

5. The initial number of moles of hydrochloric acid taken was

- A. 2.5×10^{-3}
B. 1.25×10^{-2}

- C. 1.5×10^{-2}
D. 2.75×10^{-2}

Use the following information to answer questions 6 and 7.

A solution's concentration was determined by four separate titrations. The results in mol.dm⁻³ are as follows:

0.2041, 0.2049, 0.2039 and 0.2043

$$S = \sqrt{\frac{Q}{n}}$$

6. The mean for the set of results is

$S_b = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$

- A. 0.2034 B. 0.2041 C. 0.2048

$$\bar{x} = 0.2043$$

7. The standard deviation of the results is

A. 3×10^{-4}

B. 4×10^{-4}

C. 4×10^{-3}

D. 2×10^{-3}

8. When a series of replicate set of data is obtained from an analysis, the accuracy is connected to the

A. error

B. confidence limit

C. true results

D. deviation

9. In the analysis of a given set of results, the confidence level to use depends on

A. Level of certainty

C. average results

B. precision

D. deviation

10. Under what criteria could a deviant result be rejected because it contains gross experimental error?

A. When deviant value is less than the expected

B. When deviant value is greater than the expected

C. When the Q crit is greater than the computed Q.

D. When the computed Q is greater than the Q crit.

11. When few drops of AgNO_3 solution are added to a solution of a salt Y, a white precipitate is formed. The precipitate is soluble in both dilute HNO_3 and dilute NH_4Cl like salt Y must be

A. Potassium bromide

Sodium carbonate

B. Potassium iodide

D. Sodium phosphate

12. H_2S gas is bubbled through a solution containing a mixture of $\text{Zn}(\text{NO}_3)_2$ and $\text{Cu}(\text{NO}_3)_2$. The formation of CuS precipitate is possible only when the solution is:

A. acidified

C. made alkaline

B. concentrated

D. made neutral

13. When an aqueous solution of Pb^{2+} reacts with few drops of dilute HCl a precipitate is formed. The precipitate formed is soluble in one HCl due to the formation of

A. PbCl_2

B. $\text{Pb}(\text{OH})_2$

C. $[\text{PbCl}_4]^{2-}$

D. $[\text{Pb}(\text{OH})]^{2-}$

$\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+$ + OH^-

14. An aqueous solution of $(\text{NH}_4)_2\text{SO}_4$ was heated in D_2O with NaOH and warmed. A gas evolved which formed white fumes with hydrogen chloride. The gas evolved is

- A. SO_2 B. H_2S C. NH_3 D. H_2O

15. When a drop of dilute potassium tetroxomanganate(VII) is added to a solution of a salt and acidified with dilute tetroxosulphate(VI) acid, the solution decolorizes. Which anion is present in the salt?

- A. CO_3^{2-} B. Cl^- C. Br^- D. SO_3^{2-}

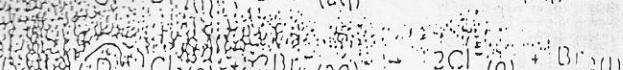
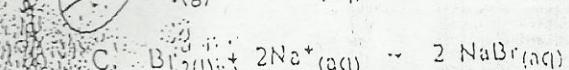
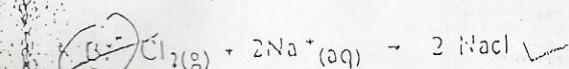
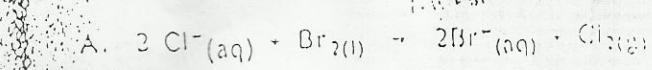
16. Flame test performed on a metal gives a golden yellow flame. When the flame was viewed through a cobalt blue glass, the yellow colour disappeared. What is the metal?

- A. K B. Na C. Ca D. Ba

17. Separate solutions containing ions of the following metals do not give precipitates with dilute HCl except

- A. Cu B. Zn C. As D. Sn

18. Which of the following reactions takes place when chlorine gas is bubbled through an aqueous solution of sodium bromide?



19. When dilute HCl was added to a solution of a mixture of two salts, effervescence occurred with the evolution of a colourless, odourless gas. On addition of BaCl_2 solution to the resultant solution, a white precipitate was formed, which was insoluble in excess dilute HCl. Which of the following order of pairs of anions was responsible for the above observations.

