



PCAT PUBLIC WEBINAR

Diagnostic Review

March 31, 2018

Today's Agenda

- ▶ **Welcome to Diagnostic Review!**
- ▶ **Introduction**
- ▶ **Why is the Diagnostic important?**
- ▶ **Exam Review**
- ▶ **What Next?**

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Who Is Next Step?



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- Focus on graduate admissions tests only
- Team of educational experts
- First company to have materials built from ground up for 2015 MCAT format
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STUDENTS HAVE A CHOICE IN TEST PREP

Introduction

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Sophia Stone

PCAT Content Manager

- ▶ **Tutored and taught for 8+ years**
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- ✓ **Next Step is a team of test prep and educational experts committed to excellence.**

Introduction to Public Webinars

Thanks for coming to our webinar!

These sessions are meant to be:

- ▶ Interactive
- ▶ Problem-focused

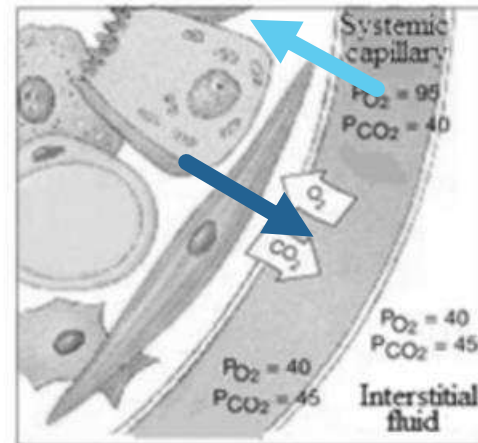
✓ **Think of a question after this webinar? Post in our forums at forum-pcat.nextstepprep.com**

Getting Started:

1. Turn on your mic
2. Locate the hand-raise button
3. Locate the Question and Chat boxes
4. Let me know if you're having at tech issues!

Biological Processes: Gas Exchange Passage

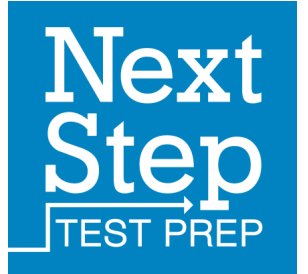
Over two-thirds of the CO_2 transported in the systemic capillaries is transformed to bicarbonate (HCO_3^-) within the erythrocytes. The enzyme carbonic anhydrase (Equation 1) catalyzes the rapid interconversion of CO_2 and water to carbonic acid (H_2CO_3). Nearly all of the bicarbonate produced exits the erythrocyte to the plasma, leading to a charge imbalance that is rectified by the movement of chloride ions from the plasma into the erythrocytes. An additional 22% of the total carbon dioxide in the blood is complexed with hemoglobin ($\text{Hb}\cdot\text{CO}_2$). When tissue P_{O_2} levels are low, the formation of $\text{Hb}\cdot\text{CO}_2$ also promotes the dissociation of O_2 from Hb. Finally, the remaining 8% of the intracellularly-produced CO_2 dissolves freely in the plasma. Both H^+ and CO_2 can reversibly bind to Hb molecules in the erythrocytes.



- CO_2 is carried in the blood as HCO_3^- , bound to hemoglobin, or dissolved in the plasma

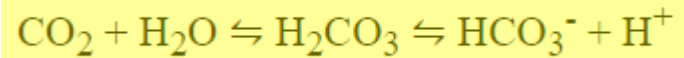
Figure 2 Partial pressures and diffusion in systemic capillaries

Biological Processes: Gas Exchange Passage



Acetazolamide, an inhibitor of carbonic anhydrase, is used to treat intraocular hypertension in patients with glaucoma. Carbonic anhydrase speeds up the interconversion of carbon dioxide, water, and carbonic acid.

Equation 1



carbonic anhydrase

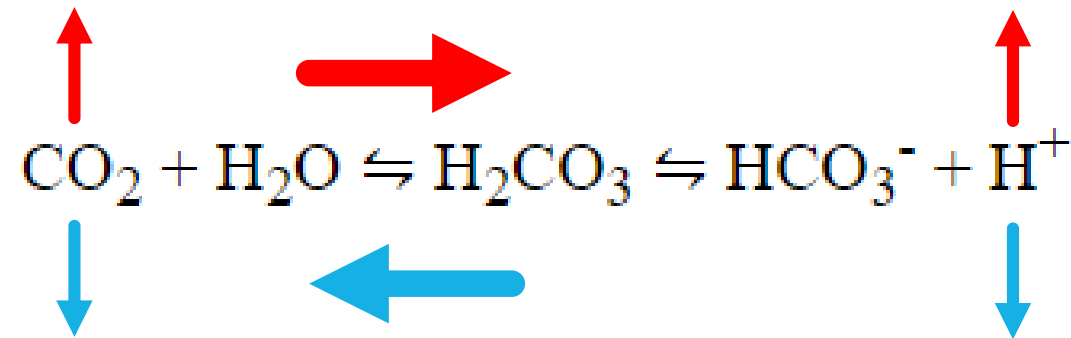
- Acetazolamide inhibits carbonic anhydrase

