Model Answers: Easy

1a

(a) The production of beneficial proteins is usually carried out by eukaryotic cells, such as yeasts or animal cells in culture, rather than by prokaryotic cells because:

- (Eukaryotic cells) will carry out post-translational modification; [1 mark]
- (By using their) Golgi Apparatus and / or enzymes that are required to produce a suitable human protein; [1 mark]

Allow 'prokaryotic cells are too unsophisticated / simple / are unable to carry out all the stages of human protein synthesis'

[Total: 2 marks]

1b

(b) Three advantages of using genetic engineering to produce recombinant human proteins are:

Three from:

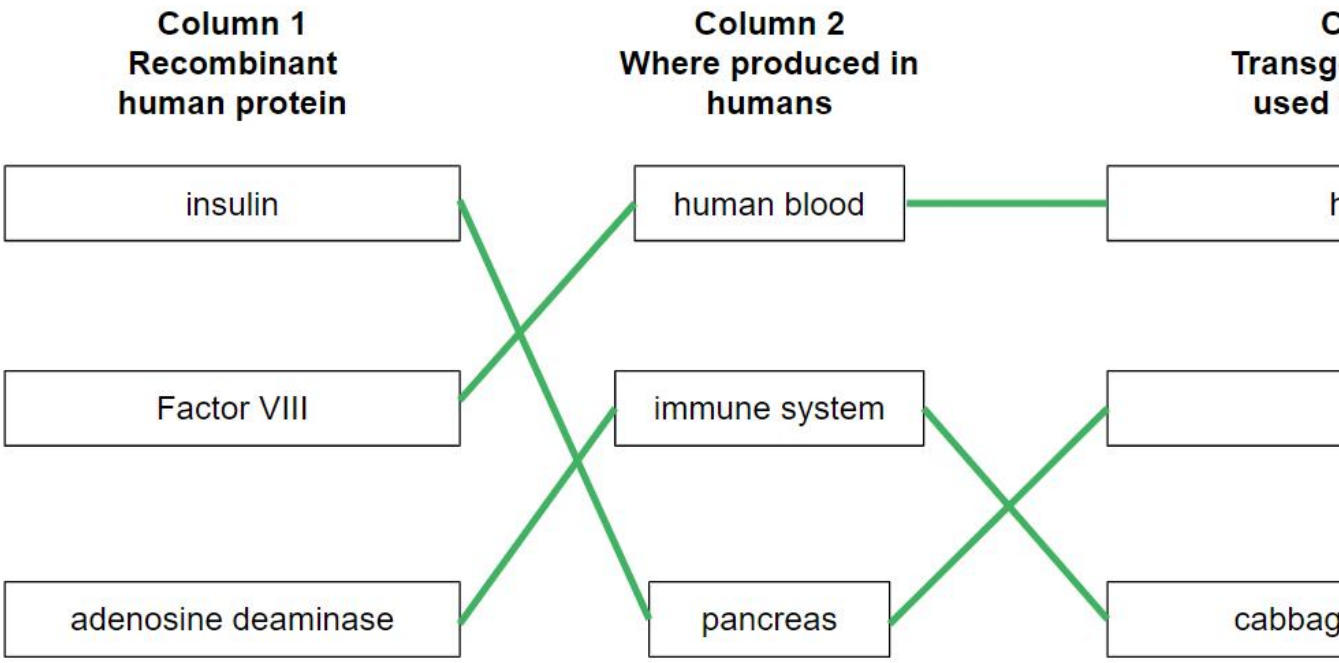
- More cost-effective (to produce large volumes); [1 mark]
- Simpler (with regards to using prokaryotic cells); [1 mark]
- Faster to produce many proteins; [1 mark]
- More reliable supply available; [1 mark]
- The proteins are engineered to be identical to human proteins or have modifications that are beneficial; [1 mark]
- It can solve the issue for people who have moral/ethical/religious concerns against using cow or pork produced proteins; [1 mark]

[Total: 3 marks]

When listing advantages, it is important to make it clear that using GM gives a better outcome than not using it. So to say, 'GM is fast at producing proteins' will not get the mark, but 'GM is faster at producing proteins' will. It's all about comparison versus what was there before.

1c

(c) The correctly-joined boxes from Fig. 1 are as follows:



[1 mark] for each correct pair links from Column 1.

[Total: 3 marks]

1d

(d) Advantages of treating diabetics with recombinant insulin over the use of animal-extracted insulin are:

Two from the following:

- It is identical to human insulin, so no issues of rejection / allergic response / an adverse immune response; [1 mark]
- There is a reliable supply available to meet demand (no need to depend on availability of meat stock); [1 mark]
- Fewer ethical, moral or religious concerns (proteins are not extracted from cows or pigs); [1 mark]
- Cheaper to produce in large volumes; [1 mark]
- That it is useful for people who have animal insulin tolerance; [1 mark]

[Total: 2 marks]

2a

(a) The part of the probe labelled **X** is...

