14/20

University of Jordan
Practical Analytical Chemistry 216
Midterm Exam

13/10/2012

ANSWER SHEET

1.	a	b	**c**	d	e	11.	a	b	c	**d**
2.	a	**b**	c	d	e	12.	a	b	c	**d**
3.	a	b	**c**	d	e	13.	a	b	c	d
4.	a	**b**	c	d	e	14.	a	**b**	c	d	e
5.	a	b	c	**d**	e	15.	a	**b**	**c**	d	e
6.	a	**b**	c	d	e	16.	**a**	**b**	c	d	e
7.	a	**b**	c	d	e	17.	**a**	b	**c**	d	e
8.	a	b	c	d	**e**	18.	a	**b**	c	**d**	e
9.	a	**b**	c	d	e	19.	a	b	**c**	d	e
10.	a	**b**	c	d	**e**	20.	**a**	b	c	**d**	e

GOOD LUCK

Calibration of volumetric glasswre

$d = \frac{m}{v}$

1) 50-ml burette was calibrated by measuring the mass of the delivered water. The following data was obtained:

- Mass of water = 49.3571 g
- Density of water at 25°C = 0.9960 g/ml

$0.9960 = \frac{49.3571}{v}$

$v = 49.55\ ml$

The actual volume of the delivered water is:

a) 50.17 ml b) 49.77 ml c) 49.55 ml d) 49.16 ml e) 49.36

2) You can distinguish clean glassware from dirty one by noticing that:

a) Water forms droplets on clean glassware while it forms a thin film on dirty glassware.
b) Water forms droplets on dirty glassware while it forms a thin film on clean surface.
c) Water forms droplets on clean and dirty glassware.
d) Cleanliness of glassware can be checked by adding certain indicator.
e) c + d

3) Which of the following statements is incorrect?

a) The object to be weighed on the balance should be at room temperature.
b) It is not acceptable to handle objects to be weighed with hands.
c) Chemicals could be weighed on small piece of paper.
d) The balance should be kept clean after weighing.
e) It is important to zero the balance before weighing

Sampling and statistical analysis

4) 8.5 ml of 0.10 M NaOH solution were needed to titrate 10.0 ml of acetic acid . The volume of NaOH needed to titrate a blank sample was 0.5 ml. The concentration of acetic acid is:

a) 0.085 M b) 0.080 M c) 0.097 M d) 0.092 M e) 0.089

$8.5 - 0.5 = 8.0\ ml$

$M V_{acetic} = M V_{NaOH}$

$0.1 \times 8.0 = 0.08$

5) **In an experiment for determination of water hardness, two students got the following results:**

	Student A	Student B
Mean value	40.42	40.23
Standard deviation	0.05	0.10

Assuming that the true value is 40.56, compared to student (A), student (B) is:

a) Less accurate, but more precise
b) More accurate, and more precise
c) More accurate, but less precise
d) Less accurate, and less precise
e) Non of the above

6) **In an analytical Lab, a student got the following data:**

15.00 ; 14.20 ; 14.90 ; 15.10 ; 15.20

If $Q_{critical}$ for five observation at 90% confidence is 0.64, the value that should be rejected is:

a) 15.00 b) 14.20 c) 15.20 d) 14.90 e) 15.10

Neutralization Titration

7) **One of the following substances can be used as a solid primary standard for the preparation of a standard solution:**

a) NaOH b) Na_2CO_3 c) NH_3 d) HCl e) H_3PO_4

8) 10.0 ml of an unknown phosphoric acid solution was titrated against 0.10 M standard solution of NaOH using phenolphthalein indicator. If 12.0 ml NaOH were required to reach the end point, The concentration of H_3PO_4 in g/L is:
Given: M.wt of H_3PO_4 = 98.0 g/mol.

a) 4.08 b) 23.52 c) 6.12 d) 11.76 e) 5.88

9) A solution was prepared by dissolving 0.424 g solid sodium carbonate (M.wt. = 106 g/mol) in 100 ml water. 10.0 ml of this solution were titrated with 16.0 ml of HCl solution using Bromocresol green indicator. The molarity of HCl is:

a) 0.025 b) 0.05 c) 0.0125 d) 0.25 e) 0.5

10) Which of the following statements is not correct?

a) The best indicator for the titration of the first proton in the phosphoric acid is Bromocresol green.
b) one can titrate NH_4OH against CH_3COOH with a sharp end point.
c) The color of Bromocresol green is yellow in acidic solution and blue in basic solution.
d) The water of crystallization of washing soda can be determined by neutralization titration.
e) In neutralization titration, the pH-working range of the indicator must match the pH at the equivalence point.