Biological Processes:

Q20

Since O_2 binds to hemoglobin more easily in a **basic** environment, the highest degree of $Hb \cdot O_2$ binding will be observed when the P_{CO_2} in the blood is:

- A. high, because Equation 1 will proceed to the left.
- B. high, because Equation 1 will proceed to the right.
- C. low, because Equation 1 will proceed to the left.
- D. low, because Equation 1 will proceed to the right.



Biological Processes:

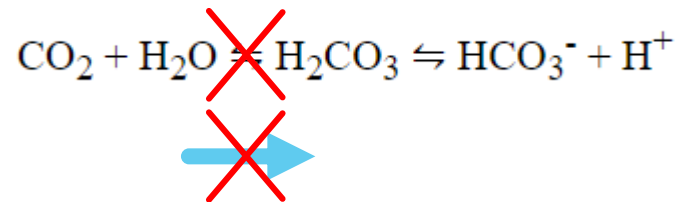
Q21

Treatment of a glaucoma patient with acetazolamide would most probably cause:

- A. an increase in the concentration of CO_2 in the tissue cells.
- B. an increase in the concentration of HCO_3^- in the erythrocytes.
- C. an increase in the concentration of H_2CO_3 in the erythrocytes.
- D. a decrease in the concentration of H_2O in the tissue cells.

Acetazolamide, an inhibitor of carbonic anhydrase, is used to treat intraocular hypertension in patients with glaucoma. Carbonic anhydrase speeds up the interconversion of carbon dioxide, water, and carbonic acid.

Equation 1

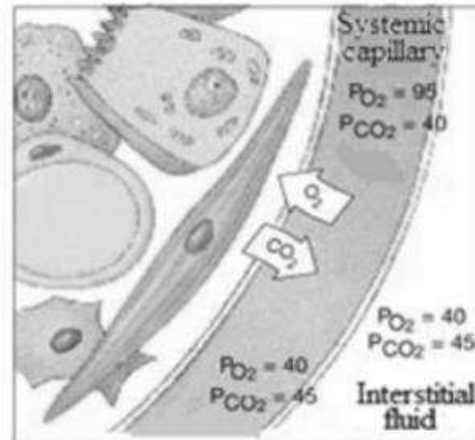


Biological Processes:

Q22

Systemic capillaries are so thin that erythrocytes move through them one cell at a time. What effect does this have on the mechanism of gas exchange?

- A. It serves to increase the amount of carbon dioxide that remains in tissue cells.
- B. It permits the alveoli to have physical contact with erythrocytes.
- C. It allows erythrocytes to move more rapidly than would otherwise be possible.
- D. It maximizes the capacity for gas diffusion.



Biological Processes:

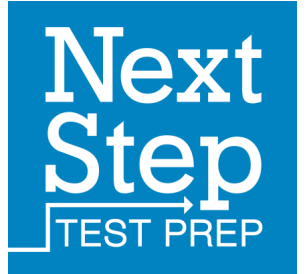
Q23

Which of the following changes in blood chemistry would NOT occur as a result of prolonged physical exercise, such as running?

- A. Increased temperature ✓
- B. Decreased partial pressure of O₂ ✓
- C. Decreased pH ✓
- D. Decreased Hb•CO₂



Chemical Processes: Polypeptides Passage



The structure of a polypeptide was determined beginning with the **identification of its constituent amino acids**. A purified sample of the polypeptide was **denatured and then hydrolyzed** by a strong acid at 110°C for 24 hours. The individual amino acids released by the treatment were then separated by **cation-exchange chromatography**. In this technique, amino acids bind with differing affinities to negatively charged groups attached to resins applied along the column.

Following treatment with a series of eluant solutions, the separated amino acids contained in the eluate from the column were **heated with ninhydrin**, a reagent that forms the blue-purple compound Ruhemann's purple with most amino acids, amines and ammonia.

