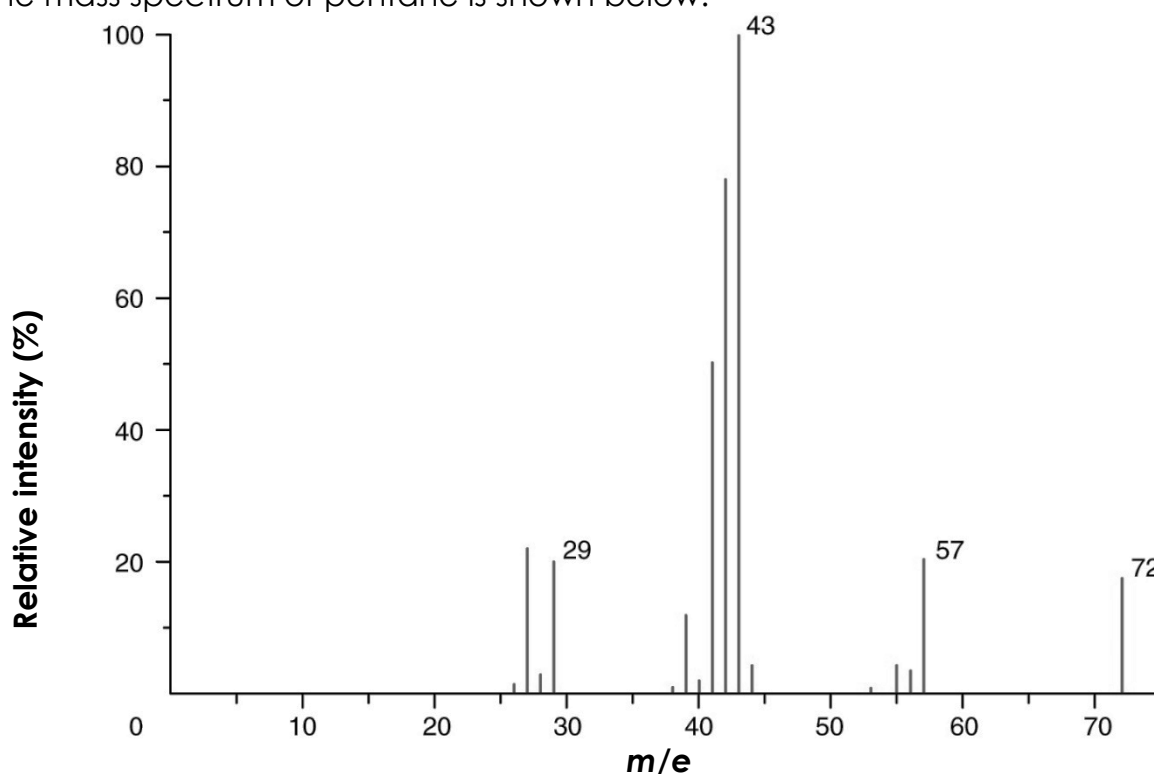


5. Which of the following causes the separation of the ions in a mass spectrometer?
- A. A vacuum pump
B. An ionization chamber
C. An electric field
D. A magnetic field
6. Which of the following methods can be used to distinguish between butanal and butanone?
- (1) Analysing their mass spectra
(2) Analysing their IR spectra
(3) Adding 2,4-dinitrophenylhydrazine
- A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)
7. Which of the following ions will be deflected to the least extent in a mass spectrometer?
- A. $^{12}\text{C}^+$
B. $^{14}\text{C}^+$
C. $^{12}\text{C}^{2+}$
D. $^{14}\text{C}^{2+}$
8. The mass spectrum of pentane is shown below.



Which of the following statements are correct?

- (1) The peak at $m/e = 29$ is due to the ion CH_3CH_2^+ .
 (2) The peak at $m/e = 43$ is due to the ion $\text{CH}_3\text{CHCH}_3^+$.
 (3) The peak at $m/e = 72$ corresponds to the molecular ion.
- A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

Section B: Structured questions

Compound X is an amino acid. It contains a carboxyl group ($-\text{COOH}$) and an amino group ($-\text{NH}_2$). X has the following composition by mass: 40.4% carbon, 7.9% hydrogen, 36.0% oxygen and 15.7% nitrogen.

- (a) Suggest a chemical test to show the presence of carboxyl group in X .
- (b) Determine the empirical formula of X .
(Relative atomic masses: $\text{H} = 1.0$, $\text{C} = 12.0$, $\text{N} = 14.0$, $\text{O} = 16.0$)
- (c) Some peaks found in the mass spectrum of X are tabulated below.

Ions	m/e	Remarks
X_1	89	The peak with the highest value of m/e
X_2	44	The peak with the highest intensity

- (i) Determine the relative molecular mass of X .
- (ii) Write the structural formulae of X_1 and X_2 respectively.

Suggested Answer

Section A

1.	D	5.	D
2.	C	6.	A
3.	B	7.	B
4.	A	8.	B

Section B

(a) Add X to sodium carbonate solution.
Colourless gas bubbles will be given out.

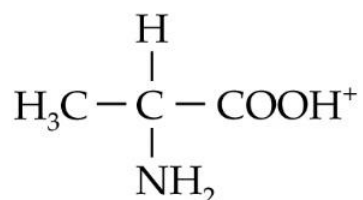
(b) Assume that there are 100 g of X.

	C	H	O	N
Mass (g)	40.4	7.9	36.0	15.7
Number of moles (mol)	$40.4/12.0$ = 3.37	$7.9/1.0$ = 7.90	$36.0/16.0$ = 2.25	$15.7/14.0$ = 1.12
Mole ratio	$3.37/1.12$ = 3	$7.90/1.12$ = 7	$2.25/1.12$ = 2	$1.12/1.12$ = 1

\therefore empirical formula of X is $C_3H_7O_2N$.

(c) (i) 89
(The peak with the highest value of m/e represents the signal generated by molecular ion.)

(ii) X_1 :



X_2 :

