

## BioMedical Admissions Test

4500/02

Wednesday

5<sup>th</sup> November 2008

Morning

30 minutes

\* 8 5 2 6 3 7 6 9 6 6 \*

### 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 17 printed pages and 3 blank pages.*

**The questions in this paper that are marked with an asterisk (\* Qs: 21, 25) assume knowledge that is not currently on the BMAT specification.**

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1 Which one of the following involves active transport?

- A** movement of carbon dioxide into alveoli in the lungs
- B** uptake of alcohol (ethanol) through the lining of the stomach
- C** secretion of sweat onto the skin's surface
- D** re-absorption of glucose in the kidney tubules
- E** loss of urine from the urethra
- F** transfer of oxygen into the blood from the alveoli

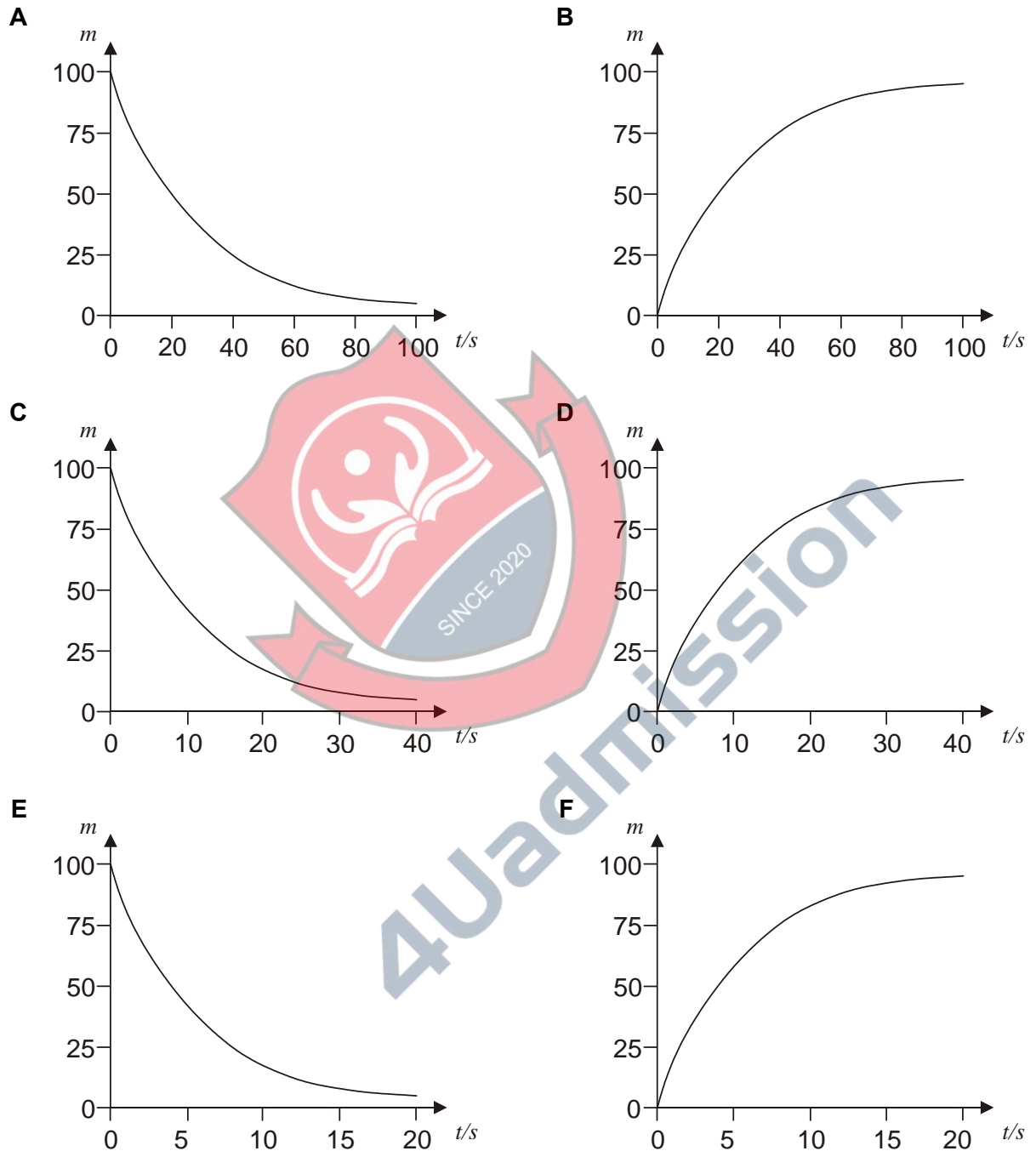
2 Element **Y** forms an ion  $\text{Y}^{3-}$  with the electronic configuration 2, 8, 8.