- **Purpose: identify amino acids in polypeptide**
- **Methods: polypeptide denatured → hydrolyzed → cation-exchange chromatography → heated with ninhydrin**

Chemical Processes: Polypeptides Passage

- ninhydrin + amino acid → Ruhemann's Purple

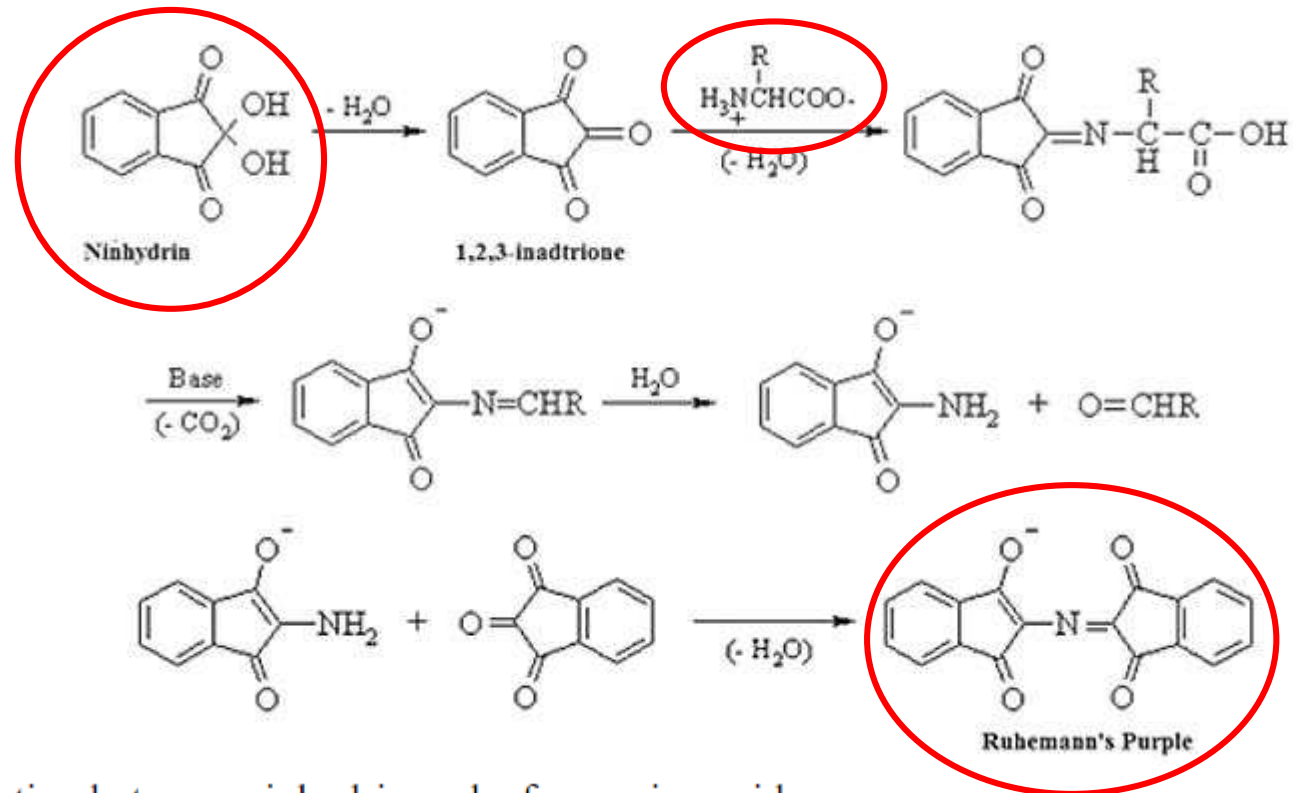


Figure 1 The ninhydrin reaction between ninhydrin and a free amino acid

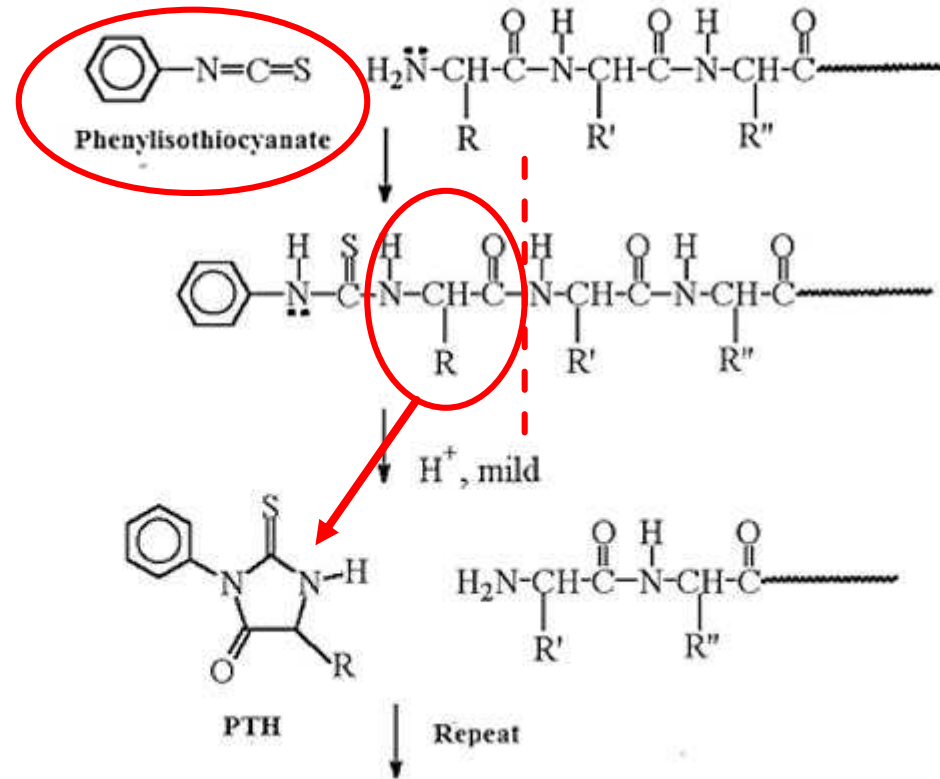
Chemical Processes: Polypeptides Passage

