Semester One Examination 2015

Question/Answer Booklet

HUMAN BIOLOGICAL SCIENCE

Stage 3

Name Solutions

Class _____

Teacher Name _____

Time allowed for this paper

Reading time before commencing work: Ten minutes

Working time for paper: Three hours

Materials required/recommended for this paper

To be provided by the supervisor:

This Question/ Answer Booklet

Multiple Choice Answer Sheet

Two Extended Answer Booklets: Part A and Part B

To be provided by the candidate

Standard items: Pens, pencils, eraser, correction fluid, ruler, highlighters

Special items: Non-programmable calculators satisfying the conditions set by the Curriculum Council for this course

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

SECTION ONE: MULTIPLE CHOICE

Total

CROSS THE BEST ALTERNATIVE

1	**A**	B	C	D	16	**A**	B	C	D
2	A	B	**C**	D	17	A	**B**	C	D
3	A	B	**C**	D	18	A	B	C	**D**
4	A	B	**C**	D	19	A	B	C	**D**
5	A	B	C	**D**	20	A	B	**C**	D
6	A	B	C	**D**	21	**A**	B	C	D
7	A	**B**	C	D	22	A	**B**	C	D
8	A	**B**	C	D	23	A	B	**C**	D
9	A	B	**C**	D	24	A	B	**C**	D
10	A	**B**	C	D	25	A	B	C	**D**
11	A	**B**	C	D	26	A	**B**	C	D
12	A	B	**C**	D	27	A	B	C	**D**
13	A	B	**C**	D	28	A	B	C	**D**
14	A	**B**	C	D	29	A	**B**	C	D
15	A	B	**C**	D	30	A	B	C	**D**

Part II **(100 marks)**

Write answers to ALL questions on the ruled lines after each question or in the spaces provided within each table. Write your answers in blue or black ballpoint or ink pen.

Question 31 **(13 marks)**

A pharmaceutical company was investigating the possibility of a new drug for the treatment of patients with heat stroke or hyperthermia. The designed effect of the drug was to increase the skin blood flow of the patients within minutes of administering the drug intra-venously.

In order to test the efficacy of the drug a trial was conducted in which patients admitted to the emergency rooms of hospitals with heat stroke were asked if they wished to participate. A total of 180 patients agreed to take part over the duration of the trial.

Participants were put in to one of two groups. One group of patients would receive an intra-venous injection of the new trial drug and the other group would receive an intra-venous injection of saline (sterile salty water). The normal protocols for treating patients with heat stroke were also carried out for both experimental groups. Each group had 90 individuals.

The skin temperature of participants was recorded on their administration to the ER and every ten minutes after their intra-venous injection. A summary of this data is included in the table below.

Examine the data presented and answer the questions that follow.

The effects of new drug on lowering body temperature of patients suffering heat stroke

Treatment group	Number of patients	Average Temperature (°C) on admission	Average Temperature (°C) following administration of drug or saline					
			10 min	20 min	30 min	40 min	50 min	60 min
New drug	90	40.8	39.9	38.6	37.5	37.3	37.2	37.2
Saline	90	40.6	39.9	39.3	38.7	38.2	37.8	37.4

a) State the hypothesis for this investigation.

The new drug will reduce body temperature quicker than saline.

(1 mark)

b) State the following variables:

