

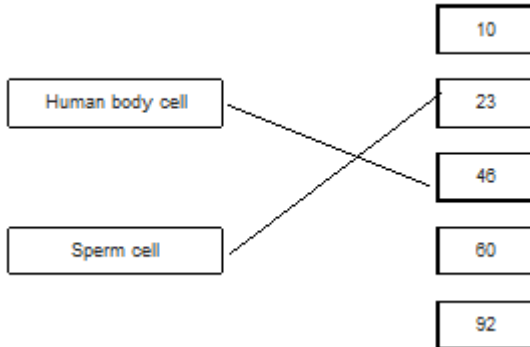
Mark schemes

1

(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

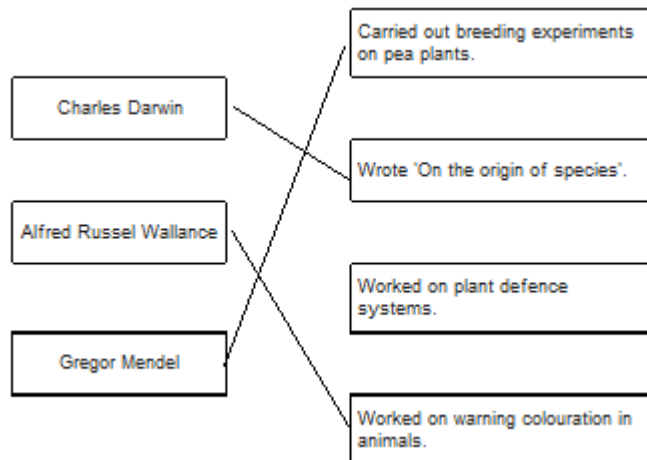
(e) 50 (%)

1

[6]

2

(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 1/4 / 25% / 1 in 4 / 1:3

1

do not accept 1:4

(e) heterozygous

1

[9]

3

(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]****4**

(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]

5

- (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]

6

- (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
 - high er cost
 - embryos might not implant / might not develop.
- 1

[8]

7

- (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]

8

- (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]

9

(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 1
- probe (then) binds with embryo DNA 1
- (UV light) to show alleles / gene for disorder 1
- (c) genotypes of parents and gametes correct (Man **D** and **d**, Wife **d** and **d**)
*allow half-size genetic diagram with only one **d** from wife* 1
- offspring genotypes correct ($\frac{1}{2} = \mathbf{Dd}$ and $\frac{1}{2} = \mathbf{dd}$)
allow ecf if parental genotypes are wrong 1
- offspring phenotypes correctly assigned to genotypes 1
- (d) genotypes of parents and gametes correct (**N** and **n**)
allow ecf if parental genotypes are wrong 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, only;
do not allow '3:1' / '1:4' 1
- [12]**
- 10** (a) (i) nucleus 1
- correct spelling only*
- accept mitochondrion*
- ignore genes / genetic material / chromosomes*
- (ii) base(s) 1
- Accept all four correct names of bases*
- ignore nucleotides and refs to organic / N-containing*
- (iii) 4 1
- (iv) codes for sequence / order of amino acids 1
- ignore references to characteristics*

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]

11

- (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 1/4 / 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]

12

(a) (i) Chromosomes

1

(ii) Characteristics

1

(iii) Classify

1

(b) Plants

ignore algae

1

[4]

13

(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]

14

(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]**15**

(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]

16

- (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 / ¼ / 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]**17**

(a) DNA

1

(b) X and Y

1

(c) (i) 46 chromosomes

1

(ii) half the number

1

(d) meiosis

1

[5]**18**

(a) Mendel

1

(b) (i) **TT**

1

(ii) a dominant allele

1

(c) 1 : 1

1

(d) 100 short plants

1

[5]

19

(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 H₂O **or** HOH but not H²O*

(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]

20

(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]

21

- (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 1/2-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 / 1/2 / 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]

22

- (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]

23

- (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]**24**

- (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

disadvantages

any **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*

(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]

