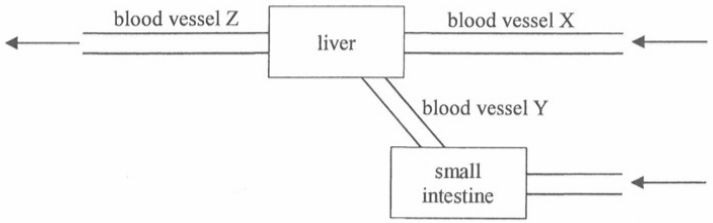
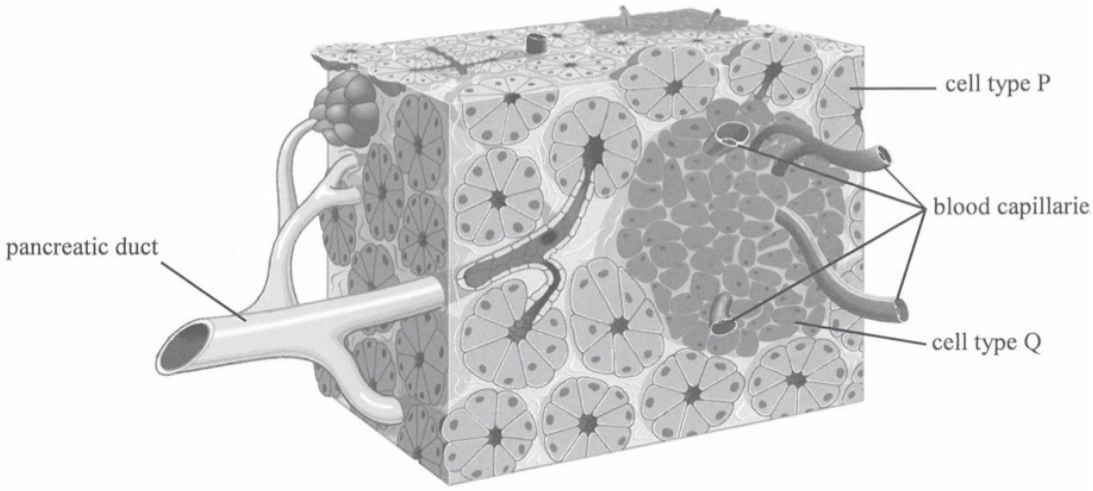
Directions: Questions 21 and 22 refer to the diagram below, which shows part of the human circulatory system and the associated organs:



21. Which of the following correctly compares the blood glucose concentration in blood vessels X, Y and Z when a person is fasting?

A. X > Z > Y
B. Y > X > Z
C. Z > Y > X
D. Z > X > Y

6. The schematic diagram below illustrates the distribution of different cell types in the human pancreas:



(a) Which type of cells, P or Q, secretes hormones? Support your answer with ***one*** observable feature illustrated in the diagram. (3 marks)

(b) A person jogs slowly for an hour. Describe how the hormones from the pancreas can regulate the blood glucose level of the person while jogging. (4 marks)

Provided by dse.life

DSE M.C. Questions - Homeostasis

(sort by difficulty)

Challenging

/

Average

2019 Q.18 (61%)

Which of the following organs serves both endocrine and exocrine functions?

A. Pancreas
B. Pituitary
C. Oesophagus
D. Adrenal gland

Easy

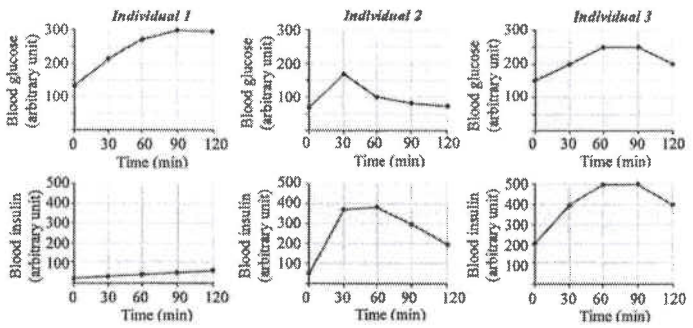
2013 Q.33 (79%)

A person has not taken any food for 24 hours. Which of the following will increase in concentration in blood?

A. glucagon
B. glucose
C. glycogen
D. insulin

2020 Q.31

31. The graphs below show the changes in blood glucose level and the blood insulin level of three individuals after consuming a sugary drink:

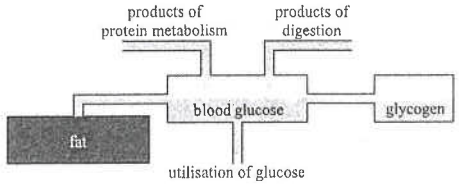


Which of the following combinations correctly shows the health conditions of these three individuals?