Independent variable: Substance - drug or saline

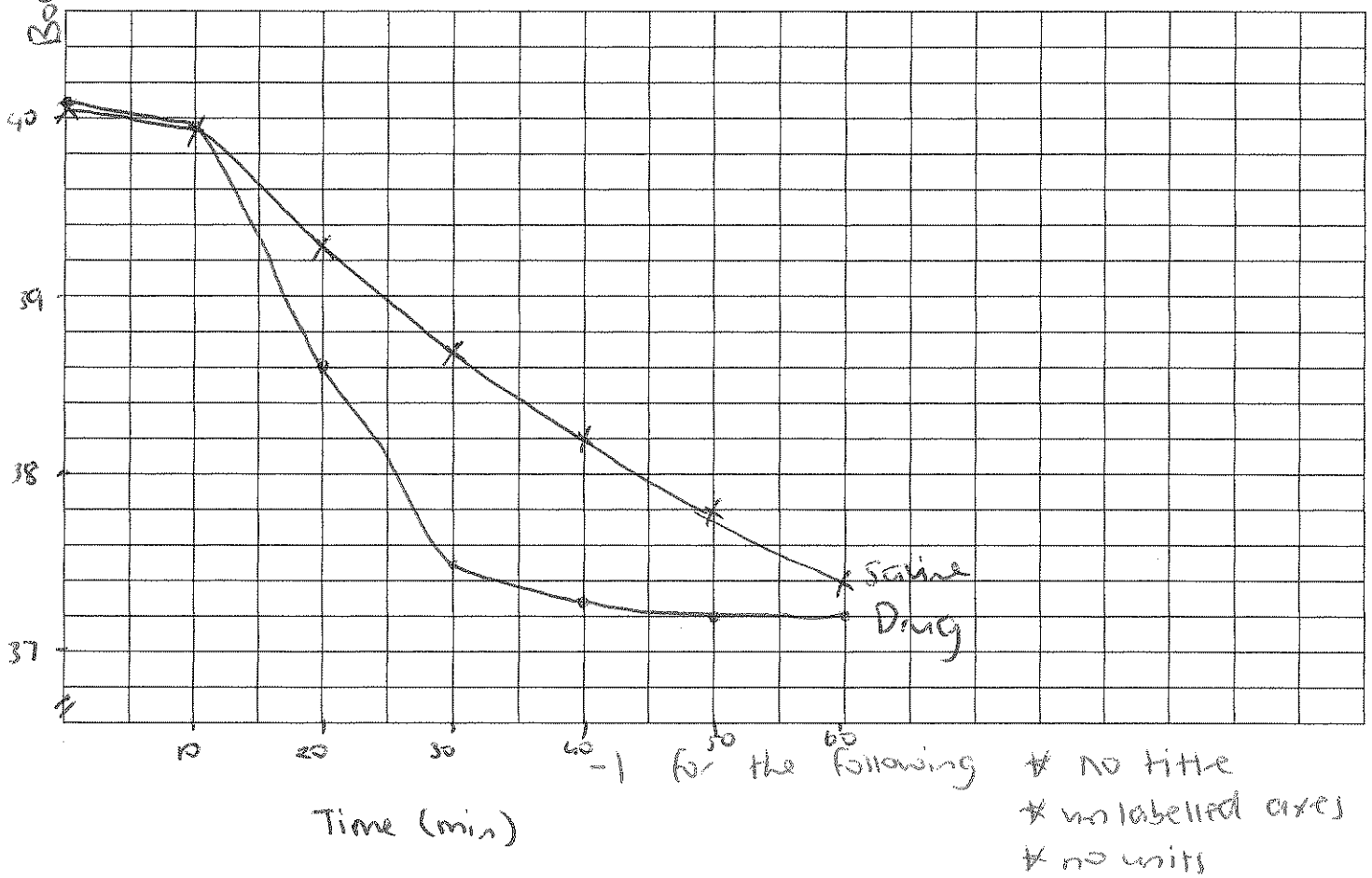
Dependent variable: Body temperature

(2 marks)

c) On the grid provided, construct a graph that can be used to represent this data (A spare grid is provided at the back of this booklet).

(4 marks)

The Effect of Drugs on Body Temperature



-1 for the following
* no title
* unlabelled axes
* no units
* inaccurate plotting
* inconsistent scale

d) Write a valid conclusion for this investigation.

The new drug reduced body temperature quicker than saline.

(1 mark)

e) Why was one group given the saline injection?

(1) This was the control group

(1) Used to compare the results of the new drug to see if it was more effective at reducing body temperature.

(2 marks)

f) Use the data above to explain the effect of this drug on blood flow to the skin.

(1) ↑ vasodilation

(1) ↑ blood flow to skin

(1) ↑ heat loss via radiation

(3 marks)

Question 32 (5 marks)

