

## What are Isobars Chemistry Questions with Solutions

**Q-1:** The isobars among the following is

- a)  $^{40}\text{Ca}_{20}$  and  $^{23}\text{Na}_{11}$
- b)  $^{150}\text{Sm}_{62}$  and  $^{150}\text{Eu}_{63}$
- c)  $^{98}\text{Tc}_{43}$  and  $^{99}\text{Tc}_{43}$
- d)  $^{129}\text{Te}_{52}$  and  $^{128}\text{Sb}_{51}$

**Answer:** b)  $^{150}\text{Sm}_{62}$  and  $^{150}\text{Eu}_{63}$

**Explanation:** Because the mass number of  $^{150}\text{Sm}_{62}$  and  $^{150}\text{Eu}_{63}$  are the same, these element pairs are isobars.

**Q-2:** Consider the atoms  $^{16}\text{O}$ ,  $^{18}\text{O}$ ,  $^{18}\text{F}$ ,  $^{18}\text{Ne}$  and  $^{20}\text{Ne}$ . Answer the following:

- a) Which atoms are isobars?
- b) Which atoms are isotopes?
- c) Do isobars have the same/different physical properties?
- d) Which have the same number of neutrons?
- e) Which atoms have the same number of valence electrons?

**Answer:**

- a)  $^{18}\text{O}$ ,  $^{18}\text{F}$  and  $^{18}\text{Ne}$
- b)  $^{16}\text{O}$  and  $^{18}\text{O}$  are isotopes  
 $^{18}\text{Ne}$  and  $^{20}\text{Ne}$  are isotopes
- c) Isobars have the same physical properties.
- d)

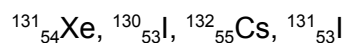
| Atoms            | Mass number | Atomic number | Number of neutrons= Mass number-Atomic number |
|------------------|-------------|---------------|-----------------------------------------------|
| $^{16}\text{O}$  | 16          | 8             | 8                                             |
| $^{18}\text{O}$  | 18          | 8             | 10                                            |
| $^{18}\text{F}$  | 18          | 9             | 9                                             |
| $^{18}\text{Ne}$ | 18          | 10            | 8                                             |
| $^{20}\text{Ne}$ | 20          | 10            | 10                                            |

From the table it is concluded that  $^{16}\text{O}$  and  $^{18}\text{Ne}$  have the same number of neutrons. Also  $^{20}\text{Ne}$  and  $^{18}\text{O}$  have the same number of neutrons.

e)  $^{16}\text{O}$  and  $^{18}\text{O}$  have the same valence electrons.

$^{18}\text{Ne}$  and  $^{20}\text{Ne}$  have the same number of valence electrons.

**Q-3:** Select the isotopes, isobars, and isotones from the following list of atoms.



**Answer:**

**Isotopes:**  $^{130}_{53}\text{I}$  and  $^{131}_{53}\text{I}$

**Isobars:**  $^{131}_{54}\text{Xe}$  and  $^{131}_{53}\text{I}$

The species which have the same number of neutrons are called isotones.

Number of neutrons of  $^{131}_{54}\text{Xe} = 77$

Number of neutrons of  $^{130}_{53}\text{I} = 77$

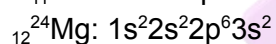
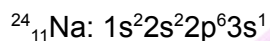
Number of neutrons of  $^{132}_{55}\text{Cs} = 77$

Number of neutrons of  $^{131}_{53}\text{I} = 78$

**Isotones:**  $^{131}_{54}\text{Xe}, ^{130}_{53}\text{I}, ^{132}_{55}\text{Cs}$

**Q-4:** Write the electronic configuration of any one pair of isobars.

**Answer:**  $^{24}_{11}\text{Na}$  and  $^{24}_{12}\text{Mg}$  is one pair of isobar. Their electronic configuration is given below:



**Q-5:** Composition of the nuclei of two atomic species A and B is given below:

|          | A  | B  |
|----------|----|----|
| Protons  | 18 | 20 |
| Neutrons | 22 | 20 |

Give the mass numbers of A and B. What is the relation between two species and which element or elements they represent?

