NATIONAL JUNIOR COLLEGE
SH2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

CHEMISTRY **9729/01**
Paper 1 Multiple Choice **15 September 2022**
1 hour

Additional Materials: Optical Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.
There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

Instructions on how to fill in the Optical Mark Sheet
Shade the index number in a 5 digit format on the optical mark sheet:
2nd digit and the last 4 digits of the Registration Number.

Example:

Student	Examples of Registration No.	Shade:
	2105648	**15648**

This document consists of **15** printed pages and **1** blank page.

1 Technetium (Tc) is a second row transition element that does not occur naturally on Earth. One of its isotopes has 56 neutrons.

What is the nucleon number of this isotope?

A 43 **B** 56 **C** 99 **D** 112

2 Which row has the greater number of particles?

A 1 mol of liquid sulfuric acid

B 12000 cm^3 of oxygen gas at s.t.p.

C 32.5 g of zinc

D 16 g of nitrogen gas

3 Which species will have the smallest deflection when passed through the same electric field?

A $^{23}Na^+$ **B** $^{11}B^{3+}$ **C** $^{19}F^-$ **D** $^{32}S^{2-}$

4 0.0353 g of a sample of volatile organic compound was completely vaporized at 50 kPa and 300K. The vapour occupied a volume of 40 cm^3. On complete combustion in excess oxygen, 80 cm^3 of carbon dioxide and 80 cm^3 of water vapour were formed. All gaseous volumes were measured under identical conditions.

What would be the molecular formula of the compound?

A C_2H_2O **B** C_2H_4O **C** C_2H_6O **D** C_3H_8

5 Which species has the most number of unpaired electrons?

A Co^{2+} **B** N **C** Fe **D** S

6 Rubidium and bromine form ions that are isoelectronic.

1 Ionic radius of rubidium is smaller than its atomic radius.

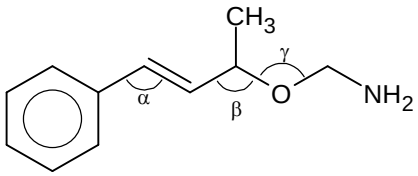
2 Ionic radius of bromine is larger than its atomic radius.

3 Ionic radius of bromine is smaller than that of rubidium.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

7 Which row correctly shows the bond angles for α, β, γ in the molecule below?



	α	β	γ
A	109.5°	120°	109.5°
B	120°	109.5°	107°
C	120°	107°	105°
D	120°	109.5°	105°

8 In which pair is the melting point of the **second** species higher than that of the **first** species?

A C and Si

B K and Rb

C NaC*l* and NaBr

D $SiCl_4$ and SiO_2

9 When liquid N_2F_4 is heated, it decomposes into a single product, **B**.

Which statements are correct?

1 N–F bonds are broken during this decomposition.

2 The enthalpy change when N_2F_4 decomposes into **B** is approximately +160 kJ mol^{-1}.

3 Molecules of **B** are non-linear.

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

10 Three experiments were carried out involving acids and alkalis of the same concentration. The temperature changes were recorded as shown in the table below.

Volumes of acids and alkalis added together	ΔT/ ^{o}C
25.0 cm^3 of HC*l*(aq) + 25.0 cm^3 of NaOH(aq)	ΔT_1
50.0 cm^3 of HC*l*(aq) + 50.0 cm^3 of NaOH(aq)	ΔT_2
25.0 cm^3 of HC*l*(aq) + 25.0 cm^3 of NH_3(aq)	ΔT_3

Which row shows the correct relative magnitude of ΔT values?

A $\Delta T_2 > \Delta T_3 > T_1$ **B** $\Delta T_1 = \Delta T_2 > \Delta T_3$ **C** $\Delta T_2 = \Delta T_3 > \Delta T_1$ **D** $\Delta T_1 = \Delta T_2 = \Delta T_3$

11 Some ΔH values are given below.

	enthalpy change of formation / kJ mol^{-1}
Fe_2O_3	– 824.2
CO	– 110.5
CO_2	– 393.5

In the industrial production of iron, iron(III) oxide is reduced by carbon monoxide.

What is the enthalpy change of reaction for one mole of iron formed?