	Individual 1	*Individual 2*	*Individual 3*
A.	No diabetes	Type 1 diabetes	Type 2 diabetes
B.	Type 1 diabetes	Type 2 diabetes	No diabetes
C.	Type 2 diabetes	No diabetes	Type 1 diabetes
D.	Type 1 diabetes	No diabetes	Type 2 diabetes

2021 Q.26,27

Directions: Questions 26 and 27 refer to the model below, which shows the regulation of blood glucose level in humans:



26. A student adds the following remarks to this model. Which remark is *incorrect*?

A. Glycogen can be stored in muscles.
B. Insulin converts glucose to glycogen for storage.
C. The products of digestion take the form of simple sugars.
D. The products of protein metabolism come from the liver.

27. When the blood glucose level is higher than normal, which of the following changes is *incorrect*?

A. The utilisation of glucose will increase.
B. The conversion of fat to glycogen will increase.
C. The conversion of blood glucose to fat will increase.
D. The conversion of blood glucose to glycogen will increase.

Provided by dse.life

Answers

Challenging

Average

2019
18 [A]

2020
31 [D]

Easy

2013
33 [A]

Provided by dse.life

Past papers – Homeostasis

CE - 2000

3. (b) Diabetes mellitus is a disease found in humans and other mammals. The main symptom of this disease is the presence of glucose in the urine. In the early twentieth century, the cause of diabetes mellitus was still known. In order to study this disease, a scientist performed the following experiments on dogs :

Experiment	Experimental subject	Treatment	Result
1	Healthy dogs	Removing the pancreas	Symptoms of diabetes appeared
2	Diabetic dogs from experiment 1	Injecting extracts of pancreas	Symptoms of diabetes disappeared
3	Diabetic dogs from experiment 1	(a) Injecting extracts of pancreas which had been treated with protease	Symptoms of diabetes remained
		(b) Injecting extracts of pancreas which had been treated with lipase	Symptoms of diabetes disappeared

(i) Comparing the results of experiments 1 and 2, what conclusion can be drawn? (2)

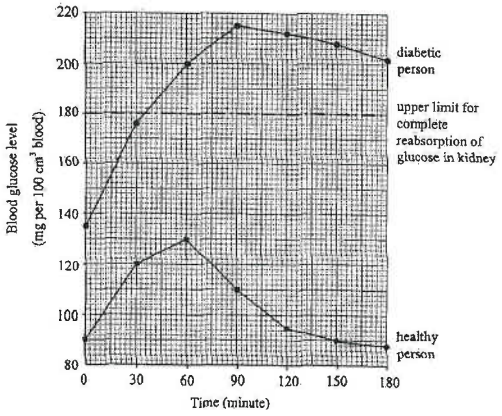
(ii) What is the aim of performing experiment 3? (2)

(iii) Based on the results of experiments 2 and 3 (a), explain whether the diabetic dogs would show symptoms of the disease if they were treated with the extracts of pancreas by feeding instead of by injection. (3)

(iv) Based on your biological knowledge, explain why the urine of a diabetic person usually contains glucose. (5)

CE - 2002

1. (c) In a study, a healthy person and a person with diabetes mellitus fasted for 12 hours. They then stayed at rest in the same room and drank equal volumes of glucose solutions of the same concentration. Their blood glucose levels were measured immediately afterwards and at 30-minute intervals for three hours. The results are shown in the graph below:



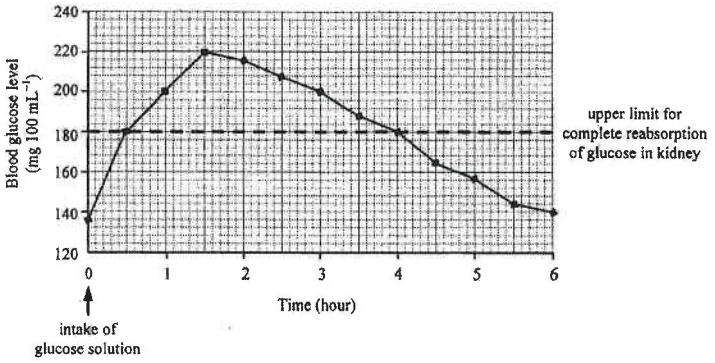
(i) What is the increase in the blood glucose level after 1 hour in
(1) the healthy person
(2) the diabetic person? (2)

