

Part I. Question 1 to 10, you should choose the answer closest in meaning to the underlined word or phrase. **One answer only.** 2 points for each.

1. When they heard the good news about the court's decision, the angry crowd cheered and then began to disperse.
A. roar B. get upset C. get excited D. scatter E. gather
2. Because their fundamental difference, they would never get to like each other.
A. disparity B. contradictory C. hatred D. delinquency E. intensity
3. No one suspected that Jerry was a spy. On the surface he behaved like any normal citizen. When his covert activity was discovered and announced to the world, we were all shocked.
A. friendly B. helpful C. loud D. stimulating E. hidden
4. Michael is an ardent supporter of his presidential candidate. That became obvious to me when I found out how much time he's donated to the campaign.
A. old B. intelligent C. foolish D. very strong E. stubborn
5. Kathy was looking for a strong but light material to use for making her water jugs. Unfortunately, she chose noodelite. It proved too porous to hold jelly.
A. good for holding things B. protective C. permeable D. necessary E. luscious
6. Based on what is known, the term pulsar is used to describe the phenomenon of short, precisely timed radio bursts that are emitted from somewhere in space.
A. released B. jumped C. revolved D. received E. wandered
7. This replica fooled a lot of experts and was considered a valuable work of art.
A. a dishonest act B. something ugly C. anything that has no value D. a copy E. an evil act
8. The status quo of the country remains a debated issue among people.
A. future B. current situation C. crisis D. benefit E. changing situation
9. These results support the hypothesis that individuals are willing to pay more in order to live in communities that provide high-quality services.
A. angle B. experiment C. theory D. benefit E. evidence
10. The examiners soon realized that this student came to the oral defense for his thesis off the cuff.
A. on time B. in a hurry C. with careful observation D. enthusiastically E. without preparation

Part II. Question 11-15, please choose the answer that best completes the sentence. Question 16-25 you should choose the best answer to fill each of the numbered blanks in the passage. **One answer only.** 2 points for each.

11. They said they had their equipment _____ yesterday.
A. to be shipped B. shipped C. shipping D. ship E. was being shipped.
12. The ability to identify and exploit opportunities is the key _____ business product.
A. to B. of C. for D. toward E. in
13. _____ the size of urban populations in the world is the most urgent problem many countries face.
A. Rising B. Rise with C. The rise of D. Being Risen by E. Rise in
14. _____ incidents of Ebola virus outbreaks have been isolated incidents.
A. The most B. Mostly C. Most D. Most of E. The most of
15. _____ the difficulty and expense of working on an isolated island, construction took nearly a decade.
A. Due to B. Because C. Despite D. Although E. Regarding

Question 16-18

America's 78 million credit cardholders carried an average balance of \$7,564 last year. The cost 16 interest and fees amounted to more than \$1,000 for the typical budget. If you just said, "Budget - what budget?," you know what I mean. Truth is, most of us go on spending sprees from time to time.

But, when power shopping creates the illusion of success, even 17, it has become a weakness. Some obvious

signs that spending is out of control include making minimum payments on your credit cards, late fees, 18, lack of a budget and loss of sleep over money worries.

16. A. on B. in C. with D. by E. of
 17. A. with debts spiral out of control B. which debts spiraled out of control
 C. because debts spiraling out of control D. as debts spiral out of control
 E. when debts being spiral out of control
 18. A. bouncing checks B. bounce checks C. check bounces D. bounce of checks E. bounced checks

Question 19 to 22

Freeze-drying is a technique that can help to provide food for astronauts. But it also has other applications nearer home. Freeze-drying is like suspended animation for food; you can store a 19 for years, and then, when you're finally ready to eat it, you can completely revitalise it with a little hot water. Even after several years, the original foodstuff will be virtually unchanged.

The technique basically involves completely removing the water from some material, such as food, while 20. The main reason for doing this is either to preserve the food 21 reduce its weight. Removing the water from food keeps it from spoiling, because the microorganisms such as bacteria that cause spoiling cannot survive without it. Similarly, the enzymes which occur naturally in food cannot cause ripening without water, so 22 from food will also stop the ripening process.

