

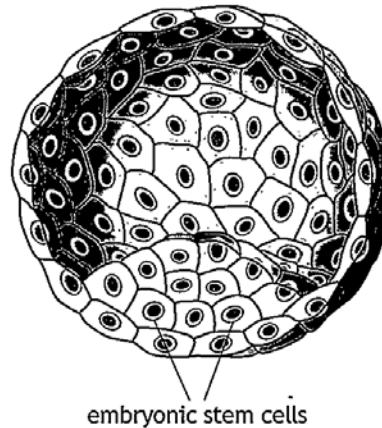
Candidate 1 evidence

Total marks — 95

Attempt ALL questions

Question 14 contains a choice

1. The diagram shows an early stage in the development of a human embryo.



- (a) (i) The embryonic stem cells shown can differentiate into all body cell types.
State the term that describes this feature of these cells. 1
- pluripotent
- (ii) Explain why embryonic stem cells can differentiate into all cell types. 1
- turn genes on or off to express traits.
- (b) State the number of chromosomes in the nuclei of cells produced when germline stem cells divide by meiosis. 1
- ~~46~~ 23

1. (continued)

- (c) Stem cells can be cultured in the laboratory for research purposes.

State one way in which stem cells are used in research.

1

Used to study how stem cells
work in different conditions

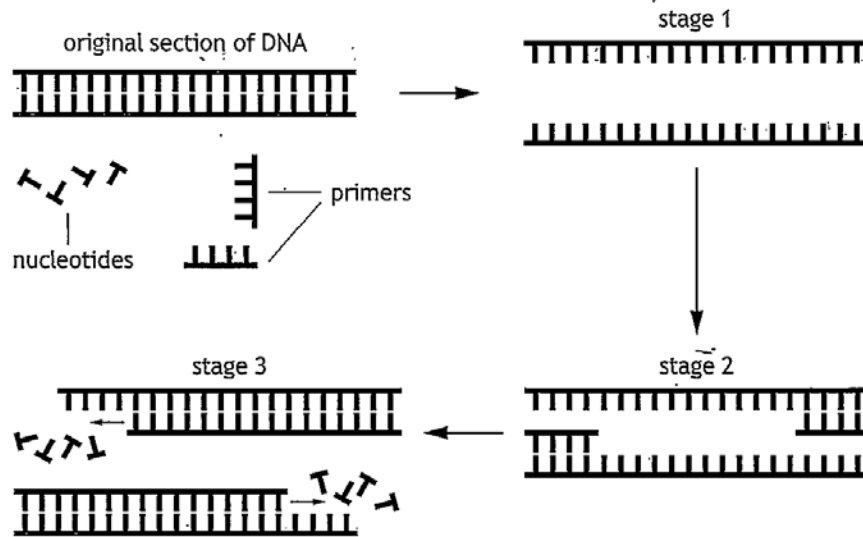
- (d) Scientists have recently found a way of converting skin cells into embryonic stem cells.

Suggest why this is an advantage from an ethical viewpoint.

1

Does not destroy embryos.

2. The polymerase chain reaction (PCR) is a process used to help solve crimes. The diagram shows the stages in one PCR cycle.



(a) Each stage of PCR is temperature dependent. Complete the table for stages 1 and 3.

2

Stage	Temperature (°C)	Reason
1	95	Separate strands
3	50	To allow replication of DNA

2. (continued)

3 4
6 16

(b) Each PCR cycle produces two copies of a section of DNA.

This PCR cycle takes 3 seconds.

Calculate how long it would take for at least 2000 copies of the original section to be produced.

1

Space for calculation.

768s

(c) Describe the role of primers in stage 2 and stage 3.

2

Stage 2 Bind to specific target sequence.
(complimentary)

Stage 3 primers released.

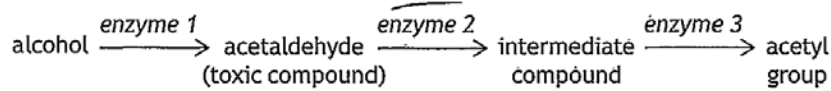
(d) PCR was first used to help solve a crime in 1986.

