SECTION A

Question			Marking point	Answers	Notes	Total
1.	a		*a*	no difference on normal diet ‹between control and GPR120 deficient› ✓		3
			b	both higher on a high fat diet than a normal diet ✓		
			c	GPR120 deficient higher than control on a high fat diet ✓		
	b		*a*	base substitution changes a codon ✓		2
			b	amino acids are coded for by different codons ✓		
			c	several codons can code for the same amino acid ✓		
	c			*1.* 95 337 031 ✓ ***AND*** *2.* 95 337 014 ✓	*Both needed*	1
	d		*a*	increase reliability ✓		2
			b	identify anomalous results ✓		
			c	some allele frequencies are very low ✓		
			d	because there is much genetic variation among obese people ***OR*** different causes of obesity ✓		
			e	to allow statistical testing of results ✓		
	e			R27OH because of larger percentage difference between obese and control ✓		1

(Question 1 continued)

Question			Marking point	Answers	Notes	Total
	f		***a***	control variables ✓		**2 max**
			b	cells from obese people will have lots of differences ✓		
			c	only difference will be the genes that have been introduced ✓		
			d	repeatable experiment with the culture of the clone ✓		
	g		***a***	intracellular calcium concentration increases as linolenic acid concentration increases ✓	*Do not accept answers stating that there is a slow initial increase.*	**2**
			b	increases become smaller ‹given the logarithmic *x*-axis› ✓		
	h		***a***	both mutant alleles reduce calcium concentration by the same amount at low linolenic acid concentrations ✓		**2**
			b	still lower with high linolenic acid with R270H but as high as WT with R67C ✓		

(Question 1 continued)

Question			Marking point	Answers	Notes	Total
	i				*Do not accept answers that are unrelated to the data eg: overeating, sedentary lifestyle.*	**3 max**
			a	*Arguments for both factors having an effect:* ‹all› mice on a high fat diet had higher body mass than on a normal diet ✓		
			b	mass of GPR deficient mice was higher than control mice on the high fat diet ✓		
			c	high fat diet will give high blood concentrations of linolenic acid ✓		
			d	responses in WT humans are mediated via an increase in intracellular Ca^{2+} ✓		
			e	less Ca^{2+} release with mutant alleles so less response ✓		
			f	*Argument for diet having more effect:* more of mass increase on the high fat diet was due to diet than to the genetic difference ✓		
			g	*Argument for genes not being the only factor:* there are differences in allele frequency between obese and non-obese groups ✓		
			h	but some non-obese people have the same alleles as obese people ✓		

Question			Marking point	Answers	Notes	Total
2.	**a**		***a***	*1.* multicellular ***OR*** made of cells ✓		**2**
			b	*2.* cell specialization ***OR*** differentiation ***OR*** presence of tissues ✓		
	b		***a***	fixes CO_2 ***OR*** carboxylation ✓		**2 max**
			b	production of glycerate 3-phosphate ✓		
			c	RuBP is a substrate ✓		
	c		***a***	*location*: stroma ***OR*** chloroplast ✓		**4**
			b	‹palisade› mesophyll ✓		
			c	*function*: hydrogen acceptor ***OR*** accepts electrons ✓		
			d	transfers hydrogen/electrons to Calvin cycle ***OR*** reduces glycerate 3-phosphate ✓		

Question			Marking point	Answers	Notes	Total
3.	**a**		***a***	*similarity*: same length ***OR*** same centromere position ***OR*** same sequence of genes ✓		**2**
			b	*difference*: different alleles ‹of some genes› ✓		
	b			diploid because a pair of homologous chromosomes are present ✓		**1**
	c		***a***	mutual exchange of DNA/alleles/genes ✓		**3 max**
			b	between non-sister chromatids ✓		
			c	splits up combinations of linked genes/alleles ✓		
			d	new combinations of alleles produced ✓		
			e	independent assortment of genes on a chromosome ✓		
			f	recombination ✓		
	d		***a***	sexual reproduction ✓		**2**
			b	producing gametes without doubling the ‹chromosome› number in the ‹zygote› ***OR*** conserving chromosome number ✓		

Question			Marking point	Answers	Notes	Total
4.	**a**		***a***	*X*: combustion ✓		**2**
			b	*Y*: photosynthesis ✓		
	b		***a***	anaerobic ✓		**2 max**
			b	warm ✓		
			c	presence of the methanogenic bacteria ✓		
			d	waterlogged ✓		
	c		***a***	CO_2 is the main greenhouse gas ✓		**2**
			b	methane contributes to the greenhouse effect ✓		

SECTION B

Clarity of communication*: *[1]