**Answer:** Mass number is the sum of protons and neutrons in an atom.

Mass number of A =  $18 + 22 = 40$

Mass number of B =  $20+20= 40$

Because they both have the same mass number, they are isobars.

Atomic number of A = number of protons in A = 18

Atomic number of B = number of protons in B= 20

Referring to the periodic table, Element A is Argon and Element B is Calcium.

**Q-6:** Determine the pair of isobars from the table below.

| Atoms | Number of neutrons | Number of protons |
|-------|--------------------|-------------------|
| K     | $X-1$              | $Y+3$             |
| L     | $X+2$              | $Y-1$             |
| M     | $X$                | $Y+2$             |
| N     | $X+3$              | $Y-4$             |

**Answer:** K and M

Explanation:

| Atoms | Number of neutrons | Number of protons | Mass number |
|-------|--------------------|-------------------|-------------|
| K     | $X-1$              | $Y+3$             | $X+Y+2$     |
| L     | $X+2$              | $Y-1$             | $X+Y+1$     |
| M     | $X$                | $Y+2$             | $X+Y+2$     |
| N     | $X+3$              | $Y-4$             | $X+Y-1$     |

Because the atoms K and M have the same mass number, they are isobars.

**Q-7:** Isobar of an element have

- a) the same number of neutrons but different atomic masses
- b) same number of nucleons but different protons
- c) same number of nucleons and protons
- d) same number of neutrons

**Answer: b)** same number of nucleons but different protons

**Q-8:** State which of the following statements is true. If False, state a reason.

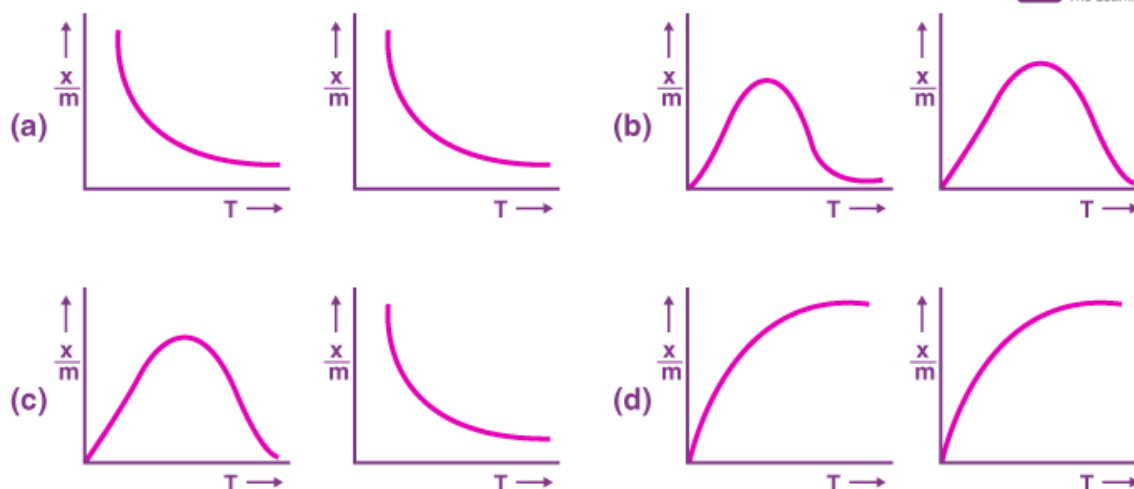
**Statement 1:** The atoms of different elements having the same mass number but different atomic number are known as isobars.

**Statement 2:** Neutrons and protons are present in the nucleus and their sum is different for isobars.

**Answer:** Statement 1 is true but statement 2 is false.

**Explanation:** Statement 2 is false because the sum of protons and neutrons is called mass number which is the same for isobars.