Suggest why PCR can now be used to help solve a crime committed in 1980, where only a small blood spot was found as evidence.

1

can make copies of DNA evidence

3. The diagram shows some of the stages in the breakdown of alcohol by the liver.



- (a) Use information from the diagram to explain how alcohol can be used as a substrate in respiration. 2

acetyl group is used in the
citric acid cycle. combines with
Co-enzyme A to make acetyl
Co-enzyme A.

- (b) Some individuals cannot produce enough fully functioning enzyme 2.

- (i) In these individuals an altered form of enzyme 2 is produced due to a missense mutation.

Suggest why this altered form of enzyme 2 works less well than the unaltered form. 1

altered amino acid changes
shape of the enzyme.

- (ii) Explain why these individuals are less tolerant of alcohol. 1

Unable to break down
acetaldehyde into the intermediate
compound,

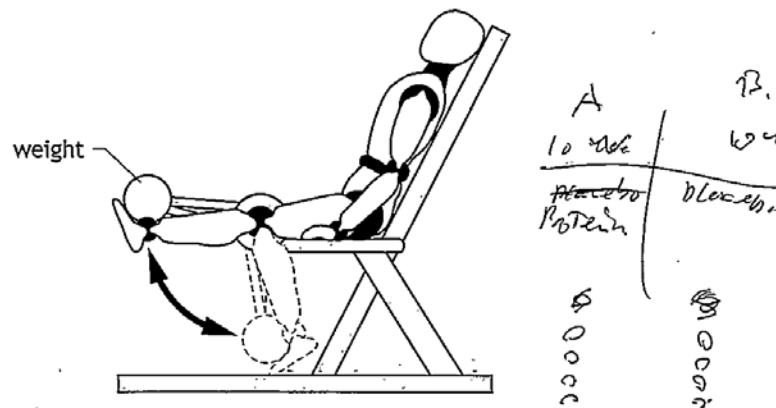
- (c) A drug that acts as a competitive inhibitor of enzyme 2 can be prescribed to treat alcoholism.

Explain how this drug will affect the enzyme. 1

slow down the breakdown of
acetaldehyde.

4. A protein supplement is used by some people who take part in sport. They believe its use increases muscle mass and therefore improves performance in sporting activities such as weightlifting.

An investigation was carried out to test if protein supplements improved the ability of the upper leg muscles to raise weights.



A class of 20 students was divided into two groups, A and B. The groups were balanced for age, gender, fitness level and body mass.

Each student carried out 10 weeks of regular training on the apparatus.

Students in group A took a daily dose of a protein supplement.

Students in group B took a daily dose of a placebo.

All students had their results recorded every 2 weeks for 10 weeks, by measuring the maximum weight that could be raised using the apparatus shown in the diagram.

- (a) State two additional variables, other than those described above, that would need to be controlled during this investigation. 2

1. Type of protein supplement.
2. dosage of protein supplement.

4. (continued)

(b) The results from the investigation are shown in Table 1.

