NAZARBAYEV
UNIVERSITY

Foundation Year Programme

Entrance Tests

BIOLOGY & CHEMISTRY

SPECIMEN PAPER

for

NUFYP SET 2017

Biology & Chemistry

SPECIMEN for NUFYP SET 2017   **60 minutes**

Instructions to Candidates

Please read this page carefully, but do not open the question paper until you are told that you may do so.

A separate answer sheet is provided for this section. Please check you have one.

You require a soft pencil and an eraser.

Please check that the title of the paper you are taking matches the title on the answer sheet.

Please complete the top section of the answer sheet in soft pencil with your personal details.

There are 30 questions in this paper. Each question is worth one mark. There are no penalties for incorrect responses, only marks for correct answers, so you should attempt all 30 questions.

Answer in soft pencil on the answer sheet provided. For each question, choose the one answer you consider correct and record your choice on the separate answer sheet. If you make a mistake, erase thoroughly and try again.

Speed as well as accuracy is important in this paper. Work quickly, or you might not finish the paper.

Any rough work should be done on this question paper.

Calculators are NOT permitted.

Please wait to be told you may begin before turning this page.

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1 The table below shows information relating to gas exchange in an active muscle when blood first enters that muscle.

Which row of the table is correct?

	oxygen concentration in red blood cells	process of gas exchange	oxygen concentration in muscle cells	concentration of carbon dioxide in muscle cells
A	low	diffusion	high	low
B	low	osmosis	high	low
C	low	osmosis	low	high
D	high	diffusion	high	low
E	high	diffusion	low	high
F	high	osmosis	low	high

2 Which one of the following involves active transport?

A loss of urine from the urethra

B movement of carbon dioxide into alveoli in the lungs

C release of glucose into the small intestine

D transfer of oxygen into the blood from the alveoli

E uptake of ions from soil into a root hair cell

3 In a population with 50 healthy men and 50 healthy women, what is the percentage of each type of sex chromosome?

	percentage of each sex chromosome	
	X	Y
A	25	50
B	50	75
C	75	25
D	25	75
E	50	50
F	50	25

4 The following statements are about cell division by meiosis and mitosis.

1 In mammals meiosis only occurs in the reproductive organs.

2 Mitosis can result in the formation of clones.

3 Meiosis results in two nuclei.

4 Mitosis results in four nuclei.

5 Only mitosis occurs during asexual reproduction.

Which of these statements are true?

A 1, 2 and 3 only

B 1, 2 and 5 only

C 1, 3 and 4 only

D 2, 4 and 5 only

E 3, 4 and 5 only

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**5** The table below shows the proportions of undigested and digested carbohydrates, fats and proteins in three regions of the digestive system.

type of nutrient	mouth	stomach	small intestine
1			
2			
3			

Key

◢ undigested food

☐ digested food
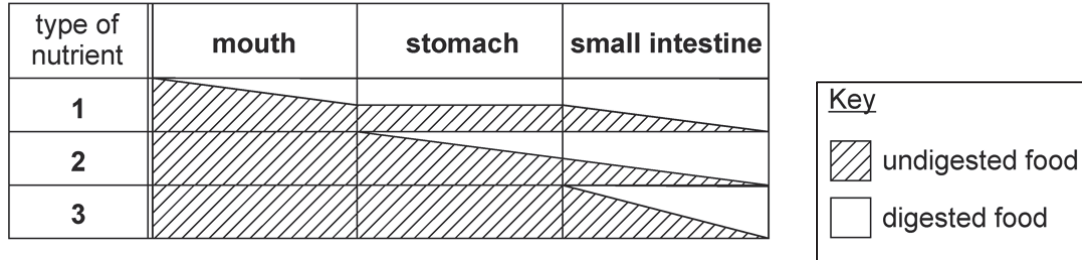
Which row of the table below correctly identifies the types of nutrient **1**, **2** and **3**?

	1	2	3
A	protein	fat	carbohydrate
B	carbohydrate	protein	fat
C	protein	carbohydrate	fat
D	fat	protein	carbohydrate
E	carbohydrate	fat	protein
F	fat	carbohydrate	protein