**Q-9:** Select the correct adsorption isobars for chemisorption and physisorption respectively:  
Here,  $x/m$  = degree of adsorption)



**Answer: c)**

**Explanation:** The adsorption isobar is a plot of the amount adsorbed versus the temperature ( $T$ ) of the adsorbate at constant pressure. In the case of chemisorption, there is an initial increase and then a decrease, whereas in the case of physisorption, there is a consistent decrease as temperature increases.

Thus, c) is the correct adsorption isobars for chemisorption and physisorption respectively.

**Q-10:** Determine which pairs are not isobars.

- a)  ${}_6^{12}\text{X}$ ,  ${}_6^{13}\text{Y}$
- b)  ${}_{17}^{35}\text{X}$ ,  ${}_{17}^{37}\text{Y}$
- c)  ${}_4^8\text{X}$ ,  ${}_5^8\text{Y}$
- d)  ${}_6^{14}\text{X}$ ,  ${}_7^{14}\text{Y}$

**Answer: a) and b)**

Explanation: Since  ${}_6^{12}\text{X}$ ,  ${}_6^{13}\text{Y}$  and  ${}_{17}^{35}\text{X}$ ,  ${}_{17}^{37}\text{Y}$  have different mass numbers, therefore they are not isobars.

**Q-11:** Which theory states that 'Atoms of different elements may have the same atomic mass'?

- a) Berzelius Hypothesis
- b) Modern Atomic Theory
- c) Avogadro's Hypothesis
- d) Maxwell theory

**Answer: b) Modern Atomic Theory**

**Q-12:** For the isobars  ${}_{27}^{64}\text{Co}$  and  ${}_{28}^{64}\text{Ni}$ , answer the following questions:

- a) Find the number of d-electrons
- b) To which group and period, do they belong to?

**Answers:**

a) For  ${}_{27}^{64}\text{Co}$ , the electronic configuration is  $[\text{Ar}] 3d^7 4s^2$ . Thus, the total number of valence electrons is equal to 9.

For  ${}_{28}^{64}\text{Ni}$ , the electronic configuration is  $[\text{Ar}] 3d^8 4s^2$ . Thus, the total number of valence electrons is equal to 10.

- b)  ${}_{27}^{64}\text{Co}$ : Period-3, group-27
- ${}_{28}^{64}\text{Ni}$ : Period-3, group-28

**Q-13:** How are isodiaphers different from isobars in chemistry?

**Answer:** Isodiaphers are a pair of nuclides with the same difference in the number of protons and neutrons in their nucleus. Both nuclides have different numbers of protons and neutrons in their nuclei, but the difference is the same.

For example: Uranium  ${}_{92}^{238}\text{U}$  and Thorium,  ${}_{90}^{234}\text{Th}$

Uranium's nucleus contains 92 protons and 146 neutrons, so the difference is:  $146 - 92 = 54$ .

Thorium's nucleus contains 90 protons and 144 neutrons, so the difference is  $144 - 90 = 54$

On the other hand, isobars have the same sum of protons and neutrons in their nucleus.

**Q-14:** Which pair of neutrons and protons correspond to the isobar of N and C which have a mass number of 14?

- a) N: 7 protons and 7 neutrons ; C: 8 protons and 6 neutrons
- b) N: 6 protons and 8 neutrons ; C: 8 protons and 6 neutrons
- c) N: 6 protons and 8 neutrons ; C: 6 protons and 8 neutrons
- d) N: 7 protons and 7 neutrons ; C: 6 protons and 8 neutrons

**Answer:** d) N: 7 protons and 7 neutrons ; C: 6 protons and 8 neutrons

**Q-15:** Give the electronic configuration for the following isobars?

- a)  $^{40}_{18}\text{Ar}$
- b)  $^{40}_{19}\text{K}$
- c)  $^{40}_{20}\text{Ca}$

**Answer:**

| Elements              | Number of electrons | Electronic configuration<br>K L M N |
|-----------------------|---------------------|-------------------------------------|
| $^{40}_{18}\text{Ar}$ | 18                  | 2 8 8                               |
| $^{40}_{19}\text{K}$  | 19                  | 2 8 8 1                             |
| $^{40}_{20}\text{Ca}$ | 20                  | 2 8 8 2                             |

