

BioMedical Admissions Test

4500/12

Wednesday 2nd November 2011

30 minutes

* 1 0 1 5 0 1 3 6 0 9 *

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 complete the answer sheet with your:

- BMAT candidate number
- centre number
- date of birth
- name

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. All questions are worth one mark.

Answer on the sheet provided. Most questions ask you to show your choice between options by shading a circle. 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 19 printed pages and 1 blank page.

The questions in this paper that are marked with an asterisk (* Qs: 1, 21) assume knowledge that is not currently on the BMAT specification.

*

1

Gland	Hormone	One function
Adrenal	Adrenaline	
	Oestrogen	Female secondary sexual characteristics
	Antidiuretic hormone (ADH)	
Testes		Male secondary sexual characteristics
Pancreas		Regulates blood glucose level

Which word or statement does **not** correctly fit into one of the gaps left in the table?

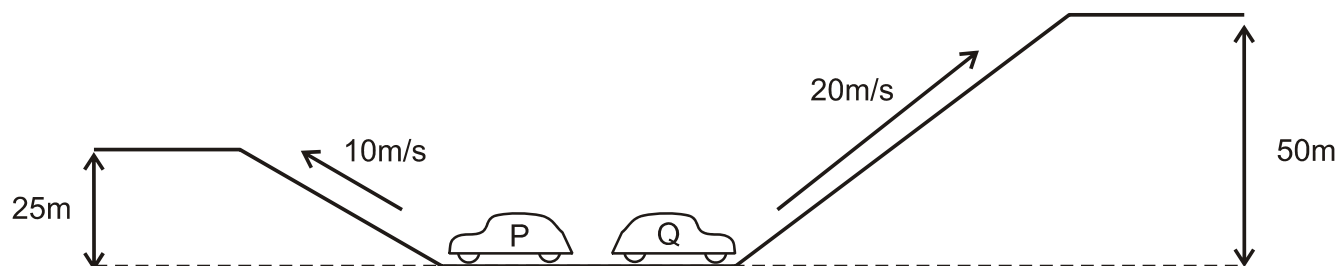
- A Insulin
- B Increases heartbeat rate
- C Pituitary
- D Testosterone
- E Ovary
- F Carbohydase
- G Regulates water level in blood

- 2 A metal, X, is in group III of the periodic table. A non-metal, Y, is in group VI of the periodic table. They react together to form a compound.

What is the formula of the compound?

- A X_2Y
- B X_2Y_3
- C X_3Y_2
- D X_3Y_6
- E X_6Y_3

- 3 Two identical cars, P and Q, start at the same level. Car P moves at a constant speed of 10m/s up a hill to a height of 25m in a time of 20s. In the same time car Q moves at a constant speed of 20m/s up a hill to a height of 50m.



What are the kinetic energies of the cars while they are travelling up the hills, and what are their gravitational potential energies once they have reached the top?

	kinetic energy	gravitational potential energy
A	car Q has twice as much as car P	car Q has twice as much as car P
B	car Q has twice as much as car P	car Q has four times as much as car P
C	car Q has four times as much as car P	car Q has twice as much as car P
D	car Q has four times as much as car P	car Q has four times as much as car P

- 4 Simplify:

$$3x(3x^{-\frac{1}{3}})^3$$

A $\frac{1}{9}$

B 1

C 81

D $\frac{x^2}{9}$

E x^2

F $81x^2$

5 The following statements relate to typical nuclear division in human cells:

- 1 mitosis results in variation within the species
- 2 meiosis results in the production of genetically identical cells
- 3 mitosis results in the production of diploid cells
- 4 meiosis results in the production of haploid cells
- 5 mitosis results in the production of two daughter cells

Which statements are correct?

- A** 1, 2 and 3 only
- B** 1, 2 and 4 only
- C** 1, 4 and 5 only
- D** 2, 3 and 5 only
- E** 2, 4 and 5 only
- F** 3, 4 and 5 only

6 When molecules collide, for a reaction to take place, two conditions must be met. Firstly, they must have sufficient energy to react and secondly, they must have the right orientation. This means that the ends of the molecules that are going to react must be in contact with each other.