- A. $\text{CO}_3^{2-}, \text{NO}_3^-$

- B. $\text{SO}_4^{2-}, \text{CO}_3^{2-}$

20. When concentrated H_2SO_4 is added to a salt there is evolution of a reddish brown gas. Which of the following pairs of salts and gases is correct with reference to the above test and observation?

- A. KI, I_2 B. $\text{Na}_2\text{SO}_3, \text{SO}_2$ C. $\text{Na}_2\text{CO}_3, \text{CO}_2$ D. $\text{NaNO}_3, \text{NO}_2$

21. If the boiling point of an organic solvent is about 70°C at 760 mmHg , then its boiling point at 650 mmHg would be about

- A. 20°C B. 60°C C. 80°C D. 120°C

$$\frac{70^\circ\text{C}}{760} = \frac{x}{650}$$

$$70 \times 650 = 1270$$

$$1270 - 1200 = 70$$

$$\frac{70^\circ\text{C}}{760} = \frac{x}{650}$$

$$70 \times 650 = x$$

$$x = 525$$

22. Which of the following process would you employ to purify benzene which has been contaminated with tetrachloroethylene?

- A. solvent-solvent extraction C. recrystallization
B. filtration D. distillation

23. It is desirable to put a disc of filter paper at the top of the column in column chromatography to avoid the disturbance of the

- A. compounds in the mixture C. eluent
B. stationary solid phase D. mobile liquid phase.

24. Which of the following pieces of apparatus is usually employed in the laboratory to extract drugs from plant materials?

- A. vacuum pump C. steam distillation apparatus
B. soxhlet pump D. simple distillation apparatus.

25. Which of the following pieces of equipment or systems would be required in TLC work?

- I. glass plate III. glass jar ✓
II. silica gel IV. solvent system.

- A. I and II only C. II and III only
B. II and IV only D. I, II, III and IV

26. How would you obtain palm oil from a mixture of palm oil and powdered chalk?

- A. Add water to mixture in separating funnel and evaporate the filtrate
B. Add ether to mixture and remove the filtrate
C. Add ether, filter the mixture and recrystallize the filtrate
D. Add dilute HCl, put mixture in separating funnel and evaporate the lower layer

27. If a small amount of water is added to eugenol, the boiling point of ethanol

- A. increases ↓ C. decreases
B. remains constant D. cannot be determined.

28. To determine whether an unknown solid substance is pure or not, one would have to perform

- A. filtration C. recrystallization ✓
B. melting point determination D. Rf value determination.

29. Crystals become impure by surface contamination or by the occlusion of impurities. What type of impurity is associated with small crystals?

- A. Adsorption B. occlusion C. absorption D. condensation

30. TLC was performed on a plant extract and four spots were seen on the TLC plate. Which of the following statements is/are true?

- I. only 4 compounds are in the plant
II. only 4 compounds are in the plant extract
III. there are at least 4 compounds in the plant extract

- A. I only B. II only ✓ C. III only D. I and II

$$q = m C_p \Delta T$$

$$= 0.75 \times 4.3 \times 277$$

Use the information below to answer questions 31 to 33.

A student prepares 200ml of HCl by diluting 3.0ml of 12M HCl. He then dissolves 0.75g of Mg powder in the diluted acid and covers the solution. The temperature raises 4.0°C in the covered solution. The density of the solution is 1.3g/ml and the specific heat of the solution is 4.3J/g°C. The molar mass of Mg is 24g/mol.

31. One of the products of the reaction above between the acid and Mg powder is

- A. water B. H^+ ion C. Mg^{2+} ions D. MgO

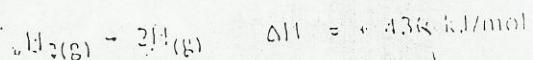
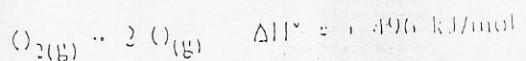
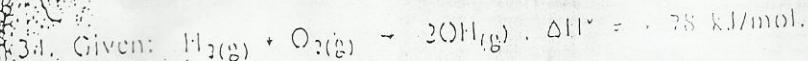
$$\frac{893}{0.75} \approx 1190$$