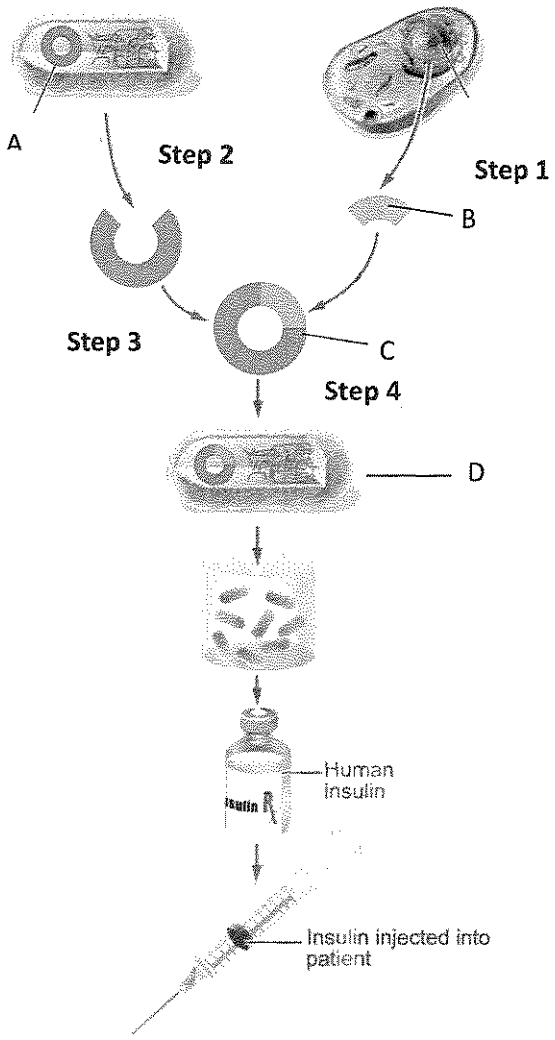
A lady has been diagnosed with 'hyperthyroidism'. Complete the table summarising the cause, symptoms and treatment for this disease.

Cause Any 1 (1)	Auto immune disease (Grave's Disease) ↑ thyroxine levels Excess iodine in diet Tumour of thyroid or Pituitary gland
Symptoms (x2) (2)	weight loss Hunger Sweating Restlessness Protruding eyes Anxiety
Treatment(s) (2)	Radioactive iodine to destroy thyroid cells Anti thyroid medication to ↓ thyroxine production Surgery to remove part of the thyroid.

(5 marks)

Question 33 **(11 marks)**

With reference to the diagram below:



a) Label the following:

½	A	Plasmid
½	B	Insulin gene (O if state gene of interest)
½	C	Recombinant DNA
½	D	Transgenic organism

(2 marks)

b) In the table below, describe the sequence of events that results in the formation of recombinant DNA in a transgenic organism.

Step	Description of events
1	Removal of insulin gene using restriction enzyme (½) (½)
2	Removal of bacterial plasmid + treating with same restriction enzyme (½) (½)
3	DNA ligase to combine insulin gene into plasmid (1)
4	Plasmid taken up by bacteria (1)

(4 marks)

c) Insulin is an important hormone for regulating blood glucose levels.

e) Which cells are responsible for secreting insulin in the human body?

Beta cells

(1 mark)

ii) What is the advantage of using recombinant technology instead of more traditional techniques to harvest insulin?

* Any one

(1 mark)

Less risk of body rejecting the insulin
Less side effects
Insulin is identical to human insulin

iii) Explain why individuals suffering from Type 1 Diabetes require insulin injections.

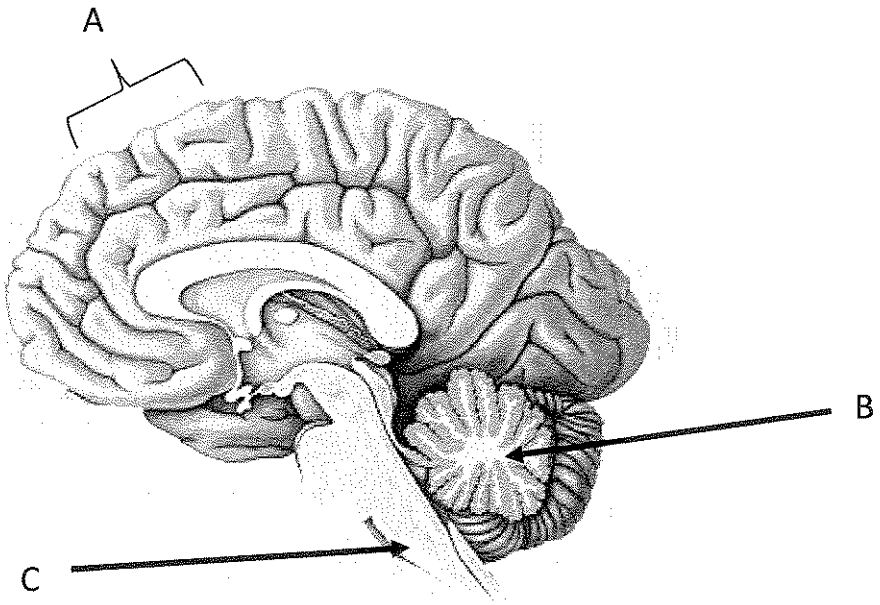
* max 3 marks.

(3 marks)

(1) Immune system has destroyed beta cells
(1) Reduced levels of insulin
(1) Insulin injections required to ↓ blg levels
(1) Cells are not resistant to insulin.

