Biology GCSE Revision

Topic 6

Inheritance, Variation & Evolution

Booklet 1 of 2

- Reproduction
- Inheritance
- Cloning

Mark Scheme

Question 5

question	answers	extra information	mark
5(a)	auxin	accept other named plant hormones	1
5(b)(i)	any **three** from: • no (fusion of) gametes / fertilisation • only one parent • no mixing of genetic material • no genetic variation **or** genetically identical offspring	 allow no meiosis **or** new cells only produced by mitosis allow not two parents allow clones	3
5(b)(ii)	more / many offspring / plants (produced from one parent plant)	allow less damage to parent plant ignore speed / cost	1
Total			**5**

BL1HP

Question 1

question	answers	extra information	mark
1(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
1(a)(ii)	(mixture of) genes / DNA / genetic information / chromosomes from both parents / horse **and** zebra	ignore nucleus / inherited information but allow second mark if given dependent on sensible attempt at 1st mark	1 1

Question 1 continues on the next page . . .

BL1HP

Question 1 continued

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 also refer to the information on page 2, and apply a 'best-fit' approach to the marking.		
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content	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.	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.	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: 6

- 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

Total			9

BL2HP

Question 4

question	answers	extra information	mark
4(a)(i)	meiosis	allow mieosis	1
4(a)(ii)	testis / testes	allow testicle	1
4(b)(i)	23		1
4(b)(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
Total			**5**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	testis / testes	allow testicle(s)	1	AO1 2.7.1f
5(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 = ½ B **and** E = ½ C for one mark	2	AO2 2.7.1e/h
5(b)(ii)	6.6	allow twice answer for cell **E** in 5bi	1	AO2 2.7.1e/h/i
5(b)(iii)	mitosis	correct spelling only	1	AO1 2.7.1a/d/i

Question 8

question	answers	extra information	mark
8(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
8(a)(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
8(b)(i)	meiosis	allow mieosis as the only alternative spelling	1
8(b)(ii)	Species A = 4 **and** Species B = 8		1
8(b)(iii)	sum of A + B from (b)(ii) e.g. 12		1

Question 8 continues on the next page...

Question 8 continued...

question	answers	extra information	mark
8(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
8(c)(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
Total			**10**

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	in the chromosome(s) in the nucleus	ignore genes / alleles allow nuclei allow mitochondria	1 1	AO1 2.7.2f, 2.7.1b
3(a)(ii)	the DNA / chromosomes / genes are replicated / copied / multiplied / doubled / duplicated	allow DNA is cloned ignore same DNA / chromosomes / genes if unqualified	1	AO1 2.7.1a,c,n
3(b)(i)	1 / one		1	AO2 2.7.2c,e, 2.7.3a,c
3(b)(ii)	2 / two		1	AO2 2.7.2c,d, 2.7.3a,b

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	idea that sexual reproduction results in genetic variation	allow converse if clearly referring to asexual reproduction allow reference to natural selection / evolution (if conditions change)	1	AO1 1.7.2a
7(b)(i)	any **four** from: • nucleus taken from egg (cell) (of female) **A or** cytoplasm (and membrane) discarded • nucleus removed / discarded from egg (cell) (from female) **B or** only cytoplasm (and membrane) kept • nucleus from **A** inserted into (enucleated / empty cell / cytoplasm from) egg (cell) (of female) **B** • fertilised / fertilisation (of 'hybrid' cell) • electric shock (after fertilisation) **or** grown into embryo	accept throughout: female **A** = person with faulty mitochondria female **B** = person without faulty mitochondria allow egg and sperm fuse allow cell division / mitosis	4	AO1/3 1.7.2a/c
7(b)(ii)	idea of cytoplasm / mitochondria of 'hybrid' / fertilised cell / embryo comes from cell / female / B with 'normal' mitochondria **OR** only the nucleus is used from A (1) the nucleus does not contain mitochondria **or** these faulty genes (1)		1 1	AO2 1.7.2c

7(b)(iii)	any **one** from: • idea that child has unknown parentage **or** 3 parents • against religious beliefs / teachings • could cause (more) prejudice (against people with perceived imperfection)	ignore ref to unethical / immoral ignore ref to being against religion / God's will unqualified	1	AO3 1.7
Total			**8**	