19. A. freeze-dried meal B. freeze-drying meal C. meal with freeze dry
 D. meal in freeze drying E. frozen dry meal
 20. A. it leaves the rest of material virtually being intact B. leaving the rest of the material virtually intact
 C. leave the rest of the material virtually intact D. leave the rest of the material virtually being intact
 E. left the rest of the material virtually intact
 21. A. to B. but C. and to D. or to E. also to
 22. A. to remove water B. remove water C. have water removed
 D. that remove water E. removing water

Question 23 to 25

Dolphins are often the star attractions at zoos, aquariums and aquatic theme parks. They jump on command through fiery hoops and 23 other dolphins. They seem delighted to perform their tricks and side up to their human handlers, content with the applause of their audience, a pat on the head and a gift of some raw fish now and then 24. Dolphins have a darker side. Dolphins have an unusual ability: to plot with others, communicate plans and execute them effectively. This indicates intelligence and communicative skills beyond 25. Dolphins, porpoises and whales are often thought of as fish since they live in the water. However, they are aquatic mammals. They cannot live indefinitely under water and must come to the surface periodically for air. They have "blowholes" at the top of their skulls to exhale air, even under water. Their young are born alive and are suckled by the parents.

23. A. synchronized with B. in synchronization with C. synchronizing with
 D. having synchronization with E. that have synchronized
 24. A. However B. Therefore C. Consequently D. For example E. Comparatively
 25. A. that most other animals are possessing B. other animals possess C. possessed by other animals
 D. which other animals have possessed E. what most other animals possess

Part III. Reading Comprehension. In this part, you will read several passages. Each one is followed by one question or a number of questions about it (them). Question 26-40, you should choose the **ONE** best answer to each question. 2 points each.

the future will be able to learn from experience. They will be smart, strong, and untiring workers whose only goal will

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Turner almost wished that he hadn't listened to the radio. He went to the closet and grabbed his umbrella. He would feel silly carrying it to the bus stop on such a sunny morning.

18. We will be able to talk to these mechanical helpers and they will be able to respond in kind.
26. Which probably happened?
A. Turner realized that he had an unnatural fear of falling radio parts.
B. Turner had promised himself to do something silly that morning.
C. Turner had heard a weather forecast that predicted rain.
D. Turner planned to trade his umbrella for a bus ride.
E. Turner planned to take a taxi.

Someday we will all have robots that will be our personal servants. They will look and behave much like real humans. We will be able to talk to these mechanical helpers and they will be able to respond in kind. Amazingly, the robots of the future will be able to learn from experience. They will be smart, strong, and untiring workers whose only goal will be to make our lives easier.

27. Which sentence from the paragraph expresses the main idea?

- A. Someday we will all have robots that will be our personal servants.
B. We will be able to talk to these mechanical helpers and they will be able to respond in kind.
C. They will be smart, strong and untiring workers.
D. Amazingly, the robots of the future will be able to learn from experience.
E. They will look and behave much like real humans.

The success of fluoride in combating dental decay is well established and, without a doubt, socially beneficial. However, fluoride's toxic properties have been known for a century. In humans excessive intake (for adults, over 4 milligrams per day) over many years can lead to skeletal fluorosis, a well-defined skeletal disorder, and in some plant species, fluoride is more toxic than ozone, sulfur dioxide, or pesticides.

3. Some important questions remain. For example, the precise lower limit at which the fluoride content of bone becomes toxic is still undetermined. And while fluoride intake from water and air can be evaluated relatively easily, it is much harder to estimate how much a given population ingests from foodstuffs because of the wide variations in individual eating habits and in fluoride concentrations in foodstuffs. These difficulties suggest that we should be wary of indiscriminately using fluoride, even in the form of fluoride-containing dental products.

28. The passage suggests which of the following about the effect of fluoride on humans?

- A. The effect is more easily measured than is the effect of exposure to pesticides.
B. The effect of fluoride intake from water and air is relatively difficult to monitor.
C. In general the effect is not likely to be as harmful as the effect of exposure to sulfur dioxide.
D. An intake of 4 milligrams over a long period of time usually leads to a skeletal disorder in humans.
E. An intake of slightly more than 4 milligrams for only a few months is not likely to be life-threatening.