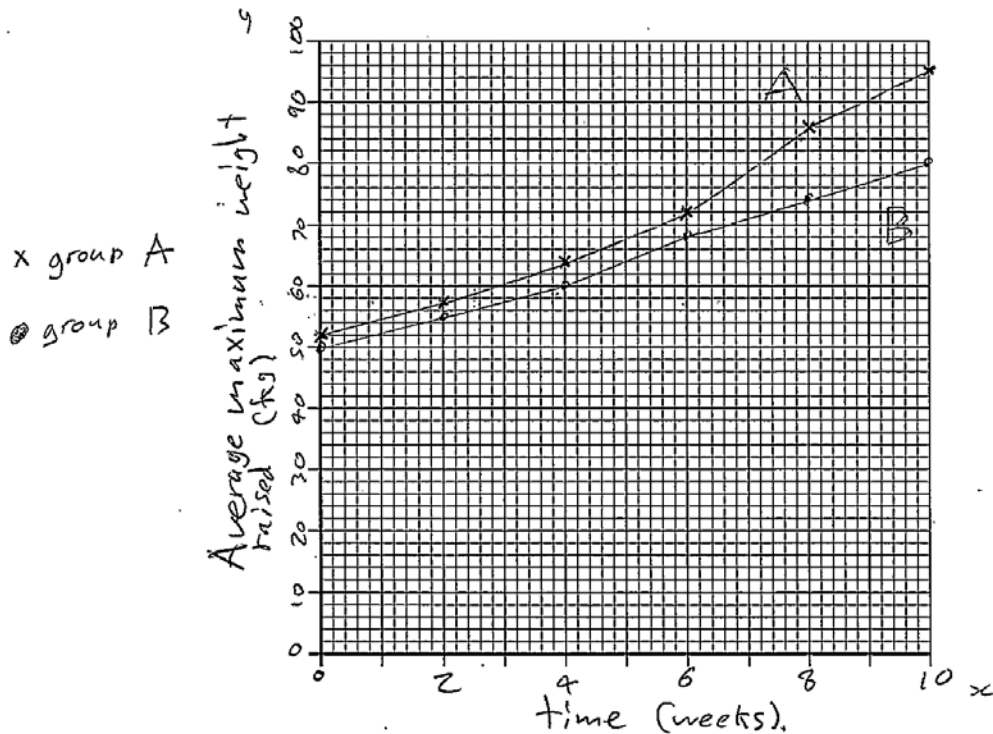
Table 1

Time(weeks) Group	Average maximum weight raised (kg)					
	0	2	4	6	8	10
A (protein supplement)	52	57	64	72	86	95
B (placebo)	50	55	60	68	74	80

(i) Draw a line graph to show all the data in Table 1.

(Additional graph paper, if required, can be found on page 30)

3



(ii) State the conclusion that can be drawn from these results.

1

protein ~~A~~ supplement increases performance.

4. (b) (continued)

(iii) Suggest a reason for the increase in performance of Group B. 1

working the muscles increases strength without supplement.

(c) The average body mass and percentage body fat of the students was measured at the start of the investigation and after 10 weeks.

The measurements for each group are shown in Table 2.

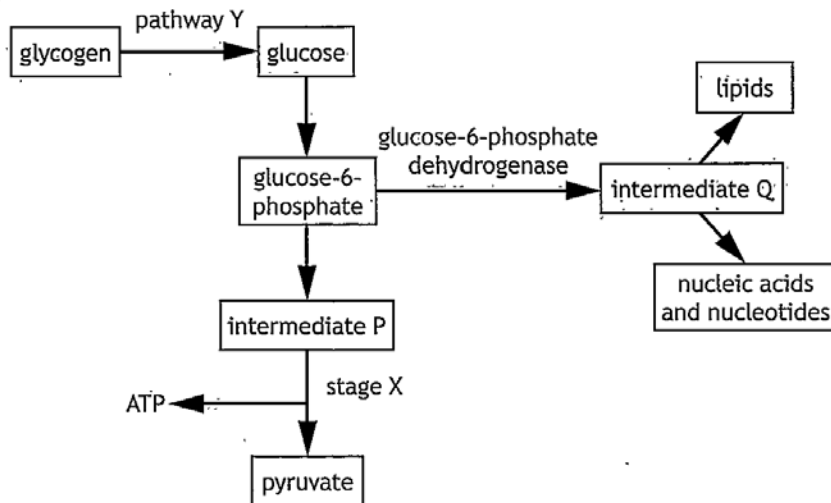
Table 2

Group	Measurement	Start (0 weeks)	After 10 weeks
A (protein supplement)	body mass (kg)	60.7	62.5
	body fat (%)	28.3	23.8
B (placebo)	body mass (kg)	60.5	61.3
	body fat (%)	27.9	25.8

Use the data to explain why taking protein supplements resulted in a greater increase in muscle mass. 2

Although group taking the supplement gained more weight, body fat is lower. Muscle weights more than fat.

5. The diagram is a summary of part of a respiratory pathway in a cell.



(a) Give evidence from the diagram that confirms stage X is the energy pay-off phase. 1

ATP is generated.