25

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

1

all offspring Bb

		Woman	
		b	b
	B	Bb	Bb
Man	B	Bb	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]**
- 26** (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]

27

(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]

28

(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** marks2 correct = **1** mark0 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
- 29** (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
- 30** (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

[7]

[6]

- (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]

31

- (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]

32

- (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]

33

(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]

34

(a) sexual

1

characteristic

1

mutation

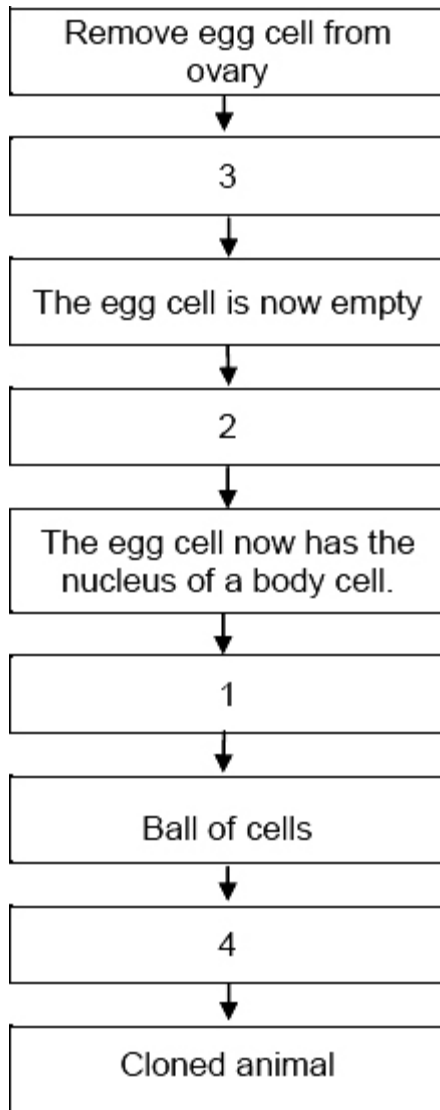
1

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]

- 35** (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]**

- 36** (a)  *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]**

- 37** (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]**38**

(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]**39**

(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]**40**

(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]

41

(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 • PGD higher incidence of false positive / use of numbers so higher risk of destroying healthy embryo
accept PGD has (surplus) embryos so some destroyed / unethical
- PGD no chance of miscarriage whereas CVS does
or PGD less chance of miscarriage

4

[10]**42**

(a) characteristics

1

genes

1

clones

1

asexual

1

(b) (i) tissue culture

*accept other asexual methods eg runners / plantlets / dividing**accept use of (named) organ e.g. root / leaf**ignore cloning / asexual / stem cuttings / reproduction / genetic engineering**do **not** accept seeds / sexual reproduction*

1

- (ii) embryo transplant / splitting
ignore asexual

or

- (adult cell / fusion) cloning
*do **not** accept clones*
*do **not** accept sexual reproduction*
ignore genetic engineering

1

[6]

43

- (a) seeds produced by sexual reproduction / fusion of gametes / fertilisation
allow produced by pollination / crossing

1

mixture of genes / genetic information / chromosomes / DNA

or from two parents / apple trees

if no other mark obtained allow 1 mark for apples had different genes / genetic information / chromosomes / DNA

or

mutation occurred

ignore environmental effects / cloned

1

- (b) (i) cuttings / tissue culture
accept grafting
allow adult cell cloning
ignore cloning unqualified
ignore genetic engineering
ignore asexual reproduction

1

- (ii) asexual reproduction
allow produced by cloning / mitosis

1

have identical genes / genetic information / chromosomes / DNA

or no mixing of genes / genetic information / chromosomes / DNA

1

[5]

44

- (a) asexual

1

(b) mitosis

1

(c) genes

1

[3]

45

(a) chromosomes

1

(b) (i) has XY / Y

allow female would be XX / has no Y

1

(ii) The strands are in pairs

1

(iii) nucleus

1

[4]

