CAMBRIDGE ASSESSMENT

BioMedical Admissions Test 4500/02

Wednesday 1 November 2006 Morning 30 minutes

SECTION 2 Scientific Knowledge and Applications

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 also require a soft pencil and an eraser.

Please first write your name, date of birth, BioMedical Admissions Test candidate number and centre number in the spaces provided on the answer sheet.
Please write very clearly.

Speed as well as accuracy is important in this section. ***Work quickly, or you may not finish the paper.*** There are no penalties for incorrect responses, only points for correct answers, so you should attempt all 27 questions.
Unless otherwise stated, all questions are worth one mark.

Answer on the sheet provided. Many questions ask you to show your choice between options by shading a circle (or circles, if specified in the question).
If questions ask you to write in words or numbers, be sure to write clearly in the spaces provided. If you make a mistake, erase thoroughly and try again.

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.

This paper consists of 15 printed pages and 5 blank pages.

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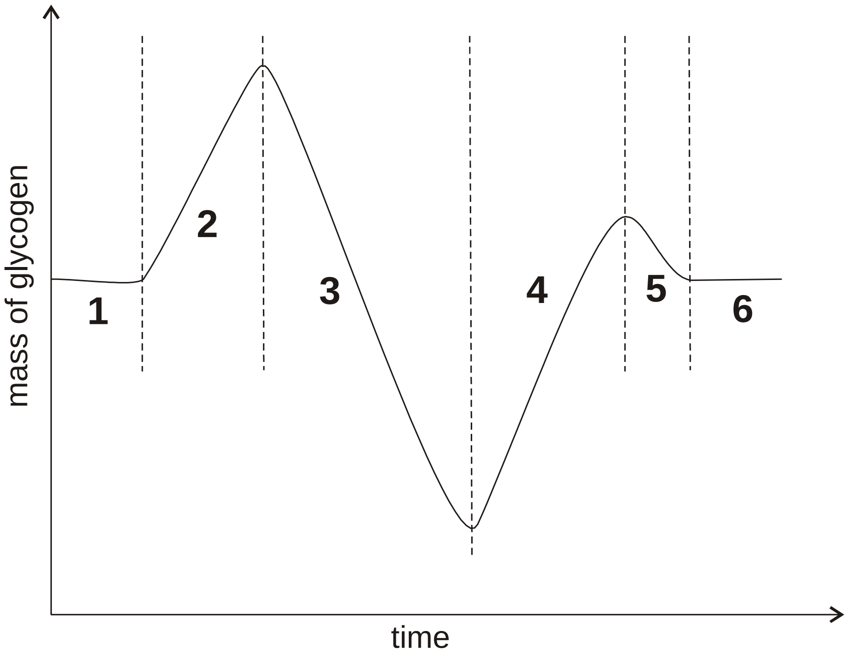
1 The graph shows changes in the mass of glycogen stored in the liver and skeletal muscles.



During which periods will the concentration of insulin in the blood be below normal?

A 1 and 6

B 2 and 3

C 2 and 4

D 3 and 4

E 3 and 5

F 4 and 5

2 Compound T has a melting point of 78 °C and a boiling point of 134 °C. T is soluble in water and its solution does not conduct electricity. T has covalent bonding and has a simple molecular structure.

Which property of T is not usually associated with its bonding and structure?

A the melting point

B the boiling point

C the solubility in water

D the lack of conductivity of the solution

3 A particular radioisotope X with a half-life of 4 years decays into the stable isotope Y.

At a particular time, a sample contains 32×10^{20} atoms of nuclide X and 4×10^{20} atoms of nuclide Y.

How many atoms of nuclide Y will be present in the sample 8 years later?

A 1×10^{20}

B 4×10^{20}

C 8×10^{20}

D 16×10^{20}

E 24×10^{20}

F 28×10^{20}

4 The amount of water in urine is controlled by the hormone ADH.

Which sequence of events will occur when you need to keep water in your body?

	blood concentration is:	**ADH production**	**nephron action**	**urine concentration becomes:**
A	dilute	falls	less water reabsorbed	dilute
B	concentrated	rises	more water reabsorbed	concentrated
C	dilute	rises	less water reabsorbed	dilute
D	concentrated	falls	more water reabsorbed	concentrated
E	dilute	falls	more water reabsorbed	concentrated
F	concentrated	rises	less water reabsorbed	dilute

5 Listed are the electronic configurations for the atoms of different elements.

Which one represents the most reactive non-metal?