The amount of each amino acid present was then determined spectrophotometrically by measuring the amount of blue-purple light absorbed.

The specific position of each amino acid in the polypeptide chain was also found. Edman reagent (phenylisothiocyanate) was used to label a terminal residue under mildly alkaline conditions, resulting in the formation of a phenylthiocarbamoyl. Under acidic conditions, the terminal amino acid of the polypeptide was cleaved, releasing free polypeptide and phenylthiohydantoin (PTH), an amino acid derivative that can be identified. Edman reagent was applied repeatedly, shortening the peptide bond obtained following each cycle. The steps of the Edman degradation are shown in Figure 2.

- **Methods (cont'd): determine amount of each amino acid**
- **New Purpose: identify position of amino acids**
- **New Methods: label with Edman reagent → cleave terminal amino acid → repeat**

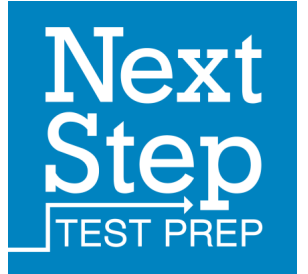
Chemical Processes: Polypeptides Passage



1. Label with Edman reagent
2. Cleave terminal amino acid
3. Repeat

Figure 2 Edman degradation of a polypeptide

Chemical Processes: Polypeptides Passage



There are **limits on the length** of polypeptides that can be sequenced by this method. Over time, the yield of PTH-amino acid products decreases relative to the background level of PTH-amino acids. Longer polypeptides can be sequenced from greater initial sample sizes and larger repetitive yields. They may also be cleaved by peptidase enzymes to create shorter polypeptides for sequencing.

Chemical Processes:

Q17

Unfolding of the polypeptide in the presence of the denaturant proceeded unimolecularly with rate constant k . What are the units of this rate constant?

- A. s^{-1}
- B. $M \cdot s$
- C. $M^{-1} \cdot s^{-1}$
- D. $M \cdot s^{-1}$

$$\text{Rate} = k[A]$$

$$\frac{M}{s} = k(M)$$

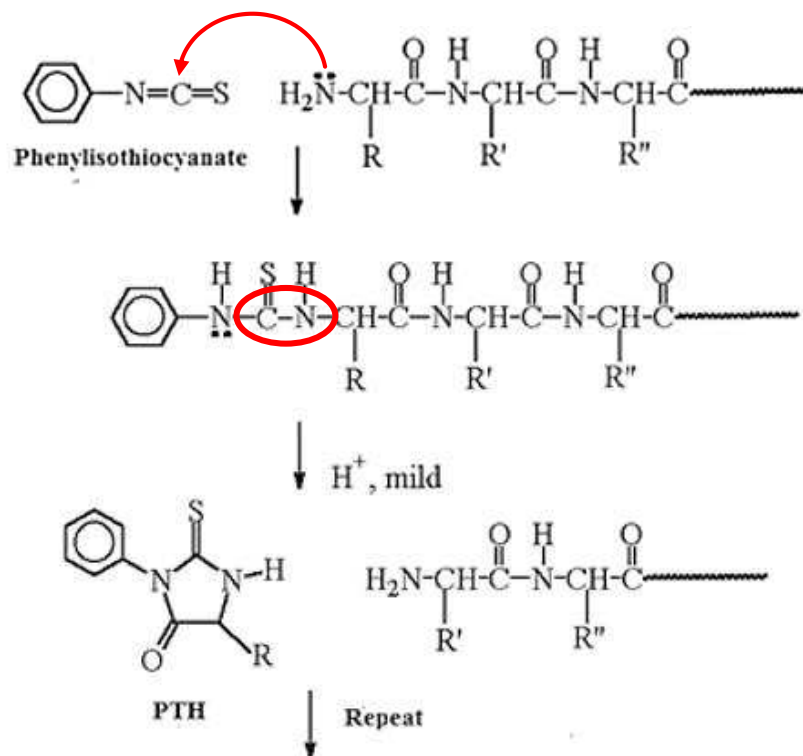
$$k = \frac{1}{s}$$

Chemical Processes:

Q18

Which of the following reaction types best describes the formation of the bond between phenylisothiocyanate and a polypeptide in the first reaction in Figure 2?