(b) State the function of dehydrogenase enzymes. 1

collects H^+ ions and e^-

(c) Name a hormone that is involved in pathway Y. 1

glucagon

5. (continued)

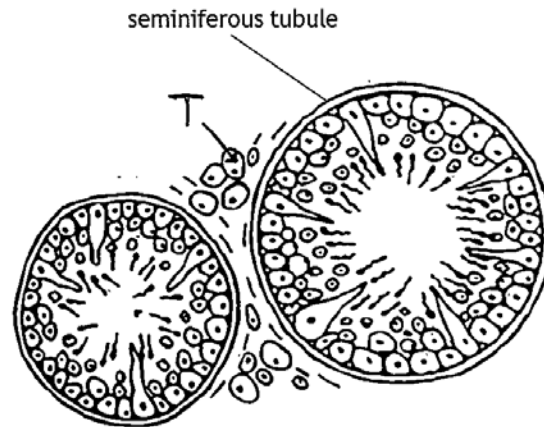
- (d) Some individuals are unable to produce the enzyme glucose-6-phosphate dehydrogenase.

Use information from the diagram to explain why this would reduce cell division in these individuals.

2

glucose-6-phosphate dehydrogenase will be
not be there to turn glucose-6-phosphate
into intermediate Q. this will ~~prevent~~ ^{mean}
lipids can't be made to create a new
membrane and nucleic acids/nucleotides
are no available for the DNA to
replicate.

6. (a) The diagram shows part of a testis.



- (i) Use the letter T to label a cell in the diagram that produces testosterone. 1
- (ii) Describe two functions of testosterone. 2

1 promotes production of sperm

2 increases libido

- (iii) Describe how negative feedback control raises the concentration of testosterone in the blood if it has fallen to a low level. 2

Low levels of testosterone is detected
in the blood, this causes the
hypothalamus to release interstitial
cell releasing hormone which
causes the interstitial cells to
produce more testosterone in the
blood.

6. (continued)

- (b) Artificial insemination (AI) and intra-cytoplasmic sperm injection (ICSI) are fertility treatments that may be used if a man has a low sperm count.

Describe how each of these treatments increases the chance of fertilisation.

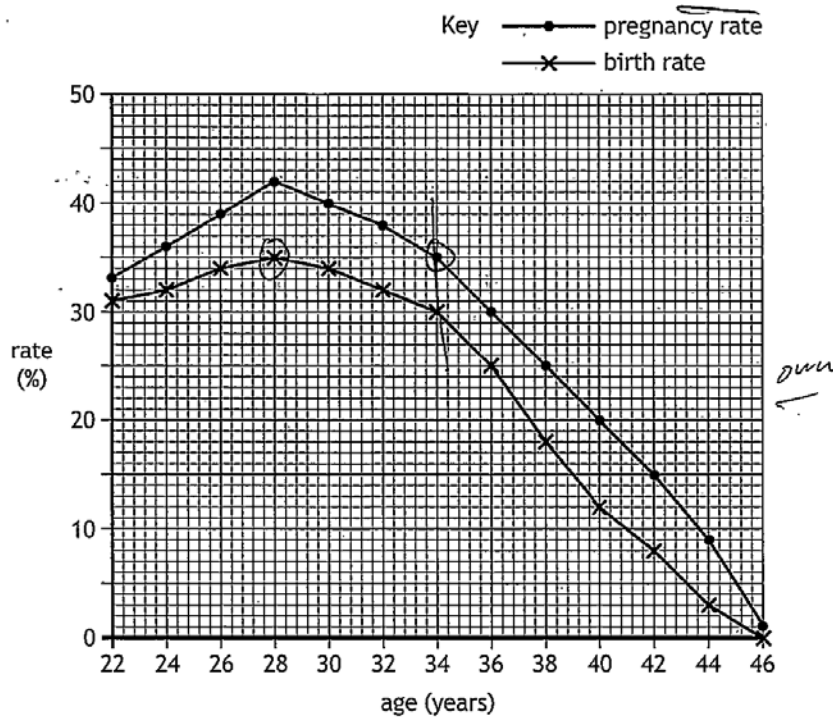
2

AI many samples of the male sperm are pooled together, so a higher sperm count is available to fertilise an ova.

ICSI head of the sperm is directly injected into the ova,

7. Data from *in vitro* fertilisation (IVF) clinics is used to indicate how a woman's age can affect the success rate of IVF.