A – 24.8 kJ mol^{-1}

B + 24.8 kJ mol^{-1}

C – 12.3 kJ mol^{-1}

D + 541.2 kJ mol^{-1}

12 Nitrogen and hydrogen form ammonia in an exothermic reaction. The rate and yield of the reaction can be altered by changing the experimental conditions.

Which row correctly describes the effect of the changes in condition?

	change in condition	effects		
		equilibrium yield	rate of forward reaction	rate of backward reaction
1	increasing temperature	decreases	increases	increases
2	increasing temperature	increases	decreases	increases
3	addition of catalyst	increases	increases	no effect
4	addition of catalyst	no effect	increases	increases

A 1 and 4 only **B** 2 and 4 only **C** 2 and 3 only **D** 1 and 3 only

13 Four solutions, each of concentration 0.1 mol dm^{-3}, were tested with a pH meter. The results are shown.

solution	pH
CH_3CO_2H	4
HNO_3	1
CH_3NH_2	11
NaOH	14

Which statement is **incorrect**?

A Conjugate base of CH_3CO_2H is less stable than that of HNO_3.

B HNO_3 has a lower pH than CH_3CO_2H because it is more soluble.

C NaOH has a higher concentration of hydroxide ions in solution than CH_3NH_2.

D Mixing equal volume of CH_3NH_2 and HNO_3 form a solution with pH less than 7.

14 Solid calcium hypochlorite pellets, $Ca(ClO)_2(s)$, are added to swimming pools to form $HClO(aq)$ which kills disease-causing bacteria and algae.

$$Ca(ClO)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2ClO^-(aq)$$

$$ClO^-(aq) + H_2O(l) \rightleftharpoons HClO(aq) + OH^-(aq)$$

What is the effect on the solubility of calcium hypochlorite and bacterial growth when pH increases?

	effect on solubility of calcium hypochlorite	effect on bacterial growth
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

15 A mixture of two oxides of period 3 elements is added to water and the resultant solution has a pH value below 7.

What could be the constituents of the mixture?

A Al_2O_3 and MgO

B Na_2O and MgO

C Na_2O and P_4O_{10}

D SO_3 and P_4O_{10}

16 Anhydrous magnesium nitrate, $Mg(NO_3)_2$, decomposes when heated, giving a white solid and a mixture of two gases, **D** and **E**. **E** is oxygen.

What is the ratio of $\frac{\text{mass of } \mathbf{D} \text{ released}}{\text{mass of } \mathbf{E} \text{ released}}$?

A $\frac{1}{0.174}$ **B** $\frac{1}{0.267}$ **C** $\frac{1}{0.348}$ **D** $\frac{1}{3.43}$

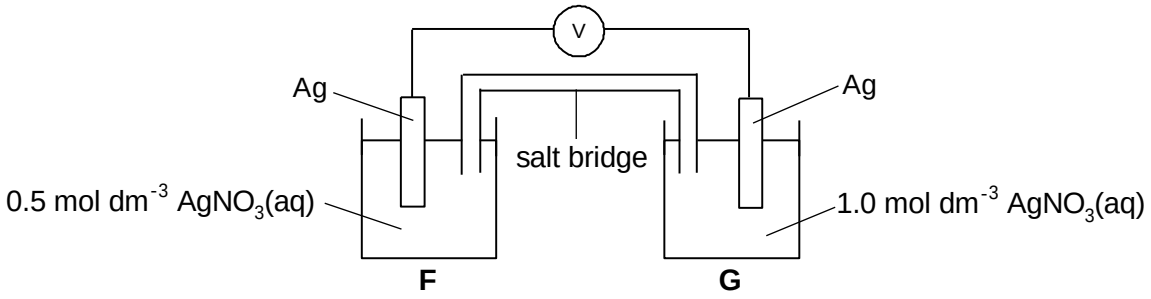
17 Addition of warm concentrated sulfuric acid, H_2SO_4, to crystals of sodium halides gives the following observations.

compound	observation
NaF	evolution of a colourless gas which etches a damp glass rod
NaC*l*	evolution of a choking colourless gas which produces a white cloud in contact with ammonia vapour
NaBr	evolution of a brown vapour and of pungent fumes which turn potassium dichromate(VI) paper green
NaI	evolution of a purple vapour and a gas smelling of rotten eggs

Which statements are consistent with the observations?

	hydrogen halide is produced in all four reactions	H_2SO_4 is acting as a reducing agent in all four reactions	SO_2 and H_2S are reduction products of H_2SO_4
A	true	false	true
B	true	true	false
C	false	false	true
D	false	true	false

18 The following electrochemical cell was set up and the E_{cell} value was found to be +0.018 V.



Which statement is correct?

