

國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：普通生物學【海資系碩士班甲組】

題號：452003

※本科目依簡章規定「不可以」使用計算機(選擇題)

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單選題 (50 題，每題 2 分，共 100 分)

- 1) Which of the following statements is FALSE? Saturated fats _____.
(A) contain more hydrogen than unsaturated fats that consist of the same number of carbon atoms
(B) have many double bonds in the carbon chains of their fatty acids
(C) are more common in animals than in plants
(D) usually solidify at room temperature
- 2) Plasmodesmata in plant cells are most similar in function to which of the following structures in animal cells?
(A) gap junctions (B) tight junctions (C) extracellular matrix (D) desmosomes
- 3) The extracellular matrix is thought to participate in the regulation of animal cell behavior by communicating information from the outside to the inside of the cell via which of the following?
(A) gap junctions (B) integrins (C) DNA and RNA (D) the nucleus
- 4) Researchers tried to explain how vesicular transport occurs in cells by attempting to assemble the transport components. They set up microtubular tracks along which vesicles could be transported, and they added vesicles and ATP (because they knew the transport process requires energy). Yet, when they put everything together, there was no movement or transport of vesicles. What were they missing?
(A) motor proteins (B) contractile microfilaments (C) endoplasmic reticulum (D) an axon
- 5) Transcription factors _____.
(A) regulate the synthesis of lipids in the cytoplasm
(B) regulate the synthesis of DNA in response to a signal
(C) control gene expression
(D) transcribe ATP into cAMP
- 6) Which of the following is a correct association?
(A) GTPase activity and hydrolysis of GTP to GDP
(B) adenylyl cyclase activity and the conversion of cAMP to AMP
(C) kinase activity and the addition of a tyrosine
(D) phosphodiesterase activity and the removal of phosphate groups
- 7) What is the final result of mitosis in a human?
(A) genetically identical 1n somatic cells (B) genetically different 2n somatic cells
(C) genetically identical 2n gamete cells (D) genetically identical 2n somatic cells
- 8) Which of the following can occur by the process of meiosis but not mitosis?
(A) Haploid cells multiply into more haploid cells.
(B) Diploid cells form haploid cells.
(C) A diploid cell combines with a haploid cell.
(D) Haploid cells fuse to form diploid cells.
- 9) Homologous pairs of chromosomes align opposite of each other at the equator of a cell during _____.
(A) meiosis telophase II (B) meiosis metaphase II (C) mitosis metaphase (D) meiosis metaphase I

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- 10) Quaking aspen can send out underground stems for asexual reproduction. Sexual reproduction is not as common, but when it does happen, the haploid gametes have 19 chromosomes. How many chromosomes are in the cells of the underground stems?
(A) 38 (B) 19 (C) 9 (D) 10
- 11) In some parts of Africa, the frequency of heterozygosity for the sickle-cell anemia allele is unusually high, presumably because this reduces the frequency of malaria. Such a relationship is related to which of the following?
(A) Darwin's explanation of natural selection (B) the malarial parasite changing the allele
(C) Mendel's law of independent assortment (D) Mendel's law of segregation
- 12) There is still some controversy among biologists about whether Neanderthals should be placed within the same species as modern humans or into a separate species of their own. Most DNA sequence data analyzed so far indicate that there was probably little or no gene flow between Neanderthals and *Homo sapiens*. Which species concept is most applicable in this example?
(A) biological (B) ecological (C) phylogenetic (D) morphological
- 13) Environmental influences appear to contribute to cellular mutations that lead to tumor growth. For example, certain diets lead to higher incidence of colon cancers, and overexposure to sunlight leads to higher incidence of skin cancers. The tissues in closest contact with a carcinogen or mutagen (anything that causes genetic mutations) are obviously the ones most likely to develop tumors. Carcinomas and melanomas account for well over half of all cancers. What type of tissue would you guess the term *carcinoma* and *melanoma* is most closely associated with?
(A) epithelial (B) muscle (C) nervous (D) connective
- 14) Cardiac muscle cells are both _____.
(A) striated and under voluntary control (B) striated and interconnected by intercalated disks
(C) smooth and under voluntary control (D) smooth and under involuntary control
- 15) In response to stress, the adrenal gland promotes the synthesis of glucose from non-carbohydrate substrates via the action of the steroid hormone _____.
(A) thyroxine (B) glucagon (C) cortisol (D) adrenocorticotrophic hormone (ACTH)
- 16) The reason that the steroid hormone aldosterone affects only a small number of cells in the body is that _____.
(A) only its target cells get exposed to aldosterone
(B) only its target cells contain aldosterone receptors
(C) nontarget cells destroy aldosterone before it can produce any effect
(D) it is unable to enter nontarget cells
- 17) A significant contribution of intestinal bacteria to human nutrition is the benefit of bacterial _____.
(A) absorption of organic materials (B) production of vitamins A and C
(C) production of vitamin K (D) recovery of water from fecal matter
- 18) You are most likely to observe coprophagy in _____.
(A) herbivores (B) suspension feeders (C) carnivores (D) fluid feeders
- 19) Among the following choices, which organism likely has the highest systolic pressure?
(A) giraffe (B) mouse (C) hippopotamus (D) human

