

Name: _____ Points: _____

Prof. K. C. Nicolaou

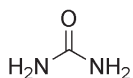
Midterm Exam

CHEM 151 - Molecules that Changed the World

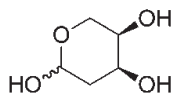
January 28, 2010

ANSWER ALL SIX [6] QUESTIONS

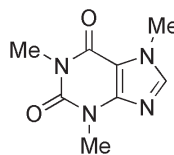
1. Match the following names of natural or synthetic molecules with their molecular structures: thymine, ribose, estrone, urea, caffeine, acetylsalicylic acid (Aspirin[®]), ibuprofen (e.g. Advil[®]), thromboxane A₂, arachidonic acid, camphor, cocaine, Tyrian purple, carminic acid, quinine, codeine, strychnine, leukotriene D₄, montelukast sodium (Singulair[®]), erythromycin B, monensin (40 points).



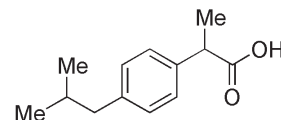
1. urea



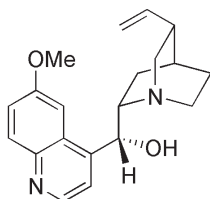
2. ribose



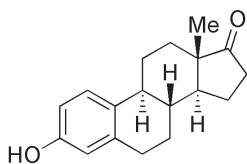
3. caffeine



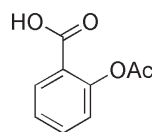
4. ibuprofen (e.g. Advil[®])



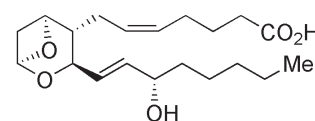
5. quinine



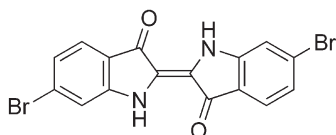
6. estrone



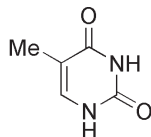
7. acetylsalicylic acid (Aspirin[®])