46

(a) **A** = Hh **B** = Hh

may not be in answer space

accept heterozygous or description

1

(allele for) polydactyly is dominant **or** polydactyly is H,

for marking points 1, 2 and 3 accept evidence in clearly labelled / annotated genetic diagram

1

cats with polydactyly have H

accept if polydactyly was recessive all offspring would have polydactyly

1

E or (some) offspring of **A** and **B**, does not have polydactyly,
so **A** and **B** must both have h

1

(b) (i) **HH and Hh or**
homozygous dominant **and** heterozygous

both required, in either order

allow description

1

(ii) any **one** from:
accept annotated genetic diagram to explain answer

- polydactyly is dominant
- parents are both Hh
- if D is Hh all offspring could inherit H

1

[6]**47**

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

- A
- C

1

(ii) any **one** from:

- B
- D

1

(b) (i) pig A

1

(ii) a gamete

1

(c) XY **or** YX

1

X Y

1

XY **or** YX

in this order only

1

[7]**48**

(a) half / 50% sperm have X (chromosome)

or

half / 50% sperm have Y (chromosome)

penalise incorrect use of gene / allele once only

1

all eggs have X (chromosome)

annotated genetic diagram could gain 2 marks

1

(b) screening

ignore selection

1

(c) any **three** from:

*max 2 if only advantages **or** only disadvantages discussed*

advantages:(**max 2**)

- (girl / children / women) don't / less likely to get / inherit (breast) cancer / this / the disease

*do **not** accept reference to allele alone for this point*

- future generations get less cancer **or** less likely to have the allele
- less expensive (for NHS) than treating cancer

disadvantages:(**max 2**)

- (wrong / immoral to) reject / kill embryos

ignore wrong / immoral / religious argument unqualified

- possible harm to embryo (that is implanted) / miscarriage

ignore reference to termination

- possible harm to mother (due to operational procedure)

allow reference to needing hormone treatment

3

argued conclusion

*must refer to **both** advantages and disadvantages and must be at end of answer*

1

[7]

49

(a) cystic fibrosis (allele / gene) recessive

allow an annotated genetic diagram

1

carrier has only one cystic fibrosis allele / gene

accept carrier is heterozygous

accept any symbol with key or

accept conventional use of symbols

penalise use of chromosome once only

1

(b) any **one** from:

- Huntington's (allele / gene) dominant
- (to have Huntington's) need only one Huntington's allele / gene

1

[3]**50**

(a) warmer / dryer

allow greenhouse effect / global warming

ignore wind

1

(b) (i) genes / alleles / chromosomes / DNA / genetic material / genetics

allow inheritance

allow nutrition / food / metabolism / growth rate

ignore environment

1

(ii) natural selection / evolution

allow survival of the fittest

1

[3]

51

(a) any **two** from:*assume it refers to asexual*

- no fusion in asexual **or** sexual involves fusion
*accept no fertilisation in asexual **or** fertilisation in sexual*
- or** no mixing of genetic information in asexual **or** mixing of genetic information in sexual
accept genes / alleles / chromosomes / genetics for genetic information
- or** asexual involves splitting (of one individual)
- no gametes in asexual **or** sexual involves gametes
accept named gametes
- only one parent in asexual **or** sexual involves two parents
- no variation in asexual
or asexual produces clones
or sexual leads to variations
allow offspring of sexual have characteristics of both parents for this point
ignore sexual intercourse
ignore external / internal
ignore plants / animals
ignore mitosis / meiosis

2

(b) nucleus of egg removed **or** involves empty egg cell

1

so only one nucleus **or** one set of genetic information / genes / chromosomes
or

so genetic information / genes / chromosomes from one parent only

1

[4]

52

(a) (i) dominant

allow clear indication

1

(ii) recessive

allow clear indication

1

- (b) (i) aa
extra ring drawn cancels the mark 1
- (ii) Aa
extra ring drawn cancels the mark 1
- (c) 3 purple : 1 yellow
extra box ticked cancels the mark 1
- [5]**