32. What is the limiting reagent in the reaction above between the acid and Mg powder?

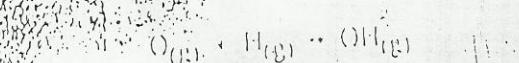
- A. Mg powder B. it depends C. HCl acid D. neither, they are present in equal amounts

33. Assuming that all 0.75g Mg reacts, what is the molar heat of the reaction? (in kJ/mol).

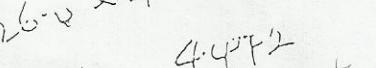
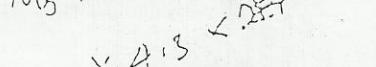
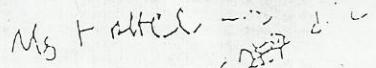
- A. -699 B. -168 C. -743 D. -111



Find ΔH° (in kJ/mol) for the reaction:

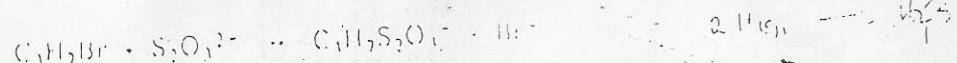


- A. -427 B. -127 C. -854 D. +854



The information below should be used to answer questions 35 to 36.

The reaction:



35. What is the rate of reaction. $\frac{dA}{dt}$?

- A. $[\Delta][\text{S}_2\text{O}_3^{2-}]$ B. $K[\Delta][\text{S}_2\text{O}_3^{2-}]$ C. $-K[\Delta][\text{S}_2\text{O}_3^{2-}]$ D. $-K[\Delta][\text{S}_2\text{O}_3^{2-}]$

36. What is the initial rate of reaction?

- A. $1.64 \times 10^{-5} \text{ mol sec}^{-1}$ B. $-1.64 \times 10^{-3} \text{ mol sec}^{-1}$ C. $-6.4 \times 10^{-5} \text{ mol sec}^{-1}$ D. $1.32 \times 10^{-8} \text{ mol sec}^{-1}$

TURN OVER

37. Which of the following is Not appropriate attire for the laboratory?

- I loose flowing clothing (II) sandals or open-toed shoes
II loose long hair (III) shorts or mini-skirts
A. I and II only C. I, II and III only
B. II and III only D. I, II, III and IV

Use the following information to answer questions 38-40.

A 10.00ml. empty volumetric flask and stopper weighed 54.35g. When it is filled exactly to the 10.00 mark with pure isopropanol, the filled flask and stopper weighed 54.440g. A solution, containing 10.0ml of isopropanol and 5.00ml of deionized water is prepared in a beaker. The solution is poured into a volumetric flask to the 10.00ml mark and reweighed. The filled volumetric flask and stopper now weigh 55.384g. Assuming the density of water is 1.000g/ml.

38. What is the total mass of solution in the Erlenmeyer flask?

- A. 8.71g B. 16.66g C. 12.73g D. 10.68g

39. What is the actual volume of the solution in the Erlenmeyer flask?

- A. 14.66 ml B. 19.59 ml C. 10.00 ml D. 15.00 ml

40. What is the percentage change in volume of solution?

- A. 2.27 B. 1.27 C. 3.42 D. 2.12

K. TUANI
A. ADEI
S. ASARE-DONKOR
F. ANSAI

$$\text{mL} = \frac{V_1 D_a + V_2 D_w}{D_f} \Rightarrow$$

$$m = \frac{V_1 D_a + V_2 D_w}{D_f}$$

$$V_1 D_a + V_2 D_w$$

UNIVERSITY OF SCIENCE AND TECHNOLOGY - KUMASI
FACULTY OF SCIENCE

B.Sc. (Chemistry) First Semester Examination 2000
First Year

CHEMICAL PRINCIPLES TEST

FEBRUARY, 2000 ONE HOUR

Write your Index Number on the back cover.
Circle the correct answers on the question paper.
Answer ALL questions.

1. What is the essence of the confidence limits in the statistical analysis of data?
 - (A) communicates the degree of accuracy
 - (B) degree of precision
 - (C) range of the standard deviation
 - (D) range of the mean.
- *2. In an experiment for the preparation and standardization of NaOH and HCl solutions, a student was asked to prepare 10% w/w NaOH solution. What is the molarity of the solution?
 - (A) 0.1M
 - (B) 0.25M
 - (C) 2.5 M
 - (D) 4.0 M

Use the following information to answer questions 3-5.

