

2021 Academic Super Bowl

Senior Science

Final Study Guide

The American Woman:

A Century of Progress, 1920-2020



"YOU DON'T MAKE PROGRESS BY STANDING ON THE SIDELINES... YOU MAKE PROGRESS BY IMPLEMENTING IDEAS."

SHIRLEY CHISHOLM
FIRST AFRICAN AMERICAN WOMAN ELECTED TO CONGRESS

- I. Chemistry- 33% - American Chemists
- A. Bettye Washington Greene (emulsions and colloids)
1. Types/examples of colloids (aerosol, foam, emulsion, gel, sol)
 2. Differences between colloids, solutions, suspensions
(particle size, characteristics, Tyndall effect, examples)
 3. Biographical (education, employment, awards)
- B. Esther Conwell (semiconductors)
1. Terminology/Properties of conductors, insulators, semiconductors:
extrinsic, intrinsic, energy bands
 2. Electronic characteristics of semiconductors and doping materials
(particularly N and P types)
 3. PN junctions and diodes
 4. History of semiconducting industry: vacuum tubes, transistors, LED's, MOSFET's
 5. Calculation of energy/wavelength of light required to overcome the
band gap in a material using $E = hc/\lambda$ in kJ/mole
 6. Biographical (education, employment, awards)
- II. Physics - 33%
- A. Spectral Classification of Stars (Annie Jump Cannon)
1. Star Temperature Classification Method - O B A F G K M
 - a. O stars are hottest and blue while M stars are coolest and red
 - b. Ten subcategories are each letter with numerical suffix:
0 - 9 with 0 as hottest
 2. Luminosity (or Absolute Brightness or Absolute Magnitude)
 - a. Power per unit surface area is proportional to the temperature
raised to the 4th power
 - b. Stars are spheres, total surface is proportional to the radius of the sphere
squared
 - c. Luminosity is proportional Total Surface Area times Power per Area $L \propto R^2 T^4$
 3. Peak Wavelength is inversely proportional to the temperature of the star
- B. Nuclear Shell Theory (Maria Goeppert Mayer)
1. Nucleon Quantum Numbers:
 - a. Orbital Angular Momentum (0, 1, 2, 3, 4...) represented by s, p, d, f, g...
 - b. Spin-Orbit coupling represented by Orbital Angular Momentum +/- 1/2
 - c. There is no principal quantum number, just an integer associated with
the appearance of the orbital angular momentum quantum number. For
example: 1 g is a possible nucleon quantum number and spin orbit coupling would
show two levels for 1g as $1g_{7/2}$ and $1g_{9/2}$
 2. Nucleons are fermions obeying Pauli Exclusion Principle: no two nucleons may have the
same quantum numbers
 3. Filled shells are possible for protons (Z) or neutrons (N) or both as exclusion
principle requires
 4. Filled shells are associated with Magic Numbers: 2, 8, 20, 28, 50, 82, 126
 5. Isotopes with magic numbers of protons and neutrons are doubly magic
 6. Stable vs. Radioactive Isotopes: Magic number isotopes are most stable

III. Biology - 33%

- A. Barbara McClintock and the “Jumping Genes”*
 - 1. McClintock Science Biography
 - 2. “Jumping Genes:” Transposable Elements or Transposons

*Requires brief overview of DNA & chromosome structure & function

- B. Viruses
 - 1. General Features & Structures
 - 2. Classification of viruses
 - 3. Virus Life Cycles
 - 4. Selected Virus Families (with examples) Important to Humans:
Classification/Structure, Life Cycle, Importance
 - a. Adenoviridae (adenoviruses, “common cold”)
 - b. Coronaviridae (SARS-CoV-2 [cause of Covid-19], MERS, common cold)
 - c. Flaviviridae (yellow fever virus, Dengue virus, hepatitis C virus, Zika virus)
 - d. Orthomyoviridae (Influenza viruses)
 - e. Paramyoviridae (measles virus, mumps virus)
 - f. Phaginae (Bacteriophages that attack bacteria)
 - g. Picornaviridae (poliovirus, rhinovirus [common cold])
 - h. Poxviridae (smallpox virus, vaccinia virus)
 - i. Retroviridae (HIV)
 - 5. Vaccines: basic principles of making and using vaccines

IV . Earth & Environmental Sciences

- A. Rachel Carson and “Silent Spring”
 - 1. Carson Science Biography
 - 2. Main Points of “Silent Spring:” Carson’s premise, analysis, and predictions
 - 3. Impact of Carson’s work and writing in Environmental awareness and U.S. policy
- B. Energy & Nutrient Movement through ecosystems
- C. Bioaccumulation & Biomagnification in Ecosystems (with a concentration on use of pesticides in agriculture and in human health systems)

RESOURCES:

https://images.search.yahoo.com/yhs/search?p=emulsions&fr=yhs-iba-syn&hspart=iba&hsimp=yhs-syn&imgurl=https%3A%2F%2Fi.ytimg.com%2Fvi%2FbC_czAL24zY%2Fmaxresdefault.jpg#id=13&i-url=https%3A%2F%2Fi.ytimg.com%2Fvi%2FDnwC8t8aCAQ%2Fmaxresdefault.jpg&action=click

<https://www.differencebetween.com/difference-between-colloid-and-emulsion/>

https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_introduction.htm

typical text books for AP Chemistry or regular high school chemistry and physics texts.

references continued on next page....

Chemistry Resources: (used by question writer but not required for purchase, research can be done through any reputable website or high school/college textbooks)

Holt Physics ISBN-10: 9780030368165 / ISBN-13: 978-0030368165

Chemistry. Chang / Goldsby. ISBN: 978-0-07-802151-0

Chemistry & Chemical Reactivity. Kotz / Trechel / Townsend.

Student Edition: ISBN-13: 978-0-495-38703-9 / ISBN-10: 0-495-38703-7

Chemistry. Zumdahl (eighth ed.)

Student copy ISBN: 978-1-111-57734-6 ISBN-13: 978-0-547-16826-5 ISBN-10: 0-547-16826-8

Chemistry AP edition (13th ed). Brown / LeMary / Bursten

ISBN-13: 978-0-321-91011-7 ISBN-10: 0-321-91041-9

Chemistry. Silberberg. ISBN: 978-1-259-63175-7

Physics Resources: http://alevelphysicsnotes.com/astrophysics/black_body_rad.htmlPeak

http://spiff.rit.edu/classes/phys230/lectures/spec_interp/spec_interp.html

https://astro.unl.edu/naap/hr/hr_background1.html

Most introductory astronomy text books discuss all of these matters

References: <http://hyperphysics.phy-astr.gsu.edu/hbase/Nuclear/shell.html>

<http://hyperphysics.phy-astr.gsu.edu/hbase/Nuclear/nstate.html#c1>

<http://hyperphysics.phy-astr.gsu.edu/hbase/Nuclear/nucnot.html#c2>

<https://www.periodic-table.org/what-is-nuclear-shell-model-shell-model-of-nucleus-definition/>

Biology resources coming soon

2021 Outlines were developed by coaches who chose to share ideas at the 2019 Academic Coaches Conference, and through email, and further developed by question writers.

Only the TI-30XA and TI-30XIIS may be used during competitions.