A Electrode potential of $AgNO_3$ / Ag electrode in half-cell **F** is found to be – 0.782V.

B The E_{cell} value becomes less positive when solid sodium chloride is added to half–cell **F**.

C The E_{cell} value becomes 0.00 V by adding concentrated ammonia gradually to $AgNO_3$ in half-cell **G**.

D The change in the magnitude of the E_{cell} value is the same when same number of moles of iodide or bromide is added to half-cell **G** separately.

19 Which statement about the anodising of aluminium using dilute sulfuric acid is correct?

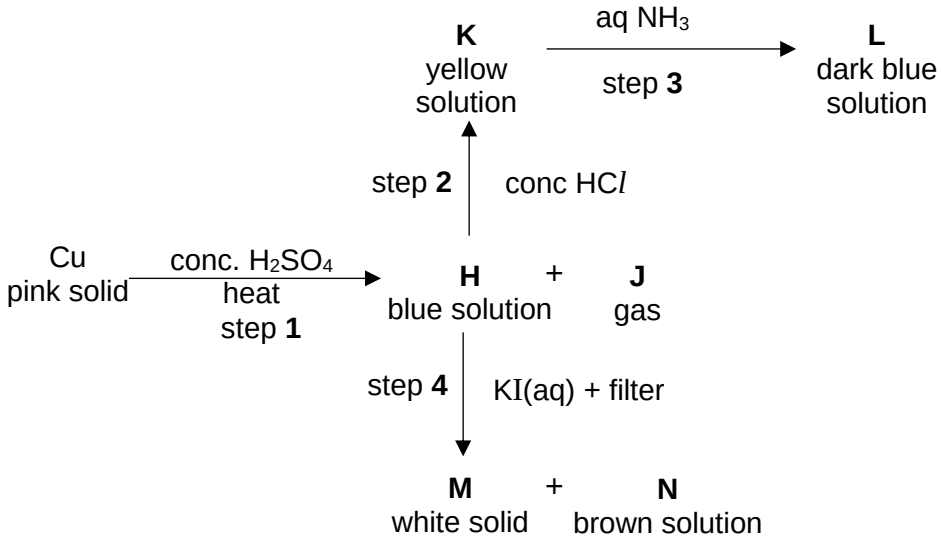
A Water is reduced at the cathode.

B Oxygen is produced at the cathode.

C The A*l* object to be anodised is the negative electrode.

D The mass of the anode increases.

20 Consider the following reaction scheme.



Which statement is correct?

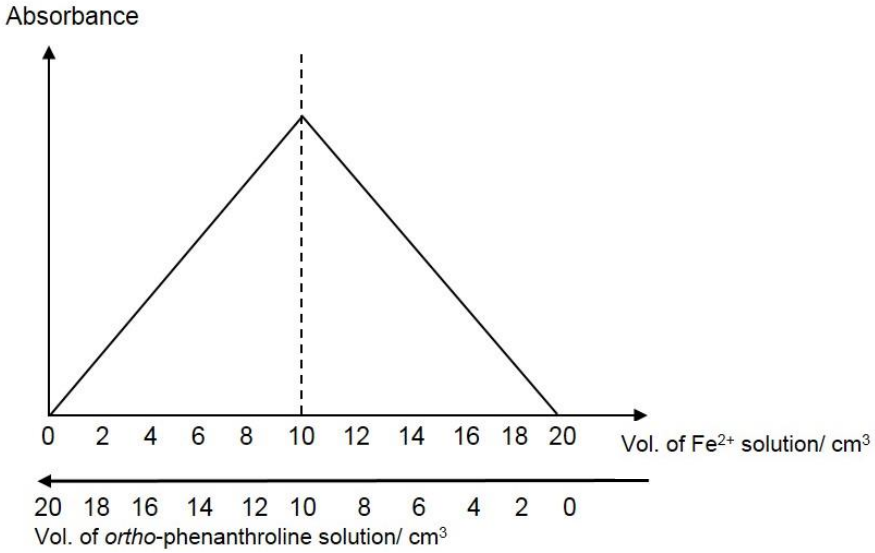
A $[Cu(OH)_4]^{2-}$ is the dark blue complex in **L**.