Question 34 **(17 marks)**

This diagram is an illustration of a cross-section through the brain. Use this diagram to answer part (a) below.

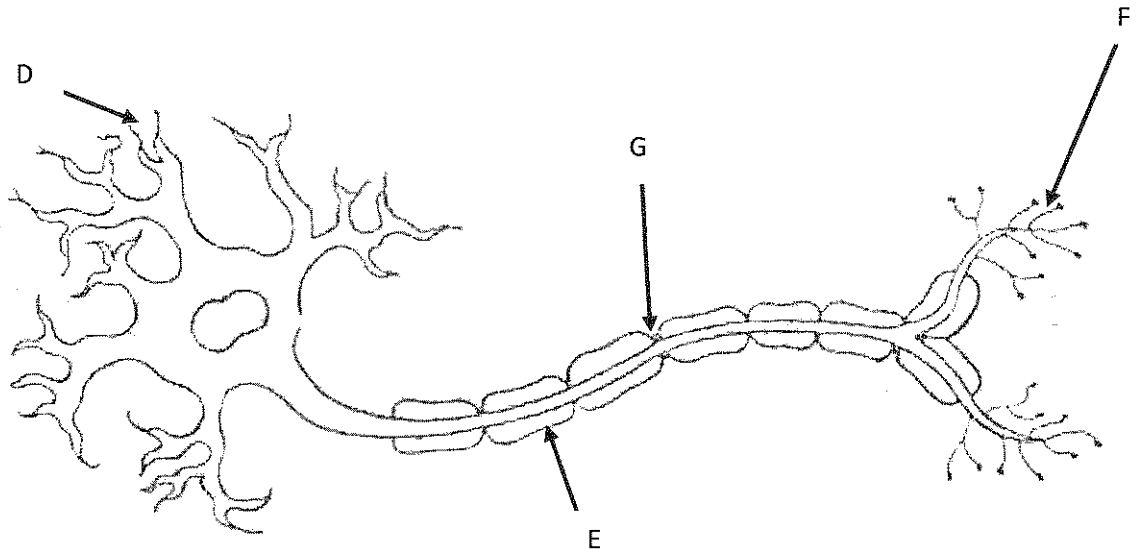


a) In terms of body movement, what is the role of the structures labelled A, B and C.

STRUCTURE	ROLE IN MOVEMENT
A	Initiate nerve impulse
B	co-ordinate movement / balance & receives sensory information from inner ear + proprio-receptors
C	Regulates breathing rate / blood vessel diameter / heart rate / blood pressure

(3 marks)

This diagram is an illustration of a motor neuron. Use this diagram to answer parts (b) and (c) below.



b) In terms of normal function, what is the role of the structures labelled D, E and F?

STRUCTURE	FUNCTION
D	Carry nerve impulse into cell body (soma)
E	Insulate neuron ✓ Speeds up nerve impulse
F	Releases neurotransmitters to diffuse across synapse.

(3 marks)

c) A student researching the term "***saltatory conduction***" stated that the region in the motor neuron labelled G experiences ***depolarisation***.

i) What is meant by the term: ***saltatory conduction?***

(1 mark)

The nerve impulse "jumps" from one node of Ranvier to another.

ii) Describe the events that occur during depolarisation of a neuron.

(4 marks)

(1) Na+ channels open
(1) Na+ ions flood into neuron
(1) Inside of neuron becomes more positive compared to outside
(1) Membrane potential increases to 30/40mV

d) The action potential is described as an all or nothing response. Explain what this means and explain how neuron transmission differ so that the brain can distinguish between a loud noise and a quiet noise.

(1) A stimulus must reach the threshold of 55 mV for a nerve impulse to occur.

(1) If stimulus does not reach the threshold then a nerve impulse is not generated.

(1) Once the threshold is reached, a nerve impulse of the same size is produced.

(1) A nerve impulse is generated or nothing

(1) Loud noise = more neurons stimulated
= more impulses generated

(1) Soft noise = less neurons stimulated
less impulses generated.