(ii) Explain why the healthy person had a smaller increase in blood glucose level in the first hour when compared with the diabetic person. (4)

(iii) During the study, a larger volume of urine was produced by the diabetic person than the healthy person. Suggest an explanation for this. (4)

CE - 2005

9. (a) In a medical test, George drank a glass of glucose solution. The graph below shows the subsequent changes of his blood glucose level:



(i) Based on the graph, state the period in which the urine of George would contain glucose. Explain why glucose in the blood would appear in the urine during this period. (4)

(ii) The doctor diagnosed that George had diabetes mellitus and advised him to get insulin injection for treatment. Which organ of George was likely to be defective? (1)

(iii) The insulin used for treating diabetes mellitus can be obtained from pigs and cattle, or produced by genetically modified bacteria. State two advantages of using insulin produced by the bacteria over that obtained from mammals. (2)

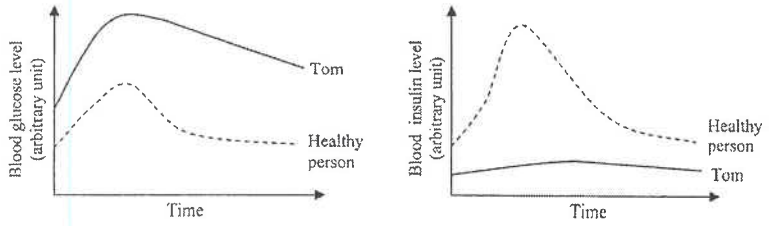
(iv) (1) Besides insulin, name another hormone that is responsible for the regulation of blood glucose level. (1)

(2) State one effect of this hormone on the activity of liver cells. (1)

Provided by dse.life

DSE-2012 1B

7. Tom suffers from diabetes. His doctor asked him to drink, after overnight fasting, a large volume of a glucose solution. After that, blood samples were taken at regular time intervals, to measure insulin and glucose contents. The following graphs show the changes in Tom's blood glucose level and blood insulin level after the test, and those of a healthy person:



(a) Which type of diabetes does Tom suffer from? Explain your answer. (4 marks)

(b) Explain the difference in blood glucose response to the oral consumption of glucose solution between Tom and the healthy person. (3 marks)

(c) What medical treatment should Tom be given? (1 mark)

HKDSE – 2015 1B

8. In a health check, Lisa was found to have glucose in her urine. She undertook a further check in which she has fasted for 12 hours before a blood sample was taken for examination. The results of the blood tests are shown below:

Test	Result	Normal range	Units
Blood glucose	8.4	4-6	mmol L^{-1}
Insulin	0.2	3-32	μU mL^{-1}
Glucagon	130	20-100	μg L^{-1}

(a) State the type of diabetes Lisa is suffering from. (1 mark)

(b) With reference to the production and actions of the two hormones, account for the results of Lisa's blood tests.

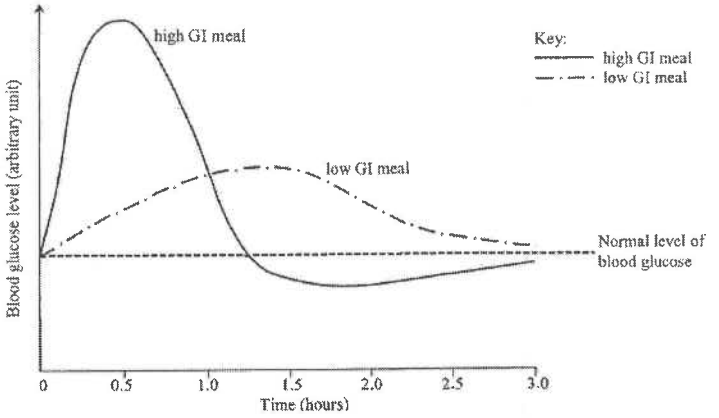
(i) Insulin (3 marks)

(ii) Glucagon (3 marks)

(c) Suggest *two* dietary habits that Lisa should establish. (2 marks)

HKDSE – 2018 1B

7. The glycemic Index (GI) is an indication of the effect of food on the blood glucose level. The higher the GI value of a food, the quicker is the rise in blood glucose level. The graph below shows the changes in the blood glucose level of a healthy individual after consuming the same quantity of a low GI or high GI meal over a period of three hours:



(a) Describe how the consumption of a meal leads to an increase in the blood glucose level (2 marks)

(b) (i) Name the key hormone which lowers the blood glucose level. (1 mark)

(ii) Describe how this hormone lowers the blood glucose level. (3 marks)

