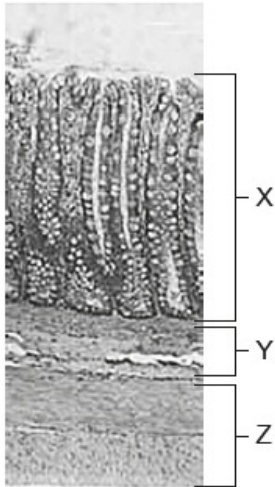


# Exam Prep 6 [46 marks]

1. The photomicrograph shows a section through a human small intestine. [1 mark]



[Source: Chiodini RJ, Dowd SE, Chamberlin WM, Galandiuk S, Davis B, Glassing A (2015) Microbial Population Differentials between Mucosal and Submucosal Intestinal Tissues in Advanced Crohn's Disease of the Ileum. *PLoS ONE* 10(7): e0134382. <https://doi.org/10.1371/journal.pone.0134382>.]

Which statement corresponds to the labelled structures?

- A. X moves food along the intestine.
- B. Y is the mucosa.
- C. Y contains lacteals.
- D. Z causes peristalsis

## Markscheme

D

2. What feature of arteries is most important in maintaining sufficiently high *[1 mark]* blood pressure?
- A. A wide lumen
  - B. Elastic fibres in the wall
  - C. Valves at intervals
  - D. A thin wall

**Markscheme**

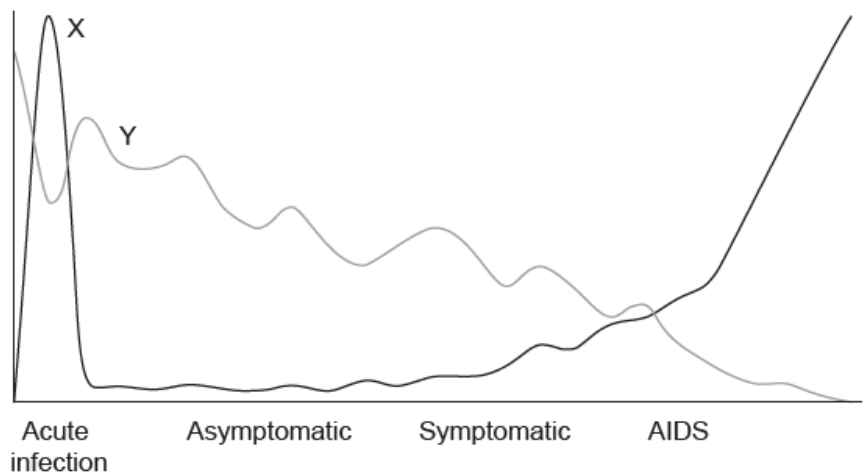
B

3. What is a feature of phagocytic white blood cells? *[1 mark]*
- A. Stimulate blood clotting
  - B. Found only in the circulatory system
  - C. Form part of non-specific immunity
  - D. Produce antibodies

**Markscheme**

C

4. The graph shows the results of measuring two factors in the blood of patients with HIV/AIDS. [1 mark]



[Source: Courtesy ACRIA.]

What do X and Y represent?

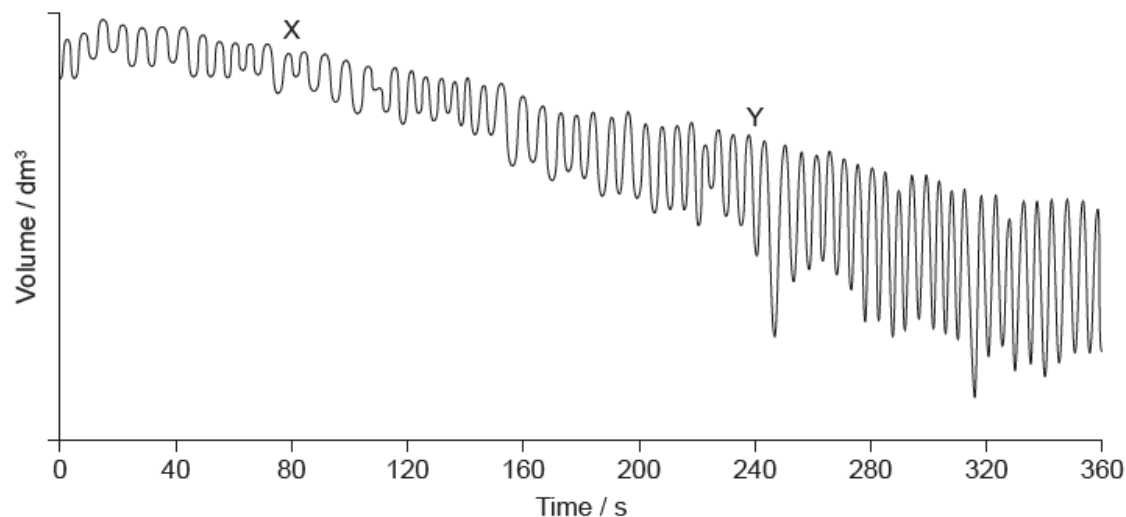
	X	Y
A.	virus	lymphocytes
B.	antibodies	virus
C.	virus	red blood cells
D.	lymphocytes	antibodies