B Infinite dilution of solution **K** gives a pale yellow solution.

C Cation in compounds **K** and **M** has the same oxidation state.

D Step 4 involves both redox and precipitation reactions.

21 Fe^{2+} ion forms a red octahedral complex with *ortho*-phenanthroline molecules. Various samples containing different volumes of 1×10^{-5} mol dm^{-3} Fe^{2+} and 3×10^{-5} mol dm^{-3} *ortho*-phenanthroline were prepared. The following graph was obtained when the colour intensity of the samples was measured using a colorimeter.



Which statement about the complex ion is correct?

A The complex ion absorbs red light.

B The overall charge of the complex ion is −4.

C The co-ordination number of the Fe^{2+} ion is 3.

D *Ortho*-phenanthroline is a bidentate ligand.

22 One molecule of dodecane, $C_{12}H_{26}$, is cracked to produce three products, **R**, **S** and **T**. **R** is a straight chain alkane. **S** and **T** are straight chain alkenes with different M_r values.

Which statements about **R**, **S** and **T** are correct?

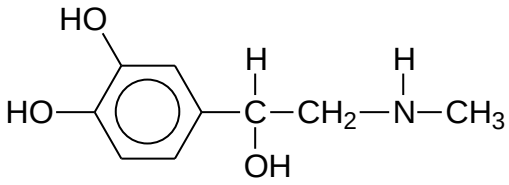
1 If **S** and **T** are but-1-ene and ethene respectively, **R** will be hexane.

2 If **R** is butane, only one, either **S** or **T**, exhibits cis-trans isomerism.

3 **R** could be octane.

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

23 Adrenalin is a stimulant produced in the adrenal glands. It has the following structure.



Which statement about adrenalin is correct?

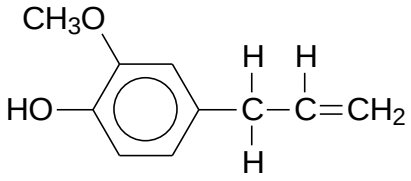
A One mole of adrenalin can only react with one mole of ethanoyl chloride.

B One mole of adrenalin reacts with two moles of hydrogen chloride.

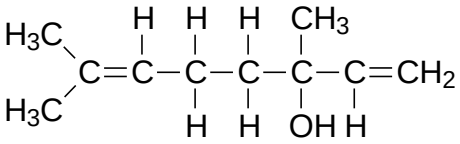
C It gives effervescence with potassium carbonate.

D It reacts with ethanoic acid to form amide.

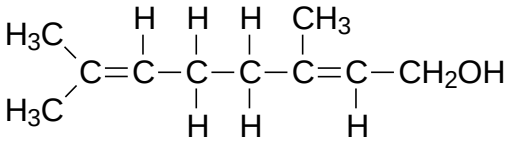
24 The following compounds are found in essential oils extracted from herbs and spices.



Eugenol



Linalool



Geraniol

Which statement is **incorrect**?

A Both Linalool and Geraniol exhibit stereoisomerism.

B One mole of Eugenol reacts with at least two moles of Br_2 in the absence of light.

C Linalool gives yellow precipitate with warm alkaline I_2(aq).

D Geraniol decolorises cold acidified $KMnO_4$.

25 Which reactions of propan-1-ol produce water as a by-product?

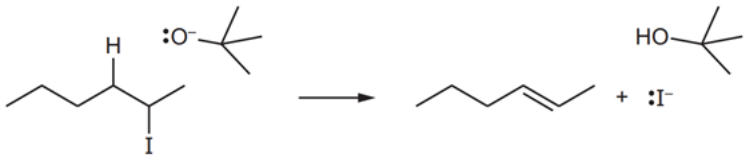
1 passing propan-1-ol vapour over hot Al_2O_3

2 mixing propan-1-ol with warm ethanoic acid and a few drops of concentrated H_2SO_4

3 warming propan-1-ol with HCN

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

26 Hex-2-ene can be made by the reaction shown.



Which statement about this reaction is correct?