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- 20) A patient with a blood pressure of 120/75, a pulse rate of 70 beats/minute, a stroke volume of 70 mL/beat (milliliters per beat), and a respiratory rate of 25 breaths/minute will have a cardiac output of _____.
(A) 2,800 mL/minute (B) 1,750 mL/minute (C) 4,900 mL/minute (D) 1,000 mL/minute
- 21) Processing of filtrate in the proximal and distal tubules _____.
(A) achieves the conversion of toxic ammonia to less toxic urea
(B) reabsorbs urea to maintain osmotic balance
(C) regulates the speed of blood flow through the nephrons
(D) maintains homeostasis of pH in body fluids
- 22) Terrestrial organisms lose water through evaporation. In what ecosystem might an entomologist find a good study organism to examine the prevention of water loss?
(A) prairie (B) chaparral (C) wet rain forest (D) desert
- 23) At the time of fertilization, the maturation of the human oogonium has resulted in _____.
(A) four secondary oocytes (B) two primary oocytes
(C) one secondary oocyte (D) four zygotes
- 24) The outer-to-inner sequence of tissue layers in a post-gastrulation vertebrate embryo is _____.
(A) ectoderm → endoderm → mesoderm (B) mesoderm → endoderm → ectoderm
(C) ectoderm → mesoderm → endoderm (D) endoderm → ectoderm → mesoderm
- 25) Vaccination increases the number of _____.
(A) major histocompatibility (MHC) molecules that can present an antigen
(B) epitopes that the immune system can recognize
(C) lymphocytes with receptors that can bind to the pathogen
(D) macrophages specific for a pathogen
- 26) Short-term and long-term memory are related but have important differences. Short-term memory _____.
(A) is essential for acquiring new long-term memories but not for maintaining them
(B) involves temporary links formed in the cerebral cortex while long-term memory involves permanent connections within the hippocampus
(C) and long-term memory store information in the cerebellum but use different neurotransmitters
(D) is essential for acquiring and retaining long-term memories
- 27) What component of amino acid structure varies among different amino acids?
(A) the presence of a central C atom
(B) the components of the R-group
(C) the glycerol molecule that forms the backbone of the amino acid
(D) the long carbon-hydrogen tails of the molecule
- 28) What is the function of the nuclear pore complex found in eukaryotes?
(A) It selectively transports molecules out of the nucleus, but prevents all inbound molecules from entering the nucleus.
(B) It regulates the movement of proteins and RNAs into and out of the nucleus.
(C) It synthesizes the proteins required to copy DNA and make mRNA.
(D) It assembles ribosomes from raw materials that are synthesized in the nucleus.