6 Which numbered structure in the diagram of a human female reproductive system and the diagram of a human male reproductive system have the same name?
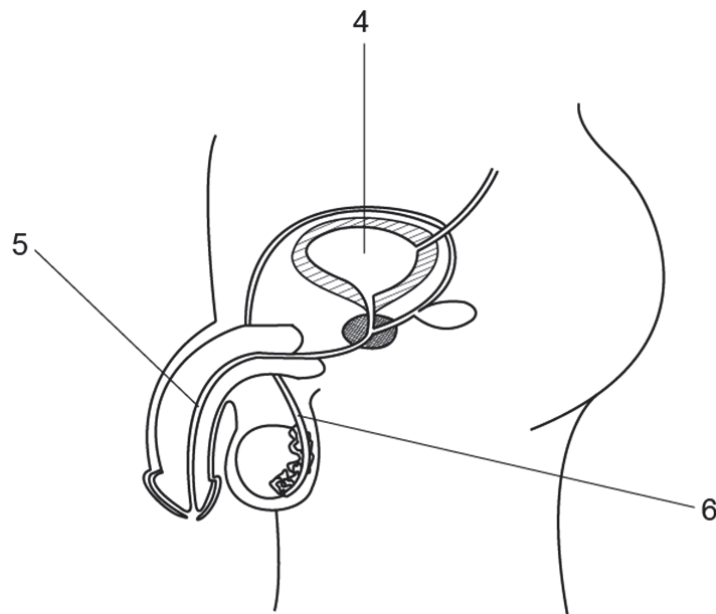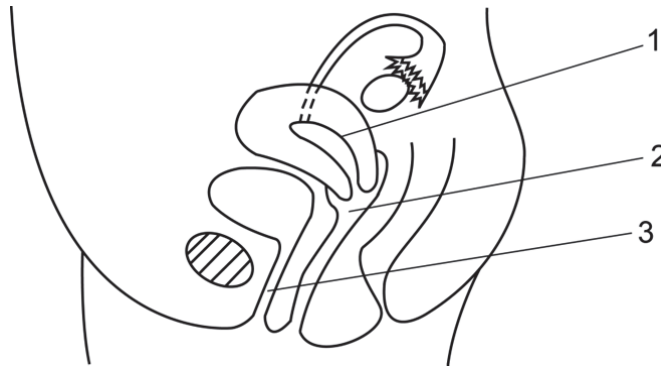

	structures with the same name	
	female	male
A	1	4
B	2	5
C	2	6
D	3	5
E	3	6

7 The three statements below are about breathing out.

      1   The ribs swing down and inwards during breathing out.

      2   The diaphragm muscles contract during breathing out.

      3   The pressure in the lungs increases during breathing out.

Which of the statements is/are correct?

A   1 only

B   2 only

C   3 only

D   1 and 2 only

E   1 and 3 only

F   2 and 3 only

8 The diagram shows a view from the front of a section through the heart and associated blood vessels.
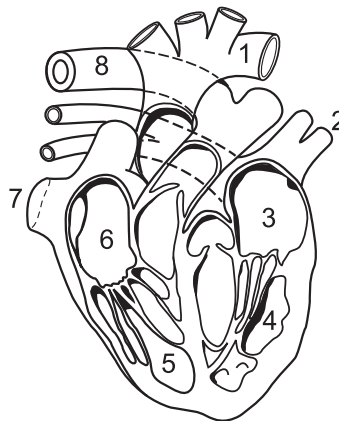
Which sequence of numbers shows the course of blood flow from the point of entry to the heart from the lungs, to its eventual exit from the heart to supply the lungs?

A $2 \rightarrow 3 \rightarrow 4 \rightarrow 8 \rightarrow 1 \rightarrow 5 \rightarrow 6 \rightarrow 7$

B $2 \rightarrow 3 \rightarrow 4 \rightarrow 1 \rightarrow 7 \rightarrow 6 \rightarrow 5 \rightarrow 8$

C $7 \rightarrow 6 \rightarrow 5 \rightarrow 8 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 1$

D $7 \rightarrow 6 \rightarrow 5 \rightarrow 1 \rightarrow 8 \rightarrow 4 \rightarrow 3 \rightarrow 2$

E $8 \rightarrow 5 \rightarrow 6 \rightarrow 7 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 1$

F $8 \rightarrow 5 \rightarrow 6 \rightarrow 7 \rightarrow 1 \rightarrow 4 \rightarrow 3 \rightarrow 2$

9 A section of DNA is 420 base pairs long and contains 42% of one of the bases, adenine (A).

Which one of the following rows in the table correctly states how many amino acids can be coded for by this section of DNA and what percentage of the base guanine (G) is present in this section of DNA?

	number of amino acids	percentage of guanine (G)
A	140	8
B	140	13
C	140	42
D	260	16
E	260	42
F	420	8
G	420	13
H	420	16

10 In a reflex action in which a person touches a hot plate and pulls their arm away, neurons of different lengths are involved. Which answer identifies the relative lengths of the neurons?

	length of neuron		
	longest	medium	shortest
A	sensory	relay	motor
B	motor	sensory	relay
C	relay	motor	sensory
D	motor	relay	sensory
E	relay	sensory	motor
F	sensory	motor	relay

11 A person is suffering from a condition/disease in which they have fewer blood platelets than a healthy person. They also have a lot of abnormal white blood cells when compared to a healthy person; however, they have a normal number of red blood cells.