To which group and period of the periodic table does **Y** belong?

	Group	Period
<b>A</b>	3	3
<b>B</b>	3	4
<b>C</b>	5	3
<b>D</b>	5	4
<b>E</b>	8	3
<b>F</b>	8	4

- 3 A radioactive isotope  $X$  decays into the stable isotope  $Y$  with a half-life of 20 s.

Which graph correctly shows how the mass ( $m$ ) of  $Y$  present in an initially pure sample of  $X$  varies with time ( $t$ )?



- 4 In the formula  $P = 2r^2t$

$$r = 3 \times 10^{-3}$$

$$t = 2.5 \times 10^4$$

Calculate the value of  $P$ . Leave your answer in standard form.

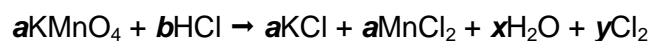
- A  $7.5 \times 10^{-2}$
- B  $45 \times 10^{-2}$
- C  $75 \times 10^{-2}$
- D  $4.5 \times 10^{-1}$
- E  $7.5 \times 10^{-1}$
- F 4.5

- 5 In mice the recessive form of a gene causes the death of the fetus if present in the homozygous state. Mice heterozygous for this gene were crossbred.

What percentage of the live offspring would be homozygous dominant?

- A 0%
- B 25%
- C 33%
- D 50%
- E 66%
- F 75%

- 6 Look at the equation for making chlorine gas and decide which answer will provide you with the numbers to balance it

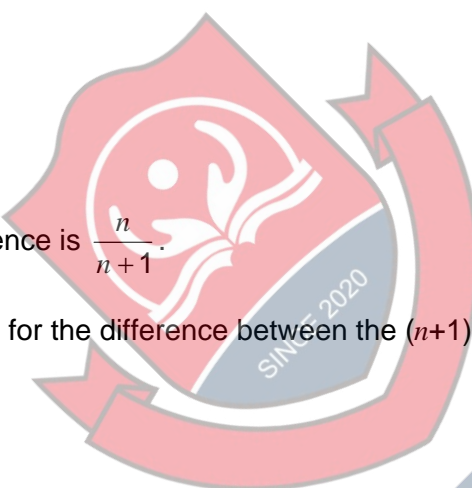


- A  $a = 1, b = 8, x = 4, y = 3$   
 B  $a = 1, b = 8, x = 4, y = 4$   
 C  $a = 1, b = 4, x = 2, y = 1$   
 D  $a = 2, b = 16, x = 4, y = 6$   
 E  $a = 2, b = 16, x = 8, y = 5$

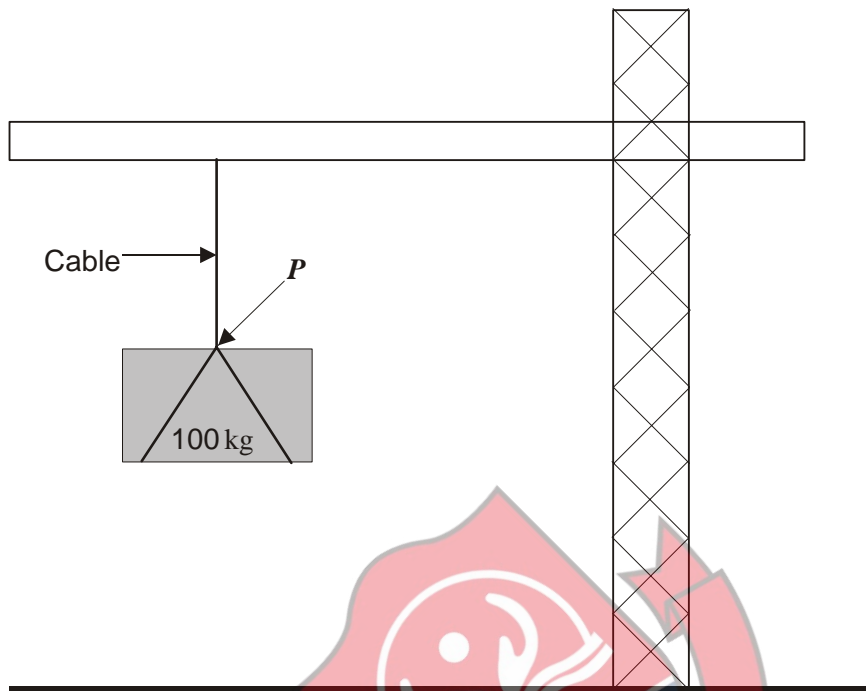
- 7 The  $n^{\text{th}}$  term of a sequence is  $\frac{n}{n+1}$ .

