

**M1.(a)** 1. Cut (DNA) at same (base) sequence / (recognition) sequence;  
*Accept: cut DNA at same place*

2. (So) get (fragments with gene) **R** / required gene.  
*Accept: 'allele' for 'gene' / same gene*

2

(b) 1. Each has / they have a specific base sequence;  
2. That is complementary (to allele r or R).  
*Accept description of 'complementary'*

2

(c) 1. Fragments L from parent rr, because all longer fragments / 195 base pair fragments;  
*Ignore: references to fragments that move further / less, require identification of longer / shorter or 195 / 135*  
*Accept: (homozygous) recessive*

2. Fragments N from parent RR, because all shorter fragments / 135 base pair fragments;  
*1 and 2 Accept: A3 for 195 and A4 for 135*  
*2. Accept: (homozygous) dominant*

3. (M from) offspring heterozygous / Rr / have both 195 and 135 base pair fragments.  
*Accept: have both bands / strips*  
*Reject: primer longer / shorter*

3

(d) 1. (Cells in mitosis) chromosomes visible;  
2. (So) can see which chromosome DNA probe attached to.

2

(e) (i) 1. For comparison with resistant flies / other (two) experiments / groups;  
*Ignore: compare results / data / no other factors*

2. To see death rate (in non-resistant) / to see effect of insecticide in non-resistant / normal flies.

*Accept: 'pesticide' as 'insecticide'*

*Accept to see that insecticide worked / to see effect of enzyme*

2

(ii) (PM must be involved because)

1. Few resistant flies die (without inhibitor);
2. More inhibited flies die than resistant flies;
3. (PM) inhibited flies die faster (than resistant flies);

(Other factors must be involved because)

4. Some resistant flies die;
5. But (with inhibitor) still have greater resistance / die slower than non-resistant flies.

*Accept: (with inhibitor) die slower than non-resistant flies*

4 max

[15]

- M2.(a)**
1. (If injected into egg), gene gets into all / most of cells of silkworm;
  2. So gets into cells that make silk.

2

- (b)
1. Not all eggs will successfully take up the plasmid;
  2. Silkworms that have taken up gene will glow.

2

- (c) Promoter (region / gene).

1

- (d)
1. So that protein can be harvested;
  2. Fibres in other cells might cause harm.

2

[7]

- M3.(a)** Reverse transcriptase;

1

- (b) 1. Probe (base sequence) complementary (to DNA of allele A / where A is (and) binds by forming base pairs / hydrogen bonds;

*Accept gene A*

2. So (only) this DNA labelled / has green dye / gives out (green) light;

*Accept glows for green light*

2

- (c) (i) 1. More probe binding / more cDNA / mRNA / more allele / gene A means more light;

2. DNA (with **A**) doubles each (PCR) cycle;

3. So light (approximately) doubles / curve steepens more and more (each cycle) / curve goes up exponentially / increases even faster;

3

- (ii) (**G** because)

1. (Heterozygous) only has half the amount of probe for **A** attaching / only half the amount of DNA / allele A (to bind to);

*Accept only one A to bind to*

2. (So,) only produced (about) half the light / glow / intensity (of **H**) (per cycle of PCR);

*If reference to 'half' for point 1, allow 'less light' in 2.*

2

[8]

**M4.(a)** Restriction / endonuclease;

*Ignore specific names of restriction enzymes e.g. EcoR1*

1

- (b) (i) 1. (Acts as a) marker gene to show that the (human) gene has been taken up / expressed;

*1. Accept: gene marker*

2. (Only) implant cells / embryos that show fluorescence / contain the jellyfish gene;

- (ii) 1. Factor IX present in / extracted from milk;
2. Gene only expressed in mammary glands / udder / gene not expressed elsewhere;  
*2. Ignore references to milk*  
*The 'only' aspect is important here.*
3. Do not need to kill sheep (to obtain Factor IX);

2 max

- (c) (i) 1. Mutation / nucleus / chromosomes / DNA may be damaged / disrupts genes;  
*1. Neutral: cell may be damaged*
2. May interfere with proteins (produced) / gene expression / translation;  
*Ignore references to hormone levels or time of implantation*

**OR**

3. Embryo / antigens foreign;  
*3. Neutral: antigens change*
4. Embryo is rejected / attacked by immune system;  
*4. sNeed idea that the immune system is involved if mark point 3 has not been given*  
*'Embryo foreign so rejected' = 2 marks*  
*'Embryo rejected by immune system' = 1 mark*  
*'Embryo is rejected' = 0 marks*

2 max

- (ii) 1. Saves time / money for others;
2. Same work is not repeated / methods can be compared / improved / amended / same errors are not made;

2

**[9]**

**M5.** (a) 1. Adenylate cyclase activated / cAMP produced / second messenger

produced;

2. Activates enzyme(s) (in cell so) glycogenolysis / gluconeogenesis occurs / glycogenesis inhibited;

2. *Neutral: 'glucose produced' as given in the question stem*

*Accept: correct descriptions of these terms*

2

- (b) (i) 1. Glucose / sugar in food would affect the results;  
1. *Accept references to starch / carbohydrate*  
Or  
2. Food / eating would affect blood glucose (level);  
Or  
3. (Allows time for) blood glucose (level) to return to normal;  
3. *Neutral: allows time for insulin to act*

1 max

- (ii) Type 2 diabetes is a failure to respond to insulin / still produces insulin / is not insulin-dependent;

1

- (iii) (For) – 3 max

*A maximum of three marks can be awarded for each side of the argument*

1. Avoids injections / pain of injections;  
2. Long(er) lasting / permanent / (new) cells will contain / express gene;  
*Ignore references to methodology e.g. sample size not known*  
3. Less need to measure blood sugar / avoids the highs and lows in blood sugar;  
4. Less restriction on diet;

(Against) – 3 max

5. Rats are different to humans;  
6. May have side effects on humans;  
6. *Accept: virus may be harmful / disrupt genes / cause*

*cancer*

7. Long(er) term effects (of treatment) not known / may have caused effects after 8 months;
8. (Substitute) insulin may be rejected by the body;

4 max

**[8]**