Raising the temperature speeds up a chemical reaction.

Which of the following could be responsible for this?

- 1 More collisions take place.
- 2 The average collision has more energy.
- 3 The orientation of the molecules is more favourable.

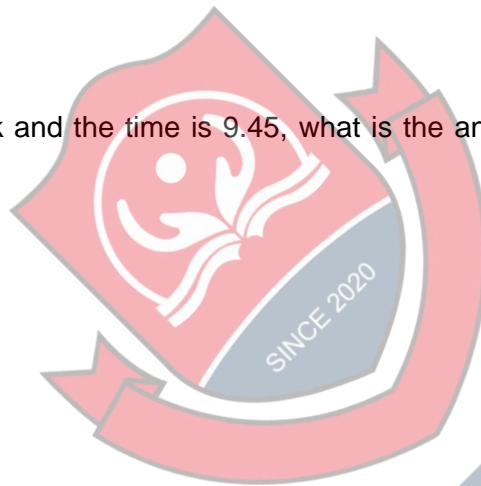
- A** 1 only
- B** 2 only
- C** 3 only
- D** 1 and 2 only
- E** 1 and 3 only
- F** 2 and 3 only
- G** 1, 2 and 3

7 Which one of the following statements about nuclear physics is true?

- A The process of emission of a gamma ray from a nucleus is called nuclear fission.
- B The half life of a radioactive substance is half the time taken for its nuclei to decay.
- C The number of neutrons in a nucleus is its atomic number (proton number) minus its mass number.
- D The process used in nuclear power stations is nuclear fusion.
- E When a nucleus emits a beta particle, there is no change in the number of particles it contains.
- F When a nucleus emits an alpha particle, one of its neutrons becomes a proton plus an electron.

8 If you look at a clock and the time is 9.45, what is the angle between the hour and the minute hands?

- A 0°
- B 7.5°
- C 15°
- D 22.5°
- E 30°



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9 Here are five statements about natural selection:

- 1 Individuals within a species show variation.
- 2 Individuals within a species compete with each other for, among other things, resources.
- 3 Individuals with advantageous adaptations are more likely to survive to adulthood.
- 4 Only individuals with advantageous adaptations will be able to breed.
- 5 Alleles for advantageous adaptations are more likely to be inherited.

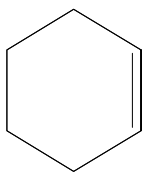
Which of the above statements are correct?

- A None
- B 1, 2, 3 & 4 only
- C 1, 2, 3 & 5 only
- D 1, 3, 4 & 5 only
- E 2, 3, 4 & 5 only
- F All

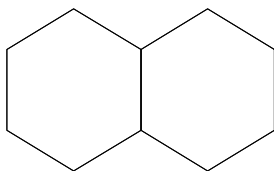


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10 Cyclohexene, C_6H_{10} , can be represented as:



Use this information to calculate the relative molecular mass of the hydrocarbon shown below:



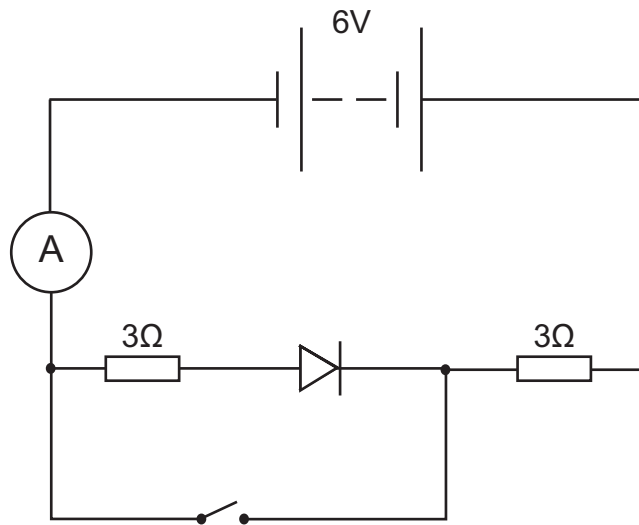
[A_r values: H = 1; C = 12]

- A 108
- B 126
- C 134
- D 138
- E 150



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11 Consider this circuit.