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Question 7

question	answers	extra information	mark
7(a)	gene / allele		1
7(b)	(in / on) ribosome(s)		1
7(c)	any **three** from: • amino acids make up a protein • (protein is) particular combination / sequence (of amino acids) • bases form a <u>code</u> • the bases work in threes or description • (code / three bases) for one amino acid	accept bases work in triplet accept eg (bases) WXZ for amino acid J for **2** marks	3
7(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
7(d)(ii)	different / example of different eye colour	allow protein may / would not be made / function (normally)	1
Total			7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	part of a chromosome	allow piece of DNA allow parts of chromosomes	1	AO1 1.7.1b/c
	controls a characteristic	allow controls characteristics allow codes for (**or** controls production of) protein / enzyme ignore examples of characteristics	1	
8(b)	(iPS method) *similarities* • (both) use of skin / body cell • (both) ref to (formation of) embryo • (both) transfer (embryo) into womb / uterus • (both) use surrogate mothers *differences* • (iPS) uses sexual reproduction • (iPS) surrogate mother is different species • (iPS) no nucleus transfer / removal • (iPS) offspring genetically different from parent • (iPS) no electric shock	max **3** similarities or differences allow converse if clearly referring to adult cell cloning allow ref to egg **and** sperm **or** gametes **or** fertilisation allow not a clone	4	AO1 / AO3 1.7.2a/c
8(c)	any **one** from: • idea of retaining biodiversity • may be (economically) useful (in the future) • idea of maintaining food chain / ecosystem		1	AO3 1.7
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
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	AO2 2.7
8(a)(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 • anomalies have limited effect / anomalies can be identified	 allow ref. to more representative / reliable do **not** allow more accurate **or** precise ignore fair / repeatable accept example of an anomaly	2	AO3 2.7, 2.7.2a
8(b)(i)	in sequence: Homozygous Homozygous Heterozygous	All 3 correct = 2 marks 2 correct = 1 mark 1 or 0 correct = 0 marks	2	AO3 2.7
8(b)(ii)	genetic diagram including: Parental genotypes: **Nn** and **Nn** **or** Gametes: **N** and **n** + **N** and **n** <u>derivation</u> of offspring genotypes: **NN Nn Nn nn** identification: **NN** and **Nn** as purple **and nn** as white	 allow other characters / symbols only if clearly defined allow genotypes correctly derived from candidate's P gametes allow correct identification of candidate's offspring genotypes but only if some F_2 are purple and some are white	 1 1 1	AO2 2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(c)	any **two** from: • did not know about chromosomes / genes / DNA **or** did not know chromosomes occurred in pairs • had pre-conceived theories • Mendel's (mathematical) approach was novel concept • Mendel was not part of academic establishment • work published in obscure journal / work lost for many years • peas gave unusual results cf other species • Mendel's results were not corroborated until later / 1900	ignore genetics eg blending of inherited characters ignore religious ideas unless qualified allow his work was not understood or no other scientist had similar ideas allow he was not considered to be a scientist / not well known / he was only a monk allow he only worked on pea plants	2	AO1 2.7
Total			**10**	

BL2HP

Question 6

question	answers	extra information	mark
6(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
6(a)(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
6(a)(iii)	heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL		1
6(b)	genetic diagram including: correct gametes: **D** and **d** **and** **d** (and **d**) derivation of offspring genotypes: **Dd** **Dd** **dd** **dd** identification of **Dd** as CADASIL **or dd** as unaffected correct probability: 0.5 / ½ / 1 in 2 / 50 % / 1 : 1	accept alternative symbols, if defined ignore 7 / 8 or male / female allow just **Dd** **dd** if ½-diagram allow ecf if correct for student's gametes allow ecf if correct for student's gametes	1 1 1 1
6(c)(i)	stem cells can differentiate **or** are undifferentiated / unspecialised can form blood vessel cells / brain cells **or** stem cells can divide		1 1

Question 6 continues on the next page . . .

BL2HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)(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 **or** if from a relative then less chance of rejection **or** if from self then no chance of rejection **or** skin cells more accessible	more ethical qualified ignore religion unqualified	1
Total			**10**

Question	Answers	Extra information	Mark	AO / spec ref.
6(a)(i)	one form of a / one gene	do **not** allow 'a type of gene' allow a mutation of a gene	1	AO1 2.7.2c,e , 2.7.3a
6(a)(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	AO1 2.7.2c,e , 2.7.3a
6(b)(i)	two parents without PKU produce a child with PKU / **6** and **7** → **10**	allow 'it skips a generation'	1	AO3 2.7, 2.7.3a
6(b)(ii)	genetic diagram including: Parental gametes: 6: **N** and **n** **and** 7: **N** and **n** derivation of offspring genotypes: **NN Nn Nn nn** identification: **NN** and **Nn** as non-PKU **OR nn** as PKU correct probability only: 0.25 / ¼ / 1 in 4 / 25% / 1 : 3	accept alternative symbols if defined allow genotypes correctly derived from student's parental gametes allow correct identification of student's offspring genotypes do **not** allow 3 : 1 / 1 : 4 do **not** allow if extra incorrect probabilities given	1 1 1 1	AO2 / AO3 2.7, 2.7.3a
6(c)(i)	mitosis	correct spelling only	1	AO1 2.7.1a,c ,d
6(c)(ii)	8		1	AO2 2.7.1c,i, 2.7.3a, 2.7.3d
6(c)(iii)	DNA	allow deoxyribonucleic acid do **not** allow RNA / ribonucleic acid	1	AO1 2.7.2g, 2.7.3a, 2.7.3d