**Markscheme**

A

5. The graph shows a spirometer trace of oxygen consumption when breathing at rest and during exercise.

[1 mark]



[Source: Courtesy of Dr. Dafang Wang for his work at University of Utah.]

What explains the difference between the traces at regions X and Y on the graph?

- A. At X, the internal intercostal muscles contract more than the external intercostal muscles.
- B. At Y, the ribcage moves up and out more than at X.
- C. At X, the diaphragm flattens more per breath than at Y.
- D. At Y, the intercostal muscles contract more slowly than at X.

## Markscheme

B

6. How do neonicotinoid pesticides cause paralysis and death in insects?

[1 mark]

- I. Acetylcholine receptors are blocked.
  - II. Cholinesterase fails to break down the pesticide.
  - III. The pesticides bind to presynaptic receptors.
- A. I only
  - B. I and II only
  - C. I and III only
  - D. I, II and III

# Markscheme

B

7. A female is overweight, feels cold and tired, and often fails to ovulate during the menstrual cycle. Which two hormones are probably secreted at insufficient levels? [1 mark]
- A. Estrogen and FSH
  - B. LH and thyroxin
  - C. Insulin and glucagon
  - D. Epinephrine and leptin

# Markscheme

B

A study was conducted to look at the short-term effects of a change in diet on the risk of disease in young adults. The table shows data on the habitual diet of the participants as well as the study diet followed for two weeks.

	Mean daily intake $\pm$ standard deviation	
	Habitual diet	Study diet
Energy / kJ	10 143 $\pm$ 949	9992 $\pm$ 479
Fat / g	100 $\pm$ 6	99 $\pm$ 5
Saturated fat / % total fat	37 $\pm$ 2	60 $\pm$ 1
Unsaturated fat / % total fat	63 $\pm$ 2	40 $\pm$ 1
Monounsaturated fat / % total fat	46 $\pm$ 1	32 $\pm$ 1
Polyunsaturated fat / % total fat	17 $\pm$ 1	8 $\pm$ 1
Carbohydrate / g	248 $\pm$ 23	232 $\pm$ 16
Protein / g	119 $\pm$ 12	120 $\pm$ 9

[Source: Horowitz, J.F., Ortega, J.F., Hinko, A., Li, M., Nelson, R.K. and Mora-Rodriguez, R., 2018. Changes in markers for cardio-metabolic disease risk after only 1-2 weeks of a high saturated fat diet in overweight adults. *PLoS ONE*, 13(6), e0198372.]

- 8a. Comment on the total energy content of the two diets. [1 mark]

## Markscheme

- a. energy is not changed (between the two diets);
- b. study diet slightly lower in energy than habitual diet (but means/SD overlap);
- c. spread of values show more variation for habitual diet / higher SD in habitual;

8b. Distinguish between the two diets.

[2 marks]