- A. Addition
- B. Dehydration
- C. Neutralization
- D. Elimination

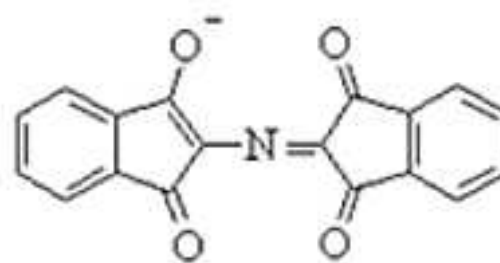


Chemical Processes:

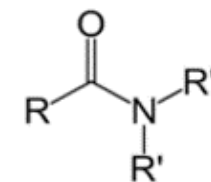
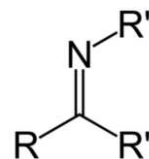
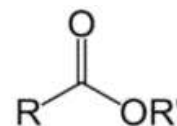
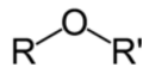
Q19

The final product in Figure 1 has which of the following functional groups?

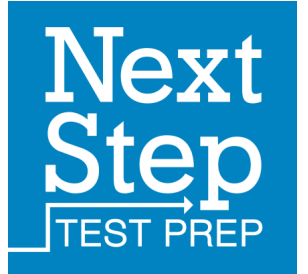
- A. Ether
- B. Ester
- C. Imine
- D. Amide



Rubemann's Purple



Critical Reading: Passage 6



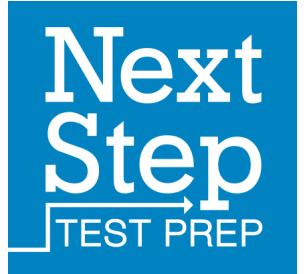
The German Empire existed for only 47 years and yet did more to shape the nature of the 20th century than any other state in Europe (or possibly, the world). While most only remember WWI and the dissolution of the Second Reich, the German Empire should instead be remembered for its startling internal contrasts. It was a nation of impressive social, electoral, and economic advances but also strictly authoritarian, a tension that embodied much of the zeitgeist of the subsequent century.

In 1871, the newly-minted Empire enacted universal male suffrage. At a time when poll taxes and literacy tests were used to disenfranchise black voters in the U.S. and the U.K. still had property requirements, the German Empire permitted every single male the right to vote. Germany also created Europe's first social welfare system, providing old-age pensions, sickness benefits, and accident and disability insurance.

In addition to these reforms, the Empire experienced an unprecedented industrial and military expansion. Germany can rightly claim to be the first truly "urbanized" nation in the world. By 1913 Germany had the largest rail network in the world, after the U.S. Germany's dye and chemical industries grew exponentially in the decades prior to 1900, and expanded into pharmaceuticals, electrochemistry, and agricultural chemicals. This rapid expansion had two significant corollaries: the development of the first class of industrial managers in the world and a scientific Renaissance in German universities – over 1/3 of all Nobel prizes issued during the German Empire's existence went to German scientists.

- German Empire had internal contrasts: social/electoral/economic advances v. authoritarian
 - ✓ Universal male suffrage, first social welfare system
 - ✓ Industrial and military expansion, industrial managers, scientific Renaissance

Critical Reading: Passage 6

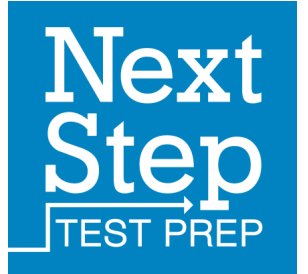


This growth was not without a significant dark side. The authoritarianism that quickly built an impressive industrial base also lent itself to disastrous social policies. Extending the vote to every adult male meant that suddenly, repressed minorities had a voice in the government. In response, Bismarck carried out two campaigns: the kulturkampf and Germanization. In the former, the Imperial government, over the course of a decade, imprisoned every single Catholic bishop and as many as 1/4 of parishes found themselves without a priest. Efforts were also made to get every single person in the Empire to speak German. Significant minorities spoke French, Polish, and Lithuanian and efforts to force such groups to adopt German backfired spectacularly. In one province, the percentage of German-speaking citizens actually dropped by over 10%.