Which line in the table gives the current flowing in the ammeter, in amps, when the switch is open, and when it is closed?

	ammeter reading/A	
	switch open	switch closed
A	0.0	1.0
B	0.0	2.0
C	1.0	0.0
D	1.0	1.0
E	1.0	2.0
F	2.0	0.0
G	2.0	1.0
H	2.0	2.0

- 12 w, x, y and z are integers such that $w < x^2$, $x > y^2$, $y^2 < z^2$ and $x > z$.

Which one of the following inequalities **must** be true?

- A** $w < x$
B $w > y$
C $w < z$
D $x > y$
E $y < z$

- 13 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?

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

- 14 Which of the following (A-E) correctly identifies **all** of the compounds from the list below that contain covalent bonds in their structure?

$\text{CO}_2(\text{g})$ $\text{Ca}(\text{OH})_2(\text{s})$ $\text{H}_2\text{SO}_4(\text{l})$ $\text{MgCO}_3(\text{s})$ $\text{NaCl}(\text{s})$ $\text{Na}_2\text{O}(\text{s})$ $\text{Na}_3\text{PO}_4(\text{s})$ $\text{SO}_2(\text{g})$ $\text{SiO}_2(\text{g})$

- A $\text{CO}_2(\text{g})$, $\text{SO}_2(\text{g})$, $\text{SiO}_2(\text{g})$
- B $\text{Ca}(\text{OH})_2(\text{s})$, $\text{H}_2\text{SO}_4(\text{l})$, $\text{MgCO}_3(\text{s})$, $\text{NaCl}(\text{s})$, $\text{Na}_2\text{O}(\text{s})$, $\text{Na}_3\text{PO}_4(\text{s})$
- C $\text{CO}_2(\text{g})$, $\text{Ca}(\text{OH})_2(\text{s})$, $\text{H}_2\text{SO}_4(\text{l})$, $\text{MgCO}_3(\text{s})$, $\text{Na}_3\text{PO}_4(\text{s})$, $\text{SO}_2(\text{g})$, $\text{SiO}_2(\text{g})$
- D $\text{NaCl}(\text{s})$, $\text{Na}_2\text{O}(\text{s})$
- E All of the compounds

- 15 A bullet of mass 50g is fired from a rifle with a velocity of 300m/s. It hits a bank of earth and after travelling 60cm into the bank comes to rest.

What is the average stopping force of the earth in the bank on the bullet?

- A 37.5N
- B $3.75 \times 10^3\text{N}$
- C $3.75 \times 10^4\text{N}$
- D $3.75 \times 10^6\text{N}$

16 The graphs of the following equations are drawn:

1 $y = 3x - 2$

2 $y = x^2$

3 $y = 1 - x^2$

4 $y = x + 6$

Which pair of graphs do **not** intersect?

A 1 and 2

B 1 and 3

C 2 and 3

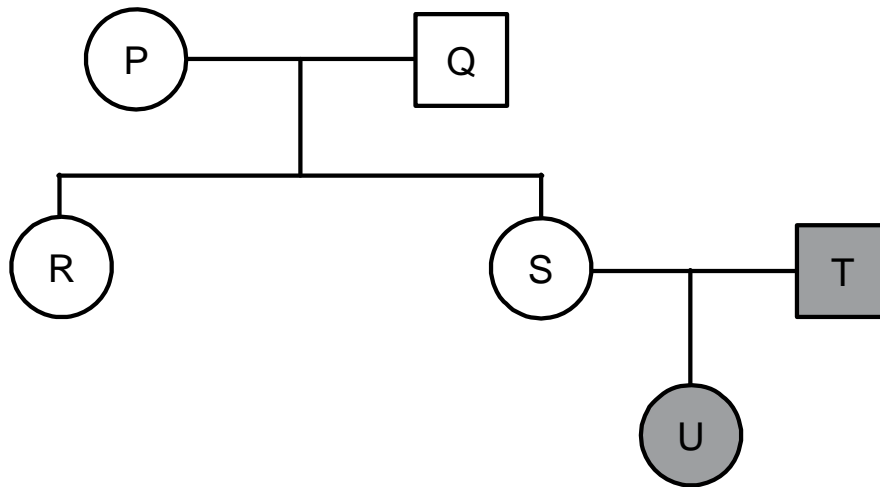
D 2 and 4

E 3 and 4



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- 17 The genetic condition represented by the shading is caused by the presence of at least one allele for the condition.