Which row of the table shows this patient's symptoms?

	disease resistance	*blood clotting*	*oxygen transport*
A	low	low	low
B	high	low	high
C	low	normal	low
D	high	normal	normal
E	low	low	normal
F	high	normal	high

12 The graph below shows how one factor in the internal environment of a person changes, and is returned to a normal level.
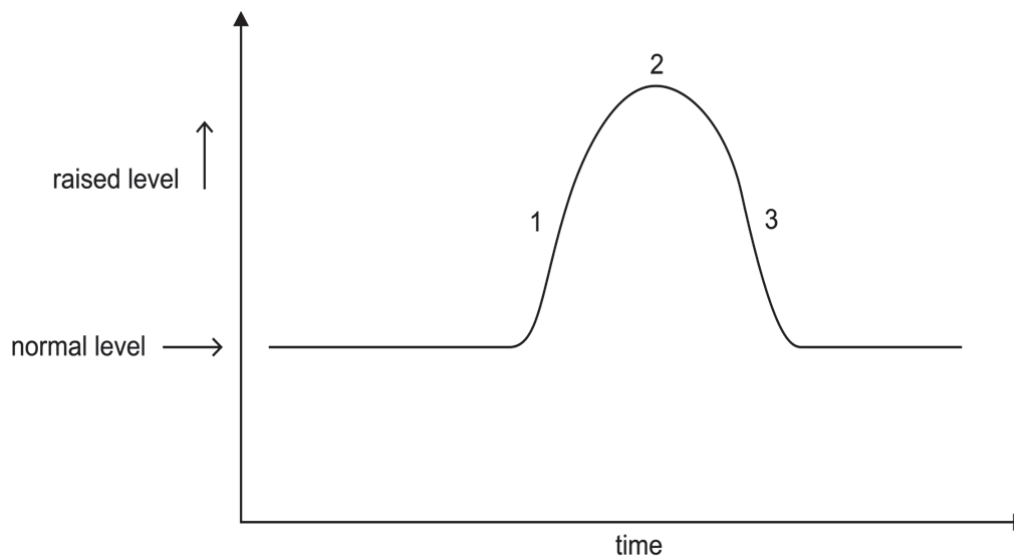
If someone had a condition that made their homeostatic system less able to respond to this factor, how would the shape of the graph be altered?

A   1 would be earlier

B   1 would be less steep

C   2 would be earlier

D   2 would be higher

**E**   3 would be steeper

F   3 would be earlier

13 In a monohybrid genetic cross a ratio of phenotypes of 3:0, rather than the usual 3:1 ratio, was seen. This could be due to:

    1   offspring with both dominant alleles not surviving

    2   only a small number of offspring being produced

    3   chance

Which of these statements is/are correct?

    A   1 only

    B   2 only

    C   1 and 2 only

    D   2 and 3 only

    E   1, 2 and 3

14 The diagram shows an experiment kept at room temperature.
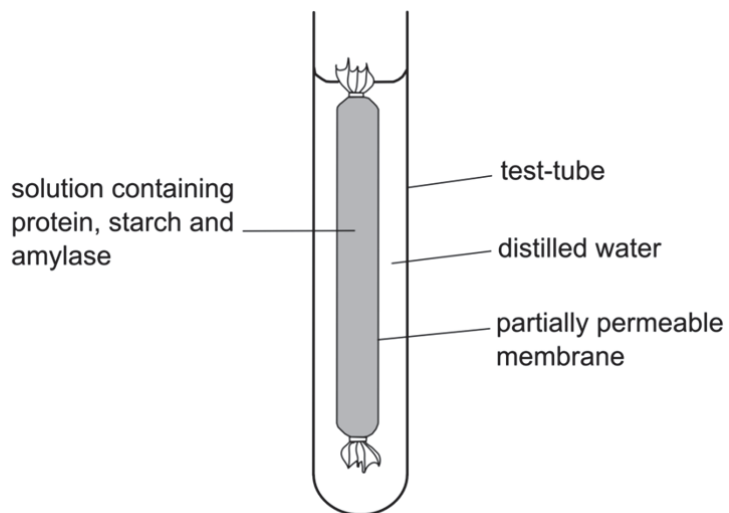
The experiment is left for 45 minutes.