In an experiment to investigate the stoichiometry of the reaction of Magnesium with hydrochloric acid, a student was provided with the following data:

$$\text{Weight of Mg} = 0.0634$$

$$\text{Volume of } 0.5\text{M NaOH used} = 25.00 \text{ ml}$$

$$\text{Correct volume of H}_2\text{O displaced} = 82.0575 \text{ ml}$$

$$\text{Volume of } 1.0\text{M HCl added} = 15.00 \text{ ml}$$

$$C = \frac{n}{V} \quad n = \frac{m}{M}$$

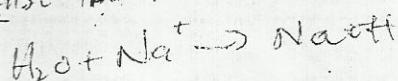
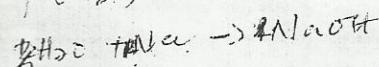
Physical Constants

$$\text{Total pressure } P_T = 760 \text{ bar}$$

$$\text{Vapour pressure of water at } 30^\circ\text{C} = 32 \text{ bar}$$

$$\text{Gas Constant (R)} = 82.057 \text{ ml atm.K}^{-1}\text{mol}^{-1}$$

$$P(V,n) = RT$$



- *3. The number of moles of gas produced by the reaction using the ideal gas equation is
 - (A) 1.39×10^{-4}
 - (B) 3.16×10^{-3}
 - (C) 1.06×10^{-1}
 - (D) 2.51×10^{-3}

4. The number of moles of unreacted hydrochloric acid left after the reaction is
 - (A) 2.5×10^{-3}
 - (B) 1.25×10^{-2}
 - (C) 1.5×10^{-2}
 - (D) 2.75×10^{-2}

The initial number of moles of hydrochloric acid taken was

- A. 2.5×10^{-3}
 B. 1.25×10^{-2}
 C. 1.5×10^{-2}
 D. 2.75×10^{-2}

use the following information to answer questions 6 and 7.

solution's concentration was determined by four separate titrations. The results in M.dm^{-3} are as follows:

0.2041, 0.2049, 0.2039 and 0.2043

The mean for the set of results is

- A. 0.2034 B. 0.2041 C. 0.2048 D. 0.2043

The standard deviation of the results is

- A. 3×10^{-4} B. 4×10^{-4} C. 4×10^{-3} D. 2×10^{-4}

When a series of replicate set of data is obtained from an analysis, the accuracy is connected to the

- A. error B. confidence limit C. true results D. deviation

In the analysis of a given set of results, the confidence level to use depends on

- A. level of certainty
 B. precision C. average results
 D. deviation.

Under what criteria could a deviant result be rejected because it contains gross experimental error?

- A. When deviant value is less than the expected
 B. When deviant value is greater than the expected
 C. When the Q_{crit} is greater than the computed Q .
 D. When the computed Q is greater than the Q_{crit} .

When few drops of AgNO_3 solution are added to a solution of a salt Y, a white precipitate is formed. The precipitate is soluble in both dilute HNO_3 and dilute NH_3 . The salt Y must be

- A. Potassium bromide B. Potassium iodide
 C. Sodium carbonate D. Sodium phosphate.

H_2S gas is bubbled through a solution containing a mixture of $\text{Zn}(\text{NO}_3)_2$ and $\text{Cu}(\text{NO}_3)_2$. The formation of CuS precipitate is possible only when the solution is:

- A. acidified B. concentrated
 C. made alkaline D. made neutral.