29. The paragraph following these passages is mostly likely about

- A. how to use fluoride carefully.
B. diseases caused by ingesting too much fluoride.
C. interesting results of experiment by some dental scientists.
D. an analysis of fluoride in its use in other industries.
E. scientific evidence provided by orthopedic specialists.

Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses. This ability to carry large amounts of current can be applied to electric power devices such as motors and generators, and to electricity transmission in power lines. For example, superconductors can carry as much as 100

times the amount of electricity of ordinary copper or aluminum wires of the same size.

Scientists had been intrigued with the concept of superconductivity since its discovery in the early 1900s, but the extreme low temperatures the phenomenon required was a barrier to practical and low-cost applications. This all changed in 1986, when a new class of ceramic superconductors was discovered that "superconducted" at higher temperatures. The science of high-temperature superconductivity (HTS) was born, and along with it came the prospect for an elegant technology that promises to "supercharge" the way energy is generated, delivered, and used.

30. In which of the following publication types would this article most likely appear in?

- A. A scholarly journal read by specialists and scientists who work directly with superconductivity
- B. A modern science magazine intended for leisure reading.
- C. A book chapter in an advanced chemistry textbook
- D. A magazine intended to be dispersed at home craft fair
- E. A trade show magazine which focuses on super-cooled refrigeration units

31. What is the barrier to superconductivity at the early stage of its discovery?

- A. high resistance
- B. technology that supercharge the way energy is used
- C. low-cost application
- D. its capacity to carry electricity
- E. low temperature

Those who criticize the United States government today for not providing health care to all citizens equate health care provision with medical insurance coverage. By this standard, seventeenth- and eighteenth-century America lacked any significant conception of public health law. However, despite the general paucity of bureaucratic organization in pre-industrial America, the vast extent of health regulation and provision stands out as remarkable.

Of course the public role in the protection and regulation of eighteenth-century health was carried out in ways quite different from those today. Organizations responsible for health regulation were less stable than modern bureaucracies, tending to appear in crises and wither away in periods of calm. The focus was on epidemics which were seen as unnatural and warranting a response, not to the many endemic and chronic conditions which were accepted as part and parcel of daily life. Additionally, religious influence was significant, especially in the seventeenth century. Finally, in an era which lacked sharp demarcations between private and governmental bodies, many public responsibilities were carried out by what we would now consider private associations. Nevertheless, the extent of public health regulation long before the dawn of the welfare state is remarkable and suggests that the founding generation's assumptions about the relationship between government and health were more complex than is commonly assumed.

32. Among the following statements about the United States government's role in the provision of health care, which finds the LEAST support in the passage?

- A. The government today addresses health concerns that formerly were not considered serious enough to warrant government involvement.
- B. What were once public health-care functions are now served by the private sector.
- C. Philosophical considerations play a less significant role today in the formulation of public health-care policies than in previous centuries.
- D. Public health care today is guided largely by secular rather than religious values.
- E. Modern public health-care agencies are typically established not as temporary measures but rather as permanent establishments.

33. Which of the following best expresses the author's point of contention with "those who criticize the United States government for not providing health care to all citizens" (lines 1)?

- A. Their standard for measuring such provision is too narrow.
- B. They underestimate the role that insurance plays in the provision of health care today.
- C. They fail to recognize that government plays a more significant role today in health care than in previous eras.
- D. They misunderstand the intent of the founding generation with respect to the proper role of the government in the

area of health care.

E. They lack any significant conception of public health law.

34. Which of the following best expresses the main point of the passage?

A. The government's role in health care has not expanded over time to the extent that many critics have asserted.

B. The government should limit its involvement in health care to epidemiological problems.

C. Health problems plaguing pre-industrial America resulted largely from inadequate public health care.

D. History suggests that the United States government has properly played a significant role in provision of health care.