In the arena of foreign policy, the results of authoritarianism were worse, a trend best revealed by the incident which led to Chancellor Bismarck's resignation. Near the end of 1889, a group of coal miners in the German region of Silesia went on strike. Bismarck's reaction was swift: he began mobilizing the Army to go in and crush the strike. Emperor Wilhelm, however, stopped him and sent an official to negotiate with a delegation from the miners. The strike ended without violence and Bismarck resigned months later. Wilhelm is reputed to have said, "I do not wish to stain my reign with the blood of my subjects." Yet such measured non-violence obviously did not stay the Emperor's hand in dealing with the Empire's colonies.

- Authoritarian "dark side" resulted in bad social policies: kulturkampf (imprisonment of Catholic bishops) and Germanization (German language requirement)
- Social and foreign policies backfired led to Bismarck's resignation

Critical Reading: Q41



The author would most likely approve of which of the following policies enacted by the German Empire?

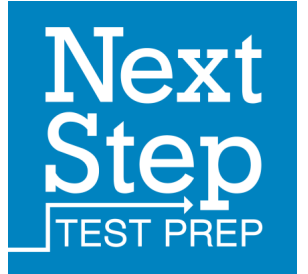
- **A.** Shortly after enacting universal male suffrage, the empire enacted a policy requiring any legislation passed by elected members of the Reichstag to be approved by the Bundesrat, a legislative body consisting of unelected landowning nobles. reaction to universal male suffrage anti-democratic
- **B.** The imperial treasury paid companies for expenses incurred providing free housing to workers. social welfare
- **C.** Males living in Kingdoms, Grand Duchies, and Duchies of the Empire could vote, but those living in Principalities and Free Cities could vote only in local politics and had no representation in Imperial assemblies. anti-suffrage
- **D.** Areas which embraced Germanization and had near-100% adoption of the German language for schools and businesses saw significant improvements in quality of life due to subsidized investments by large industrial firms. Germanization

...It was a nation of impressive social, electoral, and economic advances but also strictly authoritarian...

...The authoritarianism that quickly built an impressive industrial base also lent itself to disastrous social policies...

...In the arena of foreign policy, the results of authoritarianism were worse...

Critical Reading: Q42



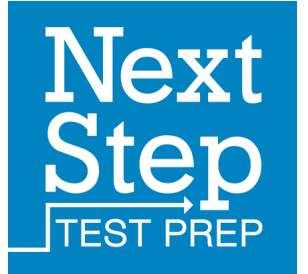
The passage suggests that the Empire's violent authoritarianism in foreign policy was:

- A. primarily due to Emperor Wilhelm.
- B. solely due to Chancellor Bismarck.
- C. crafted by Chancellor Bismarck and executed by Emperor Wilhelm.
- D. an outgrowth of a government philosophy that also led to worker support and control in domestic policy.

...It was a nation of impressive social, electoral, and economic advances but also strictly authoritarian, a tension that embodied much of the zeitgeist of the subsequent century...

In the arena of foreign policy, the results of authoritarianism were worse, a trend best revealed by the incident which led to Chancellor Bismarck's resignation. Near the end of 1889, a group of coal miners in the German region of Silesia went on strike. Bismarck's reaction was swift: he began mobilizing the Army to go in and crush the strike. Emperor Wilhelm, however, stopped him and sent an official to negotiate with a delegation from the miners. The strike ended without violence and Bismarck resigned months later. Wilhelm is reputed to have said, "I do not wish to stain my reign with the blood of my subjects." Yet such measured non-violence obviously did not stay the Emperor's hand in dealing with the Empire's colonies.

Critical Reading: Q43



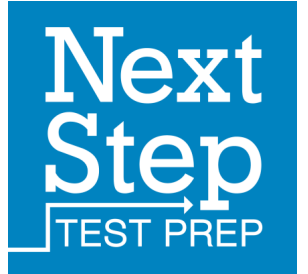
The author of this passage is most likely:

- Ⓐ a social conservative who favors limiting entitlement spending. *Author supports social welfare!*
- Ⓑ a historian discussing his area of expertise.
- Ⓒ a journalist who specializes in studying the after-effects of European colonialism. *Not related!*
- Ⓓ a Catholic scholar who examines the suppression of the Catholic faith around the world. *Not close enough to the main theme...*

The German Empire existed for only 47 years and yet did more to shape the nature of the 20th century than any other state in Europe (or possibly, the world). While most only remember WWI and the dissolution of the Second Reich, the German Empire should instead be remembered for its startling internal contrasts. It was a nation of impressive social, electoral, and economic advances but also strictly authoritarian, a tension that embodied much of the zeitgeist of the subsequent century.

Sure sounds like a historian!