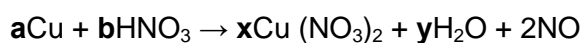
Which of the following are possible reasons why **U** has the condition?

- 1 The condition is dominant.
- 2 The sperm from **T** carried the allele for the condition.
- 3 A mutation present in a egg of **S**.

- A** 1 and 2 only
- B** 1 and 3 only
- C** 2 and 3 only
- D** 1, 2 and 3
- E** None of the above

18 Nitrogen Monoxide is prepared by reacting copper with nitric acid.

What should the values of a, b, x and y be in order to balance the following equation?

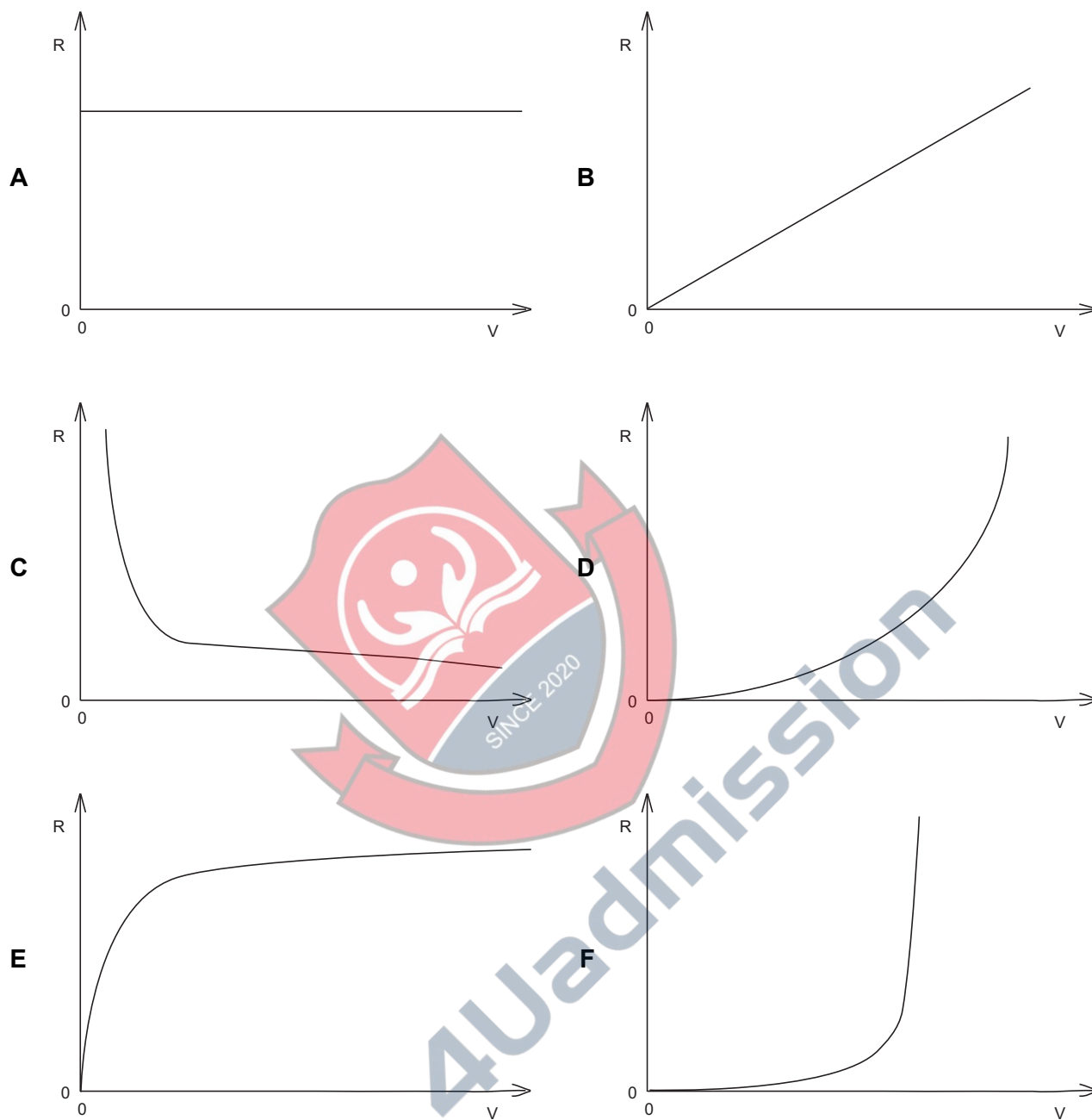


- A** $a = 2, b = 4, x = 2, y = 2$
- B** $a = 6, b = 16, x = 6, y = 8$
- C** $a = 1, b = 4, x = 1, y = 2$
- D** $a = 4, b = 10, x = 4, y = 5$
- E** $a = 3, b = 8, x = 3, y = 4$

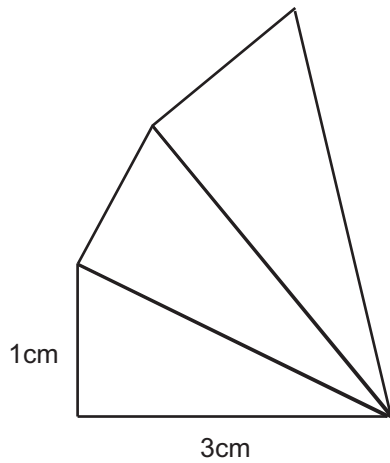


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- 19 Which graph correctly shows how the resistance (R) varies with applied voltage (V) for a resistor at constant temperature?



20 The diagram shows three similar right-angled triangles.



What is the area of the largest triangle?

- A $\frac{5}{3} \text{ cm}^2$
- B $\frac{50}{27} \text{ cm}^2$
- C 5 cm^2
- D 15 cm^2
