Question			Answer	Mark	Guid
1	(a)		*a **difference** is stated relating to* fur length **;** pattern / colour, of fur **;** eye colour **;** temperament / tameness **;** face shape **;**	max 2	**Mark the first 2 suggestions (see point 12 above)** For **each** mark point **CREDIT** ***EITHER*** a paired comparison referring to **both** cats and identifying which has which feature, e.g. "the wildcat has green eyes and the Persian has blue" but allow top / bottom, Fig. 1.1 / 1.2, first and second cat, etc, as identifiers, ***OR*** a reference to only one cat but using a **comparative** adjective ending in '-er' such as "**shorter** fur on wildcat", "second one looks **tamer**" or "second one is **more** tame", or, conversely, "wildcat looks **less** fierce". **IGNORE** use of the word different. e.g. "they have different coloured fur" if there is no further statement about how they differ. **IGNORE** answers that do not attempt to describe a difference at all, e.g. "fur length". **IGNORE** albino

Question			Answer	Mark	Guid
	(b)	(i)	selective breeding / artificial selection **;**	1	**FA (see guidance on page 2)** **IGNORE** evolution **DO NOT CREDIT** natural selection or speciation
		(ii)	(named type of) mutation / production of new alleles **;** sexual reproduction / meiosis / independent assortment / crossing-over **;**	1	**FA** **ACCEPT** substitution / insertion / base deletion / gene mutation / random mutation as named types of mutation **DO NOT ACCEPT** chromosome mutation, discontinuous variation
	(c)	(	(recessive) epistasis **;**	1	**FA** **DO NOT ACCEPT** dominant epistasis or codominance
		(ii)	**BBDD ;** **BBDd ;** **BbDD ;** **BbDd ;**	4	**CREDIT** answers written in any order but look for and tick off answers in the order given
		(iii)	*homozygous* (individual / cat / genotype with) 2 identical, alleles / version of the gene / forms of the gene **;** *gene locus* position / place / location**,** of, gene / allele, on chromosome **;**	1 1	**ACCEPT** both, pair or idea of (same on) each for 2 idea **ACCEPT** same for identical and **CREDIT** description such as "both alleles either recessive or dominant" **DO NOT CREDIT** *genes* for alleles **DO NOT CREDIT** *similar* for identical or same **CREDIT** "where / whereabouts the gene is on the chromosome" **CREDIT** DNA molecule for chromosome and **ACCEPT** DNA strand

Question			Answers	Mark	Guidance
		(iv)	seal : blue : chocolate : lilac **;** 1 : 1 : 1 : 1 **;**	2	**IGNORE** absence of colons (:) **CREDIT** phenotypes all correct in any order **ACCEPT** dark brown for seal **ACCEPT** light brown for chocolate **ACCEPT** ratio of 1 : 1 : 1 : 1 as stand alone mark, even if only one, two or three colours stated for phenotypes **DO NOT CREDIT** fractions, percentages or decimals **CREDIT** ecf for ratio **only** if four colours stated e.g. "seal, lilac, chocolate, chocolate" (no mark) followed by ecf "1:1:2"
	(d)	(	*type of behaviour* innate / instinct(ive) / reflex **;** *characteristic* automatic **;** stereotyped / always performed in the same way **;** no previous experience necessary / not learned **;** genetic(ally programmed) / AW **;**	1 max 1	**FA for each prompt line** **IGNORE** maternal (as given in question) **IGNORE** instinctive in characteristic section **ACCEPT** same in all members of the species **ACCEPT** unlearned, not taught **ACCEPT** inherited

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>(ii)</td><td>1 whether kittens, survive / breed ;

2 whether <u>alleles</u>, change in frequency / passed on / kept ;

3 correct reference to selection / how selection acts ;

4 AVP ;

5 AVP ;</td><td>max 2</td><td>Markpoints 1–3 are linked within 4 possible contexts. ‘It’ refers to good mothering behaviour in the domestic environment (with people helping at the birth of kittens). Or candidates might say what would happen to the good behaviour patterns in the wild. Alternatively, the answer might focus on bad mothering behaviour (not licking the kittens), in either environment.

