

© International Baccalaureate Organization 2025

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2025

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2025

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Chemistry
Higher level
Paper 2

19 May 2025

Zone A morning | **Zone B** morning | **Zone C** morning

Candidate session number

2 hours 30 minutes

--	--	--	--	--	--	--	--	--	--

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.



Answer **all** questions. Answers must be written within the answer boxes provided.

1. Iron(II) sulfide can be produced by heating powdered iron and sulfur together.

(a) Describe the difference between an element and a compound.

[2]

.....

.....

.....

.....

(b) Outline why solid iron(II) sulfide is a polar covalent compound. Use sections 9 and 17 of the data booklet.

[1]

.....

.....

.....

(c) Contrast **one** physical property of iron and iron(II) sulfide.

[1]

.....

.....

.....

(d) Calculate the wavelength, in m, for the limit of convergence observed in the line spectrum of iron. Use sections 1, 2 and 9 of the data booklet.

[3]

.....

.....

.....

.....

.....

.....



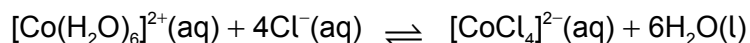
2. Cobalt ions form coloured compounds.

(a) Deduce the electron configuration of the Co^{2+} ion.

[1]

.....

(b) An equilibrium is established when hydrated cobalt ions are mixed with concentrated hydrochloric acid.



Pink

Blue

(i) Predict the effect on the value of K and the equilibrium position when solid sodium chloride, $\text{NaCl}(\text{s})$, is added to the mixture at constant temperature.

[1]

.....

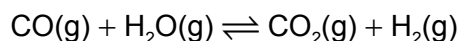
(ii) Heating an equilibrium mixture that is initially pink changes the colour to purplish-blue. Deduce, giving a reason, whether the formation of $[\text{CoCl}_4]^{2-}(\text{aq})$ is an exothermic or endothermic process.

[1]

.....



3. An equilibrium is established between gaseous carbon monoxide and steam.



Under certain conditions of temperature and pressure, 2.7 mol of CO(g) and 2.9 mol of H₂O(g) were placed in a 1 dm³ container and allowed to reach equilibrium.

- (a) State the equilibrium constant expression, K , for this equilibrium. [1]

.....

- (b) At equilibrium, there was 1.5 mol of CO₂(g) present. Calculate the amount, in mol, of the other gases and hence find the value of the equilibrium constant, K . [2]

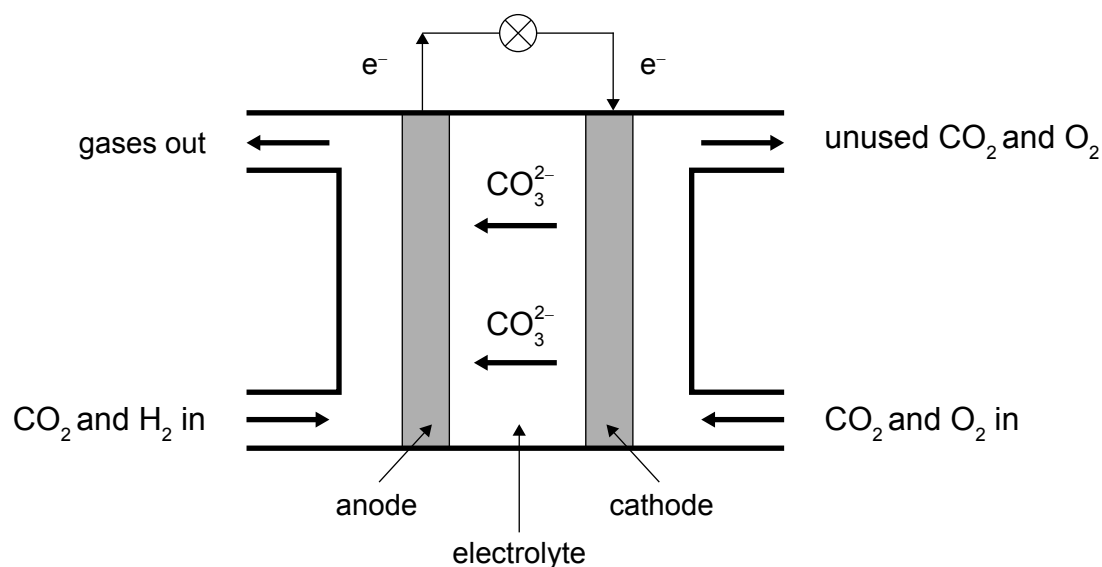
.....

(This question continues on the following page)



(Question 3 continued)

- (c) A mixture of $\text{CO}_2(\text{g})$ and $\text{H}_2(\text{g})$ can be used in a molten carbonate fuel cell, which is similar to a hydrogen fuel cell.



Deduce the half-equations for the reactions occurring at each electrode.

[2]

Anode: $\text{CO}_3^{2-} + \text{_____} \rightarrow \text{CO}_2 + \text{_____}$

Cathode: $\text{CO}_2 + \text{_____} \rightarrow \text{CO}_3^{2-} + \text{_____}$

- (d) Suggest why the molten carbonate fuel cell is considered to be environmentally friendly.

[1]

.....