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- 29) Which observation suggested to Sutherland the involvement of a second messenger in epinephrine's effect on liver cells?
(A) Glycogen breakdown was observed only when epinephrine was administered to intact cells.
(B) Epinephrine was known to have different effects on different types of cells.
(C) Receptor studies indicated that epinephrine was a ligand.
(D) Glycogen breakdown was observed when epinephrine and glycogen phosphorylase were combined.
- 30) Which of the following triggers the cell's passage past the G2 checkpoint into mitosis?
(A) Cdk (B) cyclin (C) MPF (D) PDGF
- 31) Somatic cells of roundworms have four individual chromosomes per cell. How many chromosomes would you expect to find in an ovum from a roundworm?
(A) eight (B) a diploid number (C) four (D) two
- 32) One of two major forms of a human condition called neurofibromatosis (NF 1) is inherited as a dominant gene, although it may range from mildly to very severely expressed. Which of the following is the best explanation for why a young, affected child is the first in her family to be diagnosed?
(A) One of the parents has a mild expression of the gene.
(B) The condition skipped a generation in the family.
(C) The child has one more chromosome than either of the parents.
(D) The mother carries the gene but does not express it.
- 33) Many songbirds breed in North America in the spring and summer and then migrate to Central and South America in the fall. They spend the winter in these warmer areas, where they feed and prepare for the spring migration north and another breeding season. Two hypothetical species of sparrow, A and B, overwinter together in mixed flocks in Costa Rica. In spring, species A goes to the east coast of North America, and species B goes to the west coast. What can you say about the isolating mechanisms of these two species?
(A) Reinforcement must be occurring when they winter together.
(B) They must have strong prezygotic isolating mechanisms to spend winter in such close proximity.
(C) Their winter habitat has no bearing on their degree of reproductive isolation.
(D) They must have strong postzygotic isolating mechanisms to spend winter in such close proximity.
- 34) Which of the following animals most likely uses the largest percentage of its energy budget for homeostatic regulation?
(A) a shark swimming in the open ocean (B) a snake in a tropical forest
(C) a bird living year round in a desert (D) a marine jelly (an invertebrate) living deep in the ocean
- 35) Insect hormones and their receptors _____.
(A) are a focus in pest control research (B) utilize cell-surface receptors only
(C) are active independently of environmental cues (D) act independently of each other
- 36) When a woman has her gallbladder removed, she should probably reduce her consumption of _____.
(A) proteins (B) carbohydrates (C) proteins and carbohydrates (D) fats

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- 37) The only vertebrates in which blood flows directly from respiratory organs to body tissues without first returning to the heart are the _____.
(A) amphibians (B) mammals (C) fishes (D) reptiles
- 38) The osmoregulatory/excretory system of an earthworm is based on the operation of _____.
(A) Malpighian tubules (B) metanephridia (C) protonephridia (D) nephrons
- 39) Contact of a sea urchin egg with signal molecules on sperm causes the egg to undergo a brief _____.
(A) acrosomal reaction (B) mitosis (C) vitellogenesis (D) membrane depolarization
- 40) The complement system is _____.
(A) a set of proteins involved in innate but not acquired immunity
(B) a group of proteins that includes interferons and interleukins
(C) a set of proteins that act individually to attack and lyse microbes
(D) a group of antimicrobial proteins that act together in a cascade fashion
- 41) Saturated fatty acids _____.
(A) are usually produced by plants
(B) are usually liquid at room temperature
(C) are the principal molecules in lard and butter
(D) have double bonds between carbon atoms of the fatty acids
- 42) A cell with an extensive area of smooth endoplasmic reticulum is specialized to _____.
(A) actively export protein molecules (B) play a role in storage
(C) synthesize large quantities of lipids (D) import and export protein molecules
- 43) Caffeine is an inhibitor of phosphodiesterase. Therefore, the cells of a person who has recently consumed coffee would have increased levels of _____.
(A) phosphorylated proteins (B) cAMP (C) activated G proteins (D) adenylyl cyclase
- 44) MPF is a dimer consisting of _____.
(A) cyclin and tubulin (B) a growth factor and mitotic factor
(C) ATP synthetase and a protease (D) cyclin and a cyclin-dependent kinase
- 45) A given organism has 46 chromosomes in its karyotype. Therefore, we can conclude that it must _____.
(A) reproduce sexually (B) be human
(C) be an animal (D) have gametes with 23 chromosomes
- 46) Gray seed color in peas is dominant to white. Assume that Mendel conducted a series of experiments where plants with gray seeds were crossed among themselves, and the following progeny were produced: 302 gray and 98 white. (i) What is the most probable genotype of each parent? (ii) Based on your answer in (i) above, what genotypic and phenotypic ratios are expected in these progeny? (Assume the following symbols: G = gray and g = white.)
(A) (i) $GG \times gg$; (ii) genotypic = 3:1, phenotypic = 1:2:1
(B) (i) $gg \times Gg$; (ii) genotypic = 1:2, phenotypic = 3:1
(C) (i) $GG \times Gg$; (ii) genotypic = 1:2:1, phenotypic = 2:1
(D) (i) $Gg \times Gg$; (ii) genotypic = 1:2:1, phenotypic = 3:1