Critical Reading: Q44

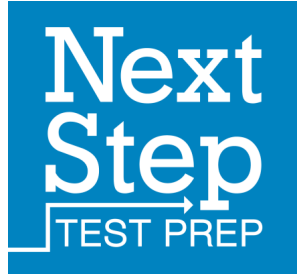


The passage suggests that Chancellor Bismarck's role in aggressive domestic policies like the kulturkampf and Germanization was:

- A. one of vigorous approval, with active support and direction.
- B. ignorance, as the Chancellor was only concerned with foreign policy.
- C. one of active disapproval, with the Chancellor using his political influence to oppose the Emperor.
- D. nonexistent, as Bismarck was not Chancellor of the German Empire during those two initiatives.

This growth was not without a significant dark side. The authoritarianism that quickly built an impressive industrial base also lent itself to disastrous social policies. Extending the vote to every adult male meant that suddenly, repressed minorities had a voice in the government. In response, Bismarck carried out two campaigns: the kulturkampf and Germanization. In the former, the Imperial government, over the course of a decade, imprisoned every single Catholic bishop and as many as 1/4 of parishes found themselves without a priest. Efforts were also made to get every single person in the Empire to speak German. Significant minorities spoke French, Polish, and Lithuanian and efforts to force such groups to adopt German backfired spectacularly. In one province, the percentage of German-speaking citizens actually dropped by over 10%.

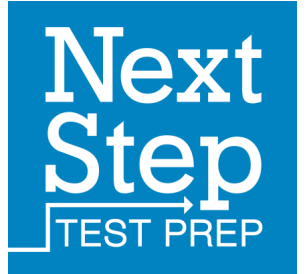
Quantitative Reasoning: Q10



If $f(x) = 3x(2x + 1)(x - 2)$, then what is the value of $f'(-1)$?

- A. 6
- B. 18
- C. 30
- D. 42

Quantitative Reasoning: Q11



What is the value of $\int_1^3 2x - 5 \, dx$?

- A. -18
- B. 6
- C. -2
- D. 28

Quantitative Reasoning: Q12

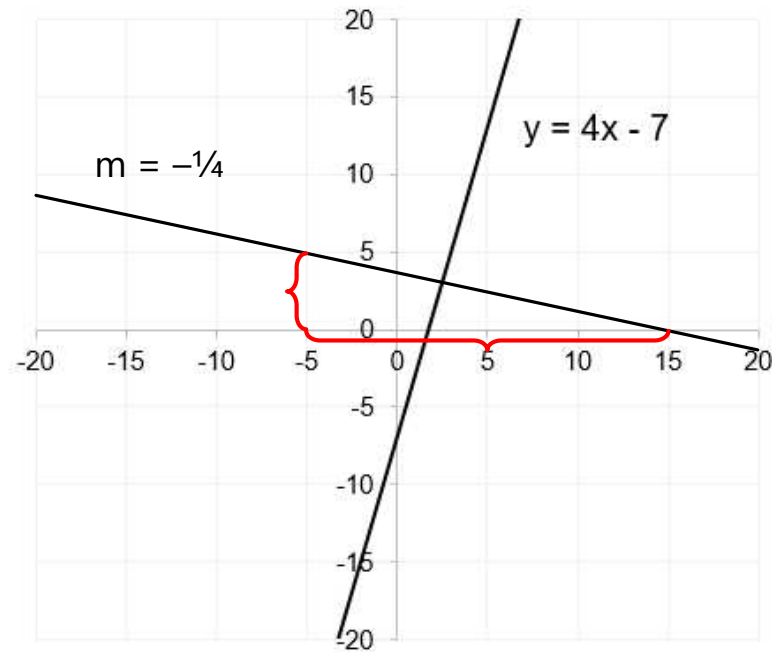
$$\frac{\frac{2}{3} + \frac{1}{4}}{\frac{11}{3}} =$$

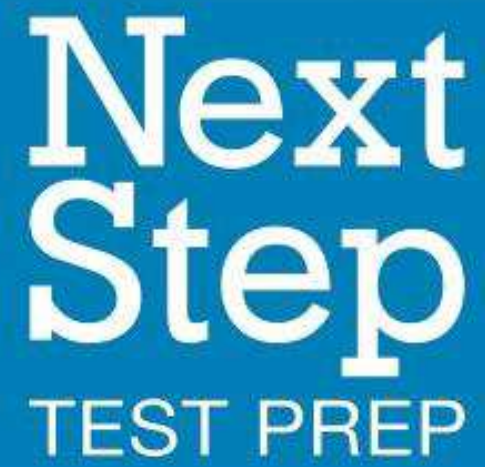
- A. $\frac{1}{4}$
- B. $\frac{16}{11}$
- C. $\frac{5}{12}$
- D. $\frac{36}{121}$

Quantitative Reasoning: Q12

Line A can be expressed as the equation $y = 4x - 7$. If line B is perpendicular to it, what is the slope of line B?