What is the expression for the difference between the  $(n+1)^{\text{th}}$  term and the  $n^{\text{th}}$  term?

- A  $\frac{-1}{(n+2)(n+1)}$   
 B  $\frac{1}{(n+2)(n+1)}$   
 C  $\frac{n^2 + n}{(n+2)(n+1)}$   
 D  $\frac{1}{n^2 + 2}$   
 E  $\frac{1}{n(n+1)}$



- 8 The diagram shows a crane that lifts a load with a mass of 100 kg at a constant speed of 0.4 m/s for 5 seconds. ( $g=10 \text{ N/kg}$ )



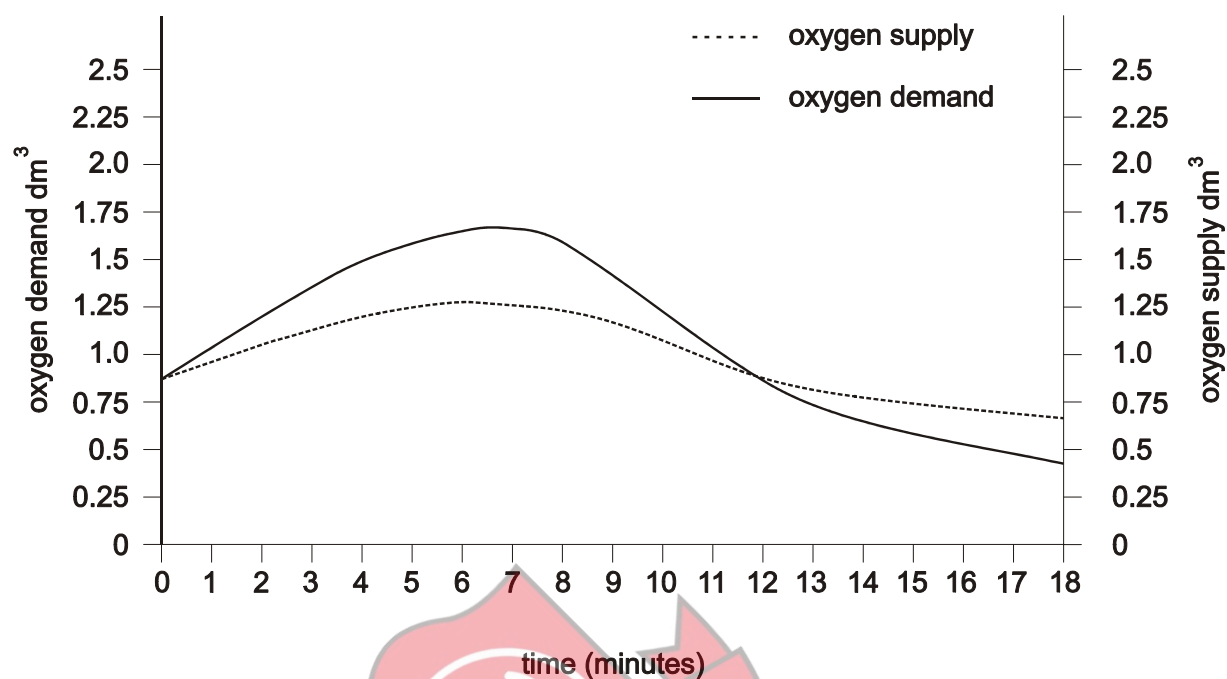
Here are 3 statements about this activity:

- 1 The gain in gravitational potential energy of the load is 2000 J.
- 2 The tension in the cable at point *P* is 2000 N.
- 3 The load accelerates at  $10 \text{ m/s}^2$ .