A 2, 8, 7

B 2, 4

C 2, 7

D 2, 8, 1

E 2, 6

F 2, 8, 6

6 The sides of triangle ABC are as follows:

AB = 3, AC = 2, BC = 4

Use the cosine rule, $a^2 = b^2 + c^2 - 2bc\cos A$, to find the cosine of $\angle BAC$

A $-\frac{1}{4}$

B $\frac{1}{16}$

C $\frac{1}{4}$

D $\frac{\sqrt{5}}{6}$

E $\frac{1}{2}$

7 The following statements can be applied to certain types of wave:

1 Their oscillations are longitudinal.
2 They travel at the speed of light in air.
3 They are used in pre-natal scanning.
4 They are used in thermal imaging.
5 They will not travel through a vacuum.

Which of these statements can be applied to microwaves?

A 2 only

B 4 only

C 1 and 5 only

D 2 and 4 only

E 1, 3 and 5 only

F 2, 3 and 4 only

8 A health club monitors the average heart rate of its members when using a cardiovascular workout machine. The lower quartile of the heart rate is 115, the upper quartile is 165.

What is the probability that when a group of 4 members is chosen at random at least 3 of them had an average heart rate of more than 165 when doing this workout?

A $\frac{1}{256}$

B $\frac{3}{64}$

C $\frac{13}{256}$

D $\frac{5}{16}$

E $\frac{11}{16}$

9 Which changes to the conditions will increase the yield of the salt in the exothermic reaction shown?

$$NH_3(g) + HCl(g) \rightleftharpoons NH_4Cl(s)$$

1 Adding a catalyst
2 Adding more ammonia
3 Increasing the pressure
4 Increasing the temperature

A 1 and 2 only
B 2 and 3 only
C 3 and 4 only
D 1 and 4 only
E 2, 3 and 4 only
F 1, 2 and 3 only

10 A gene controls the production of chlorophyll in lettuce plants. The recessive allele of this gene blocks chlorophyll formation which prevents seedling development.

Plants heterozygous for this gene were cross bred and 1000 of their seeds were planted. Only about 750 developed into mature plants.

What percentage of these mature plants would be heterozygous for this gene?

A 25%

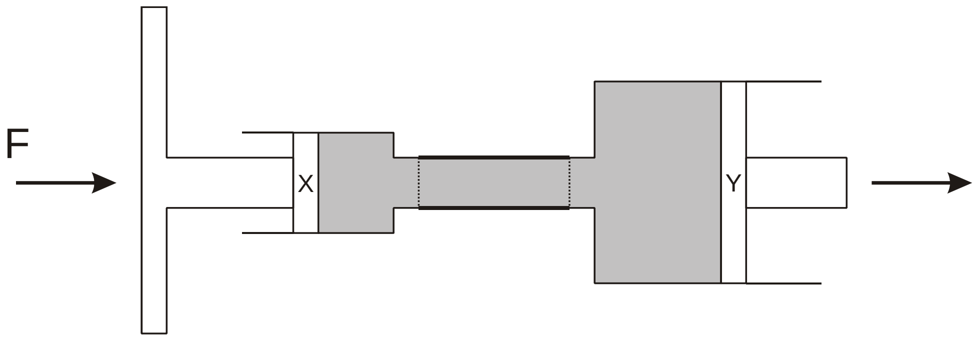
B 33%

C 50%

D 67%

E 75%

11 A force F is applied to the piston X of a brake pedal. This force is transmitted, hydraulically, to piston Y as shown in the diagram.



Diameter of piston X = 2 cm.
Diameter of piston Y = 20 cm.

The pressure applied at X is $3\,\text{N/cm}^2$.

What is the pressure transmitted to Y?

A $0.03\,\text{N/cm}^2$

B $0.3\,\text{N/cm}^2$

C $3\,\text{N/cm}^2$

D $30\,\text{N/cm}^2$

E $300\,\text{N/cm}^2$

12 In statistics Spearman's rank correlation coefficient is given by the formula:

$$r = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

Rearrange the formula to make $\sum d^2$ the subject.

A $\sum d^2 = 1 - \frac{r(n^3 - n)}{6}$

B $\sum d^2 = \left(\frac{(1-r)(n^3 - n)}{6}\right)^2$

C $\sum d^2 = \frac{(1-r)(n^3 - 1)}{6}$

D $\sum d^2 = \frac{(1+r)(n^3 - n)}{6}$

E $\sum d^2 = \frac{(1-r)(n^3 - n)}{6}$

13 At 200 °C, potassium hydrogencarbonate decomposes according to the following equation.

$$2KHCO_3 \rightarrow K_2CO_3 + H_2O + CO_2$$

What is the loss in mass when 50.0 g of potassium hydrogencarbonate are heated at 200 °C to constant mass?