(6 marks)

Question 35 **(3 marks)**

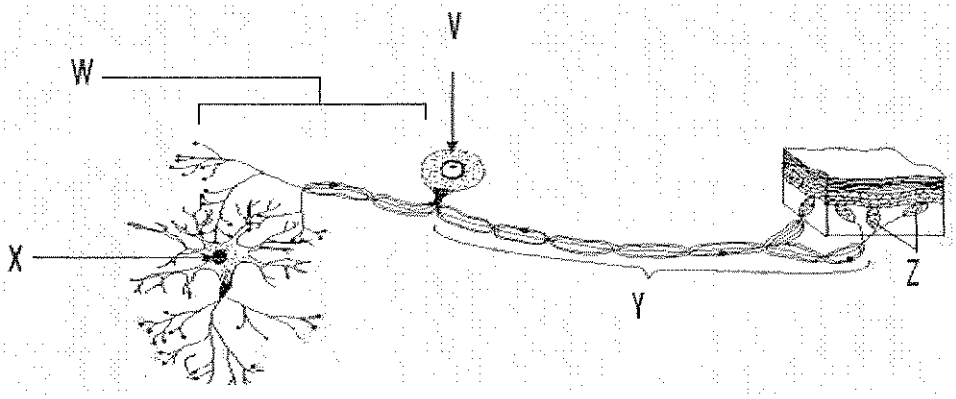
a) Our body's internal environment can be disrupted by the things we do in our everyday lives and also by disease. Explain how caffeine, alcohol and emphysema disrupts homeostasis within the human body.

Disruption to Homeostasis	Describe **ONE** way homeostasis is disrupted?
Caffeine max 1 mark	(1) caffeine binds to receptor molecules of heart (1) ↑ heart rate (1) ↑ blood flow through kidneys = ↑ urine output ↓ body fluid
Alcohol max 1 mark	(1) ↑ air in lungs = ↑ gas exchange (1) ↓ ADH = ↑ water excretion from body (1) ↑ insulin production = ↓ b/g levels
Emphysema max 1 mark.	(1) ↓ s/a of lungs (1) ↓ gas exchange

(3 marks)

Question 36 **(8 marks)**

Examine the following diagram of two neurons. One found in the peripheral nervous system and the other in the central nervous system.



a) Is this diagram illustrating the efferent or afferent division of the peripheral nervous system? Explain your answer.

(2 marks)

(1) Afferent

(1) Contains sensory neuron (unipolar)

b) Based on its structure, classify the neuron in the central nervous system.

(1 mark)

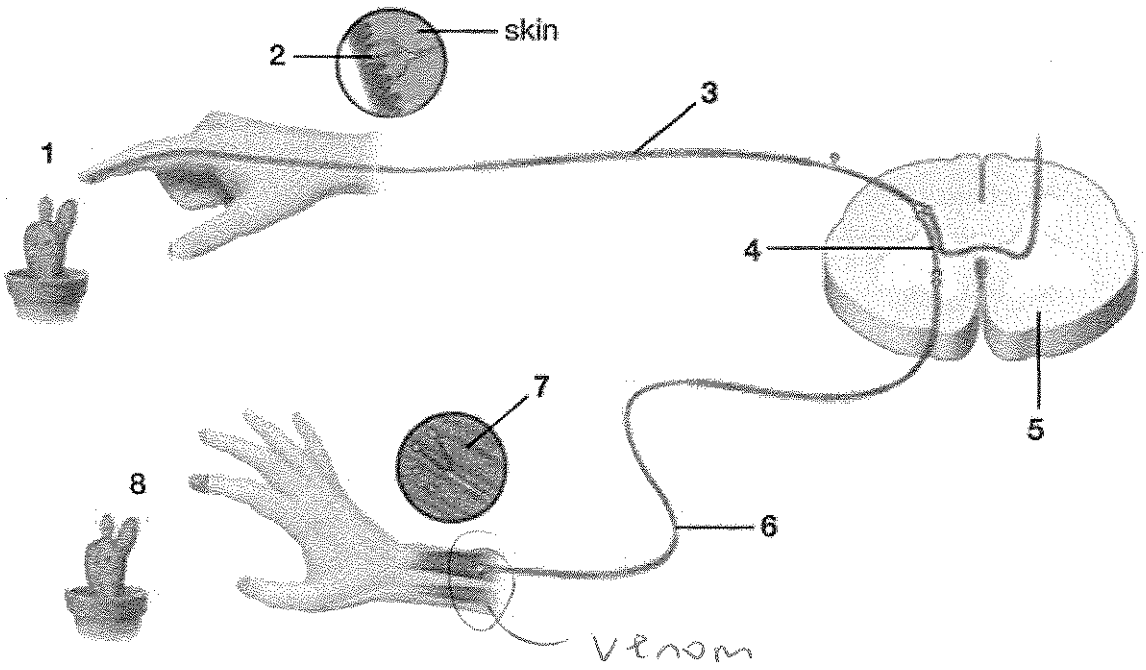
Multipolar

c) Where would part "V" in the above diagram be located?