Which statements is/are true?

- A 1 only
- B 2 only
- C 3 only
- D 1 and 2
- E 1 and 3
- F 2 and 3

- 9 The graph shows oxygen supply and demand in muscle cells during exercise.



Which statement correctly describes what is happening in the muscle cells between 0 and 11 minutes?

- A Anaerobic respiration only is taking place
- B More oxygen is being supplied than is required
- C Aerobic respiration only is taking place
- D Both anaerobic and aerobic respiration are taking place

- 10 Which one of the following would **not** be formed by cracking the hydrocarbon  $C_{12}H_{26}$ ?

- A  $CH_4$
- B  $C_2H_4$
- C  $C_6H_{16}$
- D  $C_8H_{18}$
- E  $C_{12}H_{24}$
- F  $H_2$



11 Here are four statements about radioactivity:

- 1 A beta particle is an electron that is emitted from the outermost electron shell of an atom.
- 2 A beta particle is emitted from the nucleus of the atom when a proton changes into an electron.
- 3 A beta particle is emitted from the nucleus of the atom when a neutron changes into an electron.
- 4 After a beta particle is emitted the mass number of the nucleus of the atom is unchanged.

Which statement(s) is/are true?

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

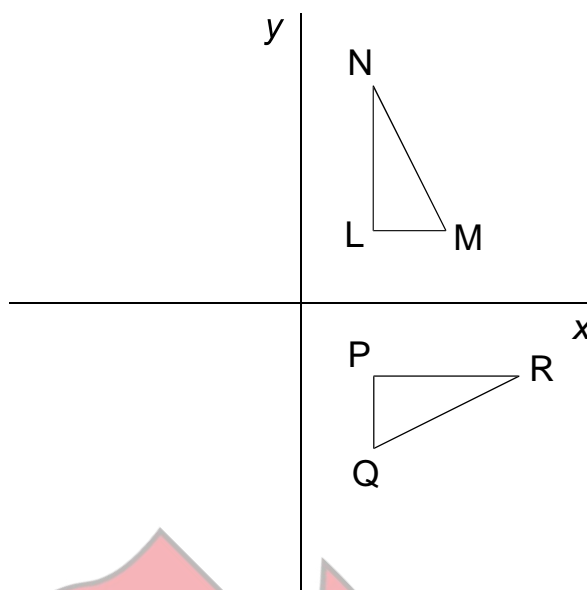


12 During the breakdown of a solution containing carbohydrates, proteins and lipids by carbohydrase, protease and lipase enzymes, the pH changed from neutral due to the products formed.

Which of the options, **A** to **E**, correctly shows which constituents contribute to the change in pH?

	Carbohydrate	Protein	Lipid
A	yes	yes	yes
B	no	yes	no
C	no	no	yes
D	yes	yes	no
E	no	yes	yes

- 13 In the diagram below, the triangles are congruent, **PQ** is a continuation of **NL** and both **L** and **P** are equidistant from the line  $X = 0$  and from the line  $Y = 0$ .

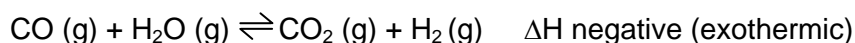


Of the transformations (**1 to 5**) described below, which one of the combinations (**A to E**) will map the triangle **LMN** onto the triangle **PQR**?

- 1 Reflection in the line  $y = 0$
- 2 Rotation of  $90^\circ$  about the origin
- 3 Reflection in the line  $y = x$
- 4 Reflection in the line  $x = 0$
- 5 Rotation of  $180^\circ$  about the origin

- A 1 followed by 2
- B 3 followed by 4
- C 5 followed by 4
- D 2 followed by 5
- E 4 followed by 5

