

Points for each question in parentheses at end of question.

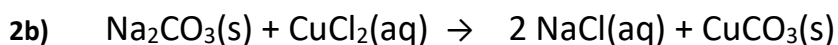
1. What mass of FeSO_4 (molar mass 151.9 g/mol) is needed to prepare 250. mL of a 0.112 M solution? (5)

_____ g FeSO_4

- 2a) What type of reaction is each of the following? (8)



- a) decomposition b) combination c) single displacement d) double displacement



- a) decomposition b) combination c) single displacement d) double displacement

3. 5.00 grams of glass at 80 °C is brought into contact with 5.00 g of wood at 20 °C. When thermal equilibrium is reached, both objects are at a temperature of 39 °C. Which has a greater specific heat capacity? (4)

- a) glass b) wood c) not enough information is given to answer

4. Ammonium nitrate is dissolved in water and the temperature of the water decreases from 22 °C to 18 °C. How is the enthalpy of the reaction described? (4)

- a) endothermic b) exothermic c) not enough information is given to answer

5. Circle the compounds below that are expected to be insoluble in water. Choose all that apply. (8)

H_2SO_3 Na_3PO_4 $\text{Fe}(\text{NO}_3)_3$ BaCO_3

6. 1.82 g CrSO_4 (0.0123 mol) is dissolved in 108.00 g H_2O in a coffee-cup calorimeter. The water increases in temperature from 25.00 °C to 26.10 °C. What is the enthalpy change for the dissolution reaction? (8)

Assume the solution specific heat capacity is 4.18 J/g·°C

$\Delta H =$ _____ kJ/mol

7. Indicate the oxidation number of the noted element in each case: (6)

Cl in ClO_2^- : _____

Cr in CrF_3 : _____

N in N_2 : _____

8. Circle the compounds below that are strong electrolytes. (4)

HNO_3

$\text{Fe}(\text{NO}_3)_2$

FeS

H_2CO_3

9. Consider the redox reaction: $\text{Cu}^{2+}(\text{aq}) + \text{Br}_2(\text{g}) \longrightarrow 2 \text{Br}^- (\text{aq}) + \text{Cu}(\text{s})$ (8)

Species oxidized: _____

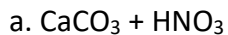
Species Reduced: _____

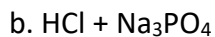
Oxidizing agent: _____

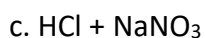
Reducing agent: _____

10. Give net ionic equations for the following reactions. If no reaction occurs, write "No Reaction"

(16)









11. The heating curves for water and benzene are shown here. Answer the following questions regarding them. (6)

Part 1. Which has the greater heat of fusion?

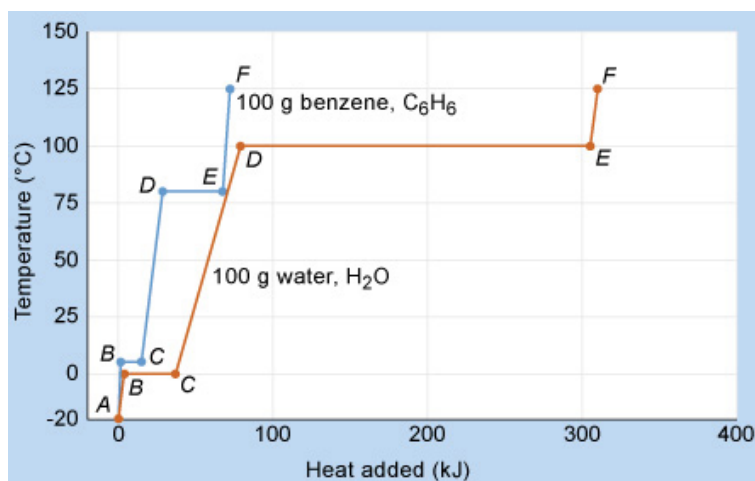
water or benzene

Part 2. From segment D to E for water, what type of energy (if any) is increasing?