## Practise Questions on What are Isobars

**Q-1:** Give answers of the questions based on the given table:

| Element | Number of protons | Number of electrons | Number of neutrons |
|---------|-------------------|---------------------|--------------------|
| A       | 17                | 20                  | 17                 |
| B       | 17                | 18                  | 17                 |
| C       | 20                | 18                  | 20                 |
| D       | 18                | 19                  | 18                 |

- a) What is the atomic number of the sample C and D?
- b) Which pair of elements are isobars?
- c) What is the valency of Sample B?
- d) What type of ion will sample A will form?

**Answer:**

**a)** Atomic number of Sample C = Number of protons in C = 17

Similarly, Atomic number of D = Number of protons in D = 18

**b)** Mass number of A = Number of protons + Number of neutrons =  $17 + 17 = 34$

Mass number of B =  $17 + 17 = 34$

Mass number of C =  $20 + 20 = 40$

Mass number of D =  $18 + 18 = 36$

Because elements A and B have the same number of sum of protons and neutrons, they are isobars.

**c)** For sample B, electronic configuration is 2,8,8.

Valency is an atom's ability to combine with other atoms. Because sample B is stable (fully filled configuration), it will not form bonds and will exist in a free state. As a result, its valency is zero.

**d)** When the number of electrons is less than the number of protons, a cation is formed; when the number of electrons is greater than the number of protons, an anion is formed.

Because electrons in sample A outnumber protons, anion will form. Because three electrons are added, a trivalent anion is formed.

**Q-2:** Given below are some of the very stable or very long lived nuclei:  $^{58}\text{Fe}$ ,  $^{60}\text{Fe}$ ,  $^{62}\text{Fe}$ ,  $^{60}\text{Co}$ ,  $^{58}\text{Ni}$ ,  $^{60}\text{Ni}$ ,  $^{62}\text{Ni}$ .

Answer the following questions:

- a) Which two nuclei are isotopes of  $^{62}\text{Fe}$ ?
- b) Which two nuclei are isobars of  $^{60}\text{Co}$ ?

**Answer:**

a) Isotopes are species that have the same atomic number.  $^{58}\text{Fe}$  and  $^{60}\text{Fe}$  are the isotopes of  $^{62}\text{Fe}$  because Fe has the atomic number of 26.

b)  $^{60}\text{Fe}$  and  $^{60}\text{Ni}$  are the two nuclei that are isobars of  $^{60}\text{Co}$ .

**Q-3:** Which of the following statement(s) is/are correct?

- a) Isotones are atoms of the same elements having the same number of neutrons.
- b) Isobars are the atoms of the same elements having the same mass number.
- c) Isobars are the atoms of the different elements having the same mass number.
- d) Isotones and Isobars both are atoms of different elements.

**Answer: c) and d)**

**Q-4:** The table given below shows the mass number and the atomic number of certain elements A, B and C. Study the given data and answer the following questions:

| Elements | Mass number | Atomic number |
|----------|-------------|---------------|
| A        | 12          | 6             |
| B        | 154         | 66            |
| C        | 154         | 65            |

- a) Which element is a f-block element and p-block element?
- b) Which two elements are isobars?

**Answer:**

a) F-block element: B and C  
P-block element: A

b) Isobars: B and C ( as they have same mass number)



**Q-5:** X and Y are two elements with the same mass number but different atomic numbers 27 and 30 respectively. If X has a mass number of 57, the number of neutrons in Y is

- a) 30
- b) 27
- c) 33
- d) 40

**Answer: b) 27**

Explanation: Mass number of X = 57

Since both X and Y have the same mass number, therefore, Y will also have a mass number equal to 57.

$$\begin{aligned}\text{Number of neutrons in Y} &= \text{Mass number of Y} - \text{Atomic number of Y} \\ &= 57 - 30 \\ &= 27\end{aligned}$$

