21. Biotechnology and genetic modification

21.3 Genetic modification

Paper 3 and 4

Marking Scheme

Q1.

(d)	*genetic modification linked to:* changes the genetic material of an organism ; inserts, change or removes genes ;	**2**	

Q2.

(a)(i)	changing the genetic material of an organism ; by, removing / changing / inserting, (individual) genes ;	**2**	
(a)(ii)	*any one from:* (insertion of human genes) into bacteria, to produce human insulin ; (insertion of genes into crop) plants, to confer resistance to herbicides ; (insertion of genes into crop) plants, to confer resistance to insect pests ; (insertion of genes into crop) plants, to provide additional vitamins ; AVP ; e.g. named examples	**1**	**AW** throughout

Q3.

	organism ; removing ; bacteria ; weeds ; vitamin ;	**5**

Q4.

(e)(i)	restriction (enzyme) ;	**1**	
(e)(ii)	*any two from:* use same (restriction) enzyme to cut cassava DNA ; sticky ends are, formed / joined ; ref. to complementary, ends / base pairs ; (joined by) ligase ;	**2**	

Q5.

(d)(i)	DNA ;	**1**	

(d)(ii)	*any two from:* cross-breeding with wild populations of plants ; expensive ; (named) unknown long-term effects (on the environment / populations) ; ethical considerations with manipulating 'nature' ; AVP ;	**2**	

Q6.

(c)(i)	*any one from:* grow, GM / wild varieties, in glasshouses ; cover flowers ; remove stamens ; plant another species around the crop ; make a large, gap / wall, around the field ; use sterile GM plants ; grow female plants (only) ; AVP ;	**1**	MP1 **A** isolate plants
(c)(ii)	*any two from:* confer resistance, to a (named) factor ; provide additional, nutrients / AW (to humans) ; improved, shelf life / flavour / yield / AW ; environmental protection idea **A** less use of pesticides / pollution ; AVP ;	**2**	

Q7.

(b)(i)	plasmid ;	**1**	
(b)(ii)	restriction (enzyme) ;	**1**	
(b)(iii)	cutting / opening, **A** / the plasmid, with same (restriction) enzyme(s) ; forming, sticky ends ; *idea that* (sticky) ends of human DNA and plasmid DNA are complementary ; reference to, bases / base sequences (of sticky ends) ; correct reference to (DNA) ligase ; e.g. inserting gene / sticky ends joining / splicing AVP ; e.g. **B** is a recombinant (plasmid / DNA)	**3**	
(b)(iv)	reliable / constant, supply ; produce, large(er) quantities / in a fermenter / bacteria reproduce quickly (to make more genetically engineered bacteria) ; not dependent on blood donations ; idea that no (named) health risk(s) ; higher quality of product ; AVP ;	**1**	

Q8.

(e)	disease resistance ; large(r) / fast(er), yield ; drought resistance ; salt resistance ; frost resistance ; (named) nutritional enrichment ; pest / insect, resistance ; herbicide resistance ; vaccine production ; *ref to* benefits to, environment ; *ref to* more desirable, product / increased income / AW ; *ref to a* qualified benefit to humans ; e.g. food shortage / described health benefit AVP ; growth modification e.g. short stems / adaptations to extreme environments / rapid improvement to crop / improvements using characteristic that are not present in natural population	**4**	