(a) The graph shows the effect of age on pregnancy and birth rate after using IVF. The data refers to women using their own eggs.



(i) State one similarity and one difference in the trends for pregnancy and birth rate.

2

Similarity Age 28 is the ideal age to undergo IVF treatment.

Difference pregnancy rate is higher for each age group. (higher than birth rate).

7. (a) (continued)

(ii) Calculate how many 34 year old women in a sample of 1000 would be predicted to get pregnant using IVF. 1

Space for calculation

35% of 1000

350

(b) Some women are given the option to use eggs from a donor when undergoing IVF. This can increase their chances of becoming pregnant and giving birth.

(i) The table shows the birth rates for women of different ages after undergoing IVF using donor eggs.

Donor -

Age (years)	22	26	30	34	38	42	46
Birth rate (%)	46	64	60	58	54	48	40

Using data in the table and graph, calculate the difference in birth rate for women aged 38 when using donor eggs rather than their own eggs. 1

Space for calculation

$(54 - 49) / 54 \times 100 =$

answer ↓

donor	54%	
own	35%	<u>35%</u>

(ii) Suggest why older women undergoing IVF are more likely to produce a child when using donor eggs rather than their own eggs. 1

Donors have healthier eggs, birth rate for older woman using donor eggs is higher than using own because younger.

(c) Some women undergoing IVF consent to pre-implantation genetic diagnosis (PGD) of their embryos.

Explain why PGD is offered to some women. 1

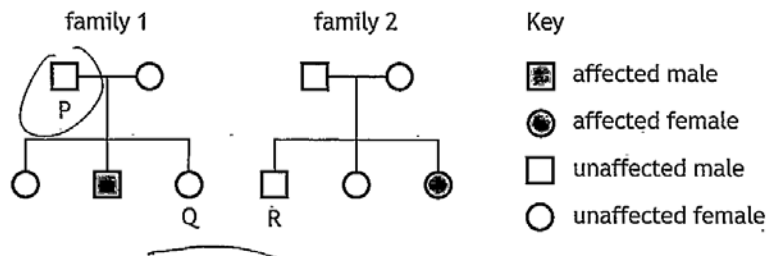
family history of genetic diseases.

8. Adenosine deaminase (ADA) deficiency is an autosomal recessive disorder that affects the immune system. It is caused by a mutation in the gene that codes for this enzyme.

- (a) Describe the difference between an autosomal disorder and a sex-linked disorder. 1

Autosomal ^{recessive} disorders ~~are~~ ^{can} skip generations and both alleles must be expressed for the trait to be shown. sex-linked mostly affects boys.

- (b) The chart shows the inheritance of ADA deficiency in two families.



- (i) State the genotype of individual P using 'a' to represent the allele for ADA deficiency. 1

Aa

- (ii) Individuals Q and R plan to have a child together.

Use information from the chart to explain why it is difficult to predict the chances of their child having the disorder. 1

Unknown if they are both "carriers" of the recessive genetic disease.

8. (continued)

- (c) Individuals with ADA deficiency have severely reduced numbers of lymphocytes. They can be treated by a bone marrow transplant.

Suggest how this treatment can help to restore a functional immune system.

1

increase amount of lymphocytes
B & T lymphocytes.

- (d) Amniocentesis and chorionic villus sampling (CVS) are examples of antenatal tests that can be carried out.