- a) no energy increase
- b) kinetic energy
- c) potential energy
- d) both kinetic and potential energy

Part 3. Which has the higher melting point?

water or benzene



12. What volume of 3.00 M HCl solution is needed to be diluted to form 250. mL of a 0.150 M HCl solution?
(12)

_____ mL 3.00 M HCl

When making the solution, should you: (circle one)

- a) put the 3.00 M HCl in the flask and add water to dilute
- b) put water in the flask, add 3.00 M HCl, then dilute more

13. A titration is performed to determine the molar mass of an unknown diprotic acid. A solution of 0.152 M NaOH is used to titrate 0.482 grams of acid. If 29.9 mL of the NaOH solution are required to titrate the acid, what is the molar mass of the acid? (10)

Molar mass = _____

14. The following information is given for **benzene** at 1 atm:

boiling point = **80.10 °C**

melting point = **5.500 °C**

specific heat gas = **1.040 J/g °C**

$$\Delta H_{\text{vap}}(\mathbf{80.10\text{ °C}}) = \mathbf{393.3\text{ J/g}}$$

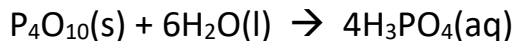
$$\Delta H_{\text{fus}}(\mathbf{5.500\text{ °C}}) = \mathbf{127.4\text{ J/g}}$$

$$\text{specific heat liquid} = \mathbf{1.740\text{ J/g °C}}$$

A **31.40 g** sample of liquid **benzene** is initially at **56.90 °C**. If the sample is heated at constant pressure ($P = 1$ atm), calculate the amount of energy in kJ needed to raise the temperature of the sample to **101.90 °C**. (10)

_____ J

15. Using standard heats of formation, calculate the standard enthalpy change for the following reaction. (8)



	ΔH°_f , kJ/mol
$\text{P}_4\text{O}_{10}(\text{s})$	-2984.0
$\text{H}_2\text{O}(\text{l})$	-241.8
$\text{H}_3\text{PO}_4(\text{aq})$	-1288.0

$$\Delta H_{\text{rxn}}^{\circ} = \sum \Delta H_{\text{f}}^{\circ}(\text{products}) - \sum \Delta H_{\text{f}}^{\circ}(\text{reactants})$$

$$\Delta H_{\text{rxn}}^{\circ} = \sum \text{bond energies of bonds broken} - \sum \text{bond energies of bonds formed}$$

<u>Weak Acids</u>	<u>Weak Bases</u>
CH ₃ COOH	CH ₃ COO ⁻
NH ₄ ⁺	NH ₃
H ₂ CO ₃	CO ₃ ²⁻
H ₂ C ₂ O ₄	C ₂ O ₄ ²⁻
H ₂ SO ₃	SO ₃ ²⁻
H ₂ S	S ²⁻
H ₃ PO ₄	PO ₄ ³⁻
HCN	CN ⁻
HF	F ⁻
NHO ₂	NO ₂ ⁻
HClO	ClO ⁻

Soluble Ionic Compounds*

Notable Exceptions

All sodium (Na⁺), potassium (K⁺), and ammonium (NH₄⁺) salts

All nitrate (NO₃⁻), acetate (CH₃CO₂⁻), chlorate (ClO₃⁻), and perchlorate (ClO₄⁻) salts

All chloride (Cl⁻), bromide (Br⁻), and iodide (I⁻) salts

Compounds also containing lead, silver, or mercury(I) (Pb²⁺, Ag⁺, Hg₂²⁺) are insoluble.

All fluoride (F⁻) salts

Compounds also containing calcium, strontium, barium, or lead (Ca²⁺, Sr²⁺, Ba²⁺, Pb²⁺) are insoluble.

All sulfate (SO₄²⁻) salts

Compounds also containing calcium, mercury(I), strontium, barium, or lead (Ca²⁺, Hg₂²⁺, Sr²⁺, Ba²⁺, Pb²⁺) are insoluble.

Insoluble Ionic Compounds

Exceptions

Hydroxide (OH⁻) and oxide (O²⁻) compounds

Compounds also containing sodium, potassium, or barium (Na⁺, K⁺, Ba²⁺) are soluble.

Sulfide (S²⁻) salts

Compounds also containing sodium, potassium, ammonium, or barium (Na⁺, K⁺, NH₄⁺, Ba²⁺) are soluble.

Carbonate (CO₃²⁻) and phosphate (PO₄³⁻) salts

Compounds also containing sodium, potassium, or ammonium (Na⁺, K⁺, NH₄⁺) are soluble.

PERIODIC TABLE OF THE ELEMENTS

1																18				
1A																8A				
1 H 1.008											2 He 4.003									
2 2A												13 3A	14 4A	15 5A	16 6A	17 7A				
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18			
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95			
3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B											
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80			
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3			
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)			
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Ds (269)	111 Rg (272)	112 Uub (277)			114 Uuq (277)			116 Uuh (277)			118 Uuo (277)

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)