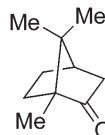
8. thromboxane A₂



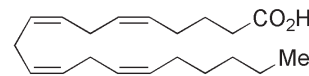
9. Tyrian purple



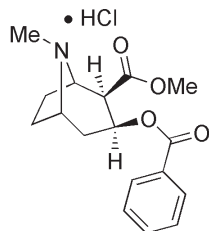
10. thymine



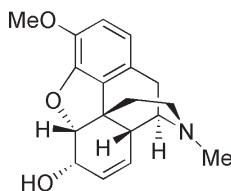
11. camphor



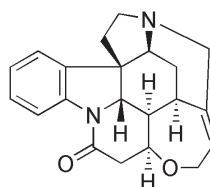
12. arachidonic acid



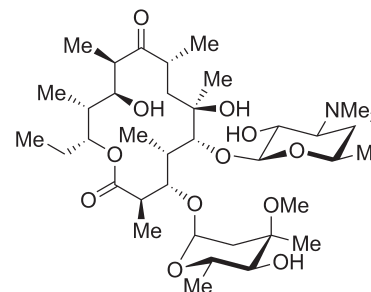
13. cocaine



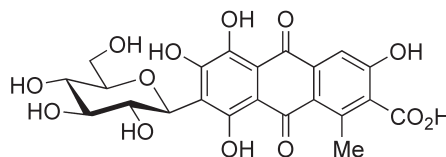
14. codeine



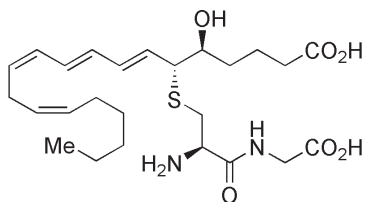
15. strychnine



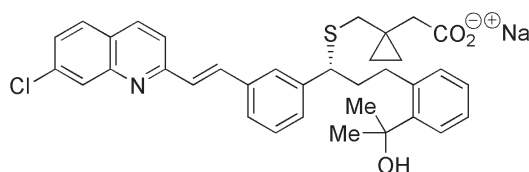
16. erythromycin B



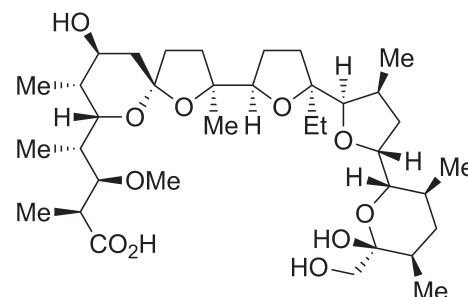
18. carminic acid



17. leukotriene D₄



19. montelukast sodium (Singulair[®])



20. monensin

2. Match the following names with the appropriate discovery or achievement: Hermann Kolbe, Felix Hoffmann, Henry Perkin, Jr., Carl Wilhelm Scheele, Marshall Gates, Marker E. Russell, Charles J. Pedersen, Selman A. Waksman, James Lind, Robert Woodward, Albert Eschenmoser (20 points).