(A_r : H = 1; C = 12; O = 16; K = 39)

A 11.0 g

B 15.5 g

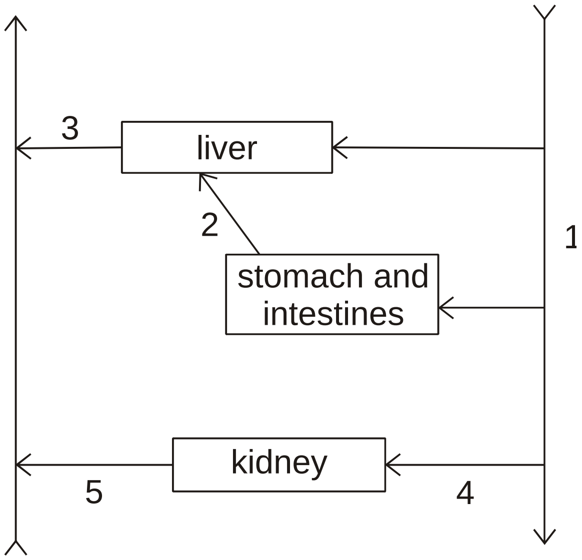
C 22.0 g

D 31.0 g

14 Find the positive solution of the following simultaneous equations:

$$4x^2 + y^2 + 10y = 47$$
$$2x - y = 5$$

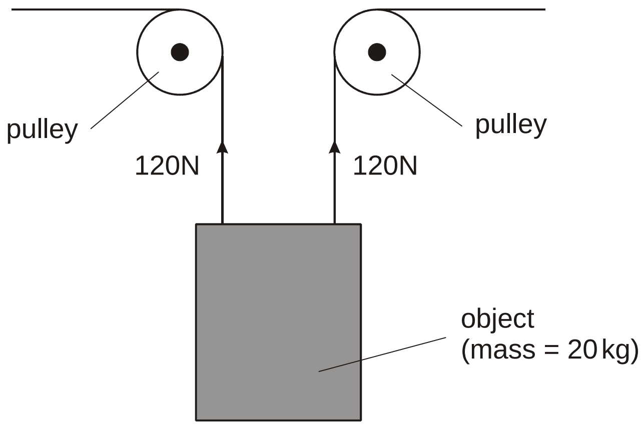
15 The diagram shows part of the circulatory system.



Which row of the table identifies the blood vessels that best fit the descriptions after eating a carbohydrate rich meal?

	concentration of substances in the blood		
	highest concentration of glucose	**highest concentration of urea**	**lowest concentration of oxygen**
A	1	5	4
B	5	3	4
C	2	2	3
D	1	5	2
E	2	3	3
F	5	2	2

16 An object with a mass of 20 kg is lifted by the arrangement shown in the diagram. Air resistance (drag) can be ignored, and the gravitational field strength (acceleration due to gravity) can be taken as 10 N/kg.



What is the acceleration of the object, in m/s²?

17 The element has a mass number of 40 and an atomic number of 20.

Consider the statements and decide which of them are correct.

1 The nucleus has a relative mass of 20.
2 It is a noble gas.
3 It would form a negative ion.
4 It is in group 2 of the periodic table.
5 It is a non-metallic element.

A 1, 2 and 3 only

B 5 only

C 2, 3 and 5 only

D 1, 4 and 5 only

E 4 only

F 1, 3 and 4 only

18 The table shows some details of the composition of inhaled and exhaled air of a student.

Gas	Inhaled air	Exhaled air
Carbon dioxide	0.03%	4%
Nitrogen	78%	78%
Oxygen	21%	16%

The student is breathing 500 cm^3 of air 14 times per minute.

How many dm^3 of oxygen will be absorbed into the lung capillaries in 4 minutes?