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- 47) Positive feedback differs from negative feedback in that _____.
(A) positive feedback benefits the organism, whereas negative feedback is detrimental
(B) the effector's response increases some parameter (such as body temperature), whereas in negative feedback it can only decrease the parameter
(C) the positive feedback's effector responses are in the same direction as the initiating stimulus rather than opposite of it
(D) positive feedback systems have only effectors, whereas negative feedback systems have only receptors
- 48) The relationship between the insect hormones ecdysteroid and PTTH is an example of _____.
(A) homeostasis maintained by antagonistic hormones
(B) how peptide-derived hormones have more widespread effects than steroid hormones
(C) an interaction of the endocrine and nervous systems
(D) competitive inhibition of a hormone receptor
- 49) The active ingredient orlistat acts to decrease the amount of fat that is absorbed by attaching to enzymes that digest fat. Which of the following are potential targets of orlistat?
(A) pancreatic lipase (B) salivary amylase (C) secretin (D) pepsidase
- 50) Blood is pumped at high pressures in arteries from the heart to ensure that all parts of the body receive adequate blood flow. Capillary beds, however, would hemorrhage under direct arterial pressures. How does the design of the circulatory network contribute to reducing blood pressure to avoid this scenario?
(A) Capillary beds have the thickest walls of any blood vessel to resist these high pressures.
(B) Fluid loss from the arteries is high enough that pressure drops off significantly by the time blood reaches the capillaries.
(C) Blood flow through the capillaries is essentially frictionless, and this reduces the amount of pressure on their walls.
(D) The total cross-sectional diameter of the arterial circulation increases with progression from artery to arteriole to capillary, leading to a reduced blood pressure.

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科目名稱：科學英文【海資系碩士班乙組】

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PART I: Multiple Choice Questions, select the SINGLE correct answer (單選, 每題 2 分).

1. Science is limited since it cannot: (A) Predict the future (B) Make judgments about ethics, values, and morality (C) Arrive at fundamental truths (D) Provide information that can be applied to real life (E) Provide exceptions for negative evidence
2. An anthropogenic impact is one caused by: (A) Physical factors in the environment (B) Organisms that are part of marine communities (C) The destruction of primary producers (D) Organisms that live in neighboring marine communities (E) Human activities
3. The following is a synonym of autotrophs: (A) Consumer (B) Primary producer (C) Heterotroph (D) Animal (E) Predator
4. The ecosystem best encompasses one of the following: (A) All living organisms living in one area (B) Populations in one area but not the physical environment (C) The community or communities but not the physical environment (D) The community or communities and the physical environment (E) Populations and communities living in one area
5. A substance that is biodegradable: (A) Evaporates very slowly (B) Forms tar balls or other solid residues (C) Can be broken down only by special chemicals (D) Sinks to the bottom (E) Can be broken down by bacteria
6. One of the following is known to be responsible for thermal pollution: (A) Radioactive fallout (B) Sewage (C) Excessive use of fertilizers (D) Solid waste (E) Power plants
7. By definition, demersal catches are those that are harvested from: (A) The open water (B) The bottom (C) Estuaries (D) Waters where primary production is increased by upwelling (E) The continental shelf
8. The maximum sustainable yield is best defined as the: (A) Highest catch that can be taken without overfishing (B) Maximum fishing effort allowed after overfishing is reached (C) Highest catch that will pay the minimum cost of the fishing effort (D) Minimum catch that will still allow the population to grow (E) The annual size of the catch that will balance natural death and predation
9. Desalination plants: (A) Extract minerals for industrial use from seawater (B) Convert seawater into fresh water (C) Extract table salt from seawater (D) Convert seawater into brackish water for industrial uses (E) Extract oil from seawater
10. Which of the following is a renewable resource from the marine environment? (A) Oil (B) Gas (C) Seaweeds (D) Minerals
11. Photophores are: (A) Specialized eyes (B) Buoyancy-regulating organs (C) Specialized jaws (D) Light-sensitive organs that lack the lens of true eyes (E) Light-producing organs
12. Most animals in the ocean are omnivores. This means that they eat: (A) Producers and consumers (B) Part of the neuston (C) Zooplankton (D) Detritus (E) Phytoplankton
13. Euryhaline species: (A) Are less common in estuaries than stenohaline species (B) Need less oxygen to survive (C) Tolerate only a narrow range of salinities (D) Can survive