- A radioactive/fluorescent label; [1 mark]

Its role is to...

- Show the presence/location of the probe **OR** shows whether or not the probe has bound to its complementary DNA sequence; [1 mark]

[Total: 2 marks]

The DNA base sequence will bind to its complementary sequence if it is present, and the label shows whether or not this binding has occurred. If the probe binds then its presence can be identified by the label, showing that a particular gene/base sequence is present in a sample.

2b

(b) The process in which a DNA probe binds to a complementary sequence on a DNA strand is called...

- (DNA) hybridisation; [1 mark]

[Total: 1 mark]

2c

(c) The process of genetic screening involves...

Any **three** of the following:

- Patient DNA is isolated / the patient provides a sample of DNA; [1 mark]
- The patient DNA is amplified using PCR; [1 mark]
- Restriction endonucleases are used to cut the DNA into smaller fragments; [1 mark]
- The fragments undergo gel electrophoresis; [1 mark]
- DNA fragments are transferred to a nylon membrane; [1 mark]
- DNA probes are added to the sample/nylon membrane; [1 mark]
- The gel/sample is washed (to remove any unbound probe); [1 mark]
- UV light or an x-ray is used to reveal the position/presence of the probe; [1 mark]

[Total: 3 marks]

There are other ways of carrying out genetic screening, such as the use of a microarray to screen many samples at once, or to screen a sample for multiple different genes. Because there are so many marking points available above, you should still be able to pick up 3 marks for describing a different screening method e.g. Isolate patient DNA [1 mark], add DNA probes to sample [1 mark], wash sample/microarray [1 mark], shine UV light on the sample to reveal probe [1 mark].

2d

(d) A patient might choose to receive genetic counselling because...

Any **two** of the following:

- To help decide whether or not to undergo genetic screening; [1 mark]
- To explain the results of a genetic screening test; [1 mark]
- To help a patient learn about a particular condition / living with a particular condition; [1 mark]
- To discuss treatments available for a genetic condition; [1 mark]
- To discuss lifestyle choices that might reduce the risk of a genetic condition developing / make a genetic condition easier to manage; [1 mark]
- To discuss implications of a (potential) parent's result for children / future children / deciding whether or not to have a child / deciding whether to continue with a pregnancy; [1 mark]
- To discuss ethical issues thrown up by any results gained (e.g. pregnancy termination); [1 mark]

[Total: 2 marks]

3a

(a) Two techniques that can be used to obtain cells from a growing foetus in order for that foetus to undergo genetic screening are:

- Amniocentesis; [1 mark]
- Chorionic villus sampling / CVS; [1 mark]

Allow a description of sampling amniotic fluid

[Total: 2 marks]

It's important to note that these two techniques pose inherent risks of miscarriage and can only be carried out in the first half of a normal-term pregnancy: 10-15 weeks for amniocentesis and 10-13 weeks for CVS. A normal full-term pregnancy is 40 weeks.

3b

(b) Gene delivery has been largely difficult to implement because:

One from the following:

- Difficulty inserting alleles to replace faulty ones; [1 mark]
- Lack of a suitable vector; [1 mark]
- New alleles are only expressed in existing cells and not in future generations; [1 mark]
- (Giving) only short-term relief (from the symptoms); [1 mark]

[Total: 1 mark]

3c

(c) The terms *in vivo* and *ex vivo*:

- Both involve genes/alleles being delivered into cells/nuclei/chromosomes; [1 mark]
- *In vivo* means delivery into cells **inside** the body **whereas** *ex vivo* is delivered into cells **outside** the body; [1 mark]

[Total: 2 marks]

For a [2 mark] question where the command line is 'compare and contrast' it is reasonable to answer on the basis that the examiners are looking for **one** similarity and **one** difference between the two modes of delivery.

3d

(d) The choices that genetic screening may offer this couple in their family planning considerations are:

Two from the following:

- Establishing whether they (the parents) are carriers / heterozygous or non-carriers / homozygous; [1 mark]
- Assessing the likelihood / % chance of a child inheriting the condition; [1 mark]
- (If already pregnant) taking steps to prepare for the birth / further care of a child with the condition; [1 mark]
- Making a decision on birth/termination (if medical criteria / religious / ethical beliefs allow); [1 mark]
- Whether to participate in research / clinical trials; [1 mark]

[Total: 2 marks]