A 0.14 dm^3

B 0.35 dm^3

C 1.4 dm^3

D 3.5 dm^3

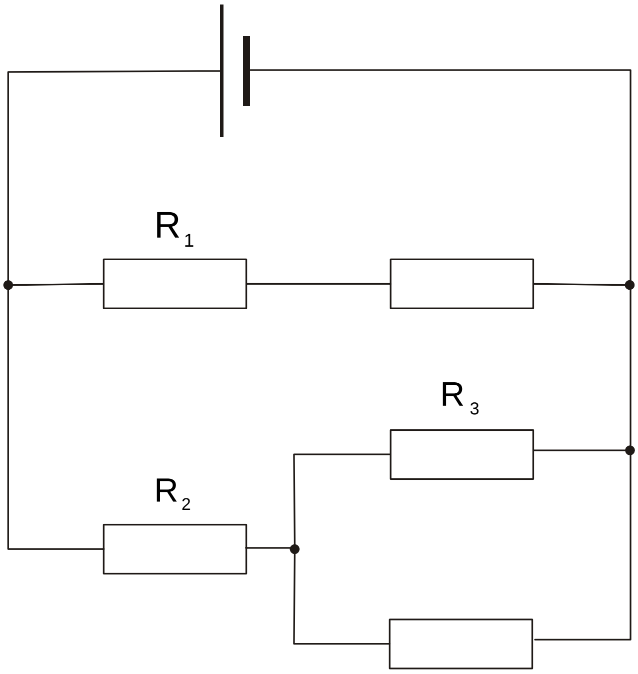
E 35.0 dm^3

F 140.0 dm^3

19 Which row of the table shows the response of the iris to reducing levels of light?

	radial muscles	circular muscles	pupil
A	contract	relax	is contracted
B	relax	contract	is dilated
C	contract	relax	is dilated
D	relax	contract	is contracted

20 Five identical resistors are connected to a cell as in the diagram.



The potential differences across R_1, R_2 and R_3 are V_1, V_2 and V_3 respectively.

What is the order of increasing potential differences (smallest first)?

A V_1, V_2, V_3

B V_1, V_3, V_2

C V_2, V_1, V_3

D V_2, V_3, V_1

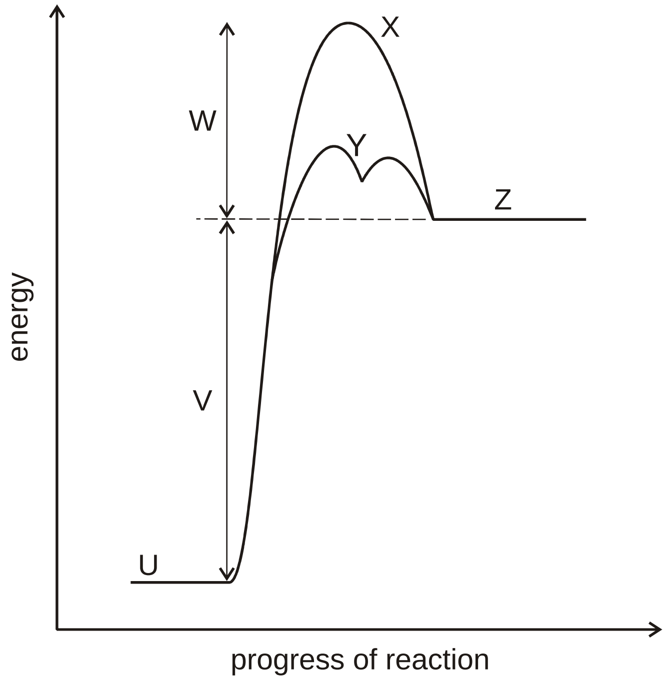
E V_3, V_1, V_2

F V_3, V_2, V_1

21 Evaluate

$$\left(\frac{32^{1/5}+9^{0}}{81^{3/4}}\right)^{-1}$$

22 The energy profile for a reaction is shown below.



Which of the following is a fully correct statement about this energy level profile?

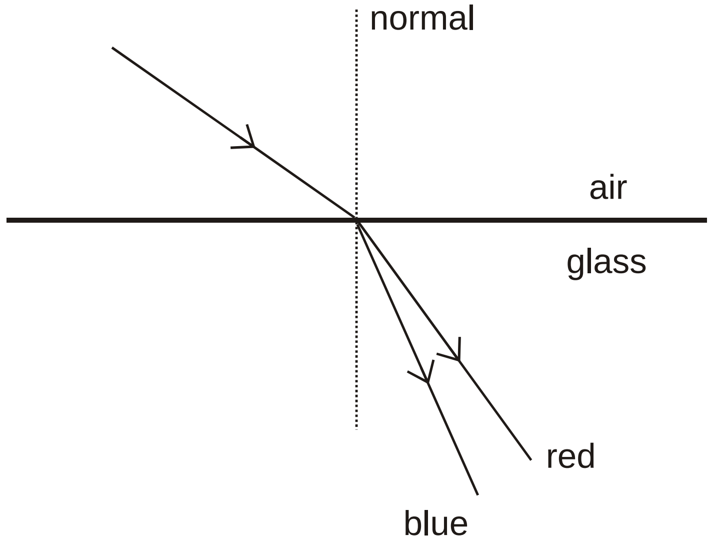
A The reaction is endothermic, V is the heat of reaction (positive sign) and X is the activation energy.