11) Which of the following statements about primary standard is correct:

a) A primary standard should be pure
b) A primary standard should be stable under all storage conditions
c) A primary standard should be thermally stable
d) A primary standard should be not hygroscopic
e) All of the above.

Precipetation with $AgNO_3$

12) For the Argentometry experiment, which of the following is true

a) In the Cl^- determination using the Fajan's method, dichloro-fluorescene is used as indicator.
b) Dichlorfluoroscene is an adsorption indicator
c) Titration using Fajan's method is a back titration
d) (A+B)
e) (B+C)

13) A 0.5222 g sample containing chloride was dissolved in water, then treated with 15.00 ml of 0.1533 M $AgNO_3$ to precipitate the chloride ions. The excess $AgNO_3$ was back titrated with 12.3 ml of 0.1014 M KSCN. The percentage of chloride in the sample is: (A.wt. of Cl = 35.5 g/mol)

a) 3.04% b) 0.02% c) 5.32% d) 0.22% e) 7.15%

14) In the determination of Cl^- by volhard's method, nitrobenzene is added before the excess Ag^+ is titrated with SCN^-. The role of nitrobenzene is to prevent:

a) Dissociation of AgSCN
b) Dissociation of AgCl
c) Precipitation of AgCl
d) Precipitaion of Fe^{3+}
e) Precipitation of AgSCN

Redox titration with dichromate

15) What is Johne's reductor?

a) HCl
b) Zinc granules
c) Amalgamated zinc
d) Diphenyl amine

16) The chemical equation for the reaction between Fe^{+2} and $Cr_2O_7^{2-}$ in acidic solution is:

$$A\ Cr_2O_7^{2-} + B\ Fe^{2+} + C\ H^+ \rightarrow D\ Cr^{3+} + E\ Fe^{3+} + F\ H_2O$$

C is: a) 6 b) 14 c) 7 d) 1 e) 2

17) When titrating a solution containing Fe^{2+} and Fe^{3+} with dichromate in an acidic medium, the volume of dichromate consumed correspond to:

a) Fe^{2+} b) Fe^{3+} c) Fe^{2+} and Fe^{3+} d) Pottasium dichromate does not react with iron whether in the oxidation state 2+ or 3+
e) All above statements are wrong.

Redox-titration (Iodometry)

18) In standardization of I_2 solution by titration with standard solution of sodium thiosulfate, the starch solution was added:

a) At the end of the titration
b) Near the end of the titration
c) When the solution becomes dark orange
d) After the solution becomes colorless
e) No starch solution is required in this type of titration.

$$6Fe^{+2} \rightarrow 6Fe^{+3} + e^-$$

$$14H^+ + Cr_2O_7^{-2} \rightarrow 2Cr^{+3} + 7H_2O$$

$$6Fe^{+2}$$

6

19) **Which of the following statements is correct:**

a) Sn^{2+} can be determined by direct titration with I_2
b) Sn^{2+} can be determined by titration with thiosulfate solution
c) Due to the slow reaction between Sn^{2+} and I_2 , Sn^{2+} can be determined by adding a measured excess of I_2, leave it for enough time to react, and then back titrate the excess I_2 with standard thiosulfate solution.
d) Sn^{2+} is converted to Sn^{4+} when titrated with thiosulfate
e) Sn^{2+} is converted to Sn when treated with iodine.

