Past-paper walk-through

Formulas, functional groups and the naming of organic compounds ▪ 13.1

eXercise

Questions in this set

- 9701/11 N25 Q26 ▪ 1 mark
- 9701/14 N25 Q28 ▪ 1 mark
- 9701/14 N25 Q37 ▪ 1 mark
- 9701/22 N25 Q3 ▪ 14 marks

Reading the mark scheme

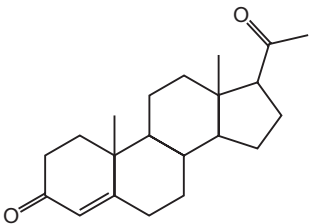
- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 26

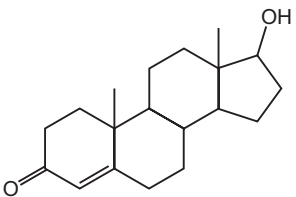
9701/11 N25 ▪ Q26 ▪ 1 mark

26 The skeletal formulas of two compounds are shown.

progesterone



testosterone



Which statements about progesterone and testosterone are correct?

Question 26

A They both contain a ketone group, and they both have geometrical isomers due to the C=C bond.

B They have the same molecular formula, and they both have geometrical isomers.

C They have the same number of chiral carbons, and they have the same molecular formula.

D They have the same number of chiral carbons, and they both contain a ketone group.

Solution 26

Answer: **D**

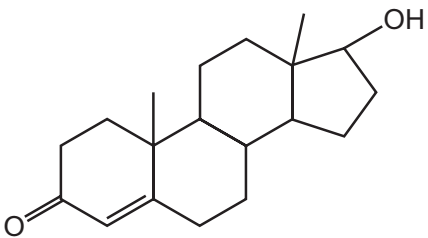
Why

- Both steroids carry a ketone in the first ring, and both have a C=C inside that ring.
- A C=C *inside* a six-membered ring cannot show geometrical isomerism – the ring locks it.
- Their molecular formulas also differ, since progesterone carries an extra ethanoyl group.

Question 28

9701/14 N25 ▪ Q28 ▪ 1 mark

28 The diagram shows the skeletal formula of the hormone testosterone.



What is the molecular formula of testosterone?

Question 28

A $C_{19}H_{28}O_2$ **B** $C_{17}H_{22}O_2$ **C** $C_{17}H_{24}O_2$ **D** $C_{19}H_{26}O_2$

Solution 28

Answer: **A**

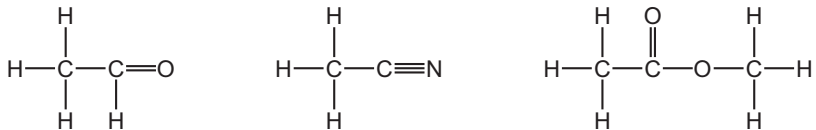
Why

- Read the skeletal formula: every vertex and every line end is a carbon atom.
- Fill in hydrogens to give each carbon four bonds.
- Testosterone comes out as $C_{19}H_{28}O_2$, with one OH and one ketone oxygen.

Question 37

9701/14 N25 ▪ Q37 ▪ 1 mark

37 The structures of three organic compounds are shown.



1 2 3

Which compounds produce ethanoic acid when heated with HCl(aq)?

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

Solution 37

Answer: **D**

Why

- Acid hydrolysis turns a nitrile into a carboxylic acid, so CH_3CN gives ethanoic acid.
- An ester of ethanoic acid hydrolyses back to ethanoic acid plus the alcohol.
- An aldehyde is not hydrolysed by aqueous acid at all – that would need an oxidising agent.

Question 3

9701/22 N25 ▪ Q3 ▪ 14 marks

3 The alkanes are a homologous series of organic molecules. Alkanes are generally unreactive and are commonly used as fuels.

(a) Define homologous series.

Question 3

(b) Give two reasons to explain the general unreactivity of alkanes.

Question 3

Question 3

[2]

(c) Alkanes with low relative molecular mass, M_r, are more useful than those found in heavier crude oil fractions.

Name the process that is used to obtain alkanes with low M_r from heavier crude oil fractions.

Question 3

(d) Hexane, C_6H_{14}, has four structural isomers.

Fig. 3.1 shows hexane and two of its structural isomers.

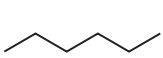
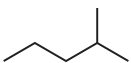
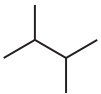
hexane	A	B	C	D
				

Fig. 3.1

(i) Complete Fig. 3.1 by drawing structures for **C** and **D**, the other two structural isomers of hexane. [2]

(ii) **A**, **B** and hexane have different boiling points.

Question 3

Question 3

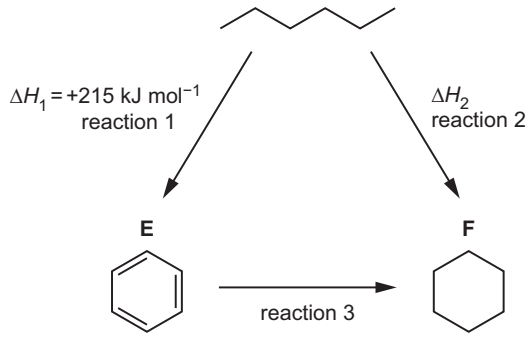
Arrange **A**, **B** and hexane in order of increasing boiling point.

Explain your answer.

Question 3

[3]

(e) Hexane can be converted into compounds **E** and **F** at high temperature and pressure. Fig. 3.2 shows the reaction scheme involving hexane, **E** and **F**.



Question 3

Fig. 3.2

Question 3

(i) Identify a suitable reagent for reaction 3.

Question 3

(ii) Use the data in Fig. 3.2 and in Table 3.1 to calculate the enthalpy change of reaction 2, ΔH_2.

Table 3.1

compound	enthalpy change of formation, ΔH_f / kJ mol^{-1}
	−156
	+48

Question 3

Question 3

Question 3

(iii) Write an equation for the complete combustion of hexane.

Question 3

[Total: 14]

Solution 3

(a)

Mark scheme

- M1 (family of molecules / compounds / series with) same general formula
- OR (family of molecules where) molecular formula differs (only) by (units of) CH2(n). **M2**
- similar chemical properties / reactions
- 2

Solution 3

(b)

Mark scheme

- M1 strong C—H (bonds) M2
- non-polar (C—H / molecule / bonds)
- 2

Solution 3

(c)

Mark scheme

- cracking
- 1

Solution 3

(d)(i)

Mark scheme

- 2

(d)(ii)

Mark scheme

- M1 B $<$ A $<$ hexane. **M2**
- hexane / unbranched has stronger / more IMFs **M3**
- hexane / unbranched requires most / more energy
- 3

Solution 3

(e)(i)

Mark scheme

- H2 ((g)) OR hydrogen (gas)
- 1

Solution 3

(e)(ii)

Mark scheme

- M1 $+215 + (-156) - (+48) =$ M2
- $+11$ kJ mol–1
- 2

Solution 3

(e)(iii)

Mark scheme

- C6H14 + 9½O2 → 6CO2 + 7H2O
- 1