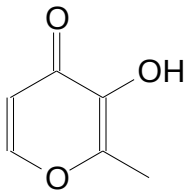
A $(CH_3)_3CO^-$ is behaving as a Lewis base.

B $(CH_3)_3CO^-$ is behaving as an oxidising agent.

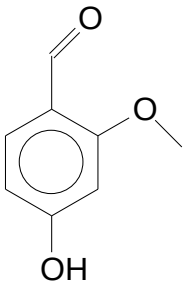
C The C–I bond breaks via homolytic fission.

D This is a nucleophilic substitution reaction.

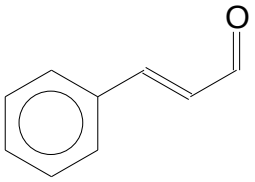
27 Maltol, vanillin and cinnamaldehyde are some naturally occurring flavouring agents.



maltol



vanillin



cinnamaldehyde

Which pair of reagents would enable the three compounds to be distinguished from one another?

	reagent 1	reagent 2
A	2,4-dinitrophenylhydrazine	hot acidified $K_2Cr_2O_7$
B	$[Ag(NH_3)_2]^+$ solution	neutral aqueous $FeCl_3$
C	Fehling's solution	hot acidified $KMnO_4$
D	anhydrous $SOCl_2$	aqueous Br_2

28 The following compounds were treated with hot acidified $KMnO_4$ (aq).

Which compound gives an organic product that is **different** from the other three?

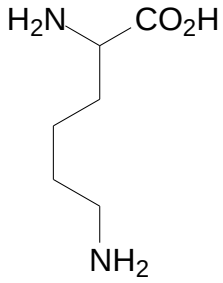
A CH_3COCl

B $CH_3CH_2OCOCH_3$

C $CH_3CH=CHOH$

D $CH_3CH_2COOCH_3$

29 Amino acid **Y** has three pK_a values given below:



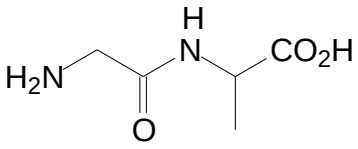
amino acid **Y**

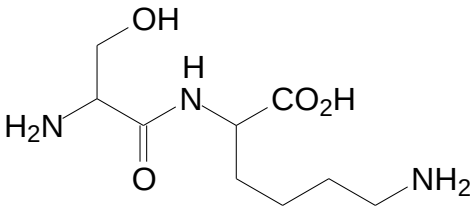
	α-carboxyl group	α-amino group	Side chain
pK_a	2.15	9.16	10.67

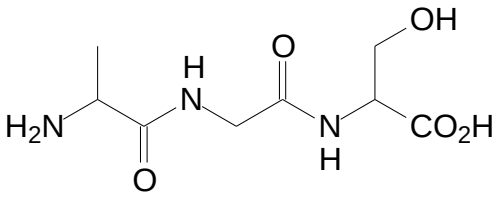
What is the net charge of the predominant species of amino acid **Y** at pH 7?

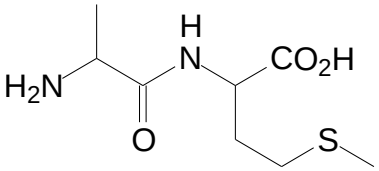
A +2 **B** +1 **C** 0 **D** –1

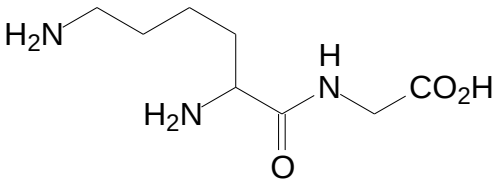
30 Heptapeptide **X** contains seven amino acid residues. When **X** is partially hydrolysed, the following dipeptide and tripeptide fragments are produced.