<table>
<tr><th></th><th>domestic</th><th>in the wild</th></tr>
<tr><td>good mothering</td><td>1 kittens do, survive / breed

2 alleles not necessarily, passed on / kept

3 not selected for</td><td>1 kittens do, survive / breed

2 alleles, increase / passed on / kept

3 selected for</td></tr>
<tr><td>bad mothering</td><td>1 kittens do, (still) survive / breed

2 alleles, increase / passed on / kept

3 not selected against</td><td>1 kittens do not, survive / breed

2 alleles, decrease or alleles not, passed on / kept

3 selected against</td></tr>
</table>
e.g. linkage (4) of poor mother, genes / alleles, with desirable alleles selected for in domestic cats (5)
OR
<u>genetic drift</u> (4) in small population (5)
OR
pleiotropic / multi-effect genes (4) with a desirable effect and this side effect (5)</td></tr>
</table>

Question			Answer	Mark	Guid
1	(e)	(	**1** inbreeding **/** small or decreasing, gene pool **;** **2** homozygous recessive (genotypes) **;** **3** gene / allele **,** for desired characteristic on same chromosome as problem, gene / allele **;** **4** selecting for one trait (unintentionally) selects for another **;** **5** breeders select for looks not health **;** **6** weaker selection against less healthy animals (than in wild) **;**	max 2	**ACCEPT** decreasing genetic variation **IGNORE** interbreeding **CREDIT** good and bad genes, linked / show linkage
		(ii)	**1** entrapment / alginate beads / cellulose network **;** **2** a**d**sorption / carrier bound **or** stuck to **,** porous carbon / clay / resin / glass **;** **3** covalent bonding **or** cross-linking enzymes to each other and to clay (using glutaraldehyde) **;** **4** membrane separation **or** enzyme and substrate either side of partially permeable membrane **;**	max 2	**Mark the first 2 answers** **ACCEPT** encapsulation, inclusion **IGNORE** a**b**sorption
			Total	**21**	

Question			Answer	Marks	Guidance
2	(a)	(i)	tyrosinase **;**	1	**First Answer (**Mark the **first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks)**.**
		(ii)	phenylketonuria / PKU **;**	1	**Mark the First Answer**
	(b)		*both have an* amine / amino / NH_2 **;** COOH / carboxyl / carboxylic **;**	2	**DO NOT CREDIT** if formula given does not match name **DO NOT ACCEPT** ammonia, amide
	(c)		**1** low / less / no, thyroid hormones **;** **2** less (aerobic) respiration **;** **3** less, ATP produced / energy **;** **4** slow(er) metabolism / low(er) (B)MR **;** **5** low body temperature **;** **6** AVP **;**	3 max	**DO NOT CREDIT** no respiration / ATP eg sleep more, get tired quickly, poor muscle tone, mental retardation
	(d)	(i)	homozygous **;**	1	**Mark the First Answer** **IGNORE** dominant / recessive
		(ii)	*genotype* combination of alleles **;** possessed by organism **;** *allele* alternative / mutant, form / version **;** of, a gene **;**	4	**ACCEPT** *idea of* **all** alleles or '**the**' alleles (suggesting all) **ACCEPT** *idea of* eg that a, person has / you have / of an individual / cell *'all my alleles'* = 2 marks **ACCEPT** altered, different (form / version) **CREDIT** DNA if qualified, eg at a locus / codes for X

Question			Answer	Marks	Guidance
	(e)		population, not large / (too) small **;** not randomly-mating / matings arranged **;**	2	
	(f)		natural / artificial / directional, selection **;** genetic drift **;** mutation **;** migration / AW **;**	2 max	**Mark the first two suggestions only** **ACCEPT** selection pressure, selective breeding, selective advantage
			Total	**16**	

Question			Answer	Marks	Guidance
3	(a)	(i)	artificial selection / selective breeding **;**	1	**First Answer**
		(ii)	*idea that* males can father many offspring / mate several females **;** *idea that* females produce only a few offspring **;** (so) more females (than males) needed to maintain numbers (each generation) **;** (20% females chosen as) inbreeding / genetic problems, if breeding population is too small **;** (5% males chosen as) selection pressure stronger if fewer (tamest) are used **;**	2 max	**IGNORE** artificial insemination eg one litter at a time
	(b)		**1** (mostly) genetic **;** **2** as can be selected for / selective breeding increases frequency **;** **3** allele(s) for tameness **;** **4** (from) mutation **;** **5** query role of environment / learning **;** **6** ref. DRD4 / dopamine receptor **;**	3 max	**DO NOT CREDIT** if environment also given as cause **IGNORE** genetic drift **DO NOT CREDIT** if environment given as main cause **ACCEPT** query about experimental method, eg was environment controlled for?