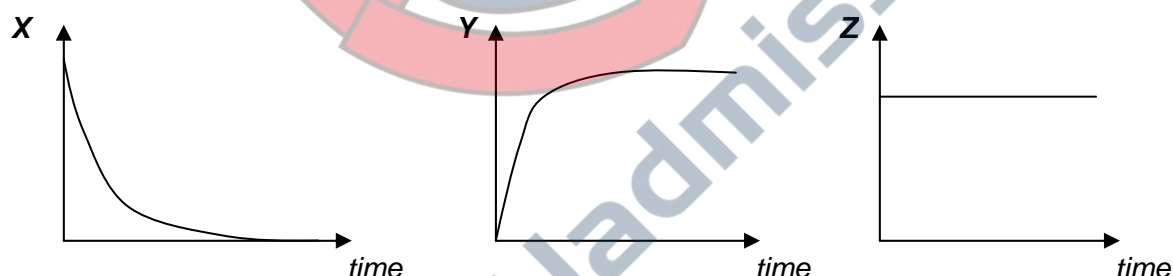
- 14 In the manufacture of hydrogen from methane and steam, carbon monoxide is produced as an unwanted side product. The amount of carbon monoxide is reduced by mixing the gases with steam when the following reversible reaction takes place.



When this reaction reaches equilibrium, which of the following changes would result in more carbon monoxide being removed?

- A Adding a catalyst
- B Increasing pressure
- C Decreasing pressure
- D Decreasing temperature
- E Adding nitrogen at constant pressure

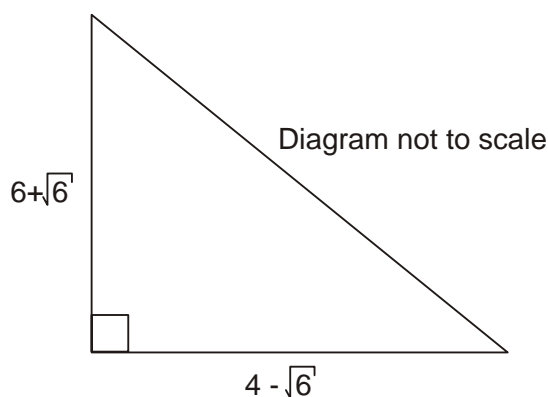
- 15 A car is accelerated from rest along a horizontal road by a constant thrust force produced by the engine. The car eventually reaches a terminal speed, and the graphs below show the variation with time of three quantities (**X**, **Y** and **Z**) for the car:



Which line in the table could correctly identify the quantities **X**, **Y** and **Z**?

	<b>X</b>	<b>Y</b>	<b>Z</b>
<b>A</b>	acceleration	drag force	kinetic energy
<b>B</b>	acceleration	mass	weight
<b>C</b>	potential energy	velocity	kinetic energy
<b>D</b>	potential energy	drag force	weight
<b>E</b>	resultant force	mass	kinetic energy
<b>F</b>	resultant force	velocity	weight

- 16 A right-angled triangle is shown.



Calculate the area of the triangle.

- A  $9 - \sqrt{6}$   
 B  $9 - \sqrt{3}$   
 C  $\sqrt{52 + 4\sqrt{6}}$   
 D  $9 + \sqrt{6}$   
 E  $15 + 5\sqrt{6}$

- 17 The reflex arc enables the body to make rapid responses to certain stimuli.



Which row in the table correctly identifies the elements 1 to 5 in the reflex arc shown above?

	receptor	response	stimulus	muscles	CNS
A	5	4	3	2	1
B	2	5	1	4	3
C	1	4	3	2	5
D	5	1	2	3	4
E	1	2	5	4	3
F	2	5	1	3	4

- 18 The general formula for the alkane series is  $C_nH_{2n+2}$

The amide series has the same saturated structure as the alkanes but with one H substituted by the  $-CONH_2$  group.

What is the general formula for the amide series?

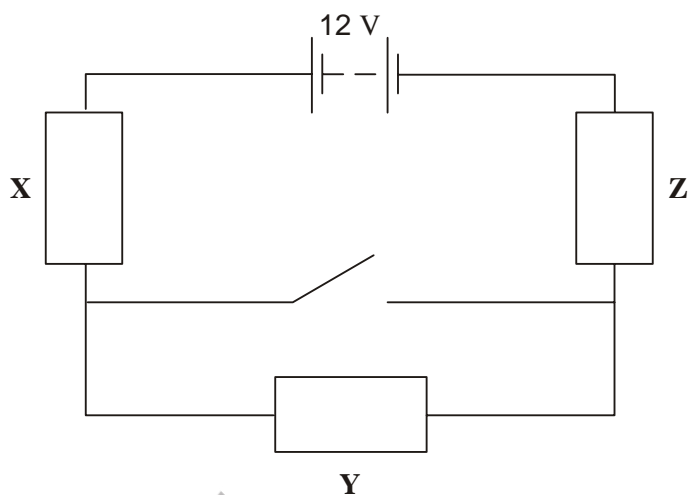
- A  $C_nH_{2n}ON$
- B  $C_nH_{2n+2}ON$
- C  $C_nH_{3n-1}ON$
- D  $C_{n+1}H_{2n}ON$
- E  $C_{n+1}H_{2n+1}ON$
- F  $C_{n+1}H_{2n+3}ON$