(1 mark)

Dorsal root ganglion

The diagram below is of the reflex arc. The Red-back spider is one of Western Australia's most deadly spiders. The spider's venom acts specifically at nerve endings to reduce the release of contents from synaptic vesicles at motor nerve endings.



d) On the diagram, indicate where this venom would act.

(1 mark)

e) Explain the effect of the venom.

(1) ↓ neurotransmitter (acetylcholine) from vesicles

(1) ↓ neurotransmitter diffusing across synapse + binding to receptors

(1) The muscles will not be stimulated to contract.

(3 marks)

Question 37 **(10 marks)**

There are several different ways hormones are recognised by cells.

a) Identify the location of each receptor associated with each type of hormone and then describe the effect on the cell.

Hormone	Location of receptor protein	Effect on the cell
Protein/ amine hormone	Cell membrane	Secondary message to enter cell / Enzyme activation
Steroid hormone	Cytoplasm/ Nucleus	Protein synthesis

(1) each cell

(4 marks)

b) Complete the following table.

	Prolactin	Oxytocin	Adrenocorticotrophic hormone
Where produced	APG	Hypothalamus	APG
Where released	APG	PPG	APG
Target organ(s)	Mammary glands	Uterine muscles mammary glands	Adrenal cortex
Effect	↑ milk production	uterine contractions or eject milk into ducts.	↑ cortisol ↑ aldosterone

$\frac{1}{2}$ each cell.

(6 marks)

Question 38 **(8 marks)**

A man is swimming in the ocean and gets a huge fright when seeing a large, dark shape below him. As a result, a number of physiological changes occur to his body to assist his survival in this situation. Discuss one action of each of the following organs and how that action may assist survival.

ORGAN	ACTION	ASSISTANCE WITH SURVIVAL
Liver	Glycogenolysis	Breakdown of glycogen to glucose for energy
Iris	Dilation of pupil	Increased light into the eye
Bronchioles	Dilation of bronchioles	↑ gas exchange
Blood vessels of the intestine	Constrict	Allows greater blood flow to muscles

(8 marks)

Question 39 **(6 marks)**

Complete the table below indicating

i. Which modes of transport are passive and which are active.

ii. Identify one molecule which uses each process to cross the cell membrane.

Water, oxygen, alcohol, amino acids, salivary amylase, glucose, sodium ions, cholesterol

Type of transport	Passive or Active	One Substance transported by this method
DIFFUSION	P	O_2 / Na^+ / Alcohol
OSMOSIS	P	H_2O
FACILITATED DIFFUSION	P	Glucose / Amino acids
ACTIVE TRANSPORT	A	Glucose / Amino acids
ENDOCYTOSIS	A	cholesterol
EXOCYTOSIS	A	salivary amylase

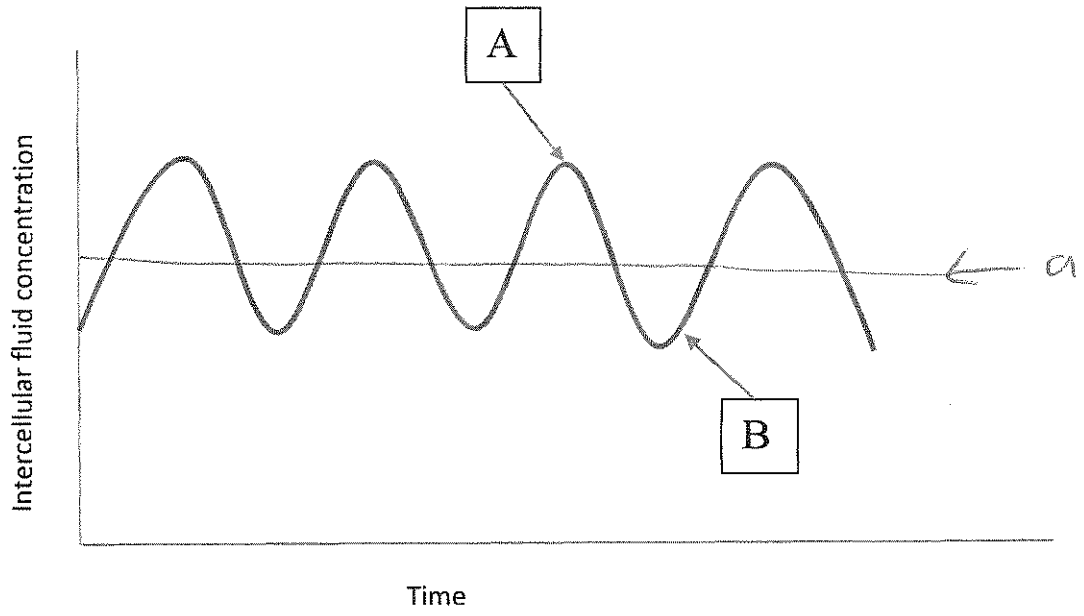
* only one answer per cell

$\frac{1}{2}$ mark each.

