

1 mark for correct column and row headings
 1 mark for correct outcomes

4

- (b)
- green colour gives an advantage/camouflage
 - more green flies than black flies survive to breed*
 - pass on their genes to the next generation
 - (* but implied by 3rd bullet point)
for 1 mark each

3

[7]

Q2.



sex
genes
chromosomes
nucleus *in order*
for 1 mark each

[4]

Q3.

- (a) sexual / sex
for 1 mark 1
- (b) *idea that*
sexual reproduction brings about a mixture of genes
or similar / different genes / parents / gametes / DNA /
characteristics / chromosomes (*not* features)
for 1 mark 1
- (c) (i) asexual / cloning (*allow* vegetative)
for 1 mark 1
- (ii) (A) *idea that* (they are exactly the same). *Do not allow*
similar or just one named feature.
for 1 mark 2
- (B) different (*allow* similar but *do not allow* same).
Allow any one named difference
for 1 mark
- (d) (i) greater the X-ray dose, greater the % of mutations
or % of mutations increases steadily / in proportion to X-ray dose
for 1 mark 1
- (ii) ionising radiations / ultra-violet light / alpha particles / beta particles
/ gamma rays / radio activity / chemicals / drugs / smoking / natural
in meiosis / spontaneous / cell replication / toxic waste / pollution
1
- Accept* radioactivity but not radiations alone.
for 1 mark

[7]

Q4.

- (a) • caused by a recessive* gene / allele
(allow non / not dominant)
- both parents heterozygous / carry the gene / allele
for 1 mark each



offspring needs two recessive genes to have / inherit disease
for 2 marks

or

- $Nn \times Nn$
- $NN \quad Nn \quad Nn \quad nn$
for 1 mark each

nn identified as having the disease*
for 2 marks

4

- (b) any reference to DNA
gains 1 mark

but
different genes means difference in DNA
gains 2 marks

idea of
different codes / instructions for making proteins

or
different (order of) amino acids (in proteins)
for 1 mark

3

[7]