E. Private insurance is an inadequate solution to the problem of health care.

Graffiti is a general term for wall writing, perhaps humankind's earliest art form. The crude wall writings of prehistoric times and the highly stylized street art of today's inner-city youths share one common feature: Each stems from a basic human need to communicate with others. For youths who may not be able to express themselves through other media, such as prose or music, graffiti represents an easily accessible and effective way to communicate with a large audience. Anyone can obtain a can of spray paint and "make their mark" on a highway overpass or the side of a building.

Modern graffiti generally falls into one of three categories—junk graffiti, gang graffiti, and tagging. Junk graffiti messages are not gang-related but often involve obscene, racist, or threatening themes. The line separating gang graffiti and tagging to more threatening gang activities, is now considered an entry level offense that can lead to more serious crimes, including burglary and assault.

35. According to these two passages, what is the common feature of Graffiti?

A. To threaten others B. To make their mark C. To communicate with others as a human need

D. To vandalize the landscape E. To challenge the public

36. Paragraphs following these passages are most like about

A. detailed description of three categories of graffiti.

B. how to punish those who make graffiti.

C. why youths need to express themselves through such an urban crime.

D. other ways to communicate with people through other art forms.

E. the development of earlier graffiti.

Most cultures set an age at which its young people become adults in the eyes of the law. This age is called the age of majority. When people reach this age, usually 18, they become entitled to certain inalienable rights from which they were precluded as minors, such as the right to vote. Before becoming adults, minors are not able to enter into legal contracts. This is seen as being for their own protection. They are also protected from statutory rape, from being exploited in the labor market, and from having to go through the same penal system as adults.

37. Which of the following would be an example of a protection specifically to minors?

A. The right to vote B. The right to a fair trial C. Child labor laws

D. Separate penal system E. Legal contracts

38. Which of the following would be an example of a right denied to minors?

A. The right to vote B. The right to a fair trial C. Child labor laws

D. Separate penal system E. Going to court

39. The word "statutory" in the passage is closest in meaning to

A. part of a statue B. punishable under the law C. said or stated D. serious E. casual

40. In which of the following publication types would this article most likely appear in?
- A. A scholarly journal read by sociologists. B. A modern magazine intended for leisure reading.
C. A book chapter in a textbook about law and life D. A newsletter intended to be dispersed at court
E. A scholarly journal read by lawyers.

Part IV. Essay. 20 points.

The world's climate scientists recently reported unequivocally that the Earth's climate system is increasingly heating up and that it likely has not been this warm for at least 1300 years. We all must begin reducing global warming, and fortunately there is much to do. **Please write an essay in about 150 words about how you can help to reduce global warming.**

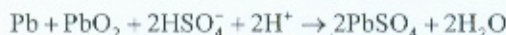
1. Define the following words:
 (a) elementary reaction, (b) rate of conversion, (c) composite reaction, (d) Michaelis constant and (e) pseudo first order. (10%)
2. The rate constant $k_{HI} = 80.2 \text{ dm}^3/\text{mol min}$ for $H_2 + I_2 \rightarrow 2HI$; what will be the value of k_{HI_2} (10%)
3. What are the concentration changes with time for a competing reaction?
 $A \longrightarrow F$; $A \longrightarrow G$ (10%)
4. Explain the importance of (a) Compression factor Z; (b) Law of corresponding state. (10%)
5. Explain why the phase rule is written as $f = c_{ind} - p + 2$? (10%)
6. For the gas-phase reaction,
 $I_2 + \text{cyclopentene} \rightleftharpoons \text{cyclopentadiene} + 2HI$ (10%)
 measured K_p° values in the range 450 to 700 K are fitted by
 $\log K_p^\circ = 7.55 - (4.83 \times 10^3) (K/T)$, Calculate ΔH° , ΔG° , ΔS° , ΔC_p° at 510 K for this reaction. Assume all are ideal gases
7. Please prove $(\frac{\partial H}{\partial P})_T = V - T(\frac{\partial V}{\partial T})_P$ if temperature is a constant (10%)
8. Please describe the Joule experiment and what is the purpose of this experiment? (10%)
9. Find $\Delta_{mix}G$, $\Delta_{mix}V$, $\Delta_{mix}S$ and $\Delta_{mix}H$ for mixing 150 g of benzene with 100 g of toluene at 20°C and 1 atm. Assume an ideal solution. (10%)
10. Please define the following words: (10%)
 - a. Colligative properties
 - b. Excess Gibbs energy
 - c. Convention II activity coefficient
 - d. Reverse osmosis
 - e. Azeotrope