20) **In determination of Sn^{2+} (A.wt. = 118.7 g/mol) by I_2 titration, 45.00 ml of 0.005 M I_2 was added to 10.0 ml of unknown Sn^{2+} Solution and left to react. The unreacted I_2 was titrated with 3.73 ml of 0.12 M Na_2SO_3 solution. The concentration of Sn^{2+} in mg/L is:**

a) 14.24 b) 312.9 c)1.057 d)0.311 e) 0.512

$Mv\ I_2 = Mv\ Sn^{2+} + Mv\ S_2O_3^{-2}$

$0.225 = M \times 10 + 0.2239^{-2}$

$\frac{1.2 \times 10^{-3}}{10}$

$\times 118.7 = 14.24$

GOOD LUCK

$M\ I_2 = 2.25 \times 10^{-4}$

UNIVERSITY OF JORDAN DEPARTMENT OF CHEMISTRY

Practical Analytical Chemistry 0303216 Second Semester 11/12

Midterm Exam 7/4/2012

1	a	b	c	d	e
2	a	b	c	d	e
3	a	b	c	d	e
4	a	b	c	d	e
5	a	b	c	d	e
6	a	b	c	d	e
7	a	b	c	d	e
8	a	b	c	d	e
9	a	b	c	d	e
10	a	b	c	d	e

11	a	b	c	d	e
12	a	b	c	d	e
13	a	b	c	d	e
14	a	b	c	d	e
15	a	b	c	d	e
16	a	b	c	d	e
17	a	b	c	d	e
18	a	b	c	d	e
19	a	b	c	d	e
20	a	b	c	d	e

Circle the letter of the following multiple-choice problems and mark the letter of correct answer on the provided answer sheet (front page).

I - CALIBRATION OF A BURET

1. You can differentiate between clean glassware and dirty glassware by observing the spreading of water on the glass surface. One of the following is correct regarding this issue:
   a) water forms droplets on clean glass surfaces
   b) water forms thin films on dirty glass
   c) water forms films on clean and dirty glass surfaces
   d) water forms droplets on clean and dirty glass surfaces
   e) none of the above

2. In an experiment for determination of the magnitude of determinate error (if there is any) in the volume delivered by a 25.00 mL pipet, the following data were recorded:
   Mass of water filling the pipet = 24.6674 g
   Temperature of water = 25.0 °C
   1.0 mL of distilled water at 25.0 C = 1.0038 g
   Then the actual volume of the pipet is
   a) 25.00 mL
   b) 24.99 mL
   c) 24.57 mL
   d) 24.43 mL
   e) 25.76 mL

3. One of the following procedures is correct in performing a titration:
   a) It is recommended to leave the funnel at the top of the buret in order to add the titrant solution to the buret whenever it is needed
   b) It is recommended to discharge any trapped air bubbles in the buret before starting the titration
   c) It is recommended to read the scale on the buret while your eyes are lower than the level of the solution in the buret
   d) It is recommended to read the scale on the buuret while your eyes level is higher than the level of solution in the buret
   e) It is recommended to take the reading from the upper part of the meniscus

II- SAMPLING AND STATSTICAL TREATMENT OF DATA

4. Taking a representative sample from Mazola oil/acetic acid mixture must be preceded by
   a) Strong shaking of the mixture and taking the sample before re-separation of the two phases
   b) Strong shaking of the mixture then waiting for few minutes until the phases separate and taking the sample from the aqueous layer
   c) Strong shaking of the mixture followed by enough time for the phases to separate and then taking the sample from the oil layer
   d) The mixture is not shaken at all and the sample is taken directly from the oil layer
   e) The mixture is not shaken at all and the sample is taken from the aqueous layer

5. Upon determination of the molarity of acetic acid in four samples of Mazola oil-acetic acid mixture the following data was obtained:
   0.101 M, 0.099 M , 0.105, 0.095 M
   Calculate the average deviation from the median for these data
   a) 0.006
   b) 0.003
   c) 0.001
   d) 0.005
   e) 0.007

III- ACID_BASE TITRATIONS

6. One of the following base standard solutions **is not suitable** for titration of a solution of **acetic acid**
   a. NaOH
   b. KOH
   c. $Ba(OH)_2$
   d. NH_3
   e. None of the above

7. In an experiment, acid-base titration was used to determine the solubility of $Ca(OH)_2$. A 25.00 mL aliquot was taken from the supernatant solution and titrated with 0.0200 M HCl standard solution where 21.36 mL was needed to reach the endpoint. Calculate the molar solubility of $Ca(OH)_2$.