- E $\frac{50}{3} \text{ cm}^2$



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- * 21 Using the table, select the correct answer from the table.

Cell	Quantity of nuclear DNA
P	1
Q	2
R	0

	P	Q	R
A	gamete	cheek cell	fetal body cell
B	zygote	enucleated egg cell	red blood cell
C	sperm cell	adult stem cell	white blood cell
D	egg cell	nerve cell	enucleated egg cell
E	red blood cell	fertilised egg cell	embryo cell

- 22 An ore of lead contains 70% of PbS.

Calculate the mass of lead that can be extracted from 478kg of the ore.

[A_r : Pb = 207; S = 32]

- A 28.98kg
 B 41.40kg
 C 144.90kg
 D 289.80kg
 E 414.00kg

- 23** A ray of orange light travelling through air has a speed of $3.0 \times 10^8 \text{ m/s}$ and a wavelength of 600nm. ($1 \text{ nm} = 10^{-9} \text{ m}$)

What could be the speed, frequency and wavelength of this orange light when travelling through glass?

	Speed/ ms^{-1}	Frequency/Hz	Wavelength/nm
A	2.0×10^8	3.3×10^{14}	400
B	2.0×10^8	3.3×10^{14}	600
C	2.0×10^8	5.0×10^{14}	400
D	2.0×10^8	5.0×10^{14}	600
E	3.0×10^8	3.3×10^{14}	400
F	3.0×10^8	3.3×10^{14}	600
G	3.0×10^8	5.0×10^{14}	400
H	3.0×10^8	5.0×10^{14}	600