B Products (Z) have more energy than the reactants (U), X shows the route taken when a catalyst is present and W is the activation energy.

C Y is the route taken when a catalyst is present, V is the heat of reaction and the reaction is exothermic overall.

D X shows the route taken without a catalyst, V + W is the activation energy and V (the heat of reaction) has a positive sign.

23 The diagram shows the dispersion of white light as it passes from air into glass.



Red light travels at speed c in air, but only $2c/3$ in glass. Red light has a wavelength of λ in air.

What is the frequency of red light, and the speed of blue light in glass?

	frequency of red light in glass	**speed of blue light in glass**
A	$2c/3\lambda$	$< 2c/3$
B	$2c/3\lambda$	$> 2c/3$
C	c/λ	$< 2c/3$
D	c/λ	$> 2c/3$
E	$3c/2\lambda$	$< 2c/3$
F	$3c/2\lambda$	$> 2c/3$

24 The statements are about respiration.

1 Aerobic respiration releases more energy per unit mass of glucose than anaerobic respiration.

2 Aerobic respiration in muscles causes an oxygen debt to occur.

3 Aerobic respiration forms carbon dioxide as the only waste product.

4 Reduced aerobic respiration will limit the active uptake of mineral ions in the kidney tubules.

5 When there is little oxygen available to muscles only anaerobic respiration occurs.

6 Anaerobic respiration forms lactic acid as the only waste product.

Which statements are correct?

A 1, 2 and 3 only

B 4, 5 and 6 only

C 1, 3 and 5 only

D 2, 4 and 6 only

E 1, 4 and 6 only

F 2, 3 and 5 only

25 In stars four protons, p, are fused together to form helium, $^{4}\mathrm{He}$, with a mass of four units, by the following processes.

$$2\mathrm{p} \rightarrow {}^{2}\mathrm{H} + \mathrm{e}^{+}$$
$$2\ {}^{2}\mathrm{H} + \mathrm{p} \rightarrow {}^{3}\mathrm{He}$$
$$2\ {}^{3}\mathrm{He} \rightarrow {}^{4}\mathrm{He} + 2\mathrm{p}$$

Which one of the following shows the overall change that has taken place when $^{4}\mathrm{He}$ is formed?

(e^{+} is a positively charged electron, n is a neutron, $^{2}\mathrm{H}$ is a hydrogen of mass two and $^{3}\mathrm{He}$ is helium of mass three.)

A $1\mathrm{p} \rightarrow 1\mathrm{n} + \mathrm{e}^{+}$

B $2\mathrm{p} \rightarrow 2\mathrm{n} + 2\mathrm{e}^{+}$

C $3\mathrm{p} \rightarrow 3\mathrm{n} + 3\mathrm{e}^{+}$

D $4\mathrm{p} \rightarrow 4\mathrm{n} + 4\mathrm{e}^{+}$

26 a is inversely proportional to the square of b.

When $a = 9$, $b = 4$.

What is the positive value of b when $a = 4$?

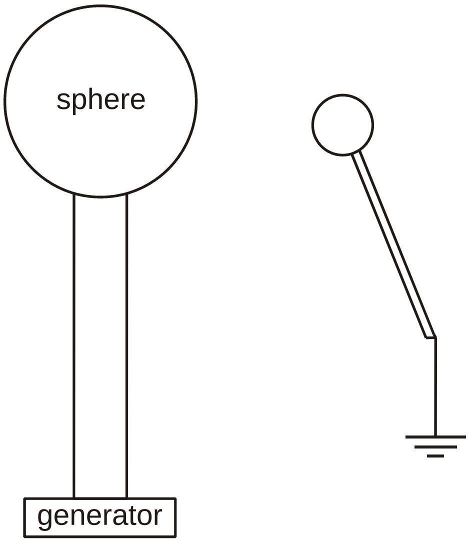
A 6

B 9

C 20.25

D 36

27 A small conducting sphere is held at a fixed distance from a larger sphere which is continually charged by a generator.



The surface area of the large sphere is $0.04\,m^2$, and it discharges by sparking to the small sphere when the charge density on the large sphere reaches $0.25\,C/m^2$.

charge density = charge per unit surface area

If the large sphere is charged at a rate of 2 mA, calculate the time interval (in seconds) between sparks.

END OF SECTION 2

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