17. Selection and Evolution

17.1 Variation

Paper 4

Marking Scheme

Q1.

(a)	1 genetic / genotype / alleles **or** example ; mutation / crossing over / independent assortment / random fertilisation / random mating 2 environmental **or** example ; climate / disease / food availability / soil pH / selection pressure 3 combination / interaction, of genes and environment **or** example ; gene (expression) is modified by environment	**3**

Q2.

(a)(i)	as mutation rate increases lifespan decreases ;	**1**

Q3.

(a) *any **two** from:* — **2**

discontinuous	*continuous*
(forms / phenotypes / categories) distinct / discrete / categoric / do not overlap / do not form a (gradual) range / no intermediates / two or few different forms	(forms / phenotypes / categories) not distinct / not discrete / overlap / form a (gradual) range / include intermediates / many different forms / many values on a spectrum ;
not a normal distribution / few bars (on bar chart)	normal distribution **or** normal / bell-shaped curve (on graph) ;
no / little, effect from environment **A** genes only	some / large, effect from environment ;

(b) *any **two** from:* — **2**

1 one / two, genes (control colour pattern) ;
2 different alleles of a gene have a large effect ;
3 multiple / three, alleles ;
4 gene interaction / epistasis ;
5 AVP ;

(c) *any **two** from:* — **2**

1 temperature / food (supply) ;
2 of larva / during larval development ;
3 egg size / diet of mother / size of mother ;

Q4.

(a)	<table><tr><th>statement</th><th>discontinuous variation</th><th>continuous variation</th></tr><tr><td>often involves one gene only</td><td>✓</td><td></td></tr><tr><td>environmental factors may affect gene expression</td><td></td><td>✓</td></tr><tr><td>there is an additive effect of genes that contributes to the phenotype</td><td></td><td>✓</td></tr><tr><td>there are distinct differences between the various forms of a characteristic</td><td>✓</td><td></td></tr></table> ;;;;	4
(b)(i)	*ref. to* spread of results about the <u>mean</u> ;	1

(b)(ii)	t = <u>4.255</u> ;;; *give 2 marks:* *if answer is 4.25 or 4.26* *if answer is more than 4 significant figures e.g. 4.255439871* *if answer is incorrectly rounded to 4 significant figures e.g. 4.256* *if answer incorrect then max 2 for working* numerator = 4.2 denominator = 0.986972 ecf - if no working mark given then allow one mark for 12.02 as the answer	3
(b)(iii)	1 there is a higher (mean) concentration of serum 25-OHD in summer ; **ora** *any **two** from:* 2 value of t / 4.255 > critical value / 3.773 ; 3 there is a <u>significant difference</u> between the two means ; 4 any <u>difference</u> is not due to chance / <u>difference</u> due to chance less than 0.0001% ; ecf from incorrect answer to 5bii	3
(b)(iv)	genetic **AND** environmental **OR** an example of a genetic cause **AND** an example of an environmental cause ;	1

Q5.

(a)(i)	<u>discontinuous</u> ;	1
(a)(ii)	*any **two** from:* 1 mutation **A** description **or** (formation of a) new allele ; 2 change in, environment / selection pressure ; **A** description 3 cross pollination / cross breeding / hybridisation ; 4 new allele combination / codominant alleles together ;	2

Q6.

(a)	**1** environmental ; **2** discontinuous ;	**2**

Q7.

(b)	*any **two** from:* 1 colours / shades / categories / phenotypes, not distinct / not discrete / overlap / form a (gradual) range / include intermediates ; 2 >1 / 4 / several / many, genes ; 3 environment affects, it / colour / phenotype ;	**2**

Q8.

(a)	**1** different alleles at a single gene locus have small effects (on the phenotype) ; **2** different genes may have an, additive / combined, effect (on the phenotype) ; **3** *ref. to* multiple genes / polygenes / description ;	**3**
(b)	*any **two** from:* **1** quantity / availability, of, food / nutrients ; **A** competition for food **2** quality of food / malnutrition ; **3** disease ; **4** temperature ;	**2**

Q9.