(iii) On the graph on the opposite page (page10), sketch a curve to show the change in the level of this key hormone in response to the consumption of high GI meal by the healthy person. (2 marks)

(c) Explain why diabetic patients should consume low GI meals. (2 marks)

Provided by dse.life

Past papers Marking Scheme – Homeostasis

CE - 2000 Q.3 (b)

(i) Diabetes is caused by the absence of certain substance(s) 1
which can be found in pancreas 1

(ii) To determine whether the substance in the pancreas extract effective in treating diabetes is a protein 1
or a fat 1

(iii) Symptoms of diabetes would remain 1
This is because protease in the alimentary canal 1
will digest the active substance which is protein in nature 1

(iv) In the diabetic person, the pancreas cannot produce enough insulin 1
Thus the liver cannot convert excess glucose in the blood into glycogen 1
His blood glucose concentration remains high 1
leading to a high level of glucose in the glomerular filtrate 1
The kidney tubules cannot reabsorb all the glucose from the filtrate 1
thus glucose is excreted in the urine
Effective communication (c) *1*

CE - 2002 Q.1 (c)

(i) (1) 40 mg per 100 cm^3 blood 1
(2) 65 mg per 100 cm^3 blood 1
Deduct ½ mark for each answer if the unit is left out; wrong unit, no mark

(ii) In the healthy person, the initial rise in blood glucose level stimulates the secretion of insulin 1
by the pancreas 1
while there is no / less insulin secretion in the diabetic person 1
Insulin stimulates the conversion of glucose into glycogen in the liver / uptake of glucose by body cells 1
so the increase in blood glucose level in the healthy person is smaller 1
Effective communication (c) *1*

(iii) Since the 36th minute, the blood glucose level of the diabetic person is higher than the upper limit for complete reabsorption of glucose 1
so glucose is present in the filtrate / urine in the collecting duct 1
The water potential of the filtrate / urine is lowered by the glucose present 1
thus the reabsorption of water is reduced 1
and a larger volume of urine would be produced 1

CE - 2005 Q.9 (a)

(i) 0.5 to 4 hour 1
Blood glucose is filtered into the kidney tubule 1
In this period, the glucose level in the glomerular filtrate is higher than the upper limit for complete reabsorption of glucose 1
so some glucose will be left in the glomerular filtrate / cannot be reabsorbed and excreted in the urine 1

(ii) Pancreas 1

(iii) Less side effects
More effective in action
Insulin produced from genetically modified bacteria is cheaper and in greater supply
(accept other reasonable answers) any two 1,1

(iv) (1) glucagon 1
(2) Glucagon will stimulate the conversion of glycogen in liver cells to glucose 1

exceed the threshold value 1
that glucose cannot be completely reabsorbed in the kidney 1
Thus it appears in the urine
Effective communication (c) *1*

CE - 2007 Q.8 (b)

(i) Glucose consumption increases during exercise 1
because glucose is used in respiration / respiration rate is faster 1
to provide more energy for muscle concentration 1

(ii) More glucagons is released during exercise 1
which stimulates the conversion of glycogen to glucose in liver 1
to restore the blood glucose level / compensates for the increase in glucose consumption 1
Effective communication (c) *1*

(iii) Trends:
Increase during exercise 1
Decrease after exercise 1

CE - 2008 Q.8 (b)

(b) (i) Diabetic patients lack insulin / do not have enough insulin in their blood 1
and hence the liver fails to convert glucose into glycogen for storage ... 1
During intense exercise, blood glucose is consumed for muscle activities / more blood glucose is consumed 1
The blood glucose level drops continuously without replenishment from the glycogen stored 1

(ii) (1) It takes time for starchy food to be digested before absorption 1
As a result, a small amount of glucose is absorbed gradually 1
The fluctuation of blood glucose level is less / blood glucose level will not increase too fast after a normal meal 1

(2) Sugar is easily digested / absorbable 1
Blood glucose level can be raised immediately / quickly /
Faster to alleviate the symptoms of hypoglycaemia 1

Provided by dse.life

AL - 2006 1B

10. (a)
- absorption of glucose from the gastrointestinal tract (1) results in an elevation of plasma glucose level
- this rise triggers the release of insulin (1) which stimulates glucose uptake into its target tissues (1) / the conversion of glucose into glycogen in the liver, resulting in the decline in plasma glucose level

3

(b) Any two of the following:
- B shows a sharper rise in plasma glucose level (1)
- plasma glucose level of B rises to a higher peak than A (1)
- the peak of plasma glucose level in B occurs later than that in A (1)
- its level fails to return to its basal level after 3 h, while that of A drops back to the basal level (1)