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第一部份：單選題 (50%)

- Consider the numbers 23.68 and 4.12. The sum of these numbers has ____ significant figures, and the product of these numbers has ____ significant figures.
A) 3, 3 B) 4, 4 C) 3, 4 D) 4, 3 E) none of these
- When $\text{NH}_3(\text{aq})$ is added to $\text{Cu}^{2+}(\text{aq})$, a precipitate initially forms. Its formula is:
A) $\text{Cu}(\text{NH}_3)$ B) $\text{Cu}(\text{NO}_3)_2$ C) $\text{Cu}(\text{OH})_2$ D) $\text{Cu}(\text{NH}_3)_4$ E) CuO
- Which of the following salts is insoluble in water?
A) Na_2S B) K_3PO_4 C) $\text{Pb}(\text{NO}_3)_2$ D) CaCl_2
E) All of these are soluble in water.
- You have exposed electrodes of a light bulb in a solution of H_2SO_4 such that the light bulb is on. You add a dilute solution and the bulb grows dim. Which of the following could be in the solution?
A) $\text{Ba}(\text{OH})_2$ B) NaNO_3 C) K_2SO_4 D) $\text{Ca}(\text{NO}_3)_2$ E) none of these
- You have two salts, AgX and AgY , with very similar K_{sp} values. You know that K_a for HX is much greater than K_a for HY . Which salt is more soluble in acidic solution?
A) AgX B) AgY C) They are equally soluble in acidic solution.
D) Cannot be determined by the information given. E) None of these
- On a new temperature scale ($^{\circ}\text{Z}$), water boils at 120.0°Z and freezes at 40.0°Z . Calculate the normal human body temperature using this temperature scale. On the Celsius scale, normal human body temperature could typically be 37.5°C , and water boils at 100.0°C and freezes at 0.00°C .
A) 3000°Z B) 12.5°Z C) 70.0°Z D) 113°Z E) 30.0°Z
- How many moles of $\text{Fe}(\text{OH})_2$ [$K_{sp} = 1.8 \times 10^{-15}$] will dissolve in 1.0 liter of water buffered at $\text{pH} = 12.93$?
A) 2.5×10^{-13} B) 8.5×10^{-2} C) 7.2×10^{-3} D) 4.0×10^{12} E) 2.1×10^{-14}
- Given the following reaction in acidic media:
$$\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Fe}^{3+} + \text{Cr}^{3+}$$

The coefficient for water in the balanced reaction is
A) 1. B) 3 C) 5. D) 7. E) none of these
- If a reducing agent M reacts with an oxidizing agent N^+ to give M^+ and N , and the equilibrium constant for the reaction is 2.0, then what is the E° value for the oxidation-reduction reaction at 25°C ? ($R=8.3145\text{JK}^{-1}\text{mol}^{-1}$, $F=96485\text{C/mol}$, $\text{Hint: } \Delta G = \Delta G^{\circ} + RT \ln Q$)
A) $1.8 \times 10^{-2}\text{V}$ B) $-1.8 \times 10^{-2}\text{V}$ C) $8.9 \times 10^{-3}\text{V}$ D) $-8.9 \times 10^{-3}\text{V}$ E) $3.6 \times 10^{-2}\text{V}$
- A common car battery consists of six identical cells each of which carries out the reaction



Suppose that in starting a car on a cold morning a current of 125 amperes is drawn for 13.0 seconds from a cell of the type described above. How many grams of Pb would be consumed? (The atomic weight of Pb is 207.19.)