25.0 ml x 0.2 = 21.36 M

a) 0.0334 M
b) 0.0117 M
c) 0.0200 M
d) 0.00854 M
e) 0.100 M

8. A 25.00 mL of 0.0500 M H_3PO_4 was titrated with 0.100 M NaOH standard solution. Calculate the theoretical volume of the standard solution that would be needed to reach the second equivalence point.

a) 25.00 mL
b) 50.00 mL
c) 12.50 mL
d) 6.25 mL
e) 100.00 mL

9. Titration of phosphoric acid has practically three equivalence points. In our calculations of the concentration of an unknown phosphoric acid solution it must be known whether the first or the second endpoint is reached. How do you know whether you reach the second or the first endpoint?

a) from the concentration of phosphoric acid solution
b) from the strength of the base used for the titration
c) from the intensity of the color produced at the endpoint; if it is pale it is the first while if it is intense then it is the second
d) from the indicator used for the titration
e) none of the above

IV- PRECIPITATION TITRATIONS

10. A 25.00 mL of 0.0500 M $AgNO_3$ standard solution was added to 20.00 mL of an unknown concentration of Cl^- solution in a conical flask. HNO_3 was added followed by addition of few milliliters of nitrobenzene and few drops of Fe^{3+} were added to the solution and the solution was titrated with 0.0500 M SCN^- solution where 15.00 mL of the SCN- standard solution was needed to reach the endpoint. Calculate the molarity of Cl^- in the solution.

a) 0.100 M
b) 0.0500 M
c) 0.0250 M
d) 0.0750 M
e) 0.00100 M

$AgNO_3 \rightarrow Ag^+ + NO_3^-$
25.0 mL
0.5 M

11. A 25.00 mL of 0.0500 M $AgNO_3$ standard solution was added to 20.00 mL of an unknown concentration of Cl^- solution in a conical flask. After acidification with HNO_3 few milliliters of nitrobenzene and few drops of Fe^{3+} were added to the solution and the solution was titrated with 0.100 M SCN^- solution where 15.00 mL of the SCN^- standard solution was needed to reach the endpoint. Why Fe^{3+} is added ?

a) Fe^{3+} is added to prevent dissociation of AgCl
b) Fe^{3+} acts as an indicator in this titration
c) Fe^{3+} catalyzes the reaction
d) Fe^{3+} reacts with the excess Ag^+
e) None of the above

12. Mohr method for endpoint detection using potassium chromate (K_2CrO_4) as an indicator in the precipitation of Cl^- with $AgNO_3$ standard solution cannot be performed in acidic solution because

a) Ag^+ is precipitated in acidic solutions
b) Cl^- oxidized in acidic solutions
c) CrO_4^{2-} converts to $Cr_2O_7^{2-}$ in acidic solutions
d) CrO_4^{2-} does not react with Ag^+ in acidic solutions
e) None of the above

13. In an experiment for standardization of $AgNO_3$ vs. NaCl as a primary standard the concentration of an $AgNO_3$ (molar mass = 169.87 g/mol) solution was found to be 0.0500 M . The concentration of this solution
expressed in grams of $AgNO_3$ per liter is

mass = ?
Mm. = 169.87
M = 0.05
$n = \frac{m}{Mm}$
$M = \frac{n}{V}$

a) 14.1 g/L
b) 8.49 g/L
c) 3.69 g/L
d) 16.99 g/L
e) 0127 g/L

V - Redox titrations

14. A solution that contains Fe^{2+} or Fe^{3+} or both of them. A 20.00 mL aliquot was titrated with 0.0500 M standard solution of $Cr_2O_7^{2-}$ where 15.00 mL of $Cr_2O_7^{2-}$ was needed to reach the equivalence point. Another 20.00 mL alquot was treated with Jones reductor. Upon titration the sample took 15.00 mL to reach the endpoint too. This result can be explained on basis that

Fe +3
Fe 2+

a) The sample didn't contain Fe^{3+}
b) The sample didn't contain Fe^{2+}
c) The sample contains both Fe^{3+} and Fe^{3+} in equal concentrations
d) The sample contains Fe^{3+} but didn't contain Fe^{2+}
e) None of the above

