



AP[®] Chemistry
2004 Sample Student Responses
Form B

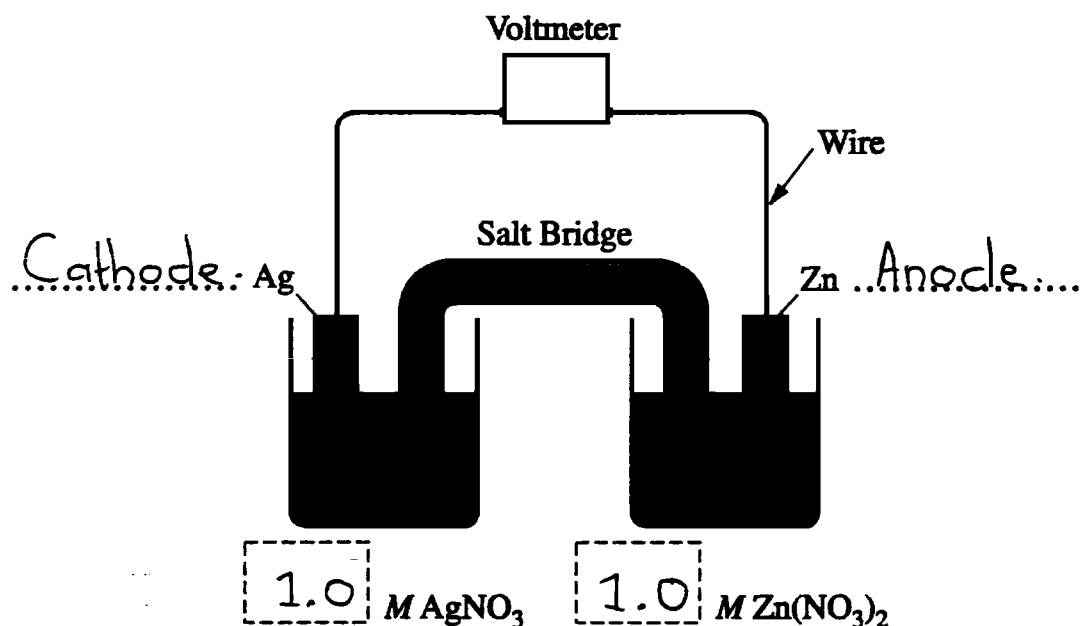
The materials included in these files are intended for noncommercial use by AP teachers for course and exam preparation; permission for any other use must be sought from the Advanced Placement Program[®]. Teachers may reproduce them, in whole or in part, in limited quantities, for face-to-face teaching purposes but may not mass distribute the materials, electronically or otherwise. This permission does not apply to any third-party copyrights contained herein. These materials and any copies made of them may not be resold, and the copyright notices must be retained as they appear here.

The College Board is a not-for-profit membership association whose mission is to connect students to college success and opportunity. Founded in 1900, the association is composed of more than 4,500 schools, colleges, universities, and other educational organizations. Each year, the College Board serves over three million students and their parents, 23,000 high schools, and 3,500 colleges through major programs and services in college admissions, guidance, assessment, financial aid, enrollment, and teaching and learning. Among its best-known programs are the SAT[®], the PSAT/NMSQT[®], and the Advanced Placement Program[®] (AP[®]). The College Board is committed to the principles of excellence and equity, and that commitment is embodied in all of its programs, services, activities, and concerns.

For further information, visit www.collegeboard.com

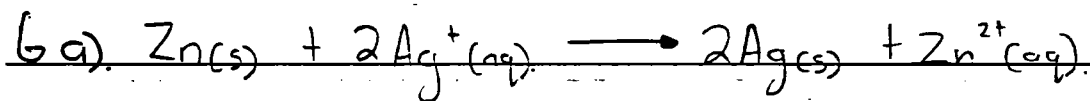
Copyright © 2004 College Entrance Examination Board. All rights reserved. College Board, Advanced Placement Program, AP, AP Central, AP Vertical Teams, APCD, Pacesetter, Pre-AP, SAT, Student Search Service, and the acorn logo are registered trademarks of the College Entrance Examination Board. PSAT/NMSQT is a registered trademark of the College Entrance Examination Board and National Merit Scholarship Corporation. Educational Testing Service and ETS are registered trademarks of Educational Testing Service. Other products and services may be trademarks of their respective owners.

For the College Board's online home for AP professionals, visit AP Central at apcentral.collegeboard.com.