- 19 I stop while out walking and take the bearing of a windmill and note it as  $\theta^\circ$ . I then walk 5 km north and take the bearing again – it is now  $2\theta$ .

How far away, in km, was the windmill from the position where I took the first bearing?

- A  $5 \cos \theta$
- B  $5 \cos 2\theta$
- C  $10 \cos \theta$
- D  $5 \sin 2\theta$
- E  $10 \sin \theta$

- 20 The diagram below shows three identical resistors and a battery that supplies a constant 12 V.



With the switch open, as shown, the current in resistor **Y** is 20 mA.

When the switch is closed, what is the current in resistor **X**, and what is the potential difference (voltage) across resistor **Z**?

	Current in <b>X</b> (mA)	Potential difference across <b>Z</b> (V)
<b>A</b>	$13\frac{1}{3}$	4
<b>B</b>	$13\frac{1}{3}$	6
<b>C</b>	20	4
<b>D</b>	20	6
<b>E</b>	30	4
<b>F</b>	30	6

- \* 21 The four statements are about the movement of blood during one complete circuit of the body.

- 1 Blood flowing from the lungs flows through the heart twice.
- 2 All the blood flowing from the lungs flows through the kidneys.
- 3 All the blood flowing from the liver flows through the lungs.
- 4 Only blood flowing from the digestive system flows through the liver.

Which of the above statements are correct?

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

- 22 In addition to diamond and graphite, another allotrope of carbon is Buckminster fullerene,  $C_{60}$ , which is in the shape of a sphere.

Which one of the following statements applies to all three allotropes?

- A Weak intermolecular forces hold the structures together.
- B Carbon atoms are bonded to four other carbon atoms.
- C They have similar physical properties.
- D They all react with  $O_2$  to give the same products.
- E They are electrical insulators.

- 23** A lorry of mass  $m$ , and travelling initially at speed  $v$  along a horizontal road, is brought to rest by an average braking force  $F$  in time  $t$ .

Ignoring any other resistive forces, what distance is travelled by the lorry during this time?

- A**  $\frac{F}{mg}$
- B**  $\frac{mgv}{F}$
- C**  $\frac{mv^2}{2F}$
- D**  $\frac{v^2}{2g}$
- E**  $vt$
- F**  $2vt$

- 24** A quadratic equation has solutions  $a$  and  $b$ .

$$a + b = -5 \qquad ab = 3$$

What is the equation?

- A**  $x^2 + 5x + 3 = 0$
- B**  $x^2 - 5x - 3 = 0$
- C**  $x^2 - 5x + 3 = 0$
- D**  $x^2 + 3x + 5 = 0$
- E**  $x^2 + 5x - 3 = 0$
- F**  $x^2 + 3x - 5 = 0$



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- 25 Red-green colour blindness is a condition caused by a recessive allele. The gene is carried on the X chromosome.

A man is red-green colour blind, which of his relatives **must** carry the recessive allele?

- A father and grandfather
- B mother and grandmother
- C son and daughter
- D mother and daughter
- E father and son
- F brother and sister

- 26 A sample of an alkali  $\text{XOH}$  of mass 2.8 g was dissolved in water.

This solution was neutralised by  $12.5 \text{ cm}^3$  of sulphuric acid of concentration  $2.0 \text{ mol dm}^{-3}$ .



What is the relative atomic mass of **X**?

( $A_r$  : H = 1, O = 16, S = 32)

- A 13
- B 26
- C 39
- D 52
- E 65
- F 78

- 27 Taking the speed of sound in air as 300 m/s and in steel as 4800 m/s. A worker lies next to a railway line and hears the whistle of a train through the steel rails and 1.5 s later hears the same whistle through the air.

How far away was the train when its whistle sounded?

- A 200 m
- B 450 m
- C 480 m
- D 4500 m
- E 6750 m
- F 7200 m



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