15. In titrating solutions that contain Fe^{2+} or Fe^{3+} with $K_2Cr_2O_7$ standard solution

a) No need for an indicator since $K_2Cr_2O_7$ acts as self-indicator
b) Addition of H_3PO_4 is unnecessary since H_2SO_4 is added
c) Titration can be carried out in a basic solution to which NaOH is added
d) Zinc amalgam is as good as zinc in reducing Fe^{3+} to Fe^{2+}
e) none of the above

16. In Jones reductor, zinc amalgam is used to reduce

a) H^+ from H_3PO_4 to H_2
b) Fe^{3+} to Fe^{2+}
c) Fe^{2+} to Fe
d) Fe^{3+} and Fe^{2+} to Fe
e) None of the above

$\frac{2.0 * 10}{150} = \frac{15.0\ M}{15.0}$

M =

VI – IODINE TITRATIONS

17. Ascorbic acid (Molar Mass = 176.126 g/mole) is a reducing agent, and can be determined by reaction with iodine.
A 200.0 mL sample of citrus fruit drink that contains ascorbic acid is acidified, and 10.00 mL of 0.0500 M I_2 is added. After the reaction is completed the excess I_2 is titrated with 38.62 mL of 0.0120 M $Na_2S_2O_3$. Calculate the number of milligrams of ascorbic acid per milliliter of fruit drink.

Equations: $C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2\,H^+ + 2\,I^-$

$I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$

a) 519.6 mg/L
b) 236.3 mg/L
c) 472.7 mg/L
d) 722.5 mg/L
e) 280.4 mg/L

18. Iodine solutions can be standardized by

a) Direct weighing an amount of iodine and dissolving it in a volumetric flask and filling the flask to the mark on the neck
b) standardization with potassium dichromate (an oxidizing agent)
c) standardization with $AgNO_3$ standard solution
d) standardization with $S_2O_3^{2-}$ standard solution
e) None of the above

19. A 0,5316 g KIO_3 (Molar Mass 214.0) was dissolved in 100.00 mL water to preparte a standard solution.. To 10.00 mL of this solution, 0.20 g of KI was added and the solution is acidified using HCl. The liberated iodine was titrated with 15.00 mL of a $Na_2S_2O_3$ solution. What is the molarity of the $Na_2S_2O_3$ solution.

Equations: $KIO_3 + 5\,KI + 6\,HCl \rightarrow 3\,H_2O + 3\,I_2 + 6\,KCl$

$2\,S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2\,I^-$

a) 0.011 M
b) 0.033 M
c) 0.049 M
d) 0.099 M
e) 0.200 M

$KIO_3 \Rightarrow m = 0.5316\,g$, $Mm = 214.0$

$V = 100.0\,ml$

$KI = 0.20\,g$

$= 15.0\,ml\ Na_2S_2O_3$

$M_1V_1 = M_2V_2$ ($Na_2S_2O_3$)

1.656

20. A 20.00 mL of 0.100 M I_2 standard solution was added to a 10.00 mL of an aliquot of Sn^{2+} solution. The mixture was left for few minutes for completion of the reaction. The excess I_2 was titrated with 20.00 mL of 0.0500 M $S_2O_3^{2-}$. Calculate the concentration of Sn^{2+} solution.

Equations:

$Sn^{2+} + I_2 \rightarrow Sn^{4+} + 2I^-$

$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + 2S_4O_6^{2-}$

a) 0.0500 M

b) 0.100 M

c) 0.0750 M

d) 0.250 M

e) 0.150 M

$M_V I_2 = M_V Sn^{2+} + M_V S_2O_3^{-2}$ / 2

$2 \times 10^{-3} = M * 10 \times 10^{-3} + 5 \times 10^{-4}$

-5×10^{-4}

1.99×10^{-3}

$2 = M \times 10 + 0.5$

-0.5

$\frac{1.5}{10} = \frac{M \times 10}{10}$

THE END THE END THE END

$40 = M \times 10 + 0.5$

-1

$2 = M \times 10 + 0.5$