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- changes in salinity (E) Only tolerate small temperature changes
14. All of the following are examples of abiotic factors except one: (A) Salinity (B) Predation (C) Substrate (D) Temperature (E) Light
15. A population's carrying capacity is: (A) Affected by the growth rate of the population (B) The number of individuals a habitat can support with available resources (C) A constant that has been predetermined for all habitats (D) The number of individuals in a habitat (E) Determined by comparing birth rate and death rate in a population
16. Convergent evolution means that: (A) Organisms possess similar structures because they have a similar lifestyle (B) Organisms possess similar structures because they descended from a common ancestor (C) Closely related organisms have evolved and do not resemble one another anymore (D) Closely related organisms have different structures for same purpose (E) None of the above
17. Anadromous fishes migrate: (A) Up and down the water column (B) From fresh water to reproduce at sea (C) From polar regions to the tropics (D) From the sea to reproduce in freshwater (E) Along the Equator to reproduce along the coast
18. A larva is best defined as: (A) Immature stage that is able to reproduce (B) Early colony of cells of fresh-water sponges (C) Early stage of development of an organism, typically part of the plankton (D) Sperm cell that lives free in the water (E) Egg that has been fertilized by more than one sperm
19. Most cnidarians are specialized as: (A) Filter feeders (B) Parasites (C) Carnivores (D) Plant-feeders (E) Feeders of organic matter on the bottom
20. Echolocation is a sense that relies on: (A) Vibrations (B) Sound (C) Smell (D) Vision (E) Electromagnetic waves

PART II: Answer questions 21-25 according to the abstract of the following article:

(單選，每題 2 分). **Reconciliation of the carbon budget in the ocean's twilight zone**

2014. *Nature* 507, 480-483

Photosynthesis in the surface ocean produces approximately 100 gigatonnes of organic carbon per year, of which 5 to 15 per cent is exported to the deep ocean. The rate at which the sinking carbon is converted into carbon dioxide by heterotrophic organisms at depth is important in controlling oceanic carbon storage. It remains uncertain, however, to what extent surface ocean carbon supply meets the demand of water-column biota; the discrepancy between known carbon sources and sinks is as much as two orders of magnitude. Here we present field measurements, respiration rate estimates and a steady-state model that allow us to balance carbon sources and sinks to within observational uncertainties at the Porcupine Abyssal Plain site in the eastern North Atlantic Ocean. We find that prokaryotes are responsible for 70 to 92 per cent of the estimated remineralization in the twilight zone (depths of 50 to 1,000 metres) despite the fact that much of the organic carbon is exported in the form of large, fast-sinking particles accessible to larger zooplankton. We suggest that this occurs because zooplankton fragment and ingest half of the fast-sinking particles, of which more than 30 per cent may be released as suspended and slowly sinking matter, stimulating the deep-ocean microbial loop. The synergy between microbes and zooplankton in the twilight zone is important to our understanding of the processes controlling the oceanic carbon sink.

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21. Porcupine Abyssal Plain is located in (A) Pacific Ocean (B) Atlantic Ocean (C) Indian Ocean (D) Arctic Ocean (E) Antarctic Ocean
22. How many tonnes of organic carbon that produced by photosynthesis in the surface ocean is exported to the deep ocean per year? (A) 10^{12} (B) 10^{11} (C) 10^{10} (D) 10^9 (E) 10^8
23. Twilight zone is depths of (A) 0 to 100 m (B) 50 to 1000 m (C) 500 to 2000 m (D) 1000 to 4000 m (E) 4000 to 10000 m
24. According to this passage, which organism is responsible for majority of the estimated remineralization in the twilight zone? (A) Prokaryotes (B) Zooplankton (C) Phytoplankton (D) Fishes (E) Human
25. The difference between carbon sources and sinks in the surface ocean is about (A) 5 (B) 4 (C) 3 (D) 2 (E) 1 order(s) of magnitude.

PART III: Translate the following passages into CHINESE (每題 10 分).