The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question			Marking point	Answers	Notes	Total
5.	**a**		***a***	oxygen in water ‹slightly› negatively charged and hydrogens ‹slightly› positive ✓		**8 max**
			b	hydrogen bonding due to the dipolar nature ✓		
			c	water molecules are cohesive due to hydrogen bonding ✓		
			d	cohesion useful in xylem transport ***OR*** other application ✓		
			e	hydrogen bonds with other structures, giving adhesive properties ✓		
			f	adhesion of water to cellulose in cell walls ***OR*** other application ✓		
			g	high boiling point due to cohesion/hydrogen bonding ✓		
			h	water is liquid rather than a gas over the global temperature range ***OR*** other application ✓		
			i	high latent heat of vaporisation as energy needed to break hydrogen bonds ✓		

(Question 5a continued)

Question			Marking point	Answers	Notes	Total
			j	use of sweat for cooling the body ***OR*** other application ✓		
			k	high specific heat capacity as hydrogen bonds must be broken to warm water up ✓		
			l	water is a thermally stable habitat ***OR*** other application ✓		

	b		***a***	thick waxy cuticle to reduce cuticular transpiration ✓		**4 max**
			b	few/small stomata ✓		
			c	stomata that open at night when it is cooler ✓		
			d	leaf surface area small/reduced ***OR*** leaves replaced with spines ✓		
			e	water storage tissue in leaves/stems/roots ✓		
			f	deep/extensive roots ✓		

(Question 5 continued)

Question			Marking point	Answers	Notes	Total
	c		***a***	models allow one factor/aspect to be studied independently ✓		**3 max**
			b	‹glass› capillary tubes to model adhesion between water and xylem vessel walls ✓		
			c	porous pot to model flow in a xylem vessel due to transpiration from the leaf ✓		
			d	blotting paper ***OR*** porous pot ***OR*** other suitable material to model capillary attraction/adhesion ✓		

*(Plus up to **[1]** for quality)*

Question			Marking point	Answers	Notes	Total
6.	**a**		***a***	exchange occurs in the placenta ✓		**8 max**
			b	large placental surface area due to placental villi ✓		
			c	microvilli on the surface of the villi increase the surface area ✓		
			d	fetal blood flows through capillaries in villi/placenta ✓		
			e	capillaries/fetal blood very close to the surface of the placenta/to mother's blood ✓		
			f	maternal blood flows in inter-villous spaces ***OR*** in spaces around the villi ✓		
			g	membranes/cells separating the fetal and maternal blood are selectively permeable ✓		
			h	water movement by osmosis ✓		
			i	oxygen from mother to fetus by diffusion ✓		
			j	carbon dioxide/urea/waste products from fetus to mother by diffusion ✓		
			k	glucose/amino acids/digested foods from mother to fetus by facilitated diffusion ✓		
			l	antibodies from mother to fetus by endocytosis ✓		
	b		***a***	discovered the circulation of blood ✓		**4 max**
			b	showed that valves in the veins/heart ensure one-way flow of blood ✓		
			c	showed that blood was not consumed by the body ✓		
			d	predicted the existence of capillaries ✓		
			e	showed that the theories of Galen were false ✓		

(Question 6 continued)

Question			Marking point	Answers	Notes	Total
	c		***a***	arteries have thick walls relative to the diameter of the lumen ***OR*** have large amounts of muscle/elastic fibres ✓		**3**
			b	veins have thin walls relative to the diameter of the lumen ***OR*** have valves ✓		
			c	capillaries have a thin wall containing only one layer of cells ***OR*** are about 10 micrometres wide ✓		

*(Plus up to **[1]** for quality)*

Question			Marking point	Answers	Notes	Total
7.	a			*directional selection:*		8 max
			a	natural selection favours one end of the range of variation ✓		
			b	progressive change in a population in that direction ✓		
			c	species changes sufficiently over time to be regarded as a different species ‹in the fossil record› ✓		
			d	isolated population subjected to directional selection while other parts of the species are not ✓		
			e	isolated population eventually different enough not to interbreed/to be regarded as new species ✓		
				disruptive selection:		
			f	extreme types selected for/intermediate types selected against ✓		
			g	extreme types are adapted to different niches ✓		
			h	reproductive barriers become established between extreme types ✓		
				polyploidy:		
			i	having three or more sets of chromosomes ✓		
			j	sometimes occurs due to an error in mitosis/meiosis/cytokinesis/ gametogenesis ✓		
			k	many new species formed as tetraploids ✓		
			l	triploids are infertile/sterile so tetraploids and diploids do not produce fertile offspring together ✓		

(Question 7 continued)

Question			Marking point	Answers	Notes	Total
	b		***a***	international system ✓		**4 max**
			b	names/naming system agreed at congresses ✓		
			c	all scientists use the same names for species ✓		
			d	misunderstandings due to language differences are avoided ✓		
			e	double names are easy to use/remember ✓		
			f	first name is the genus name and shows which other species are closely related ✓		

	c		***a***	consist of pairs of choices ✓		**3 max**
			b	each choice in a pair leads to another pair of choices or gives the identification ✓		
			c	necessary to have a good specimen for identification ✓		
			d	key should only use clear/reliable characteristics ✓		
			e	example of a simple key to illustrate the answer ✓		

*(Plus up to **[1]** for quality)*