Which molecules are in the distilled water after 45 minutes?

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Key
✓ present
✗ not present
```

	amino acids	*amylase*	*glucose*	*protein*	*starch*	*glycerol*
A	✓	✗	✗	✗	✗	✗
B	✗	✗	✓	✗	✗	✗
C	✓	✗	✓	✗	✗	✓
D	✗	✗	✓	✗	✗	✓
E	✗	✓	✗	✓	✗	✗
F	✗	✓	✗	✓	✓	✗

15 Which of the following, if any, could be found in a healthy adult liver cell?

      1   gene for amylase

      2   at least one X chromosome

      3   starch

A   none of them

B   1 only

C   2 only

D   3 only

E   1 and 2 only

F   1 and 3 only

G   2 and 3 only

H   1, 2 and 3

16 Which of the following ionic equations are correct?

      1 $X^+ + e^- \rightarrow X$

      2 $X^- - e^- \rightarrow X$

      3 $O^{2-} + 2e^- \rightarrow O$

      4 $O^{2-} - e^- \rightarrow O_2$

      5 $2I^- - 2e^- \rightarrow I$

      6 $Ca^{2+} + 2e^- \rightarrow Ca$

A   1, 2 and 6 only

B   1, 3 and 5 only

C   1, 4 and 5 only

D   2, 3 and 6 only

E   2, 4 and 5 only

F   3, 4 and 6 only

17 In which reaction (A–E) would the position of equilibrium shift to the left when the pressure is increased?

Assume that each reaction reaches equilibrium in a closed system of fixed volume and that there is no change in temperature when the pressure is increased.

A $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

B $S(s) + O_2(g) \rightleftharpoons SO_2(g)$

C $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

D $2Zn(s) + O_2(g) \rightleftharpoons 2ZnO(s)$

E $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

18 When concentrated aqueous sodium chloride solution is electrolysed using inert electrodes, a reaction occurs at each electrode.

Which is the correct combination of elements actually produced at the electrodes in this electrolysis?

A   anode = oxygen; cathode = hydrogen

B   anode = chlorine; cathode = sodium

C   anode = oxygen; cathode = sodium

D   anode = chlorine; cathode = hydrogen

E   anode = sodium; cathode = chlorine

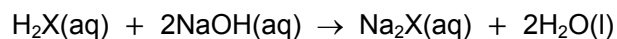**19** Cyclohexene, C_6H_{10}, can be drawn as:
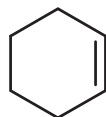
What is the total number of carbon atoms in the steroid molecule below?
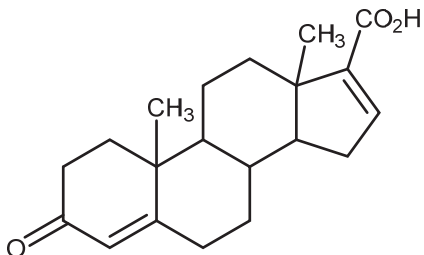
A	17
B	20
C	21
D	22
E	26
F	27

20 A sample of an acid, H_2X, with a mass of 4.5 g was dissolved in water.

This solution was neutralised by 50.0 cm^3 of aqueous sodium hydroxide of concentration 2 mol/dm^3.

$$H_2X(aq) \; + \; 2NaOH(aq) \; \rightarrow \; Na_2X(aq) \; + \; 2H_2O(l)$$

What is the relative formula mass, M_r, of the acid?

A 45

B 90

C 100

D 180

E 205

21 A particle consists of 19 protons, 18 electrons and 20 neutrons.

Which row in the table shows the correct atomic number, mass number and charge of this particle?

	atomic number	mass number	charge
A	18	37	−1
B	18	37	+1
C	19	39	−1
D	19	39	+1
E	20	37	−1
F	20	39	+1

Standard ATS Sample Material

22 Naturally occurring chlorine is a mixture of two isotopes with mass numbers 35 and 37. The isotope with mass number 35 is three times as common as the isotope with mass number 37.

Naturally occurring bromine is a mixture of two isotopes with mass numbers 79 and 81. They are present in equal amounts.

What fraction of the naturally occurring compound CH_2BrCl has a relative molecular mass of 128?

[A_r values: H = 1, C = 12]

A $\dfrac{1}{8}$

B $\dfrac{1}{4}$

C $\dfrac{3}{8}$

D $\dfrac{1}{2}$

E $\dfrac{5}{8}$

23 Lithium (Li) and potassium (K) are elements in Group 1 of the Periodic Table.

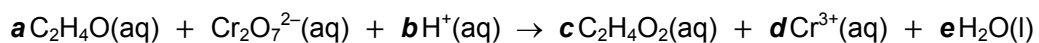Which statement best explains why potassium reacts more violently with water than lithium?