1. The hydrological cycle describes the exchange of water in gaseous, liquid, and solid states among the various water reservoirs. Water is evaporated from the ocean's surface, fall as precipitation on land, and return to the oceans as river runoff and groundwater flow, thereby completing the hydrologic cycle.
2. Long-term records indicate that plankton abundance and species composition may change substantially over decadal time scales. Decreasing plankton biomass may be caused by climate changes that increase water stratification and depress upwelling; conversely, in other regions, increasing winds may enhance nutrient concentrations in the euphotic zone and lead to increased phytoplankton and zooplankton production.
3. Future scientific studies of the ocean will rely more and more on large international programs and remote-sensing techniques, including measurements from satellites, ocean buoys, unmanned platforms at sea, and exact location by the Global Positioning System. Computers for handling and processing the enormous quantities of data and for modeling ocean processes are playing an ever-increasing role in ocean research.
4. Surveys clearly indicate that fisheries around the world are being overfished. Many of these fisheries have collapsed or are near collapse; many others are not being managed in a sustainable manner in large part because national policy makers do not or are unwilling to address the seriousness of the worldwide depletion of this important resource.
5. Estuaries and mangrove swamps are productive coastal ecosystems that constitute important spawning and nursery grounds for many fish, harbour shellfish populations, and provide rich feeding grounds for birds. As well, mangrove swamps buffer coastlines from erosion and inundation during tropical storms. However, these ecosystems are often heavily affected by human activities such as land reclamation, disposal of sewage and industrial wastes, and eutrophication.

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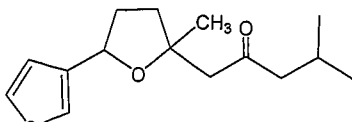
科目名稱：有機化學【海資系碩士班丙組】

題號：452001

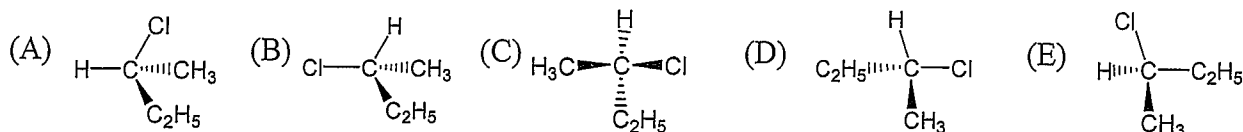
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Choose one right answer from a list of answers given for each question. (5 points for each)

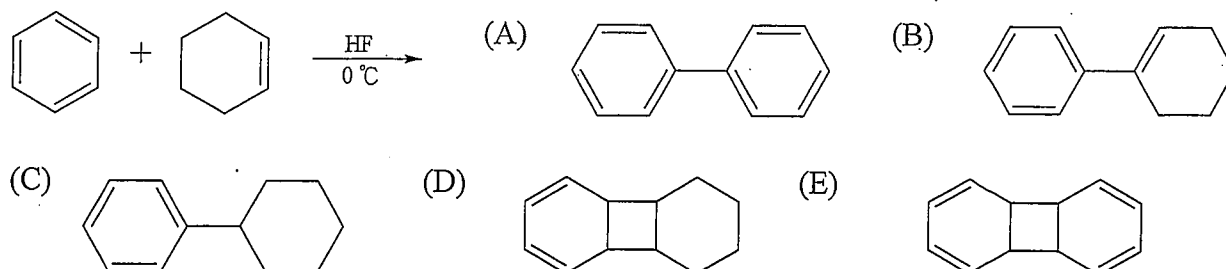
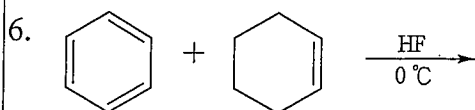
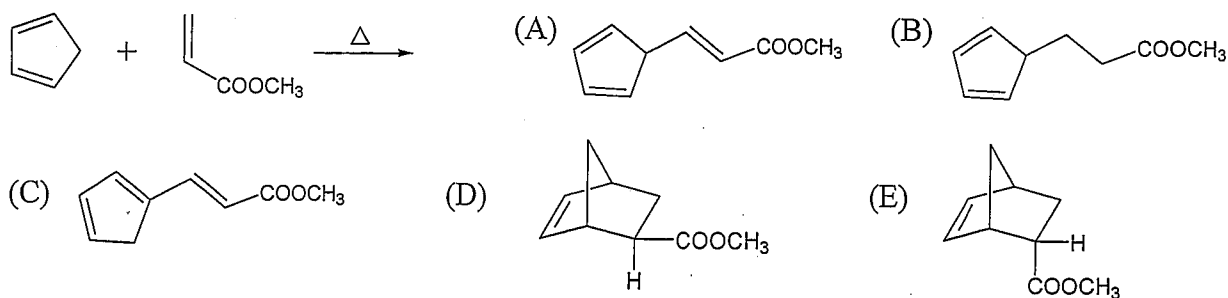
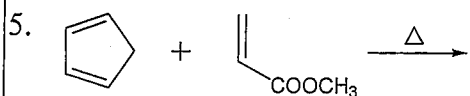
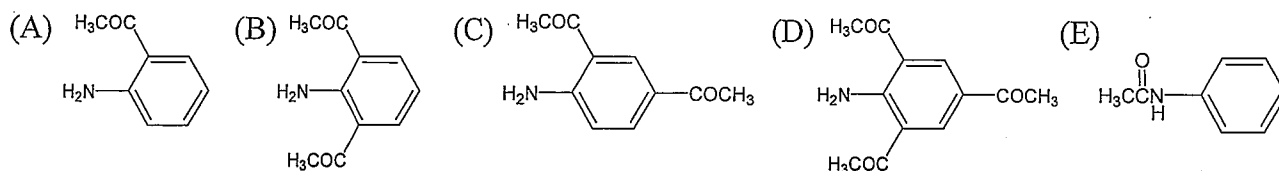
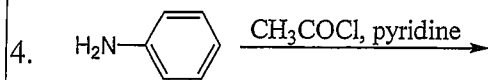
1. For the compound , please show how many isoprene units are incorporated into the structure? (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

