

Question number	Answer	Marks	Guidance
1 (a) (i)	Gel electrophoresis;	1	
1 (a) (ii)	Placed (in a well) towards the negative end of the gel; move to the right;	2	
1 (a) (iii)	DNA is negatively charged;	1	
1 (a) (iv)	(gel) slows rate of movement (of fragments); so increase separation;	2	
1 (b)	DNA probe; nucleotide sequence with, fluorescent / radioactive, label; complementary to required fragment; probe binds to required fragment;	4	
1 (c)	Small quantity of DNA obtained; PCR increases quantity of DNA;	2	
1 (d) (i)	(DNA) primers binding to (5' end) of DNA; so DNA polymerase can bind; for replication;	2 max	
1 (e) (i)	Break hydrogen bonds (between strands); to separate double stranded DNA; for semi-conservative replication;	3	
1 (e) (ii)	Both involve the breaking of bonds; due to increased temperature; protein, involves reforming of bonds; DNA, only hydrogen bonds; protein, hydrogen bonds and, other bonds / named; protein, change in, 3D shape /described; DNA, separation of strands forming double helix;	5 max	
2 (a) (i)	Gel electrophoresis, polymerase chain reaction, gene sequencing;;	2	
2 (a) (ii)	Bioinformatics allows scientists to analyse large quantities of data; DNA sequencing involves large quantities of data; DNA sequencing provides evidence for epigenetics; possible role of repetitive sequences in epigenetics;	4	
2 (b)	Reasonable suggested order of importance; explanation of importance of each principle (5); comment on validity of placing principles like these in order of importance;	7	
3 (a) (i)	Gel electrophoresis separates different sized fragments of DNA; repetitive sequences are different lengths;	2	
3 (a) (ii)	Polymerase chain reaction;	1	
3 (a) (iii)	Restriction enzymes; enzymes are specific; different sequences of nucleotides have different 3D shapes;	3	
3 (a) (iv)	One / few, possibilities in paternity testing; lower degree of match can rule subjects out; wider range of possibilities in forensic testing;	3	
3 (b) (i)	Suspect 3	1	
3 (b) (ii)	Homozygous loci will have identical alleles; with identical lengths; producing a single band;	3	
4 (a) (i)	Both increasing; industrialised countries, rate of increase is decreasing; ORA figures quote;	3	

4 (a) (ii)	Increase in intensive farming in industrialised countries; more opposition in industrialised countries; food shortages in developing countries;	3	
4 (b)	Difficult to stop spread of genetically modified plants; idea of 'super weeds'; affect food, chains / webs; reduce biodiversity; cause, allergy / disease; consumers may not be aware of modifications;	6	
5 (a)	Somatic uses of body cells; temporary; not passed on to offspring; germline use of, gametes / embryos; permanent; passed onto offspring;	4	
5 (b) (i)	Mitochondria involved in the production of ATP; large number of mitochondria present (in these cells);	2	
5 (b) (ii)	Nucleus from affected egg transferred to enucleated normal egg; <i>idea of three parents</i> ; reference to ethical issues;	3	
5 (b) (iii)	Yes nuclei of gametes not modified; mitochondrial DNA distinct from DNA in nucleus; DNA not actually modified but exchanged; no changes inherited; present in all cells of offspring;	5	