6. The following questions refer to the electrochemical cell shown in the diagram above.

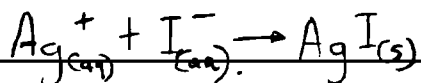
- (a) Write a balanced net ionic equation for the spontaneous reaction that takes place in the cell.
- (b) Calculate the standard cell potential, E° , for the reaction in part (a).
- (c) In the diagram above,
 - (i) label the anode and the cathode on the dotted lines provided, and
 - (ii) indicate, in the boxes below the half-cells, the concentration of AgNO_3 and the concentration of $\text{Zn(NO}_3)_2$ that are needed to generate E° .
- (d) How will the cell potential be affected if KI is added to the silver half-cell? Justify your answer.



b) $E^\circ_{\text{cell}} = E^\circ_{\text{redn Ag}} - E^\circ_{\text{redn Zn}}$

$\Rightarrow E^\circ_{\text{cell}} = 0.8 - (-0.76) = 0.8 + 0.76 = \underline{\underline{1.56 \text{ V}}}$

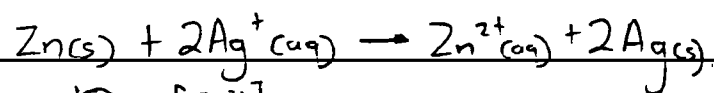
c) If KI were added to the silver half-cell. Some of the silver ions would precipitate.



This would lead to a reduction in the concentration of silver ions.

GO ON TO THE NEXT PAGE.

ADDITIONAL PAGE FOR ANSWERING QUESTION 6.



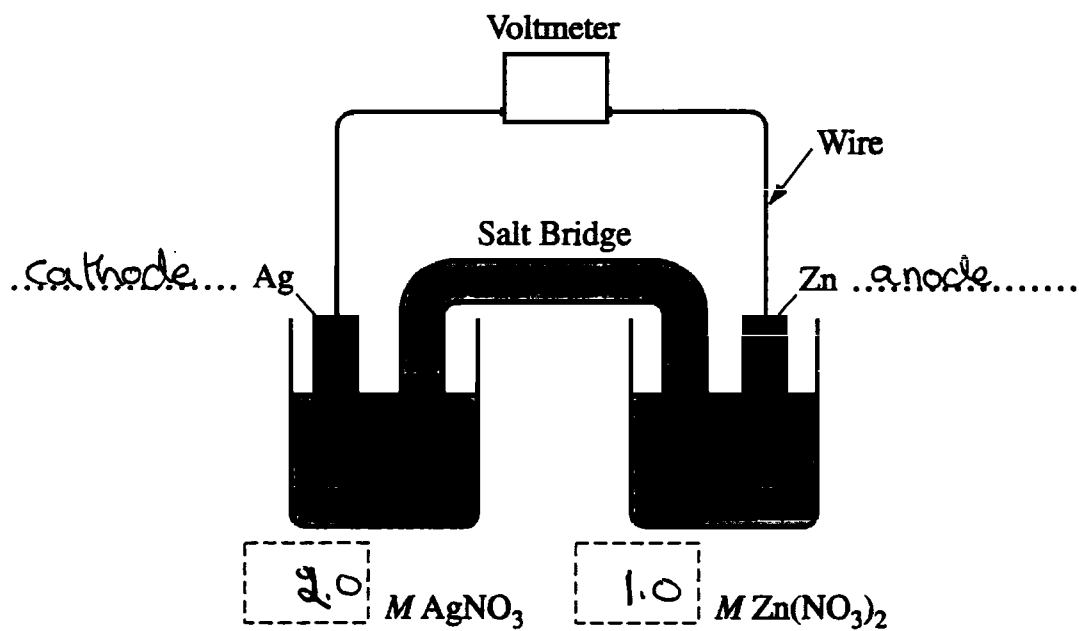
$$Q = \frac{[\text{Zn}^{2+}]}{[\text{Ag}^+]^2}$$

$$F_{\text{cell}} = F^{\circ}_{\text{cell}} - \frac{RT}{nF} \ln Q$$

$$\Rightarrow E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Ag}^+]^2}$$

The reduction in $[\text{Ag}^+]$ would lead to Q becomes more than 1. As a result, $\ln Q$ is positive and the cell potential would decrease.

GO ON TO THE NEXT PAGE.