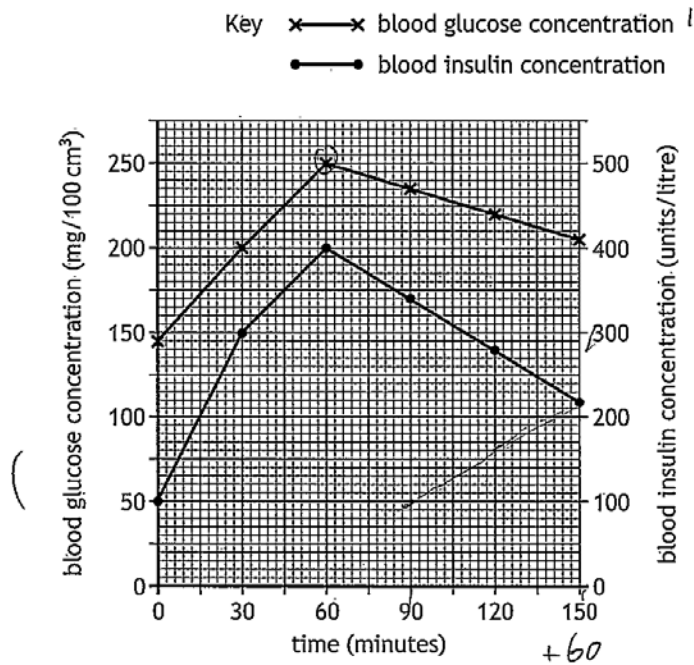
Describe an advantage and a disadvantage of using amniocentesis rather than chorionic villus sampling (CVS).

2

Advantage safer

Disadvantage takes longer to get results.

9. A man had a glucose tolerance test to indicate if he had type 2 diabetes. The graph shows changes in the concentrations of glucose and insulin in his blood during 150 minutes, after drinking the glucose solution.



- (a) State the man's blood insulin concentration when his blood glucose concentration was 200 mg/100 cm³. 1

300 units/litre

- (b) The man's blood glucose concentration will eventually return to its original value. Predict how much longer this will take after 150 minutes. 1

Space for calculation

60 minutes

9. (continued)

- (c) This man's body contains 5 litres of blood.

Calculate the total mass of glucose in his bloodstream at 60 minutes. 1

Space for calculation

$$250 \text{ mg} / 100 \text{ mL}$$

5

$$\underline{12500 \text{ mg}}$$

- (d) (i) The glucose tolerance test indicated that this man had type 2 diabetes.

Explain why production of insulin did not lower his blood glucose concentration in the first hour of the test. 2

~~insulin receptors~~ no to little
 or no functioning insulin receptors
 to allow the intake of glucose
 by the liver and cells.

- (ii) Suggest one reason why this man's blood glucose concentration started to decrease after 60 minutes. 1

glucose is being used up, but
 slowly.

- (e) Describe evidence from the graph that indicates this man does not have type 1 diabetes. 1

there would be no decrease
 in blood glucose levels

- (f) Apart from reducing the sugar intake in his diet, suggest another way in which this man could control his blood glucose levels. 1

~~inject insulin~~
 exercise more.

10. (a) (continued)

- (iv) Explain how the data in the table allows a valid comparison of deaths from CVD between England and Scotland to be made, despite their populations being different sizes. 1

~~Large sample size~~
~~different~~ different genders used.

- (b) Three thousand men took part in a clinical trial to investigate the effect of a cholesterol reducing drug. Half the men were given the cholesterol reducing drug while half were given a placebo.

- (i) Describe how a double-blind design could be achieved when setting up the clinical trial. 1

Use a computer to randomize participants to avoid experimenter bias.

- (ii) State what aspect of the design of the study increased the reliability of the results. 1

3000 men is a large sample size

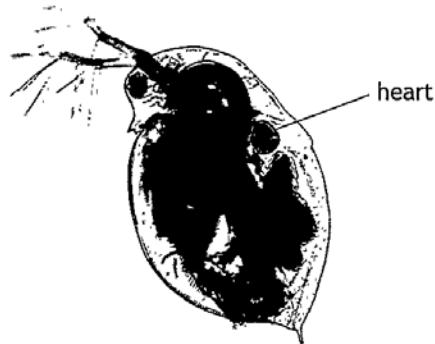
- (iii) Researchers concluded that taking the cholesterol reducing drug decreased risk of death from CVD, as it lowered the concentration of LDLs in the blood.

Explain why having a lower LDL concentration in the blood decreases the risk of death from CVD. 2

LDL can contribute to high cholesterol in the blood which can lead to atheromas being formed.

11. (a) The water flea, *Daphnia pulex*, is a small invertebrate animal that lives in ponds.

Water fleas can be used as model organisms to investigate the effect of chemicals on heart rate.



A student carried out an investigation to find out how caffeine concentration affects the heart rate of water fleas.

