選擇題（共 20 分）

1. What is the device that excites a sample with excitation light and measures the excited sample's emission light at a different wavelength? (A) Spectrophotometric detector (B) Mass Spectrometer (C) Fluorescence detector (D) pH electrode (E) Balance. (5 pt)

2. A compound of formula weight 180 has an absorptivity of 286 cm^{-1} g^{-1} L. What is its molar absorptivity? (A) 1.59 (B) 286 (C) 51480 (D) 3432 (E) 0.00019. (5 pt)

3. Which of the following acid-base indicators can be used to show the pH of samples with pH ranging between 4 and 6? (A) Bromphenol Blue, (B) Phenol Red, (c) Methyl Red, (D) Phenolphthalein, (E) Nile Blue. (5 pt)

4. Which of the following reaction is balanced (5 pt):
   (A) $2\ MnO_4^{2-} + 2H_2O = MnO_2 + 2MnO_4^- + 2OH^-$
   (B) $IO_3^- + 6I^- + 6H^+ = 3I_2 + 3H_2O$
   (C) $FeS + 3\ NO_3^- + 6H^+ = Fe^{2+} + S + 3NO_2 + 3H_2O$
   (D) $H_2AsO_3^- + I_2 + H_2O = HAsO_4^{2-} + 2I^- + 3H^+$

問答題（共 80 分）

5. Please help a chemist choose the most suitable method from the table below for each task (answer with A, B, C, D, E, or F) (2pt each). Explain your reasons (3 pt each; total 30 pt):

	Methodology
A	High-performance liquid chromatography (HPLC)
B	Inductively coupled plasma mass spectrometry (ICP-MS)
C	Ion chromatography (IC)
D	Titration
E	Gravimetric analysis
F	Electrospray ionization mass spectrometry (ESI-MS)

(1) Detect multiple trace metal compositions, such as zinc, copper, iron, and manganese, in a liver sample.

(2) Measure the buffer capacity of seawater or river water.

(3) Quantify the major anion and cation compositions in human serum.

(4) Characterize proteins and oligonucleotides.

(5) Separate organic compounds in a solution.

(6) Quantify an analyte that can form a precipitate in a reaction.

6. A student prepared a buffer solution by adding 10 mL of 0.2 M sodium acetate to 10 mL of 0.1 M acetic acid. What is the pH of the buffer solution? Show your calculation and the units involved. Note: The pKa of acetated acid is 4.76. (10 pt).

見背面

7. A student pipetted 10 mL pure water at 25 °C (density: 0.997 g/mL) in the lab to check the accuracy and precision of two pipettors in the lab. Here are the measurements. Please answer the following questions (30 pt):

Measurement #	Pipette A	Pipette B
1	9.8	10.5
2	9.6	10.6
3	20.0	10.6
4	10.0	10.4
5	10.2	10.5
6	10.4	10.7
7	10.2	10.7
8	10.5	10.4
9	9.9	10.6
10	9.4	10.6

(1) Please identify, if any, outlier(s) from the measurements (2 pt). Explain the source of the error (2 pt).

(2) Excluding the outlier(s), what is the mean, variance, standard deviation, and relative standard deviation of the weighted 10 mL seawater using Pipette A and Pipette B (16 pt)?

Statistics	Pipette A	Pipette B
Mean		
Variance		
Standard deviation		
Relative standard deviation (%)		

(3) Define analytical accuracy (3 %). Which pipette is more accurate (2 pt)?

(4) Define analytical precision (3 %). Which pipette is more precise (2 pt)?

8. The Kueisantao (龜山島) has a submarine hydrothermal venting, similar to the Tatun hot springs in the Yangmingshan National Park. A marine geologist obtained an iron pyrite (FeS_2) sample from the vent site. The sulfur content of the sample was determined by converting it to hydrogen sulfide (H_2S) gas and absorbing the H_2S in 12.0 mL of 0.00500 M I_2. Then, the excess I_2 was back-titrating with 0.00100 M $Na_2S_2O_3$. If 5.0 mL $Na_2S_2O_3$ is required for the titration, how many milligrams of sulfur is contained in the sample? Sulfur has an atomic mass of 32.065 u. Show your calculation and the units involved (10 pt).

Reactions:

$H_2S + I_2 \rightarrow S + 2I^- + 2H^+$

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

試題隨卷繳回