16. Inheritance

16.3 Gene Control

Paper 4

Marking Scheme

Q1.

(c)	*any **three** from:* 1 (DELLA proteins) bind to, PIF / transcription factor ; 2 PIF / transcription factor, cannot bind to, DNA / promoter ; 3 RNA polymerase cannot bind to promoter ; 4 no transcription / mRNA not made ;	**3**

Q2.

(c)	DNA / promoter ;	**1**

Q3.

	*any **six** from:* **1** *Ie* allele codes for a, non / less, functional enzyme ; **2** 3 beta-hydroxylase ; **3** alanine replaced with threonine at active site ; **4** inactive gibberellin / GA20, not converted to, active gibberellin / GA1 ; **5** no / less, gibberellin to bind to, (intracellular) receptor / GID1 ; **6** no / less, gibberellin-receptor-DELLA complexes formed ; **7** DELLA not broken down ; **8** DELLA (stays) bound to, transcription factors / PIF ; **9** transcription factor / PIF / RNA polymerase, cannot, bind to promoter ; **10** growth genes / XET gene, (stay) switched off / not transcribed / not expressed ; **11** stem does not elongate / internode length is small **OR** no / less, cell division in stem ;	**6**

Q4.

(b)(ii)	transcription factor(s) ;	**1**

Q5.

(c)(ii)	*any **four** from:* *variety A:* 1 gibberellin binds to, receptor / GID1 ; 2 DELLA protein breaks down ; 3 PIF / transcription factor (released) to, bind to DNA / transcribe genes ; 4 stem / internode / cell, elongation / growth, occurs ; 5 **A**, is *lele* / has no *Le* allele ; 6 **A** does not produce its own (active) gibberellin ; *variety B:* 7 does not respond to / no effect from, gibberellin ; 8 lacks / has non-functional, gibberellin receptor ;	**4**
(c)(ii)	*any **two** from:* 1 (BZR1) binds to promoter ; 2 to switch gene on / so gene is expressed / allow transcription ; 3 allows binding of RNA polymerase (to DNA / promoter) ;	**2**

Q6.

(a)	RNA polymerase attached to promoter ; repressor detached from operator ;	**2**
(b)(i)	structural (gene) ;	**1**
(b)(ii)	lactose permease ; **A** beta-galactoside permease movement / transport, of lactose into cell **or** makes (cell surface) membrane (more) permeable to lactose ;	**2**
(c)	1 population increases, then levels off, increases, then levels off / AW ; *any **three** from:* 2 (first increase) glucose, metabolised / respiration ; 3 (first levelling off) glucose has run out ; 4 (first levelling off) lactose, hydrolysed / broken down, into, glucose / galactose ; 5 (second increase) glucose / galactose, metabolised / respired ; 6 (second levelling off) lactose / glucose / galactose, has run out ; 7 AVP ; e.g. *idea of* time delay (for, lactose permease / beta galactosidase, to work)	**4**

Q7.

(e)	*any **two** from:* **1** frameshift / described ; **2** different primary structure / shortened polypeptide ; **3** TF non-functional / TF cannot bind to, DNA / promoter **or** TF not produced ; **4** gene coding for GLP-1 not expressed ; *plus* **5** less / no, GLP-1, produced / secreted ;	**3**

Q8.

(b)(i)	parental phenotype (black x yellow) parental genotype **BbEe x Bbee** ; gametes **BE Be bE be Be be** ; offspring genotypes ;; **BBEe BbEe BbEe BBee Bbee Bbee bbee bbEe** offspring phenotypes ; **black black black yellow yellow yellow yellow brown** ratio 3 black : 1 brown : 4 yellow ; *ecf to max 3*	**6**
(b)(ii)	transcription factor ;	**1**

Q9.

(a)	*any **three** from:* **transcription factor** / **promoter** 1 (C, H, O, N and) S / (C, H, O, N and) P ; 2 protein / DNA ; 3 amino acids / nucleotides ; 4 peptide bonds / phospho(di)ester bonds ; 5 globular / double helix ;	**3**

(c)	*any **three** from:* 1 production of a repressor protein ; 2 repressor protein binds to operator ; 3 prevents RNA polymerase binding to promoter ; 4 *lac* / structural, genes not transcribed ; 5 repressor only binds when, not bound to lactose / lactose absent ; 6 regulatory gene / gene I, codes for repressor (protein) ;	**3**

Q10.

(a)(i)	*any **three** from:* 1 not, made all the time / constitutive; 2 gene switched on / protein made, (only) when needed ; 3 triggered by absence of glucose ; 4 concentration increases when galactose present ;	**3**
(a)(ii)	transporter / channel, for galactose *or* to, allow galactose into cell / increase permeability to galactose ;	**1**
(b)(i)	$\frac{2012}{5275} \times 100$; 38(%) ;	**2**
(b)(ii)	***either** any **two** from mp1, mp2 or mp5* ***or** any **two** from mp3, mp4 or mp5* *either* 1 (Msn2 in nucleus) higher when glucose is absent ; 2 (as) Msn2 / transcription factors, bind to DNA in nucleus ; *or* 3 (Msn2 in nucleus) lower when glucose is present ; 4 (as) Msn2 is not, needed in nucleus / bound to DNA ; *plus* 5 AVP ; e.g. *ref. to* diffusion / movement, of tagged Msn2 / unbound Msn2 distributed equally in nucleus and cytoplasm ;	**2**

Q11.

(b)(i)	1 regulator(y) (gene) ; *plus any **two** from:* 2 gene codes for / makes, transcription factor / activator / inducer **or** protein is, transcription factor / activator / inducer ; 3 TF / (PAX3) protein / gene product / inducer / activator, binds to DNA ; 4 (binding site for TF is) promoter / enhancer ; 5 helps / stimulates, RNA polymerase (binding / action) ;	**3**

(b)(iii)	*any **three** from:* 1 small genetic difference / one gene / *PAX3*, gives, many / big, phenotypic effect(s) ; 2 because *PAX3*, regulates / controls, many / other, genes ; 3 different, level / magnitude / intensity / pattern, of gene expression (of other genes in chimps) ; 4 higher PAX3 (expression / protein) makes, chimps eyes closer together / chimp IPD smaller / decreases face width ;	**3**

Q12.

(a)(i)	**1** promoter **2** operator **3** *lac Z* / β-galactosidase gene **4** *lac Y* / lactose permease gene ; ;	**2**
(a)(ii)	*β-galactosidase – any one of:* digests / hydrolyses, lactose to, monomers / glucose + galactose ; converts / isomerises, lactose to allolactose ; *lactose permease* increases / allows, lactose uptake / lactose entry / permeability (of cell) **to** lactose ;	**2**
(b)(i)	*any one from:* (protein) produced all the time ; (protein) concentration does not vary (in response to molecular signals) ;	**1**
(b)(ii)	*any three from:* **1** repressor (protein) not bound to, lactose / allolactose ; **2** repressor binds to operator ; **3** RNA polymerase cannot move to, operator / (structural) genes ; **4** no / prevents, transcription (of genes) / formation of mRNA ;	**3**
(b)(iii)	*any one from:* proteins / enzymes, made, all the time / when not needed / too much / in excess / in uncontrolled fashion ; waste of, amino acids / ATP / nucleotides ; decrease growth ;	**1**