53

- (a) (i) release energy
allow provide / supply / give energy
*do **not** accept produce / create / generate / make energy*
*do **not** allow release energy for respiration* 1
- (ii) contain half the (number of) chromosomes **or** contains
one set of chromosomes **or** contains 23 chromosomes
allow genetic information / DNA / genes / alleles instead of
chromosomes
accept haploid 1
- (b) any two from:
- (stem cells) are unspecialised / undifferentiated
allow description eg 'no particular job'
 - are able to become differentiated
or can form other types of cell / tissue / organ
 - stem cells can / able to divide / multiply
- 2
- [4]**

54

- (a) Aa
*allow dominant **and** recessive*
allow heterozygous 1
- (b) (i) gametes A, a **and** A, a
max 1 if gametes are incorrect (eg in punnet square) 1

correctly derived offspring from cross
allow ecf from their gametes

1

identification of round **and** wrinkled offspring
for this mark the phenotype of each different offspring genotype must be indicated

1

(ii) (due to) chance **or** expected ratio is only a probability
accept the idea of small numbers not representative
ignore anomaly / random / coincidence
*do **not** accept error*

1

(c) any **one** idea from:

- genes / chromosomes / alleles / DNA not discovered / known about
*do **not** accept religious theme (ie confusion with Darwin's difficulties with the church)*
- published in obscure journal / few scientists read his work

1

[6]**55**

(a) sexual

1

(b) chromosome

1

(c) (i) any **two** from:

ignore answers that do not relate to list

- genetic-engineering can produce fast-growing food animals
- genetic engineering can be used to clone animals in danger of extinction
- using GM animals can reduce the number of animals used in medical research

2

(ii) GM animals might escape and breed with wild animals
ignore answers that do not relate to list

1

56

(a) chromosomes

ignore gene / DNA

1

(b) *to obtain 3 marks candidates must give **one** reasonable pro **and one** reasonable con*

pros eg

any **two** from:

- overcomes shortage of human eggs / rabbits produce lots of eggs
ignore all embryos identical
- ethical / religious issues with using human embryos
- reduces tests on (adult) humans
- may provide cure for / cause of disease
- embryo not allowed to develop beyond 14 days
- no harm to rabbit
- 99.5 % human genetic information so very similar to human or will react in the same way

max 2

cons eg

any **two** from:

- ethical / religious objections to mixture of human and rabbit genes
- ethical issues with experimenting with rabbits
allow some people object to using rabbits / cruel to rabbits
- ethical / religious objections to killing embryos
- 0.5% of rabbit genetic information might affect results
- 14 days too short a time to get results

max 2

plus**conclusion eg**

- possibility of cure does / does not outweigh ethical / religious objections
***Note:** the conclusion mark cannot be given unless both an advantage and a disadvantage have (already) been given*
- cure does not justify mixing human and animal genes / killing embryos
*do **not** award the mark if the conclusion only states that advantages outweigh disadvantages*

1

[5]**57**

(a) (i) sex cells

1

(ii) chromosomes

1

(b) (i) two

1

(ii) recessive

1

(c) (i) cell membrane

allow membrane

1

(ii) cytoplasm

1

(d) (i) A

1

(ii) B

1

[8]**58**(a) both parents **Aa***accept other upper and lower case letters without key or symbols with a key**allow shown as gametes in punnet square*

1

aa in offspring correctly derived from parents /

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

- sure / greater chance of healthy / non-cystic fibrosis egg / embryo /child
accept some may have the allele
reference to suitable embryo is insufficient
- greater chance of fertilisation

1

(ii) **to gain 3 marks both advantages and disadvantages must be given**

advantages

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 through generations

disadvantages

any **two** from:

- operation dangers eg infection
ignore risk unqualified
- ethical or religious issues linked to killing embryos
accept wrong / cruel to kill embryos accept right to life
- (high) cost
- possible damage to embryo (during testing for cystic fibrosis / during operation)

3

plus

conclusion

a statement that implies a valued, qualified judgement

eg it is right because the risk of infection is small

or

eg it is wrong because embryos are killed

Note: *the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage has (already) been made*

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

1

[8]