When an aqueous solution of Pb^{2+} reacts with few drops of dilute HCl a precipitate is formed. The precipitate formed is soluble in conc. HCl due to the formation of

- A. PbCl_2 B. $\text{Pb}(\text{OH})_2$ C. $[\text{PbCl}_4]^{2-}$ D. $[\text{Pb}(\text{OH})_4]^{2-}$

14. An aqueous solution of $(\text{NH}_4)_2\text{SO}_4$ was mixed with aqueous NaOH and warmed. A gas evolved which formed white fumes with hydrogen chloride. The gas evolved is
 A. SO_2 B. H_2S C. NH_3 D. H_2O
15. When a drop of dilute potassium tetraoxomanganate(VII) is added to a solution of a salt and acidified with dilute tetraoxosulphate(VI) acid, the solution decolourizes. Which anion is present in the salt?
 A. CO_3^{2-} B. Cl^- C. Br^- D. SO_3^{2-}
16. A flame test performed on a metal gives a golden, yellow flame. When the flame was viewed through a cobalt blue glass, the yellow colour disappeared. What is the metal?
 A. K B. Na C. Ca D. Ba
17. Separate solutions containing ions of the following metals do not give precipitates with dilute HCl except
 A. Cu B. Zn C. Ag D. Sn
18. Which of the following reactions takes place when chlorine gas is bubbled through an aqueous solution of sodium bromide?
 A. $2 \text{Cl}^-(\text{aq}) + \text{Br}_2(\text{l}) \rightarrow 2\text{Br}^-(\text{aq}) + \text{Cl}_2(\text{g})$
 B. $\text{Cl}_2(\text{g}) + 2\text{Na}^+(\text{aq}) \rightarrow 2 \text{NaCl}$
 C. $\text{Br}_2(\text{l}) + 2\text{Na}^+(\text{aq}) \rightarrow 2 \text{NaBr}(\text{aq})$
 D. $\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2(\text{l})$
19. When dilute HCl was added to a solution of a mixture of two salts, effervescence occurred with the evolution of a colourless, odourless gas. On addition of BaCl_2 solution to the resultant solution, a white precipitate was formed, which was insoluble in excess dilute HCl. Which of the following order of pairs of anions was responsible for the above observations.
 A. $\text{CO}_3^{2-}, \text{NO}_3^-$ C. $\text{CO}_3^{2-}, \text{SO}_3^{2-}$
 B. $\text{SO}_4^{2-}, \text{CO}_3^{2-}$ D. $\text{CO}_3^{2-}, \text{SO}_4^{2-}$
20. When concentrated H_2SO_4 is added to a salt there is evolution of a reddish brown gas. Which of the following pairs of salts and gases is correct with reference to the above test and observation?
 A. KI, I_2 B. $\text{Na}_2\text{SO}_3, \text{SO}_2$ C. $\text{Na}_2\text{CO}_3, \text{CO}_2$ D. $\text{NaNO}_3, \text{NO}_2$
21. If the boiling point of an organic solvent is about 70°C at 760 mmHg, then its boiling point at 650 mmHg would be about
 A. 20°C B. 60°C C. 80°C D. 120°C

TURN OVER

2. Which of the following process would you employ to purify benzene which has been contaminated with tetrachloromethane?

- A. solvent-solvent extraction
B. filtration

C. recrystallization
 D. distillation

CCl₄

It is desirable to put a disc of filter paper at the top of the column in column chromatography to avoid the disturbance of the

- A. compounds in the mixture
B. stationary solid phase
C. eluent
D. mobile liquid phase.

Which of the following pieces of apparatus is usually employed in the laboratory to extract drugs from plant materials?

- A. vacuum pump
 B. soxhlet pump
C. steam distillation apparatus
D. simple distillation apparatus.

Which of the following pieces of equipment or systems would be required in TLC work?

- I. glass plate
II. silica gel
III. glass jar
IV. solvent system.
A. I and II only
B. II and IV only
C. II and III only
 D. I, II, III and IV

How would you obtain palm oil from a mixture of palm oil and powdered chalk?

- A. Add water, put mixture in separating funnel and evaporate the filtrate
 B. Add ether, filter the mixture and evaporate the filtrate
C. Add ether, filter the mixture and recrystallize the filtrate
D. Add dilute HCl, put mixture in separating funnel and evaporate the lower layer.

If a small amount of water is added to ethanol, the boiling point of ethanol

- A. increases
B. remains constant
C. decreases
D. cannot be determined.

To determine whether an unknown solid substance is pure or not, one would have to

- A. perform filtration
 B. melting point determination
C. recrystallization
D. R_f value determination.

Crystals become impure by surface contamination or by the occlusion of impurities. What type of impurity is associated with small crystals?

- A. adsorption
B. occlusion
C. absorption
D. condensation.

