

ANSWERS TO THE QUESTIONS OF CHEM 151 – MOLECULES THAT CHANGED THE WORLD

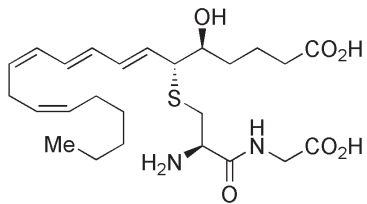
Prof. K. C. Nicolaou

Midterm Exam

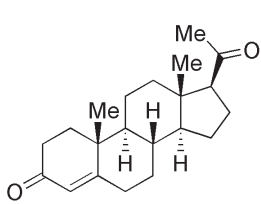
CHEM 151 – Molecules that Changed the World

February 5, 2009

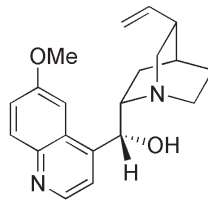
1. Match the following names with the appropriate molecular structure: adenine, penicillin G, glucose, sucrose, Aspirin®, Celebrex®, terpineol, tropinone, haemin, quinine, morphine, progesterone, strychnine, prostaglandin E₂, leukotriene D₄, prostacyclin, vitamin B₁₂, vitamin C, erythromycin A (40 points).



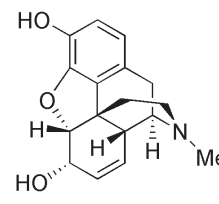
1. leukotriene D₄



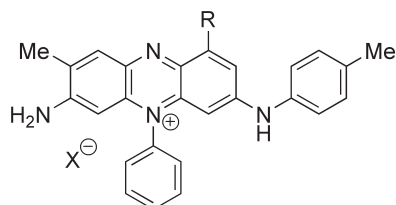
2. progesterone



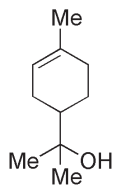
3. quinine



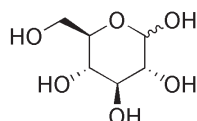
4. morphine



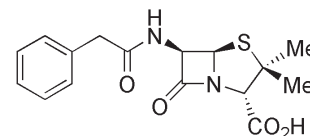
5. mauveine



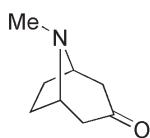
6. terpineol



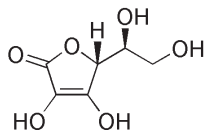
7. glucose



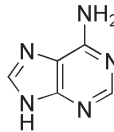
8. penicillin



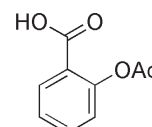
9. tropinone



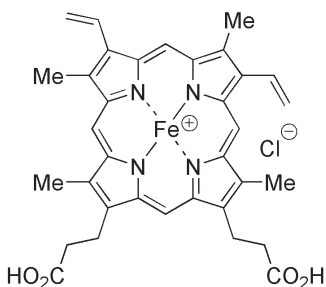
10. vitamin C



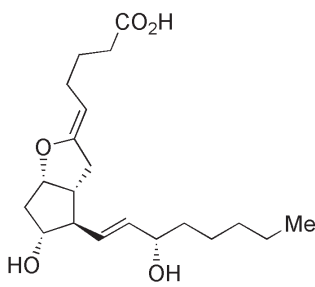
11. adenine



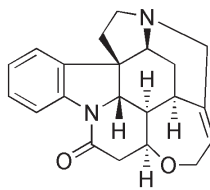
12. Aspirin®



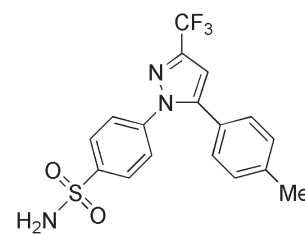
13. haemin



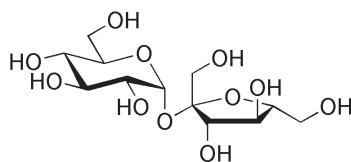
14. prostacyclin



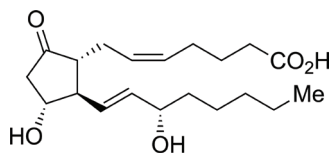
15. strychnine



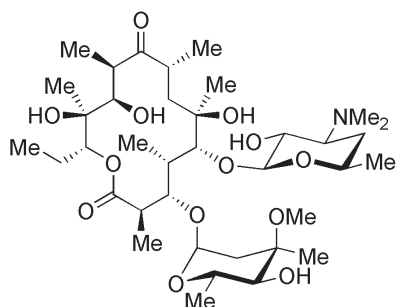
16. Celebrex®



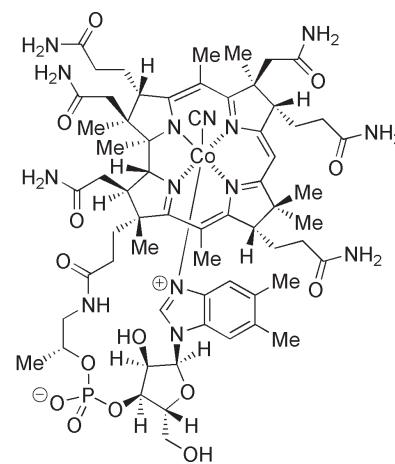
18. sucrose



19. prostaglandin E₂



17. erythromycin A



20. vitamin B₁₂

2. Match the following names with the appropriate discovery, achievement or theory shown below:
Demokritos, Friedrich Wöhler, R. B. Woodward, E. J. Corey, Emil Fischer, John C. Sheehan,
Sir Robert Robinson, William Henry Perkin, Sr., Alexander Fleming, Dorothy Crowfoot Hodgkin (20 points).

1. The discovery of the purple dye mauviene: William Henry Perkin, Sr.
2. The first total synthesis of glucose: Emil Fischer
3. The first total synthesis of urea: Friedrich Wöhler
4. The first total synthesis of penicillin G: John C. Sheehan
5. The Atomic Theory of matter: Demokritos
6. The concept of Retrosynthetic Analysis: E. J. Corey
7. The introduction of the arrow to describe reaction mechanisms: Sr. Robert Robinson
8. The discovery of penicillin: Alexander Fleming
9. The x-ray crystallographic analysis of penicillin and vitamin B₁₂: Dorothy Crowfoot Hodgkin
10. The first synthesis of quinine and strychnine: R. B. Woodward

3. Match each of the following molecules with their use, biological activity or medical indication: penicillin, morphine, haemin, quinine, prostacyclin, thromboxane, Aspirin[®], monensin, chlorophyll, leukotriene D₄ (20 points).

1. leukotriene D₄ Causes constrictions in the lungs, involved in asthmatic attacks.
2. haemin Responsible for carrying oxygen from the lungs to the cells.