2

(c)
- B has no / very low insulin secretion (1) despite an increase in plasma glucose level,
- indicating that B has insulin-dependent diabetes mellitus (1) / type 1 diabetes mellitus
- C shows a sharp increase in the plasma insulin level (1), yet his / her plasma glucose level remains higher than normal
- indicating that C has no-insulin-dependent diabetes mellitus (1) / type 2 diabetes mellitus

4

(9)

AL - 2008 1A

7. (a)
- due to uncontrolled growth of insulin-secreting cells (1), this pancreatic cancer probably leads to an excessive secretion of insulin (1)
- as insulin stimulates the conversion of blood glucose by the liver (1)
- / uptake of blood glucose by cells, excessive insulin secretion would reduce the blood glucose to a low level (1)

max. 3

- As a result of insufficient blood glucose supply to the brain(1), the man would feel dizzy

1

(4)

(b)
- some tissues of the pancreas secrete protease and lipase (1)
- they may be removed together with the cancerous tissues(1), and this would make the digestion of protein and fat difficult

AL 2009 2A

2. (b)
- insulin serves to enhance glucose uptake into body cells (1) from the plasma,
- if the drug is overdosed, a sudden over-secretion of insulin would cause the plasma glucose level to become much lower than the normal (1) and there would be insufficient supply of glucose to the brain cells (1) which depend solely on glucose for respiration (1)

(4)

(c) (i) Any two of the following sets: 2 x (1+1)
- vegetables consist of much indigestible dietary fibre (1) which will not contribute to the blood glucose level (1)
- the fibre can bond with other carbohydrates (1) / slow down their digestion, and reduces the absorption of glucose into the blood (1)
- the fibre also gives a sense of satiety, thus reducing food intake (1) and subsequently helps restrict the increase in plasma glucose level (1)

(4)

(ii)
- small meals will restrict the amount of glucose to be absorbed in each meal (1)
- frequent meal provides sufficient glucose in between meals (1)

(2)

Provided by dse.life

DSE-2012 1B

7. (a)
- despite the high blood glucose level detected in his blood, his fasting blood insulin level was lower than that of the healthy person (1) (1)
- although there is an increase in blood glucose level, the insulin level only shows little change (1) (1)
- this shows that Tom failed to produce the normal amount of insulin (1) (1)
- therefore, Tom suffered from insulin-dependent diabetes (1) / type I diabetes (1)

(b)
- with insufficient insulin, his body cells will not take up extra glucose from the blood as efficiently as the healthy person (1)
- as a result, the blood glucose concentration rised to a higher level (1) after glucose consumption (3)
- and remains high for a longer time / decreases slower than the healthy person (1)

Remarks: conversion of glucose to glycogen by insulin is not acceptable

(c)
- by injection of insulin (1) / aerosal spray of insulin applied to nasal cavity (1)

8 marks

HKDSE – 2015 1B

8. (a) type I diabetes / insulin-dependent diabetes mellitus 1

(b) (i) Lisa's pancreas failed to secrete enough insulin (1)
as a result her body / liver cells cannot be sufficiently stimulated to increase the uptake of glucose from blood / liver cells cannot be stimulated to convert glucose to glycogen / body cells cannot be stimulated to increase glucose oxidation (1)
hence, her blood glucose level dropped very slowly / remained at high level / exceeded the normal range (1) even after 12 hours of fasting 3

(ii) Without the inhibitory effect of insulin, Lisa's pancreas secretes a large amount of glucagon (1)
her liver cells are stimulated (1)
to promote the conversion of glucose from glycogen / amino acid (1)
leading to a high glucose level in blood 3

(c) having frequent meals but in small portions (1)
Avoid food which elevates blood glucose level in a short time (1) 2

HKDSE – 2018 1B

7. (a)
- digestion of foods containing carbohydrates to form glucose (1)
- absorption of glucose from the small intestine into the blood (1) (2)

(b) (i)
- insulin (1) (1)

(ii)
- it stimulates the body cells and liver cells to take up more glucose from blood (1)
- increases respiration in body cells to consume glucose (1) (3)
- it stimulate the conversion of glucose to glycogen by the liver / muscle cells (1)

(iii)
- has initial basal value and drops back to basal value at the end (1), effect lags behind (1) (2)

(c)
- low GI food will lead to small fluctuations in blood glucose level (1) (2)
- the chance of having too high blood glucose level / glucose appearing in urine is reduced (1)

10 marks

Provided by dse.life