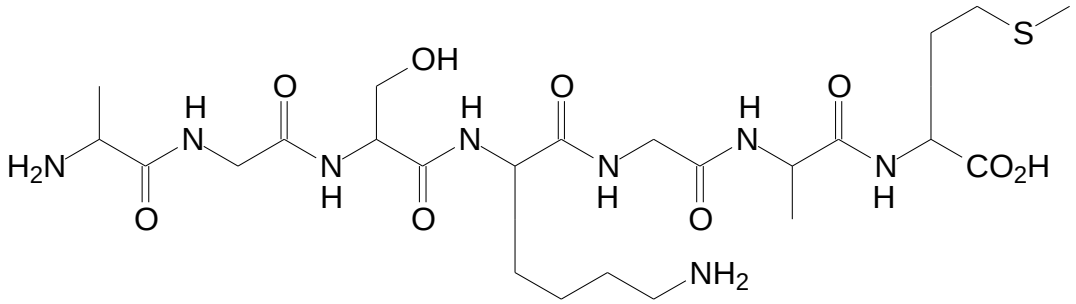




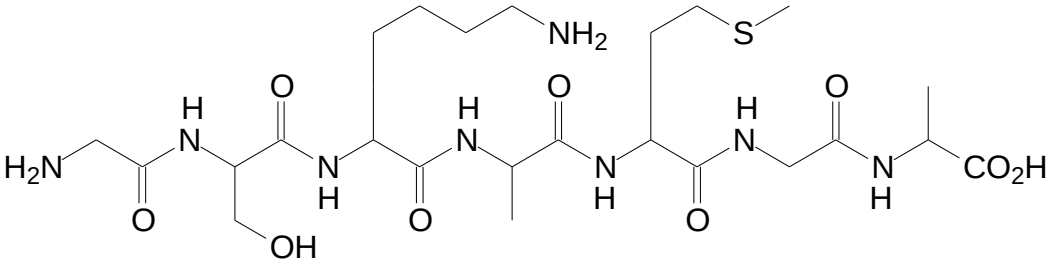


Which of the four heptapeptides on page 15 is the formula of **X**?

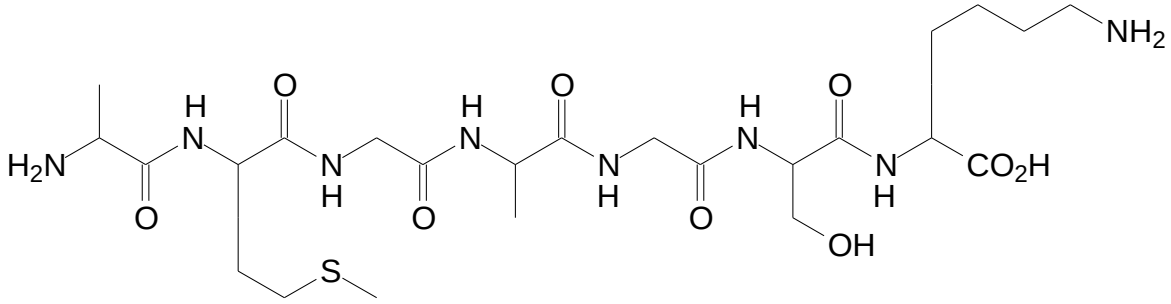
A



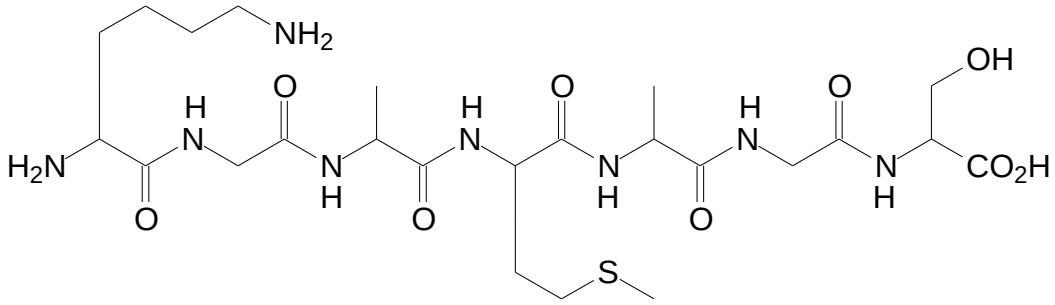
B



C



D



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