3. chlorophyll Involved in photosynthesis in plants.
4. monensin Binds metal ions, serves as an antibiotic in agriculture.
5. prostacyclin Dilates blood vessels and prevents thrombosis.
6. thromboxane A₂ Constricts blood vessels and causes aggregation of platelets.
7. Aspirin[®] Mild analgesic, pain killer, anti-inflammatory.
8. quinine First medication against malaria.
9. penicillin First major antibiotic to treat bacterial infections.
10. morphine Powerful pain killer, hallucinogenic, narcotic.

4. Name 10 Nobel Prize winners in *Chemistry*, or in *Physiology or Medicine*, and describe in one sentence (20 words or less) the contribution for which they were awarded the prize (20 points).

Year	Laureate	Citation
1902	Emil Fischer	“in recognition of the extraordinary services he has rendered by his work on sugar and purine syntheses”
1930	Hans Fischer	“for his researches into the constitution of haemin and chlorophyll and especially for his synthesis of haemin”
1947	Sir Robert Robinson	“for his investigations on plant products of biological importance, especially the alkaloids”
1950	Otto Diels and Kurt Alder	“for their discovery and development of the diene synthesis”
1964	Dorothy Crowfoot Hodgkin	“for her determinations by X-ray techniques of the structures of important biochemical substances”
1965	Robert B. Woodward	“for his outstanding achievements in the art of organic synthesis”
1982	Bengt I. Samuelsson	“for their discoveries concerning prostaglandins and related biologically active substances”
1990	Elias J. Corey	“for his development of the theory and methodology of organic synthesis”
2008	Roger Y. Tsien	“for the discovery and development of the green fluorescent protein, GFP”

5. Write a short essay (150 words or less) on the discovery and impact of penicillin on medicine and society, mentioning its discoverers, structural features, synthesis, mechanism of action and medical indications (20 points).

Penicillin was discovered and developed by Fleming, Flory, and Chain, for which they won the Nobel Prize in Physiology or Medicine in 1945. It is the first major antibiotic to be discovered from nature. The penicillin molecule contains a β -lactam ring (4-membered) and works by inhibiting the biosynthesis of the bacterial cell wall. Its molecular structure was unambiguously confirmed by x-ray crystallographic analysis carried out by Dorothy Crowfoot Hodgkins in 1945, one year after General Dwight D. Eisenhower carried with him 3 millions dose of penicillin in anticipation of D-Day. Penicillin was synthesized in the laboratory for the first time by John Sheehan's group in 1957. Penicillin and its derivatives are used to treat bacterial infections. The discovery of penicillin had a major impact on science and medicine and benefited society enormously by saving lives and also inspiring the discovery of countless other biologically active natural products from microbial sources.