## Markscheme

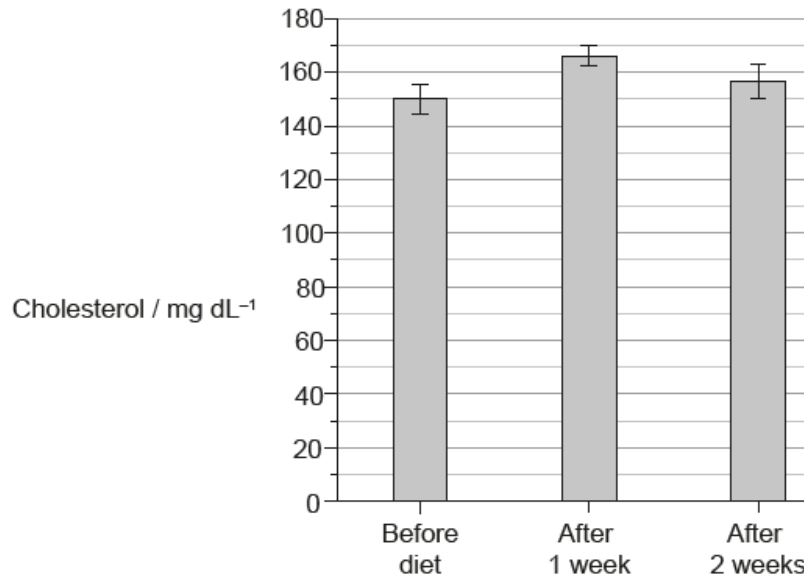
- a. they differ in percent of saturated and unsaturated fats (but not total fat);
- b. percent of saturated fats is higher in study diet / lower in habitual diet;
- c. (mono/poly) unsaturated fats decreased in study diet compared to habitual diet/more in habitual diet

**OR**

- polyunsaturated fats in study diet only half of what they were in habitual diet;
- d. (slightly) less carbohydrate in study;

*Allow numerical points if they are a valid comparison using distinguishing terms.*

Total blood plasma cholesterol levels were measured before the study began and once a week after starting the study diet. Mean results are shown in the bar chart, including the standard deviation.



[Source: Horowitz, J.F., Ortega, J.F., Hinko, A., Li, M., Nelson, R.K. and Mora-Rodriguez, R., 2018. Changes in markers for cardio-metabolic disease risk after only 1-2 weeks of a high saturated fat diet in overweight adults. *PLoS ONE*, 13(6), e0198372.]

- 8c. Calculate, showing your working, the percentage change in mean cholesterol level after **one week** on the study diet. [2 marks]

.....%

## Markscheme

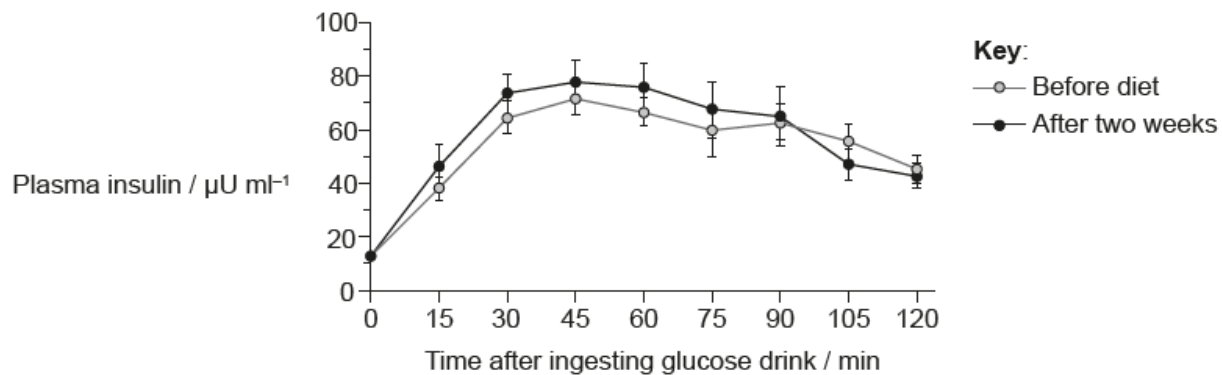
$$((165 - 150) \div 150) \times 100;$$

$$(\Rightarrow) 10 (\%);$$

*Allow up to 167 = 11.3 %*

*1 mark for correct working if above 167.*

Control of blood glucose concentration was investigated using an oral glucose tolerance test. For this test, the person was given a concentrated glucose drink (at time zero) and then blood samples were taken every 15 minutes to determine the plasma insulin level. This test was done before the study diet and after two weeks on the study diet. Mean results are shown in the graph, including the standard deviation.



[Source: Horowitz, J.F., Ortega, J.F., Hinko, A., Li, M., Nelson, R.K. and Mora-Rodriguez, R., 2018. Changes in markers for cardio-metabolic disease risk after only 1-2 weeks of a high saturated fat diet in overweight adults. *PLoS ONE*, 13(6), e0198372.]