Chromatography was performed on a plant extract and four spots were seen on the TLC plate. Which of the following statements is/are true?

- I. only 4 compounds are in the plant
II. only 4 compounds are in the plant extract
III. there are at least 4 compounds in the plant extract
A. I only
B. II only
 C. III only
D. I and II

(eluted)

Use the information below to answer questions 31 to 33.

A student prepares 200ml of HCl by diluting 30ml of 12M HCl. He then dissolves Mg powder in the diluted acid and covers the solution. The temperature raises by 4.3J/g°C. The molar mass of Mg is 24g/mol.

31. One of the products of the reaction above between the acid and Mg powder is

A. water

B. H^+ ion

C. H_2 gas

D. MgO

* 32. What is the limiting reactant in the reaction above between the acid and Mg powder?

A. Mg powder
B. HCl acid

C. it depends

D. neither, they are present in equal amounts

* 33. Assuming that all 0.75g Mg reacts, what is the molar heat of the reaction (in kJ/mol)?

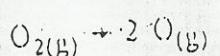
A. -699

B. -168

C. -143

D. -111

* 34. Given: $\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{OH}(\text{g})$, $\Delta H^\circ = +78 \text{ kJ/mol}$.

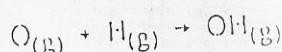


$$\Delta H^\circ = +196 \text{ kJ/mol}$$



$$\Delta H = +436 \text{ kJ/mol}$$

Find ΔH (in kJ/mol) for the reaction:



A. -427

B. +427

C. -854

D. +854

The information below should be used to answer questions 35 to 36.

The reaction:



is bimolecular and the second-order specific rate constant is $1.64 \times 10^{-3} \text{ mol}^{-1} \text{ sec}^{-1}$ at 37°C. The initial concentrations in a particular experiment are $[A] = 0.1\text{M}$ and $[\text{S}_2\text{O}_3^{2-}] = 0$ (where A denotes the $\text{C}_3\text{H}_7\text{Br}$ concentration).

35. What is the rate of reaction, $\frac{dA}{dt}$?

A. $[\text{A}][\text{S}_2\text{O}_3^{2-}]$

B. $K[\text{A}][\text{S}_2\text{O}_3^{2-}]$

C. $-K[\text{A}][\text{S}_2\text{O}_3^{2-}]$

D. $-K[\text{A}][\text{S}_2\text{O}_3^{2-}]$

36. What is the initial rate of reaction?

A. $1.64 \times 10^{-5} \text{ mol sec}^{-1}$

B. $-1.64 \times 10^{-3} \text{ mol sec}^{-1}$

C. $-6.4 \times 10^{-5} \text{ mol sec}^{-1}$

D. $1.32 \times 10^{-8} \text{ mol sec}^{-1}$

TURN C

37. Which of the following is NOT appropriate attire for the laboratory?

- | | |
|---------------------------|---------------------------------|
| I. loose flowing clothing | III. sandals or open toed shoes |
| II. loose long hair | IV. shorts or mini-skirts |
| A. I and II only | C. I, II and III only |
| B. II and III only | D. I, II, III and IV |

Use the following information to answer questions 38-40.

A 10.00ml. empty volumetric flask and stopper weighs 46.665g. When it is filled exactly to the 10.00 mark with pure isopropanol, the filled flask and stopper weighed 54.440g. A beaker containing 10.0ml of isopropanol and 5.00 ml of deionized water is prepared in a beaker. The solution is poured into a volumetric flask to the 10.00ml mark and reweighed. The filled volumetric flask and stopper now weigh 55.384g. Assuming the density of water = 1.000 g/ml.

38. What is the total mass of solution in the Erlenmeyer flask?

- A. 8.71g B. 16.66g C. 12.78 g D. 10.68 g

39. What is the actual volume of the solution in the Erlenmeyer flask?

- A. 14.00 ml B. 19.59ml C. 10.00ml D. 15.00ml

40. What is the percentage change in volume of solution?

- A. -22% B. 1.27 C. 3.42 D. 2.17

$$\text{Initial} = 46.665$$

$$\text{Final} = 54.440$$

$$55.384$$

$$55.384$$

$$46.665$$

$$8.717$$

K. TUANI
ADEI
ASARE-DONKOR
K. ANSAH