1. The total synthesis of vitamin B₁₂: Robert Woodward and Albert Eschenmoser

2. The discovery of 18-crown-6: Charles J. Pedersen

3. The discovery of streptomycin, the first antibiotic effective against tuberculosis: Selman A. Waksman

4. The discovery of oxygen (O₂), chlorine (Cl₂), tungsten (W) and molybdenum (Mo): _____

Carl Wilhelm Scheele

5. The first total synthesis of morphine: Marshall Gates

6. The first total synthesis of acetic acid and salicylic acid: Hermann Kolbe

7. The chemical synthesis of progesterone from diosgenin (occurring in the Mexican yam): _____

Marker E. Russell

8. The discovery of Aspirin®: Felix Hoffmann

9. The first total synthesis of terpineol: Henry Perkin, Jr.

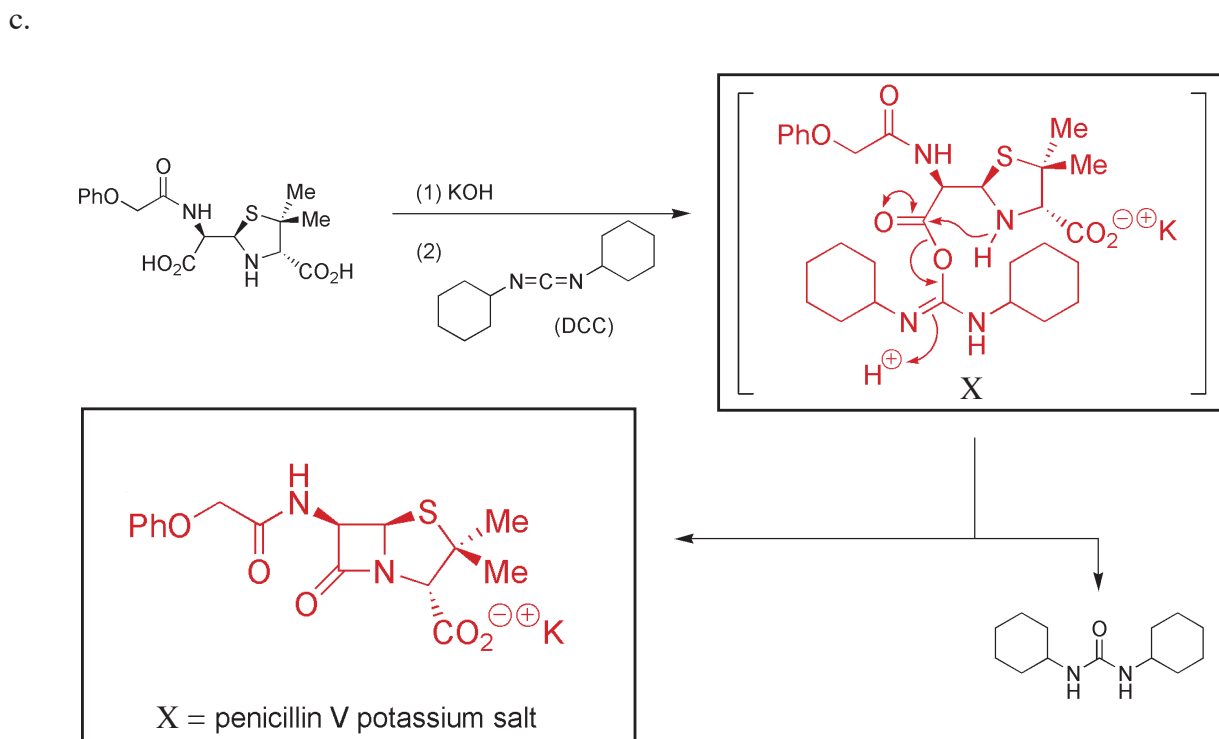
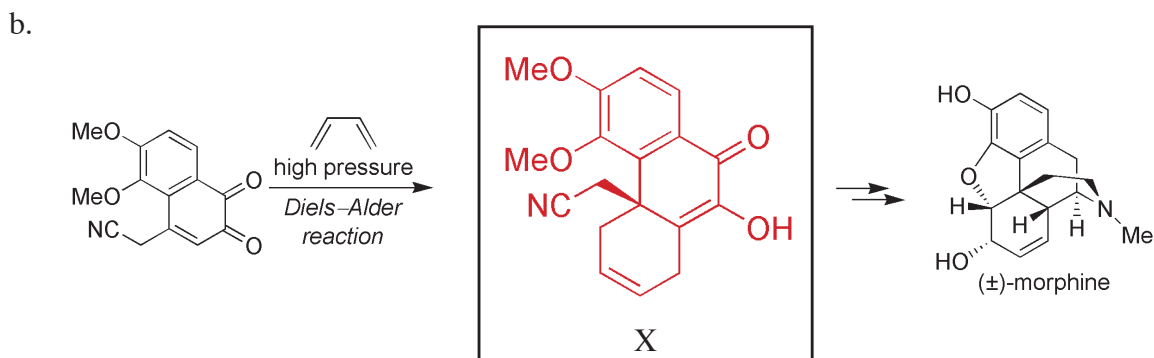
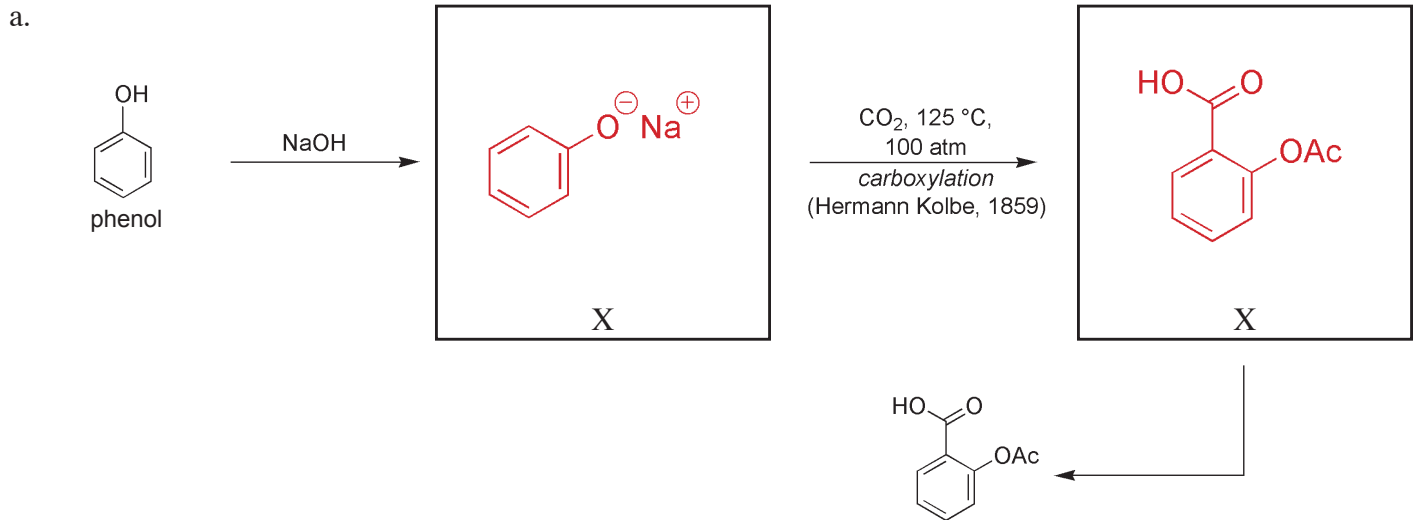
10. The discovery that oranges and lemons (vitamin C) heal the disease scurvey: _____