Question	Answers	Extra information	Mark	AO / spec ref.
6(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	AO3 2.7, 2.7.3a
6(d)(ii)	any **one** from: • prevent having child with the disorder / prevent future suffering / reduce incidence of the disease • embryo cells could be used in stem cell treatment	ignore ref to having a healthy child ignore ref to selection of gender allow ref to long term cost of treating a child (with a disorder) allow ref to time for parents to become prepared	1	AO3 2.7, 2.7.3a
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	46 **or** 23 pairs		1	AO1 2.7.2b
6(a)(ii)	(alternative / different) form(s) of a gene / of the same gene		1	AO1 2.7.2c
6(a)(iii)	only expressed if the dominant (allele) is not present / if the other (allele) is not present **or** only expressed if 2 (recessive alleles) are present	allow won't be expressed if the dominant allele is present	1	AO1 2.7.2e
6(b)(i)	having 2 different alleles	do **not** allow 2 different genes ignore carrier	1	AO1 2.7
6(b)(ii)	genetic diagram including: correct gametes **or** parental genotypes **N** and **n** <u>and</u> **N** and **n** **or** **Nn** <u>and</u> **Nn** offspring genotypes correctly <u>derived</u>: **NN** **Nn** **Nn** **nn** identification of **nn** as AKU correct probability only: 0.25 / ¼ / 1 in 4 / 25% / 1 : 3	allow alternative symbols if defined do **not** allow if alternative symbols used and not defined allow genotypes correct for student's parental gametes allow correct identification of student's offspring genotypes do **not** allow 3 : 1 / 1 : 4 do **not** allow if extra incorrect probabilities given	1 1 1 1	AO2/3 2.7 2.7.3a

6(c)(i)	mitosis	correct spelling only	1	AO1 2.7.1a/d
6(c)(ii)	4		1	AO2 2.7.1a,d
6(d)(i)	any **one** from: • may lead to damage to embryo **or** may destroy embryos • embryo cannot give consent • ref to possible miscarriage (of implanted embryo) • idea of avoiding prejudice against disabled people • idea of not producing designer babies	allow emotive terms e.g. murder allow disposal of embryos allow embryos used in research ignore religion unqualified	1	AO3 2.7 2.7.3d
6(d)(ii)	any **one** from: • prevent having child with the disorder **or** reduce incidence of the disease / inherited / genetic diseases **or** prevent future suffering of child from the disease • embryo cells could be used in stem cell treatment • can have another child without need for IVF • provides embryos for research • ref to avoiding long term cost of treating a child (with a disorder) **or** avoid parental stress	ignore ref to having a healthy child ignore ref to selection of gender allow reference to parents being prepared in advance	1	AO3 2.7 2.7.3d
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	man has (inherited) polydactyly (PD) allele (from mother) man has (inherited) other / normal / recessive allele from father 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	allow gene for allele	1 1 1	AO1/2/3 2.7, 2.7.2a/c/d 2.7.3a/b
6(a)(ii)	0.5 / ½ / 1 in 2 / 1:1 / 50%	do not allow 1:2 or 50/50 allow 50:50	1	AO3 2.7, 2.7.2a/c/d 2.7.3a/b
6(b)	parental phenotypes: both brown parental genotypes: both **Bb** gametes: **B b** and **B b** offspring genotypes: **BB (2)Bb bb** offspring phenotypes correctly assigned to genotypes: **BB** & **Bb** = brown **bb** = red	 allow only on gametes answer line allow ecf from genotypes allow ecf from gametes do not penalise confusion of 'phenotypes' & 'genotypes' here	1 1 1 1 1	AO1/2/3 2.7, 2.7.2a/c/e
Total			**9**	

BL2HP

Question 7

question	answers	extra information	mark
7(a)(i)	(alternative) forms / types of a / the same gene		1
7(a)(ii)	only expressed if 2 copies inherited **or** not expressed if other allele present	allow over ruled / over powered by the other allele	1
7(b)(i)	**Nn**	ignore heterozygous	1
7(b)(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

Question 7 continues on the next page . . .

BL2HP

Question 7 continued

question	answers	extra information	mark
7(c)	**Argued evaluation** any **four** from: • PGD higher financial cost • PGD occurs before pregnancy / implantation • PGD does not involve abortion so less trauma / less pain / ethical comparison • PGD higher incidence of false positive / use of numbers so higher risk of destroying healthy embryo • PGD no chance of miscarriage whereas CVS does **or** PGD less chance of miscarriage	 accept CVS only costs £600 accept detected at earlier stage so less unethical / less trauma accept PGD has (surplus) embryos so some destroyed / unethical	 4
Total			**10**

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Question 6

question	answers	extra information	mark
6(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
6(b)(i)	46	allow 23 pairs	1
6(b)(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
6(b)(iii)	genetic diagram including: Parental gametes: **H** and **h** from both parents	accept alternative symbols, if defined	1
	<u>derivation</u> 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
Total			**9**