A   Potassium atoms have more protons than lithium atoms, so the nuclear charge in potassium atoms is greater than in lithium atoms, so water molecules are attracted more strongly.

B   Potassium atoms are larger than lithium atoms, so water molecules will collide more frequently with potassium atoms than lithium atoms.

C   The metallic bonding in potassium is stronger than the metallic bonding in lithium.

D   Potassium atoms have more electrons than lithium atoms, so transfer of electrons to water molecules will take place more frequently with potassium atoms than with lithium atoms.

E   The outer electron in potassium atoms is further from the nucleus than in lithium atoms, so it is more easily lost from potassium atoms than from lithium atoms.

24 1.15 g of sodium completely reacts with water at standard temperature and pressure (stp). What volume of hydrogen at stp is produced by this reaction?

[Assume in this question that 1 mole of any gas at stp has a volume of 22.4 dm^3.]

[A_r values: H = 1, O = 16, Na = 23]

A   280 cm^3

B   560 cm^3

C   600 cm^3

D   1120 cm^3

E   1200 cm^3

25 By using standard techniques to balance chemical equations and ensuring that the net charge is equal on both sides, find the correct value for '**e**' in the balanced equation below:

$$\boldsymbol{a}\,C_2H_4O(aq) + Cr_2O_7{}^{2-}(aq) + \boldsymbol{b}\,H^+(aq) \rightarrow \boldsymbol{c}\,C_2H_4O_2(aq) + \boldsymbol{d}\,Cr^{3+}(aq) + \boldsymbol{e}\,H_2O(l)$$

A   1

B   2

C   4

D   6

E   8

26 Carbon, in the form of coke, is used to reduce iron oxide in a blast furnace. The three stages are shown below:

    1 $C + O_2 \rightarrow CO_2$

    2 $CO_2 + C \rightarrow 2CO$

    3 $3CO + Fe_2O_3 \rightarrow 2Fe + 3CO_2$
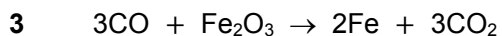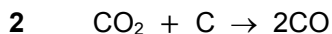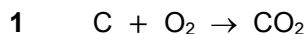
If 12 g of carbon is used in stage 2 and all the carbon monoxide produced is used in stage 3, what mass of carbon dioxide is produced in stage 3?

[A_r values: C = 12, O = 16]

A   17.8 g

B   35.6 g

C   44 g

D   88 g

E   132 g

27 Azurite is a mineral made up of a mixture of $CuCO_3$ and $Cu(OH)_2$ in a simple whole number molar ratio.

Which one of the following is a possible formula of azurite?

A $Cu_3CH_4O_4$

B $Cu_3CH_4O_5$

C $Cu_3CH_4O_6$

D $Cu_3C_2H_2O_6$

E $Cu_3C_2H_2O_7$

F $Cu_3C_2H_2O_8$

28 An impure sample of sodium hydroxide has a mass of 1.20 g. All the sodium hydroxide completely reacts with a minimum of 50.0 cm^3 of 0.50 mol/dm^3 hydrochloric acid.

What is the percentage purity of the sodium hydroxide sample?

[A_r values: H = 1, O = 16, Na = 23, Cl = 35.5]

A   37.5%

B   41.6%

C   72.7%

D   75.0%

E   83.3%

F   90.4%

29 Ammonia is manufactured from the reaction between nitrogen and hydrogen. In practice, the manufacturing process can be represented as a reaction going to completion. This reaction is given below.

$$N_2 + 3H_2 \rightarrow 2NH_3$$
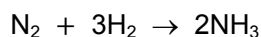
What is the maximum mass of ammonia that can be manufactured from a mixture of 56 g of nitrogen with 9 g of hydrogen?

[A_r values: H = 1, N = 14]

A   34 g

B   51 g

C   65 g

D   68 g

E   83 g

30 The following chemicals are mixed together. In which of the mixtures will a displacement reaction occur?

    1 $Pb(NO_3)_2(aq) + Al(s)$

    2 $KCl(aq) + 2KF(aq)$

    3 $Al_2(SO_4)_3(aq) + 3Fe(s)$

    4 $CuSO_4(aq) + Zn(s)$

A   1 only

B   2 and 3 only

C   3 and 4 only

D   1 and 4 only

E   1, 2 and 4 only

F   2, 3 and 4 only

END OF TEST

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