6. The following questions refer to the electrochemical cell shown in the diagram above.
- (a) Write a balanced net ionic equation for the spontaneous reaction that takes place in the cell.
 - (b) Calculate the standard cell potential, E° , for the reaction in part (a).
 - (c) In the diagram above,
 - (i) label the anode and the cathode on the dotted lines provided, and
 - (ii) indicate, in the boxes below the half-cells, the concentration of AgNO_3 and the concentration of $\text{Zn(NO}_3)_2$ that are needed to generate E° .
 - (d) How will the cell potential be affected if KI is added to the silver half-cell? Justify your answer.

a) ~~$\text{Ag}(s) \rightarrow \text{Ag}^+(aq)$~~ $\text{Zn}(s) + 2\text{Ag}^+(aq) \rightarrow \text{Zn}^{2+}(aq) + 2\text{Ag}(s)$

b) $E^\circ = E_o + E_r$

$\text{Ag} \approx$ oxd rxn: $\text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + 2e^-$ $E^\circ = 0.76 \text{ V}$

rdcn rxn: ~~$\text{Ag}^+(aq) \rightarrow \text{Ag}(s)$~~

$\text{Ag}^+(aq) + e^- \rightarrow \text{Ag}(s)$ $E^\circ = 0.80 \text{ V}$

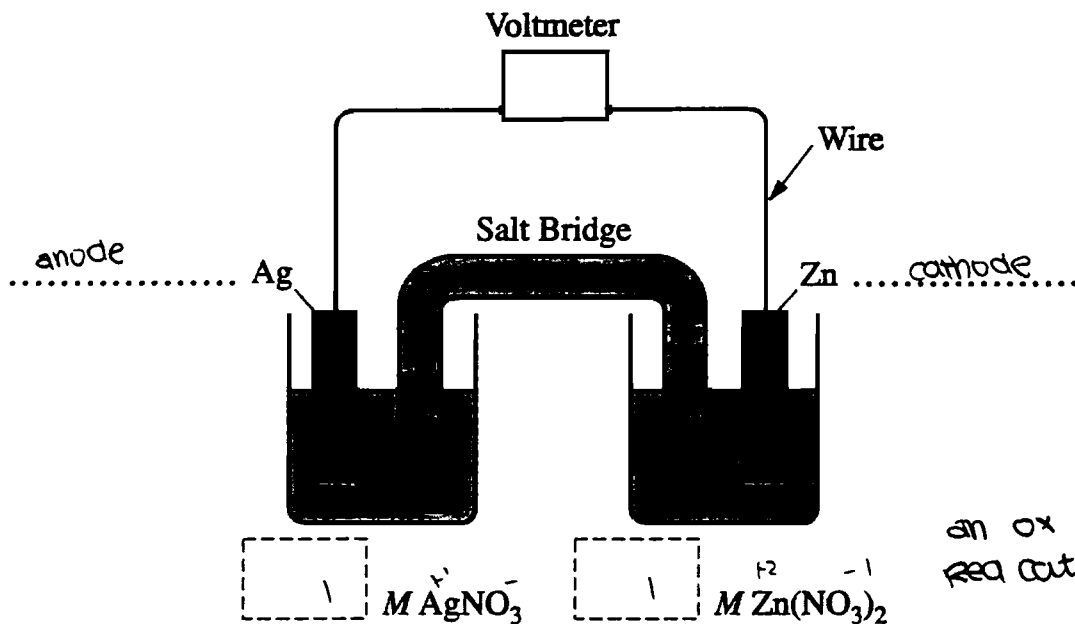
$E^\circ = 0.76 + 0.8 = 1.56 \text{ V}$

GO ON TO THE NEXT PAGE.

ONAL PAGE FOR ANSWERING QUESTION 6.

d) The cell potential will decrease because I^- will react with Ag^+ to produce a solid, AgI , ~~at~~ which will decrease the amount of $Ag(s)$ produced.

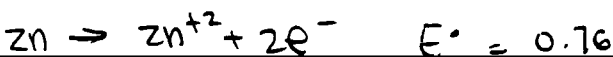
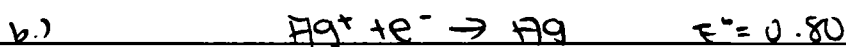
GO ON TO THE NEXT PAGE.



6. The following questions refer to the electrochemical cell shown in the diagram above.

- (a) Write a balanced net ionic equation for the spontaneous reaction that takes place in the cell.
- (b) Calculate the standard cell potential, E° , for the reaction in part (a).
- (c) In the diagram above,
 - (i) label the anode and the cathode on the dotted lines provided, and
 - (ii) indicate, in the boxes below the half-cells, the concentration of AgNO_3 and the concentration of $\text{Zn(NO}_3)_2$ that are needed to generate E° .
- (d) How will the cell potential be affected if KI is added to the silver half-cell? Justify your answer.

OIL RIG



$$\begin{array}{r} 0.80 \\ + 0.76 \\ \hline 1.56 \end{array}$$

$E^\circ = 1.56$

c.) see diagram

d.) it will be decreased because $\text{K}^+ + e^- \rightarrow \text{K}$ is negative (-2.92) while

$\text{I}_2 + 2e^- \rightarrow 2\text{I}^-$ is 0.53. the sum is still negative, so it will lower the cell potential.

GO ON TO THE NEXT PAGE.