(a)	1.45 – 0.25 = 1.20 1.20 ÷ 0.25 = 4.8 *allow ecf for mp2* *1.45 ÷ 0.25 = 5.8* **or** 5.17 – 0.25 = 4.92 ; 4.92 ÷ 0.25 = 20 ; *allow ecf for mp2* *5.17 ÷ 0.25 = 21*	**2**
(b)(i)	*any **two** from:* **1** different breeds at, **same** / named, location / environmental conditions, / have different milk yields ; **2** comparative data quote including units ; **3** (different breeds have) different gene pools / different alleles ; **4** due to selective breeding ;	**2**

Q10.

(a)(i)	*any **three** from:* **1** environmental / not genetic ; **2** as change in yield occurs in one goat ; **3** yield increases (from 1st to 2nd) in all genotypes ; **4** older / 2nd lactation, goats have, bigger / more developed, udders ; **5** age / maturity, is an environmental factor ; **6** AVP ;	**3**

Q11.

(a)	*any **two** from:* 1 discrete / distinct, categories / phenotypes / morphs / groups ; **A** (only) 3 groups 2 no range of phenotypes / no intermediates / no normal distribution ; 3 (only) one gene / only *EDA*, involved ; 4 not affected by environment ;	**2**

Q12.

(a)(i)	continuous ; **A** normal distribution	**1**
(a)(ii)	evolution / natural selection / artificial selection / directional selection / adaptation / selective breeding ;	**1**
(b)	*any **three** from:* *captive fish:* 1 controlled conditions **so** phenotype less varied ; 2 more oxygen **so** larger ; 3 less space / overcrowding, **so** smaller ; 4 less space / overcrowding, **so** (signs of) disease / wounds ; 5 food qualified **linked to**, size / muscle / fat ; 6 AVP ; e.g. named tank condition **linked to** skin colour / no predators linked to increase in size / temperature linked to size	**3**

Q13.

(d)(i)	*any **one** from:* 1 differences caused by selection in captive-bred population ; 2 (not environmental because) all, offspring / fish, were kept in same environment ;	**1**
d(ii)	*idea that* captive fish have better, wound healing / immune response ;	**1**

Q14.

(a)(i)	1 continuous ;	**1**
(a)(ii)	*any **three** from:* 1 several / many, genes ; 2 additive effect / gene(s) (products) interact ; 3 environment has, big / significant, effect ; 4 (named) environment(al factors) affects gene expression ; 5 e.g. age / diet / disease / parasites / chemicals / mutagens / alcohol in utero, can affect, development / growth / IPD / phenotype ;	**3**

Q15.

(b)(i)	*any 2 of:* 1 protoctist uses up nutrients ; 2 loss of appetite / inability to feed ; 3 *idea of* impaired absorption / diarrhoea ; 4 (so) less nutrients available for, growth / gain of body mass / increase in biomass ; 5 AVP ; e.g. *idea of* energy used to fight infection / *ref. to* immune response	**2**

(b)(ii)	(chicken) body temperature / competition with microbes / presence of drugs / presence of plant extract ;	**1**
(c)(i)	*t*-test ;	**1**
(c)(ii)	*any 3 of:* 1 two labelled bell-shaped curves ; 2 high dose curve shifted to left of low dose curve ; 3 high dose curve peak to left of 2063 ; 4 high dose curve, narrower / peak higher ;	**3**

Q16.

(c)(i)	*numerator working* 17.4 ; *denominator working* √3.76 + 0.91 **OR** √4.67 **OR** 2.16 ;	**2**
(c)(ii)	*any two from* **1** reject because, ***t*** / calculated value / it, is, higher / greater / more, than, 2.23 / critical value ; **2** probability of result by chance **is less than**, 0.05 / 5% **or** $p < 0.05$; **3** there is a significant difference between the, means / populations / test and control ;	**2**