

# Genetic technology applied to medicine

## Mark Scheme 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Genetic Technology
Sub Topic	Genetic technology applied to medicine
Booklet	Theory
Paper Type	Mark Scheme 3

Time Allowed : 63 minutes

Score : / 52

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a)**
1. rise in blood glucose concentration detected by  $\beta$  cells ;
  2. ( $\beta$  cells) in, islets of Langerhans / pancreas
  3. insulin released into blood
  4. binds to receptors in cell surface membrane
  5. ref. to liver / muscle, cells
  6. increase in uptake of glucose (by cells)  
(cell surface) membrane more permeable to glucose ;
  7. increase in use of glucose in respiration
  8. (increase in) conversion of glucose to glycogen
  9. blood glucose concentration falls
  10. inhibits, glycogen / lipid / amino acid, breakdown
- [max 6]

- (b)**
1. (stick / kit) dipped in (early morning) urine sample ;
  2. hCG / urine, moves up strip
  3. idea that hCG acts as antigen
  4. (mobile) antibody also bound to, indicator / gold
  5. (mobile) antibody in stick binds to hCG
  6. ref. to variable region (of antibody)
  7. ref. to specificity (of antibody) ;
  8. ref. to monoclonal (antibody)
- first window or region*
9. second antibody is, immobilised / fixed
  10. first antibody and hCG complex binds to second antibody
  11. coloured band indicates pregnancy
- second window or region*
12. immobile antibody binds to mobile antibody-gold complex
  13. second coloured band shows strip is working

[max 9]

**[Total: 15]**

- 2 (a) (i) 1. gene isolated ;  
2. inserted into plasmid / AW  
3. correct ref. sticky ends  
4. plasmid taken up by *E. coli* / bacterium ; **R** plasmid inserted into bacterium  
5. detail ; e.g. use of restriction enzyme / cDNA produced [3 max]
- (ii) 1. marker gene linked to gene for wanted protein ;  
2. with promoter  
3. GFP gene is, transcribed / expressed  
4. producing GFP which fluoresces [3 max]
- (b) *disadvantage*  
1. may not fluoresce very brightly / may be difficult to detect ;
- explanation*  
2. only a few molecules of GFP produced ;  
3. each enzyme molecule produces more fluorescent substance /  
*idea of enzymes can be re-used ;* [2 max]

[Total: 8]

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- 3 (a) 1 ref. sticky ends ;  
 2 GATC and CTAG ;  
 3 complementary bases (pairing) ;  
 4 A to T **and** C to G ;  
 5 H-bonds (to sticky ends of plasmid)  
 6 (gaps in) sugar-phosphate backbones sealed by (DNA) ligase ;  
 7 AVP ; e.g. formation of phosphodiester bonds / ref. terminal transferase [4 max]
- (b) (i) 1 *idea of* identifying bacteria that, are transformed / have taken up plasmid / have taken up ampicillin resistance gene ;  
 2 these bacteria have survived ;  
 3 these bacteria may contain pBR322 or recombinant plasmid / plasmids taken up may not contain human insulin gene ;  
 4 other bacteria have been killed ; [3 max]
- (ii) 1 (*Bam*HI) breaks the tetracycline resistance gene ;  
 2 (inserting human insulin gene) makes tetracycline resistance gene inactive ;  
 3 colonies that are ampicillin-resistant but **not** tetracycline-resistant have taken up recombinant plasmid / insulin gene ;  
 4 colonies that survive on, tetracycline / both ampicillin and tetracycline / plate **T**, have not taken up the recombinant plasmid / insulin gene ; [3 max]
- (iii) *Answer on Fig. 2.2*  
 left hand colony on plate **A** ; [1]
- (c) (i) 1 plasmids (easily) transferred between bacteria ;  
 2 (bacteria of), same species / different species ;  
 3 bacteria can acquire antibiotic resistance / renders antibiotic useless / AW ; [2 max]
- (ii) *mark for gene and mark for how product detected*  
 1 gene for  $\beta$  galactosidase ;  
 2 blue colour from X-gal medium ;  
**or**  
 3 gene for  $\beta$  glucuronidase (GUS) ;  
 4 produces product that is easily stained blue ;  
**or**  
 5 gene for, GFP / other fluorescent product ;  
**R** fluorescent / fluorescence, gene  
 6 fluorescence detected when present ;  
**or**  
 7 other gene ;  
 8 how detected ; [2 max]

[Total: 15]

- 4 (a) 1. caused by a single gene ;  
2. caused by a recessive allele ;  
3. delivery of, correct / dominant / normal, allele (could correct the condition) ;  
4. only need to get allele into a few cells ;  
5. ease of access to affected area ;  
6. serious so worth the risk ;  
7. AVP ; e.g. only targets eye / no surgery needed [3 max]
- (b) 1. virus no longer able to cause infections ;  
2. correct / dominant / normal, allele (of *RPE65*) added ;  
3. promoter added ; [2 max]
- (c) 1. ref. to safety / not known if the technique might have side effects ;  
2. rare condition ;  
3. expense ;  
4. AVP ; e.g. trial to see if delivery method works [2 max]

[Total: 7]

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step	reason for step
obtain copies of gene with sticky ends	the gene codes for the synthesis of insulin
plasmid (used) ;	acts as a vector for the transfer of the gene into the host
use restriction endonuclease enzyme	to produce 'sticky ends' <b>or</b> cut at specific, site / sequence ;
mix vector and gene	gene inserts into, vector / plasmid <b>or</b> forms recombinant DNA / AW ;  <b>A detail of complementary base pairing</b>
(use DNA) ligase ;	to seal the sugar-phosphate backbone
insert, plasmid / vector, into host / <i>E. coli</i> / <i>bacteria</i> ;	to obtain transformed host <i>E. coli</i> cells
screen for, and obtain, successfully transformed cells	so only recombinant host cells cultured / AW;
ref. batch / continuous, culture <b>or</b> fermenter <b>or</b> bacterial cloning / population growth ;	to obtain large amounts of insulin for extraction and purification

[7]

[Total: 7]

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