(6 marks)

Question 40 **(9 marks)**

The graph below shows the fluctuations in body fluid over time.



a) Draw in the optimal intercellular fluid concentration onto the graph.

(1 mark)

b) Name the receptors that detect changes in body fluid and their location in the body.

Name: Osmo receptors

Location: Hypothalamus

(2 marks)

c) Describe the physiological changes the body undergoes at point B and the effect of this change on the concentration and volume of urine.

(1) ↑ ADH production

(1) ↑ permeability of nephron (C.D + D.C.T)

½ Urine is more concentrated

½ Decreased volume of urine.

(3 marks)

d) The thirst reflex assists in the regulation of body fluids.

i) Name the stimulus that initiates the thirst reflex.

(1) ↑ Osmotic pressure

ii) Identify the effector that carries out the response.

(1) Cerebral cortex / body muscles eg. biceps

iii) Is this an example of positive or negative feed back. Explain your answer.

(½) Negative feedback

(½) The original stimulus has been removed.

(3 marks)

Question 41 **(10 marks)**

a) Complete the table below by writing transcription or translation next to the statement in reference to protein synthesis

Statement	Stage of Protein Synthesis
Ribosomes are involved	Translation
tRNA is involved	Translation
mRNA is made	Transcription
DNA acts as a template	Transcription.

(4 marks)

The table shows some amino acids and their corresponding tRNA anti-codon. The tRNA anti-codon for a stop signal is also shown. Below the table, a section of DNA is also shown. Use this information to answer questions (b) to (f).

Amino acid/stop signal	tRNA anti- codon
Alanine	CGG, CGA, CGU, CGC
Arginine	GCA, GCG, GCU, GCC
Cysteine	ACA, ACG
Glutamine	CUU, CUC
Glycine	CCU, CCG, CCA, CCC
Leucine	GAA, GAG, GAU, GAC
Proline	GGU, GGG, GGA
Serine	AGG, AGA, AGU, AGC
Stop signal	AUU, AUC, ACU
Threonine	UGC, UGA, UGU, UGG

DNA Template Strand:

A C A	C T T	A C A	G C C	G G T	G G G
Triplet 84	Triplet 85	Triplet 86	Triplet 87	Triplet 88	Triplet 89

b) What amino acid is coded for by triplet 85?

1 Glutamine

(1 mark)

c) List the sequence of amino acids found in the polypeptide chain that is coded for by the DNA strand above.

1 Cysteine, Glutamine, Cysteine, Arginine, Proline, Proline

(1 mark)

d) List the sequence of bases on a molecule of messenger RNA (mRNA) synthesised from the DNA strand above.

UGU, GAA, UGU, CGG, CCA, CCC

(1 mark)

e) Triplet 89 coded for the last amino acid in the polypeptide chain. What is the next triplet?

Stop triplet ATT/ATC/ACT

(1 mark)

f) Describe the polypeptide chain if triplet 90 was ACT and the next triplet was CTT on the DNA molecule.