A water flea was placed in a small container of pond water and left for 5 minutes. The container was then placed under a microscope and the water flea videoed for a period of time. The video was analysed and the heart rate of the water flea calculated. This procedure was then repeated using different concentrations of caffeine solutions.

The results of the investigation are shown in the table.

Caffeine concentration (g/l)	Heart rate of water flea (bpm)
0	135
0.2	185
0.4	220
0.6	245
0.8	270
1.0	270

- (i) Suggest why the student left the water flea in the solution for 5 minutes before videoing its heart rate.

1

to allow time for the water
flea to get used to its
environment.

11. (a) (continued)

- (ii) Suggest why the student videoed the water flea rather than simply counting its heart beat at the time. 1

to avoid human error when counting.

- (iii) Use data from the table to describe the changes that occur in the heart rate as the caffeine concentration increases. 2

as caffeine concentration increased, the heart rate of the water flea also increased. until 0.8 g/l it ~~remains~~ remains at 270 bpm.

- (iv) State how the reliability of the results from this investigation could be improved. 1

repeat experiment 3 times and get an average.

- (b) In humans, describe how the autonomic nervous system increases the heart rate. 3

involuntarily, the medulla releases noradrenaline which causes the sino-atrial ~~node~~ node (pacemaker) to send a signal the atrial ventricular node to cause an excitatory response, stimulating the cardiac fibres, increasing heart rate.

12. Endorphins and dopamine are neurotransmitters that affect mood and behaviour.

(a) (i) State one activity that increases endorphin production.

1

eating chocolate

(ii) State one function of endorphins.

1

creates a reward pathway

(b) Parkinson's disease is associated with a loss of dopamine-producing neurons in the brain. It cannot be treated by taking dopamine.

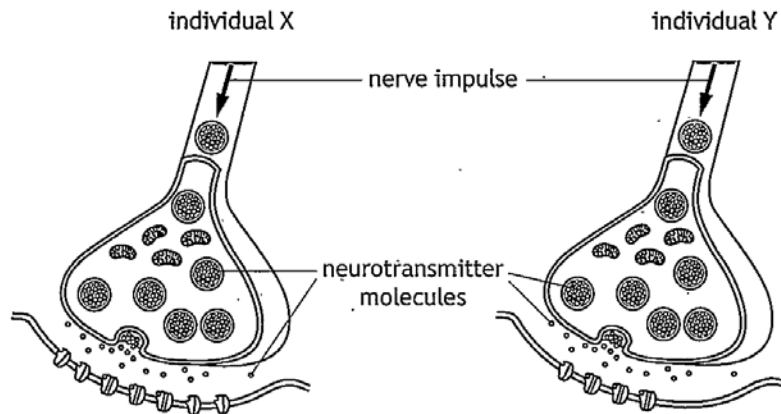
Describe a possible mode of action of a drug that could be used to treat this disease.

1

12. (continued)

(c) The diagram shows synapses from the brains of two individuals.

Individual X has never taken recreational drugs while individual Y has used a recreational drug for a long time.



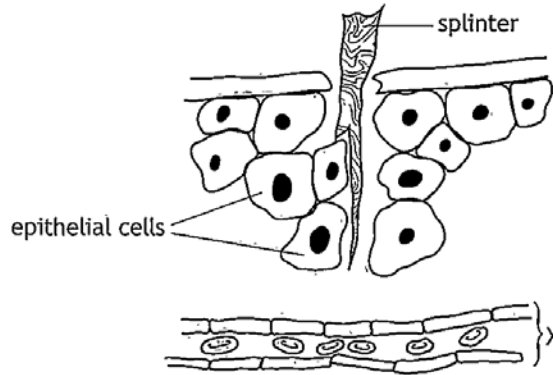
(i) Describe how the recreational drug has acted on the synapse of individual Y. 1

reduction of post-synaptic receptors.

(ii) Describe how changes to the synapses of individual Y will affect their drug-taking behaviour. 1

decrease increase tolerance of the drug

13. The diagram represents a section of human skin punctured by a splinter of wood.



- (a) (i) Describe one way in which these epithelial cells defend the body against pathogens. 1

physical barrier.

- (ii) Name structure X. 1

capillary.