- A) 3.49 B) 1.74 C) 1.03×10^{-2} D) 1.12×10^{-4} E) 8.42×10^{-3}

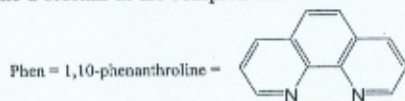
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1. Proteins at the *E. Coli* replication fork
2. Lac operon
3. (A) Fischer and Haworth projection of glucose
(B) Epimer and anomer of glucose
4. Cloning of DNA from organism
5. Phospholipids and glycolipids
6. Protein sequencing strategies
7. The adenylyl cyclase signaling pathway
8. Post-transcriptional modification of RNA
9. International classification of enzymes
10. Glycolysis and gluconeogenesis

- Compounds of Sc^{3+} are not colored, but those of Ti^{3+} and V^{3+} are. Why? (10%)
- The complex ion $\text{Ru}(\text{phen})_3^{2+}$ has been used as a probe for the structure of DNA. (phen is a bidentate ligand.) (10%)

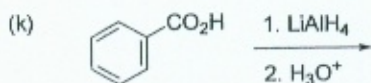
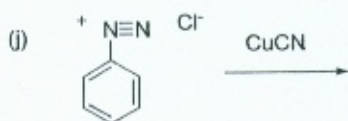
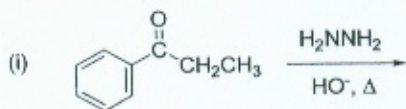
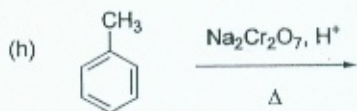
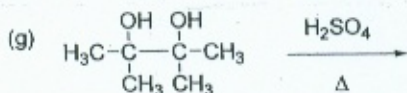
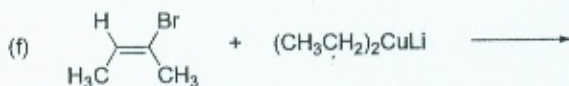
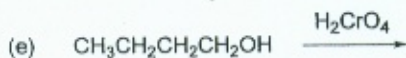
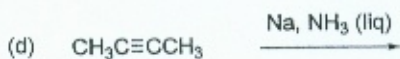
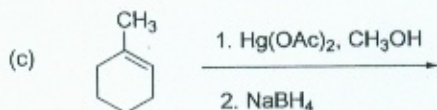
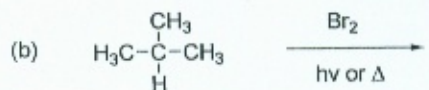
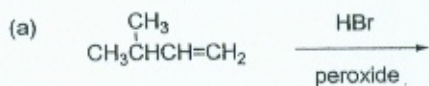
- What type of isomerism is found in $\text{Ru}(\text{phen})_3^{2+}$?
- $\text{Ru}(\text{phen})_3^{2+}$ is diamagnetic (as are all complex ions of Ru^{2+}). Draw the crystal field diagram for the d orbitals in the complex ion.

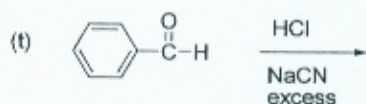
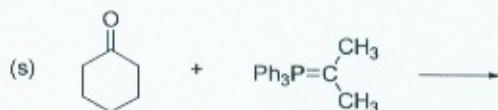
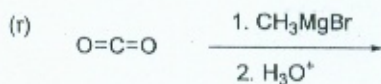
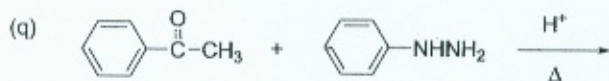
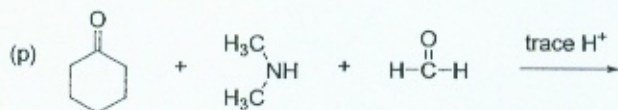
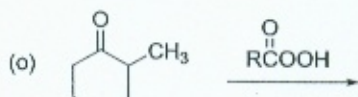
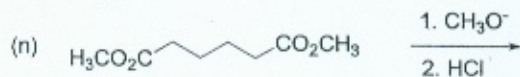
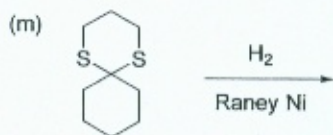
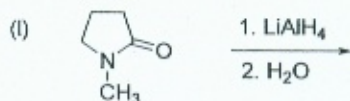