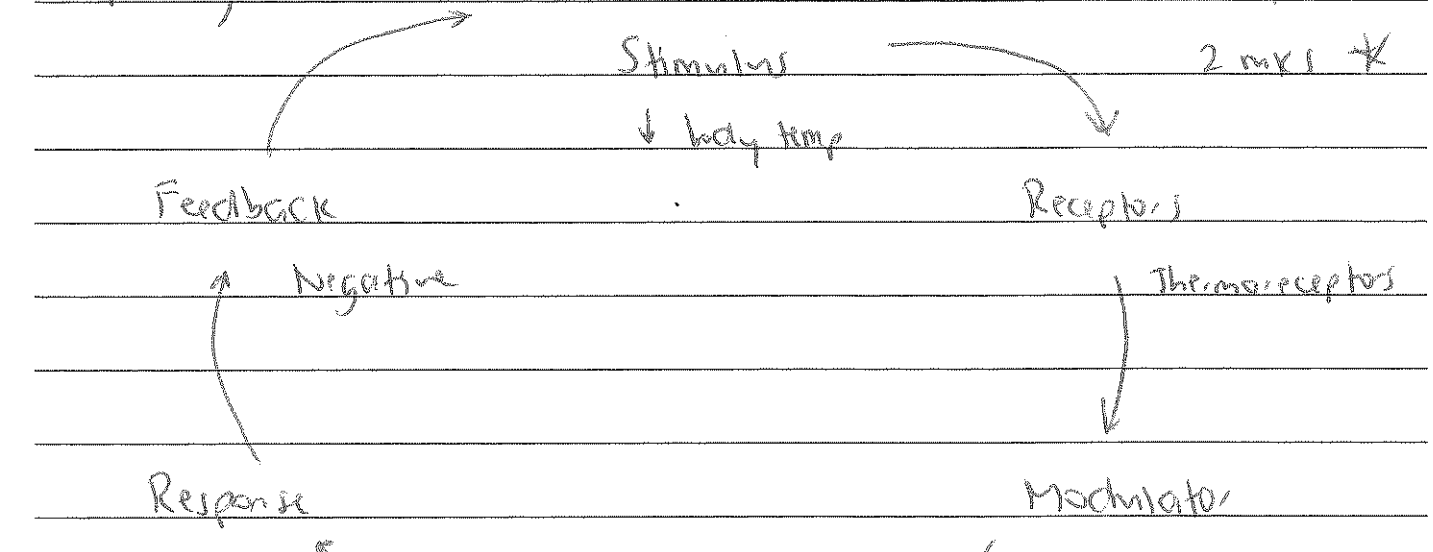
1 Polypeptide chain terminated at triplet 90 (stop)

1 New polypeptide chain begins with amino acid Glutamine.

(2 marks)

42 a)

* Feedback loop 2 mks *



Stimulus

(1) • ↓ body temp

Receptors

(1) • Thermoreceptors

(1) • Located in skin + hypothalamus

Modulator

(1) • Hypothalamus

Effectors (3 mks only)

(1) • Blood vessels

(1) • APG/Thyroid

(1) • Muscles

(1) • Cerebral cortex

Response (3 mks only)

(1) • vaso-constriction of blood vessels to skin = ↓ radiation

(1) • ↑ thyroxine ↑ metabolism ↑ heat production

(1) • Shivering ↑ heat production

(1) • Behavioural response eg put on a jumper to ↓ heat loss

Feedback

(1) • ↑ body temp due to response

(1) • Negative feedback

42 b)

(1) Holding breath causes a build up of CO_2 / ↑ H^+ / ↓ pH

(1) This ↑ CO_2 is detected by chemoreceptors

(1) located in the carotid & aortic bodies.

(1) Message sent to respiratory centre in medulla oblongata.

(1) A message is sent to diaphragm & intercostal muscles

(1) Increased movement of diaphragm & IM muscles.

(1) Child is forced to breathe

43

a)

* Max 10 mks

	Endocrine	Nervous
Nature of message	Electrical impulse (1)	Hormones (1)
Transport of message	Neuron membrane (1)	Bloodstream (1)
Cells affected	Muscles, glands, other neurons (1)	All body cells (1)
Type of response	Local + specific (1)	General + widespread (1)
Time taken to respond	Rapid – milli seconds (1)	Slower – from seconds to days. (1)
Duration of response	Brief – stops when stimulus stops (1)	Longer lasting – response may continue days after stimulus has (1)

43

b)

* must name divisions - 2 mks
* max 8 marks for structure + function.

44 a)

(1) Antibody mediated immunity (Humoral)
(1) Involves B lymphocytes
(1) B lymphocytes are stimulated by:
(1) • antigen presenting cells / Helper T cells
• antigens on bacteria
(1) B cells enlarge
(1) Develop into clone cells
(1) Most clone cells become plasma cells
(1) Plasma cells produce antibodies
(1) Antibodies enter blood stream and inactivate bacterial toxin
(1) Memory cells are also produced
(1) Memory cells remain in lymphoid tissue
(1) Memory cells recognise the same bacteria in the future and initiate a much quicker immune response.

* Max 10 marks *

44 b)

Antibodies

* Prevent pathogens entering cell by binding to them
* Enhance phagocytosis by macrophages
* Inactivate / neutralise bacterial toxins
* Agglutination (clumping) of pathogens and enhancing phagocytosis
* Make substances insoluble and consumed by phagocytosis

44 c)

Vaccines

* attenuated - reduced virulence
* dead micro-organisms
* bacterial toxins (toxoids)
* sub-unit - a piece of the organism

(1) Listing the type of vaccine
(1) Explaining the type of vaccine
> x3

max 6 marks.