- 8d. Compare the data for plasma insulin levels before and after the study diet. [2 marks]

## Markscheme

- a. both show same pattern of rise, level and then decrease / show same trend;
  - b. both show same/similar levels of insulin (at all times) due to overlapping error bars;
  - c. both rise for 30/45 minutes;
- Do not give credit for contrasts.*

- 8e. State which cells secrete insulin. [1 mark]

## Markscheme

β cells of pancreas/islets (of Langerhans);

- 8f. Outline the reason for plasma insulin levels changing in the first 30 minutes of the test. [1 mark]



## Markscheme

as blood glucose rises, insulin rises/increases to reduce the level/*OWTTE*;  
*Blood glucose must be mentioned as well as a rise in insulin.*

- 8g. The hypothesis made before the study was that saturated fats in the diet *[3 marks]* affected the risk of coronary artery blockage and diabetes. Using all the data in question 1, evaluate whether this hypothesis is supported by the study.

## Markscheme

*Hypothesis is partially supported*

- a. Increased saturated fats in study diet resulted in increase in cholesterol levels;
- b. cholesterol level is risk for blockage of coronary arteries;

*Hypothesis is not supported*

- c. high insulin levels are sign of (Type II) diabetes;
- d. insulin levels were the same in both diets so no increased risk;
- e. study only 2 weeks long;

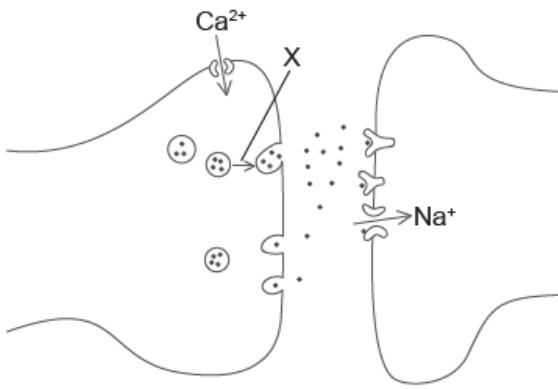
- 9a. Outline how the amphipathic properties of phospholipids play a role in membrane structure. *[2 marks]*

## Markscheme

- a. part hydrophobic/not attracted to water/non-polar **AND** part hydrophilic/attracted to water/polar; *Both needed.*
- b. bilayer formed (formed naturally by phospholipids in water);
- c. hydrophilic heads/parts face outwards **AND** hydrophobic tails/parts face inwards;

*Do not allow water loving/hating in mpa or mpc.*

The diagram shows part of two neurons.



[Source: © International Baccalaureate Organization 2020.]

9b. State the name of the structure shown.

[1 mark]

## Markscheme

synapse/synaptic

9c. X indicates the movement of a structure in the neuron. Explain what events trigger this movement and what happens next.

[3 marks]

## Markscheme

- a. depolarization of pre-synaptic membrane / action potential/nerve impulse arrives;
- b. uptake of calcium / calcium ions diffuse in / calcium channels open;
- c. structures containing neurotransmitter/vesicles move to/fuse with membrane;
- d. neurotransmitter/acetylcholine released by exocytosis into cleft/binds to postsynaptic membrane/receptors;

According to the cell theory, living organisms are composed of cells.

10a. Draw the ultrastructure of a prokaryotic cell based on electron micrographs.

[3 marks]

# Markscheme

- a. cell wall;
  - b. plasma membrane; *Clearly shown as a separate line under the cell wall or the inner line*
  - c. cytoplasm **AND** 70S ribosomes; *Do not allow (small) circles*
  - d. nucleoid/naked DNA;
  - e. plasmid
- OR**
- pili
- OR**
- flagella/flagellum;
- Structures correctly drawn and labelled.*
- Award [2 max] if any exclusively eukaryotic structures are shown.*
- Do not allow cilia as they are not found in prokaryotes.*

10b. Outline what occurs in cells in the first division of meiosis.