- Consider the complex ions $\text{Co}(\text{NH}_3)_6^{3+}$, $\text{Co}(\text{CN})_6^{3-}$, and CoF_6^{3-} . The wavelengths of absorbed electromagnetic radiation for these compounds are (in no specific order) 770 nm, 440 nm, and 290 nm. Match the complex ion to the wavelength of absorbed electromagnetic radiation. (10%)
- Which of the following ligands are capable of linkage isomerism? Explain your answer. SCN^- , N_3^- , NO_2^- , $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$, OCN^- , I^- (10%)
- Brief describe each of the following terms: (10%)
 - entatic state
 - three center two electron bond
 - CO dehydrogenases
 - Nitrogenases
 - Agostic interaction
- For each of the following metal and ligand combinations. Formulate the simplest neutral compound that conforms to the 18-electron rule. Draw a reasonable structure for each compound. (10%)
 - Fe, CO, COT = cyclooctatetraene
 - Re, CO, H
 - Cp, Co, NO
 - Mo, Cp, CO
 - Ni, Cp, NO

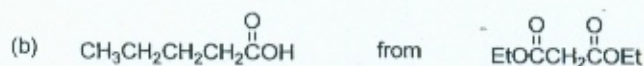
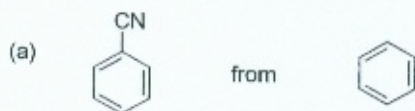
7. Which of the two complexes has the lower energy CO stretching frequency in the infrared spectrum? Rationalize your choice. (10%)
- $\text{Fe}(\text{CO})_5$ or $\text{Fe}(\text{CO})_4\text{Br}_2$
 - $\text{Mo}(\text{CO})_4(\text{PMe}_3)_2$ or $\text{Mo}(\text{CO})_4(\text{PPh}_3)_2$
8. The complex $(\text{PPh}_3)_3\text{Rh}-\text{CH}_3$ is cleaved by D_2 into $(\text{PPh}_3)_2\text{Rh}(\text{D})(\text{PPh}_2(\text{C}_6\text{H}_4\text{D}))$ and CH_4 . Suggest a mechanism for this reaction. (10%)
9. Which has broader applications in terms of definitions of acids and bases, the Arrhenius-Ostwald or the Brønsted-Lowry definitions? Please explain your answers. (10%)
10. Show how two 2p atomic orbitals can combine to form a σ and a π MO. (5%)
11. What type of experiment can be done to determine whether a material is paramagnetic? (5%)

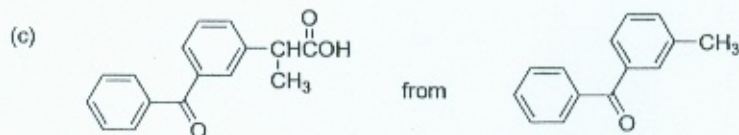
(60%) 1. Give the major product of each of the following reactions.



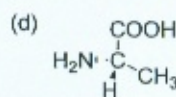
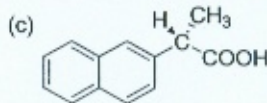
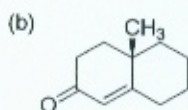
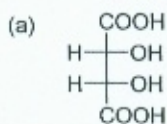


(15%) 2. How would you synthesize each of the following compounds from the given starting material?

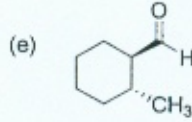
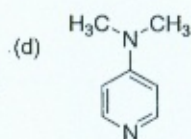
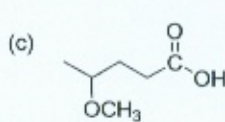
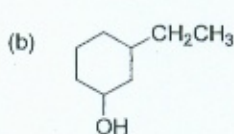
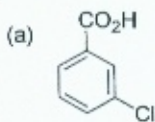




(10%) 3. Assign an *R* or *S* configuration to each asymmetric carbon of the following compounds.



(10%) 4. Give the systematic name for each of the following compounds.



(5%) 5. Propose a reasonable mechanism for the following reactions.