James Lind

3. Name the winner(s) of the Nobel Prize in Chemistry, or the Nobel Prize in Physiology or Medicine for the following discoveries or accomplishments (20 points).

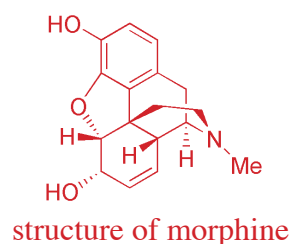
1.	Emil Fischer	“in recognition of the extraordinary services he has rendered by his work on sugar and purine syntheses”
2.	Adolf von Baeyer	“in recognition of his services in the advancement of organic chemistry and the chemical industry, through his work on organic dyes and hydroaromatic compounds”
3.	Victor Grignard	“for the discovery of the so-called Grignard reagent, which in recent years has greatly advanced the progress of organic chemistry”
4.	Adolf Windhaus	“for the services rendered through his research into the constitution of the sterols and their connection with the vitamins”
5.	Hans Fischer	“for his researches into the constitution of haemin and chlorophyll and especially for his synthesis of haemin”
6.	Alexander Fleming, Ernst B. Chain, Howard Florey	“for the discovery of penicillin and its curative effect in various infectious diseases”
7.	Sir Robert Robinson	“for his investigations on plant products of biological importance, especially the alkaloids”
8.	Otto Diels, Kurt Alder	“for their discovery and development of the diene synthesis”
9.	Robert B. Woodward	“for his outstanding achievements in the art of organic synthesis”
10.	Sune K. Bergström, Bengt I. Samuelsson, John R. Vane	“for their discoveries concerning prostaglandins and related biologically active substances”

4. Fill in the gaps [X] with structures in the following reactions (20 points).



5. Write a short essay (150 words or less) on morphine and its impact on medicine and society (history, discovery (name person), structure, good properties, bad properties, total synthesis (name person) (20 points).

Morphine is the main constituent of opium, the gummy residue obtained from the milky liquid extracted from the unripe seed head of the opium poppy. This bioactive extract has been used as a tonic and pain killer for millennia dating back to the ancient Sumerians, Egyptians, and Chinese, and subsequently the Greeks and the Romans, with recordings found in Ebers papyrus and the writings of Dioscorides. In the Middle Ages it was popularized by Paracelsus as laudanum and used both by commoners and aristocrats as a recreational substance. It was discovered by Wilhelm Adam Sertürner and first synthesized by Marshall Gates after its structural elucidation by Sir Robert Robinson. Morphine is a powerful painkiller and narcotic and today is clinically used to relieve severe pain, especially in patients dying from painful deadly ailments. It is a highly addictive substance and illegal in most countries; unfortunately however, it is still widely used as a drug of abuse, causing death and destruction to many people around the world. Its mechanism of action involves penetrating the blood-brain barrier and binding to the so-called opioid receptors, thereby leading to pain relief, euphoria, and hallucinations.



6. Write short notes (25 words or less) on the *medical indication* and *mechanism of action* of the following molecules (20 points).

erythromycin A

Antibiotic used clinically to combat bacterial infections. Works by binding to the ribosome of bacteria, inhibiting protein biosynthesis.

vitamin B₁₂

Essential vitamin promoting red blood production in the body. Used to treat anemia.

montelukast sodium
(Singulair®)

Used to treat asthma. Works as an antagonist of leukotriene D₄, thereby preventing the onset of asthmatic attacks.

penicillin

First natural antibiotic to be discovered and broadly employed to treat bacterial infections. Works by inhibiting transpeptidase in bacteria, leading to bacterial cell wall disruption.