- (b) The inflammatory response involves the release of the chemical histamine.

- (i) Name the cells that release histamine. 1

mast cells

- (ii) Explain why the skin around a puncture wound often becomes red and swollen. 1

~~vaso~~ vasodilation of blood vessels.

- (c) Lymphocytes are part of the specific defence system of the body.

- (i) Explain how a lymphocyte is able to recognise a particular pathogen. 1

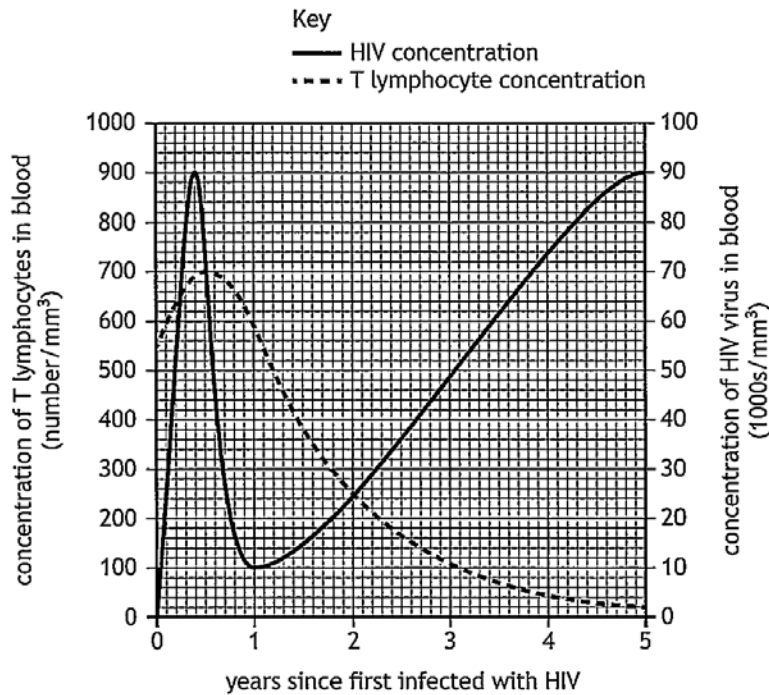
Antigen presented on pathogen.

13. (c) (continued)

(ii) Describe how T lymphocytes destroy infected body cells. 1

natural killer.
~~Nk cell inject destroying~~
 enzymes to denature the infected cell.

(d) The graph shows the concentrations of the HIV virus and T lymphocytes in the blood of an individual in the years following HIV infection.



(i) Suggest a reason for the decrease in HIV concentration during the first year after infection. 1

(ii) Explain why the T lymphocyte concentration is decreasing between 1 and 5 years after infection. 1

HIV is causing the immune systems to attack the T-cells.

14. Attempt either A or B. Write your answer in the space below and on page 29.

A Discuss the encoding, storage and retrieval of information in memory. 9

OR

B Describe vaccination and discuss its role in establishing herd immunity in a population. 9

You may use labelled diagrams where appropriate.

Encoding:

Visual encoding is when visual information is transferred into working memory.

Auditory encoding is when sound/ audio information is translated and transferred into memory.

~~Semantic to sensory encoding.~~

mostly visual and auditory information is transferred from the sensory memory (0.5-2 seconds) to the short-term memory,

14
A).

ADDITIONAL SPACE FOR ANSWER to question 14

Storage is when information is kept in memory over time. Information is stored in short term memory for 30 seconds and can be stored in long term memory for up to a lifetime. When information is retrieved from long term memory e.g. contextual cues, then it is moved to the short term memory. Short-term memory can only store 7 items at a time. Information can ~~be~~ be transferred from STM to LTM through ~~rehearsal~~ ^{rehearsal}, organisation and elaboration. Also, STM capacity can be increased by rehearsal. Organisation of information can ~~include~~ include mind maps or headings, subheadings etc.

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

14
a)

rehearsal of information is simply repeating information and can be improved by elaboration, elaboration is adding extra information eg.

instead of learning the name of a place, you can also learn more details about the place. information can be lost from STM

by decay or displacement, displacement is when old information is replaced by new information,