

5(a)	any four from: mark as pairs Name 1 dNTPs / <u>DNA</u> nucleotides ; Explanation 1 to, anneal / bind, to complementary bases ; Name 2 Taq polymerase ; Explanation 2 to make, phosphodiester bonds / the sugar phosphate backbone / double-stranded DNA / a complementary strand of DNA or ref. to functioning at higher temperature / does not denature at the higher temperature / is thermostable ; Name 3 buffer ; Explanation 3 to provide, optimum / suitable / constant, pH for, polymerase / DNA or prevents, denaturation of polymerase / damage to DNA ;
5(b)(i)	any two from: 1 (DNA ladder) compared to (other fragments) ; 2 ref. to (estimate) length of (DNA) fragment / to identify the fragment number ; 3 ref. to show electrophoresis worked correctly ;
5(b)(ii)	any three from: 1 (PCR) amplifies / makes many copies of, DNA (fragments) ; 2 (PCR) ref. to selecting fragments, small enough / less than 1000 bp / not more than 916 bp (for sequencing) ; 3 (electrophoresis) separate the (DNA) fragments ; 4 (electrophoresis) confirms / identifies, fragment lengths / fragment number / PCR worked correctly ;
5(c)	($2^{35} =$) 3.4×10^{10} ;
5(d)	any four from: 1 child may have disease when, neither parent has the disease / no family history ; 2 early, detection / treatment (for gene therapy to work) ; 3 improve, quality of life / life expectancy ; 4 ref. to informs family planning (for future pregnancies) ; 5 idea that it does not involve additional sampling ; 6 (screening is) expensive ; 7 treatment / gene therapy, expensive ; 8 test may not always be accurate ; 9 long-term effect of treatment, unknown / negative ;

8(a)	any four from: 1 (Liberty Link soybean / it, is) not harmed by / not killed by / resistant to, herbicide / glufosinate ; 2 herbicide / glufosinate, kills, weeds / unwanted plants ; 3 reduces / removes / less / no, <u>competition</u> (with, weeds / unwanted plants) ; 4 <i>ref. to</i> (sun)light / water / (named) <u>soil</u> minerals ; 5 higher yield or more crop, harvested / produced ; 6 AVP ;
8(b)(i)	restriction, enzyme / endonuclease ;
8(b)(ii)	(DNA) ligase ;
8(c)	any three from: <i>some / other / 21, countries:</i> 1 may, have, unsuitable / described problem in, climate / weather / soil ; 2 no regulatory approval / may have banned (GM / Liberty Link) ; 3 may have, (activist) groups / people, opposed to GM crops ; 4 may not have land space available ; 5 may have banned, herbicide / glufosinate ; 6 AVP ;

3(a)	<u>dominant</u> ; 3 / daughter, has disease but, 2 / father, does not or 3 / daughter, could not have the disease if allele were recessive ;
3(b)	any three from: 1 founder effect ; 2 allele / variegate porphyria, present in, migrants / settlers / founding population ; 3 higher frequency than in, Dutch / Europeans / original population ; 4 genetic drift has large effect in small, population / gene pool ; 5 inbreeding / migrants married within their own population ; 6 high frequency of allele maintained over, time / generations ; 7 AVP ;
3(c)	any four from: 1 use mRNA (from person's cells) to make, cDNA / ssDNA ; 2 add fluorescent, label / tag / dye / chemical / marker, to (this ss) DNA ; 3 cDNA / ssDNA, hybridises with / binds to / complementary base pairs with, probe(s) / microarray ; 4 fluorescence shows, disease / mutant, gene / allele, expression / transcription ; 5 AVP ;
3(d)	any one from: 1 find out / diagnose, person's disease ; 2 so can, choose / develop, right treatment ; 3 global, research resource / access ;
3(e)	any three from: 1 change from T to C or replacement / substitution, of T, with / by, C or substitution of C for T ; 2 functional / working / correct / normal, enzyme / protein, produced ; 3 <u>gRNA</u>, is specific to / only finds / just alters, CEP / disease / mutant, allele / gene or <u>gRNA</u> does not bind to genes other than CEP ; 4 AVP ;