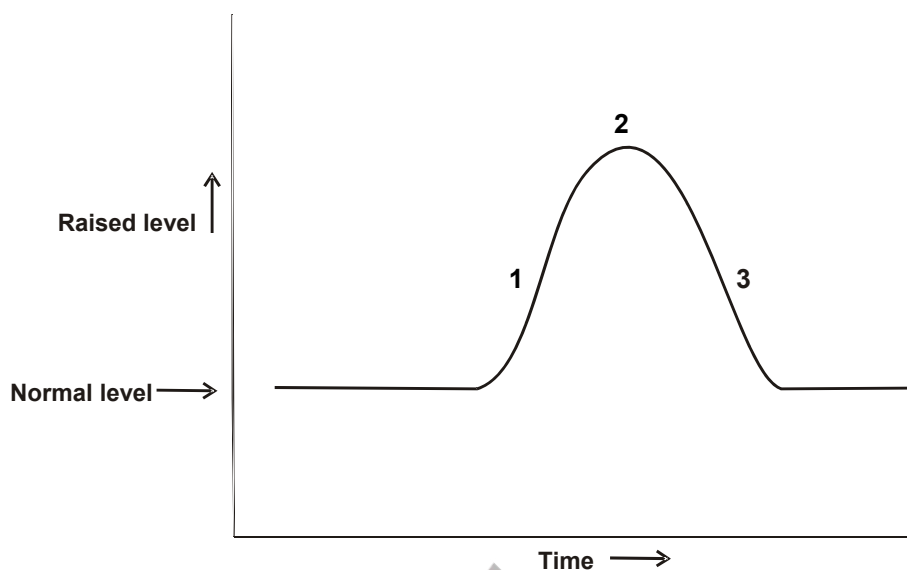
- 24** I have two six-sided dice, each with faces numbered from 1 to 6. One of the dice is fair, but the other is not – it will land on numbers 1 to 5 with equal probability, but lands on 6 with a different probability.

When I roll the dice the probability that I get a total of 12 is $\frac{1}{18}$.

What is the probability that I get a total of 2 when I roll the dice?

- A** $\frac{1}{72}$
- B** $\frac{1}{45}$
- C** $\frac{1}{36}$
- D** $\frac{1}{18}$
- E** $\frac{1}{9}$

- 25 The graph below shows how one factor in the internal environment in a person changes, and is returned to a normal level.



If someone has a condition which makes their homeostatic system less responsive, 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

- 26 An impurity in petroleum is dimethylsulphide, CH_3SCH_3 . When dimethylsulphide is burnt in an excess of air, which one of the following balanced equations represents the reaction that takes place?

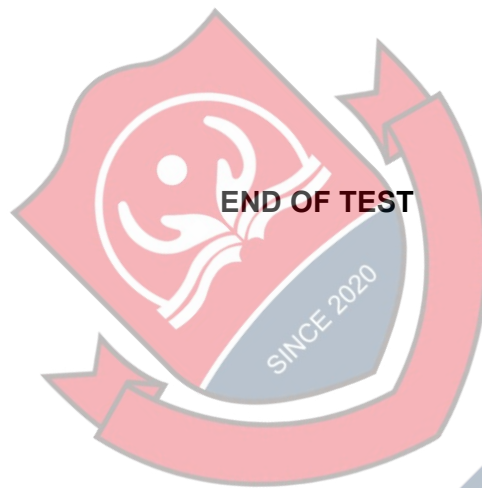
- A $\text{CH}_3\text{SCH}_3 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O} + \text{H}_2\text{S}$
- B $2\text{CH}_3\text{SCH}_3 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O} + 2\text{S}$
- C $4\text{CH}_3\text{SCH}_3 + 12\text{O}_2 \rightarrow 6\text{CO}_2 + 12\text{H}_2\text{O} + 2\text{CS}_2$
- D $2\text{CH}_3\text{SCH}_3 + 7\text{O}_2 \rightarrow 4\text{CO} + 6\text{H}_2\text{O} + 2\text{SO}_2$
- E $2\text{CH}_3\text{SCH}_3 + 9\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O} + 2\text{SO}_2$

- 27 At the front of a long column of soldiers is a man regularly hitting a drum 50 times a minute. The soldiers are told to place their left foot down on the ground when they hear the drum beat. The column is so long that the soldiers at the back put down their left feet at the same time as the soldiers in the front put down their right feet.

What is the minimum length of the column of soldiers?

[Speed of sound in air is 330m/s]

- A 165m
- B 198m
- C 330m
- D 396m
- E 660m
- F 792m



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