Question			Answer	Marks	Guidance
	(c)		*linkage* tameness genes and genes for these traits on same chromosome ; (so) inherited together ; *epistasis* (product of) one gene affects expression of another ; via enzyme pathway ; *inbreeding* (hidden / masked) recessive alleles ; selected for, as well / unintentionally ; more chance homozygous as, small gene pool / parents related ; *genetic drift* random / chance (which alleles, present / passed on) ; (effect stronger because) small breeding population ;	2	**First Answer** Look for the two mark points relevant to the first word of the four on offer that the candidate has chosen. **ACCEPT** idea of (recessive)allele inherited from both parents because, they are closely-related / small gene pool / reduced genetic diversity
	(d)		**1** geographic ; **2** wolves avoid human settlements / dogs confined by humans ; **3** behavioural ; **4** detail / description ; **5** mechanical ; **6** idea of different size of wolves and some small dogs ; **7** gamete incompatibility ; **8** possibility of different chromosome numbers ; **9** seasonal / temporal ; **10** different breeding, seasons / times ;	3 max	**IGNORE** reproductive isolation **4** eg differences in, pheromones / courtship **6 ACCEPT** different genitalia **10 CREDIT** *the idea that* dogs breed all year round / wolves breed once a year

Question			Answer	Marks	Guidance
	(e)		*biological species concept* **1** (members of same species) need can interbreed to produce fertile offspring **;** **2** not all dog breeds can do this therefore not same species **;** **3** dog and wolf can so they should be same species **;** *phylogenetic species concept* **4** *idea that* dogs and wolves monophyletic group / tip of phylogeny **;** **5** genetic differences, between dogs and wolves small **;** **6** gene flow between wolves → big dogs → little dogs / analagous to ring species **;** **7** (PSC) one species (with a lot of phenotypic variation) **;**	4 max	**4 ACCEPT** share a common ancestor **5 CREDIT** question of how much DNA difference needed to classify as separate species
			Total	**15**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	**1** sweep netting / sweep vegetation with a net **;** **2** beating / beat trees and bushes **;** **3** pooter / pooting / described **;**	**1 max**	**2** **ACCEPT** fogging **3** **ACCEPT** pitfall traps / described
	(a)	(ii)	*idea of* ladybirds not evenly distributed / some parts of hill different / more representative **;** lets <u>reliability</u> be assessed / anomalies identified **;**	**1 max**	**ACCEPT** description e.g. could be more ladybirds one side than another **ACCEPT** increases reliability **IGNORE** accuracy / precision / removes anomalies
	(b)	(i)	**M1** (calculate) % / proportion / ratio **;** **E1** as different total numbers at each site **;** **or** **M2** (draw) bar chart / kite diagram **;** **E2** pictorial data easier to understand **;**	**2 max**	**M1** **IGNORE** χ^2 **M2** **IGNORE** histogram / line graph

Question			Expected Answers	Marks	Additional Guidance
4	(b)	(ii)	*yes (for first statement)* **1** first statement true / correlation exists **;** **2** number of black ladybirds increase **,** from 100m to 300m / until 300m **;** **3** 400m number decrease **but** % black increases **;** *no (for second statement)* **4** correlation not proof of causation / no proof of causal link / second statement not (necessarily) true **;** **5** another (named) factor could be involved **;**	**3 max**	**If candidates argues 'yes' exclusively, can only be awarded mps 1-3** **If candidate answers 'no' exclusively, can only be awarded mps 4 & 5** ***Note*** *percentage of black ladybirds increases as you go up the hill* = 2 marks (mps 2 & 3) **5** **CREDIT** could be due to distance from town / more **or** less predation high up / camouflage / warning colours
	(c)	(i)	only expressed , when homozygous / in absence of dominant (allele) **;** not expressed when heterozygous / expression masked by dominant (allele) **;**	**1 max**	**DO NOT CREDIT gene** **IGNORE letters / genotypes** **ACCEPT only seen in phenotype when it is present in 'double dose'**

Question			Expected Answers	Marks	Additional Guidance
4	(c)	(ii)	1 $\underline{q^2}$ = 296 / 346 or 0.85 / 0.855 / 0.86 ; 2 q = √previous answer or 0.92 / 0.93 ; 3 p = 1 – previous answer or 0.08 / 0.07 ;	3	1 **DO NOT CREDIT** calculation or figure unless it has been indicated as q^2 2 **ACCEPT ecf** 3 **ACCEPT ecf** ***Note*** **If both p and q are correct = 3 marks** *If p and q not given to 2 decimal places* then penalise 1 mark and then apply ecf • If the 2 final answers add up to 1 give mp 3, then look for evidence of mps 1 or 2 in the working • If the 2 final answers do not add up to 1, look for evidence of mps 1, 2 & 3 in the working • Award the working mark(s) if method correct, even if subsequent calculation incorrect (e.g. $1 - 0.54 = 0.56$ could get mp 3 for '1 – previous answer' even though 0.56 is the incorrect answer for the calculation) *e.g. if black allele wrongly assumed to be recessive* $q = 0.38$ or $q = \sqrt{0.1445}$ give mp 2 as ecf $p = 0.62$ or $p = 1 - 0.38$ give mp 3 as ecf *e.g. if answer given as* $q = 0.85$ *and* $p = 0.15$ give mp 3 They will not get mp 1 as they think that 296/346 = q (rather than q^2) and so will not square root it so they won't get mp 2
				11	