- A. 4
- B. -4
- C. $\frac{1}{4}$
- D. $-\frac{1}{4}$



The logo for 'Next Step TEST PREP' is centered in a blue square. The words 'Next' and 'Step' are stacked vertically in a large, white, sans-serif font. Below them, the words 'TEST PREP' are written in a smaller, white, all-caps, sans-serif font. The background of the slide is dark blue with a repeating pattern of small white plus signs. A white triangular shape points downwards from the top, framing the logo.

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The text 'Q&A' is centered on the slide in a bold, blue, sans-serif font. The background is white with blue geometric shapes in the corners.

Q&A

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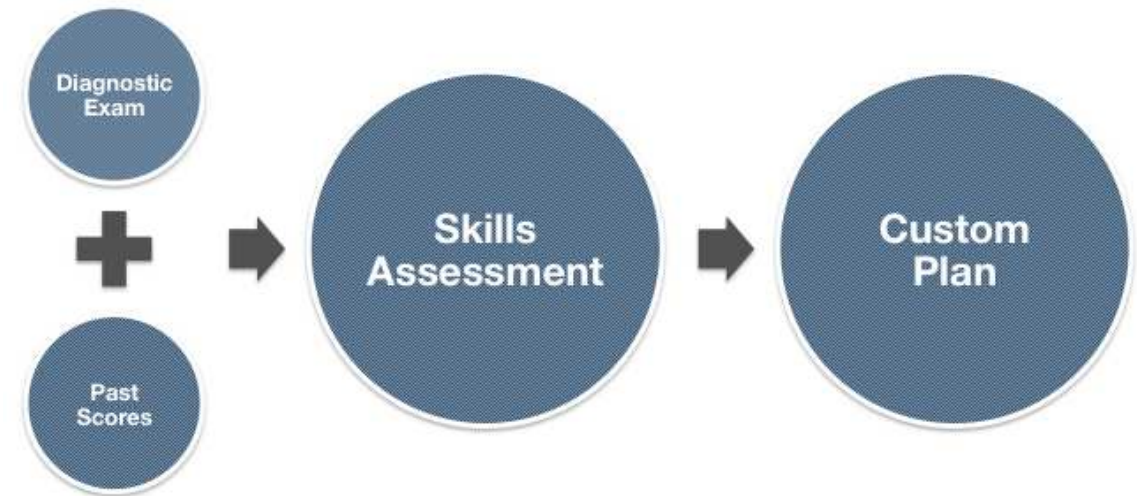
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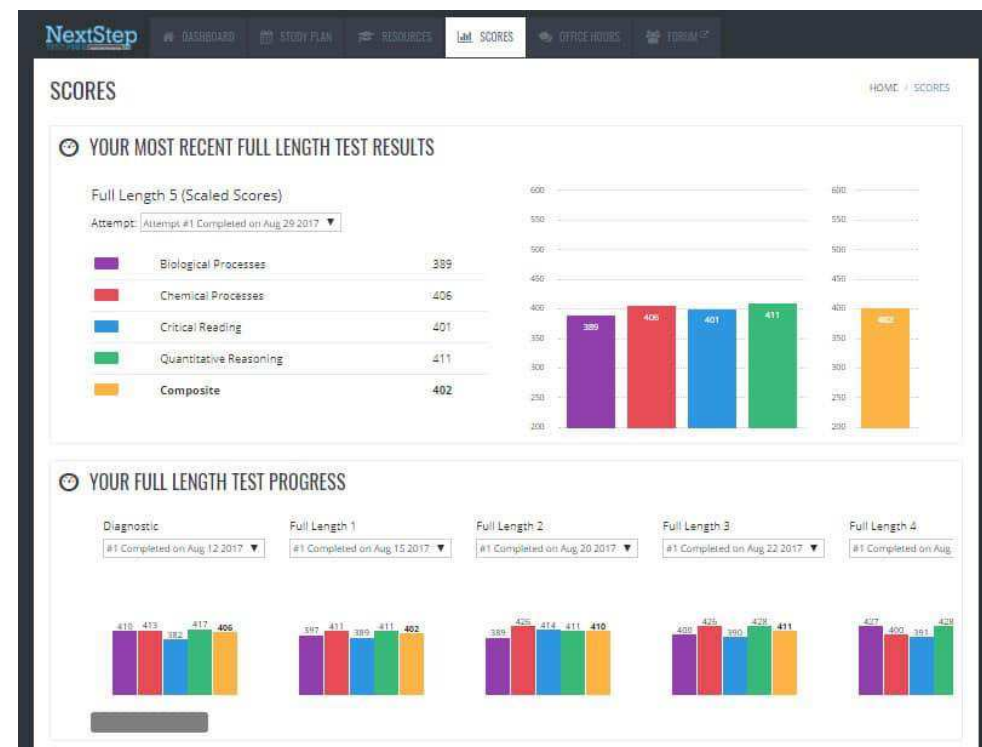


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