[5 marks]

# Markscheme

- a. halves the chromosome number/produces haploid cells;
  - b. at start of meiosis each chromosome consists of two sister chromatids attached by a centromere;
  - c. prophase (I): pairing of homologous chromosomes;
  - d. crossing over occurs;
  - e. chromosomes condense by supercoiling;
  - f. metaphase (I): pairs of homologous chromosomes/bivalents move to equator of spindle
- OR**
- metaphase (I): orientation of pairs of homologous chromosomes (prior to separation) is random;
- g. anaphase (I): centromeres do not divide
- OR**
- anaphase (I): spindle fibre pulls chromosome/whole centromere with two sister chromatids to opposite poles;
- h. telophase (I): arrival of centromere with sister chromatids at opposite poles;
- Some of these can be awarded for correctly annotated diagrams.*
- No credit for events in meiosis II.*

## Markscheme

a. cells of skin provide a physical barrier/produce fatty acids/lactic acid/lysozyme which stops entry of microbes

**OR**

mucous membranes produce mucus to trap pathogens

**OR**

stomach cells produce hydrochloric acid which kills microbes;

b. platelets start the clotting process preventing access of pathogens;

c. (two types of) white blood cells fight infections in the body;

d. phagocytes ingest pathogens (by endocytosis/phagocytosis);

e. gives non-specific immunity to diseases / ingest any type of pathogen;

f. production of antibodies by lymphocytes/B cells;

g. in response to particular pathogens/antigens;

h. gives specific immunity;

i. lymphocyte/B cell makes only one type of antibody;

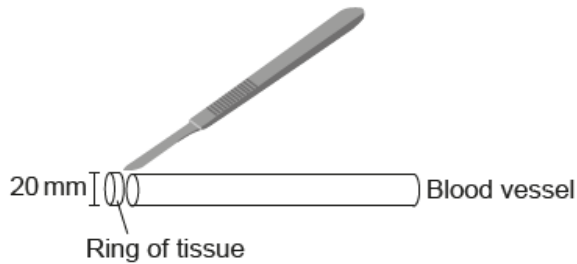
j. plasma cells produce large quantity of (one type of) antibody;

k. some lymphocytes act/remain as memory cells;

l. can quickly reproduce to form a clone of plasma cells if a pathogen carrying a specific antigen is re-encountered;

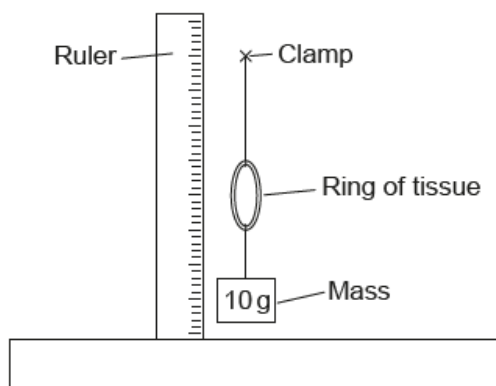
m. results in faster defence against second exposure to specific antigen/pathogen/disease;

In an investigation to compare the elasticity of arteries and veins, rings of the same diameter (20 mm) of artery and vein tissue were cut from blood vessels obtained from a mammal.



[Source: © International Baccalaureate Organization 2020.]

Each ring was attached to a clamp. Multiple masses of 10 g were added and removed. The vertical diameter of the artery and the vein was measured, both with the mass and once the mass had been removed.



The results are shown in the table.

Mass / g	Diameter of vein / mm		Diameter of artery / mm	
	With mass	Mass removed	With mass	Mass removed
0	20	20	20	20
10	26	26	26	22
20	34	33	30	23
30	38	36	35	23
40	40	37	38	24

11a. State the independent and dependent variables in this experiment. [2 marks]

Independent:

Dependent:

## Markscheme

a. Independent: mass;

b. Dependent: (vertical) diameter/length;

*Do not accept elasticity*

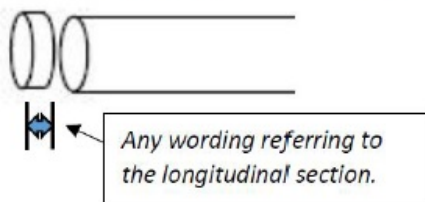
- 11b. State **one** feature of the rings that has to be kept constant apart from their initial diameter. [1 mark]

## Markscheme

- a. width/section depth/slice of the ring;
- b. same animal/age/freshness/temperature;

*Don't accept thickness or diameter.*

*Do not accept thickness or diameter.*



- 11c. Explain the differences between the results shown for vein and artery. [3 marks]

## Markscheme

- a. veins have thinner walls (than arteries);
- b. veins sustain lower (blood) pressure (than arteries);
- c. when stretched, veins become longer (than arteries);
- d. veins have less muscle/elastic (fibre in their) walls (than arteries);
- e. veins have lower elasticity/recover less/remain more stretched (than arteries after weights removed);

*Accept inverse for arteries in all cases.*

*Do not accept a listing of numerical values without explanation.*