1981 B

A 1.2516 gram sample of a mixture of CaCO3 and Na2SO4 was analyzed by dissolving the sample and completely precipitating the Ca2+ as CaC2O4. The CaC2O4 was dissolved in sulfuric acid and the resulting H2C2O4 was titrated with a standard KMnO4 solution, according to the following (unbalanced) reaction: MnO4- + H2C2O4 + H+ → Mn2+ + CO2 + H2O

(a) Indicate which substance is the oxidizing agent and which substance is the reducing agent.

(b) The titration of the H2C2O4 obtained required 35.62 milliliters of 0.1092 molar MnO4- solution. Calculate the number of moles of H2C2O4 that reacted with the MnO4-

(c) If the moles of H2C2O4 = the moles of CaCO3, calculate the percentage by weight of CaCO3 in the original sample.

Answer:

(a) oxidizing agent: MnO4- , reducing agent: H2C2O4

(b) 

(c) 

1986 D

(a) Describe what you would see if you added

1. a piece of zinc metal to a test tube that contains 6 molar hydrochloric acid.

2. a piece of copper metal to another test tube that contains 6 molar hydrochloric acid.

(b) Write balanced equations for any reactions that occur.

(c) Explain how you could use the table of standard reduction potentials [attached] to predict the observed results.

(d) In a separate experiment, concentrated nitric acid is added to a test tube containing a piece of copper metal.

1. Describe what you would see.

2. Explain any differences between the results obtained in this experiment and those obtained with copper metal in part (a).

Answer:

(a) 1. Bubbling or dissolving of Zn

2. No reaction

(b) Zn + 2 H+ → Zn2+ + H2 **or** Zn + 2 HCl → ZnCl2 + H2

(c) The table shows that Zn is a better reducing agent than H2, so Zn can reduce H+ in HCl to H2. Cu is a weaker reducing agent than H2, so no reaction occurs when Cu is added to HCl.

(d) 1. A reaction occurs in which a brown gas is given off **OR** the solution turns blue or green OR copper dissolves.

2. Nitric acid is an oxidizing acid and hydrochloric acid is not. **OR** Nitric acid is a better oxidizing agent than Cu2+ is. OR equivalent explanation.

1994 D (Required)

Discuss the following phenomena in terms of the chemical and physical properties of the substances involved and general principles of chemical and physical change.



What will be observed on the surfaces of zinc and silver strips shortly after they are placed in separate solutions of CuSO4, as shown on the right? Account for these observations.

Answer:

No reaction in the Ag | Cu2+ beaker because Ag+ is easier to reduce than Cu2+.

The zinc will go into solution as Zn2+ while the Cu2+ will reduce to Cu, forming on the surface of the zinc.

Zn*(s)* + Cu2+ → Zn2+ + Cu*(s)* *E°*cell = + 1.10 v