2. Which of the following drawings represents the structure of (*S*)-2-chlorobutane?



3. How many possible aldol condensation products could be obtained in a 1 : 1 mixture of acetaldehyde and propanal? (A) 8 (B) 6 (C) 4 (D) 2 (E) 1

Show the product (or major product) for each of the following reactions (problems 4–10).



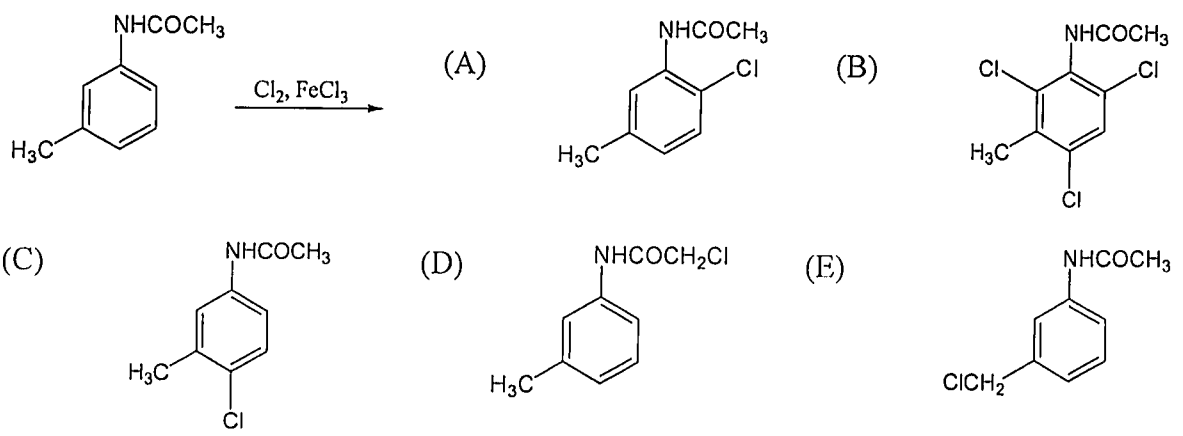
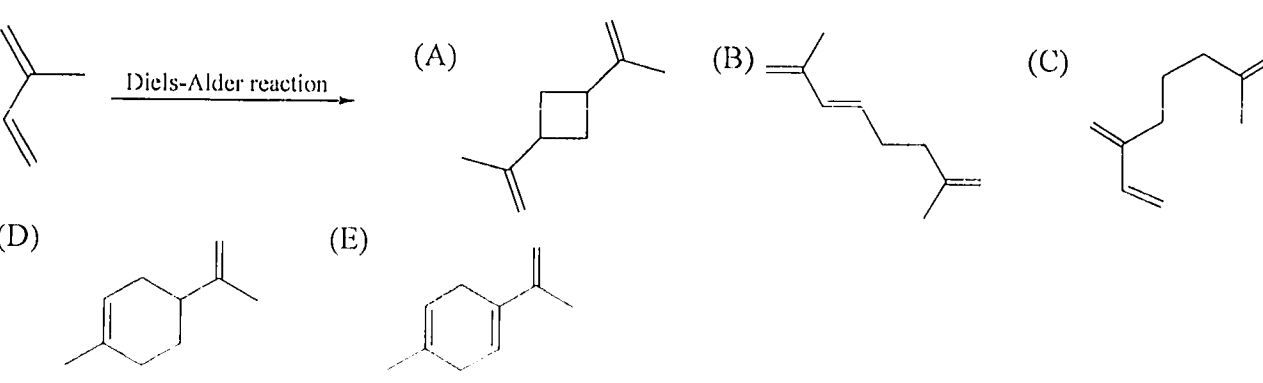
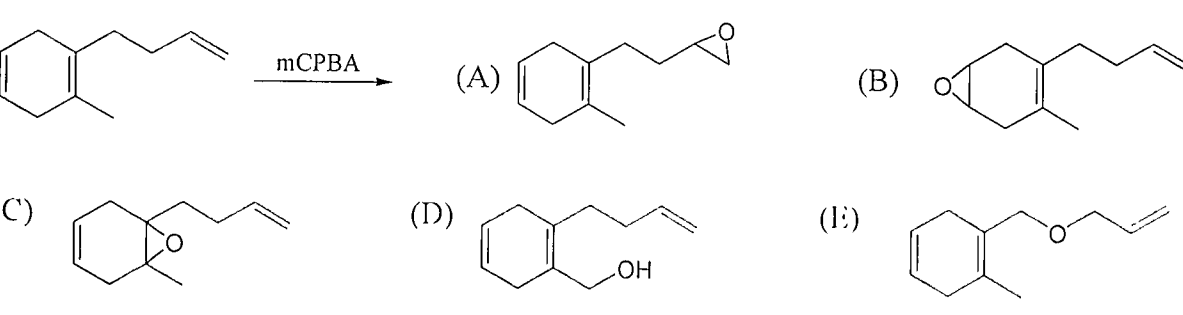
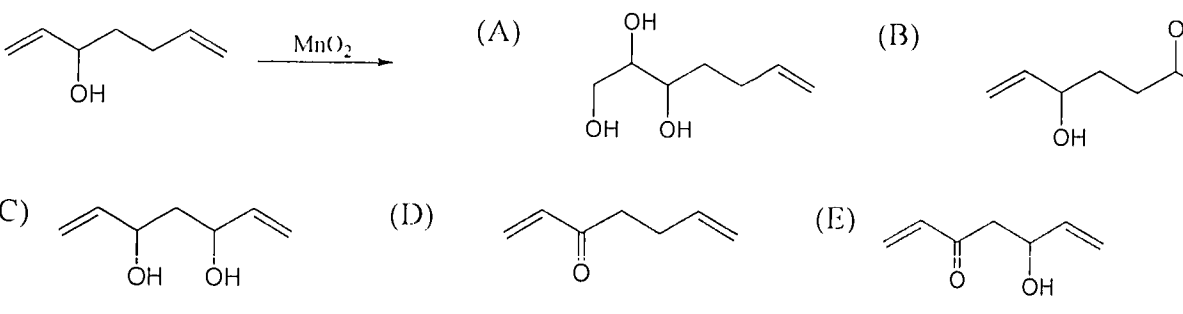
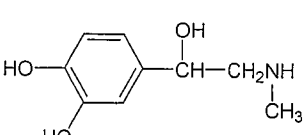
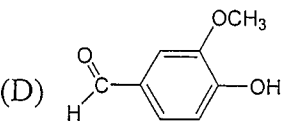
國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：有機化學【海資系碩士班丙組】

題號：452001

※本科目依簡章規定「不可以」使用計算機(選擇題)

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7. 
8. 
9. 
10. 
11. Which of the following compounds is chiral? (A) Citric acid, $\text{HOOCCH}_2-\text{C}(\text{OH})(\text{COOH})-\text{CH}_2\text{COOH}$ (B) Furan
- (C) Epinephrine,  (D)  (E) 1,1-Dichloropropane

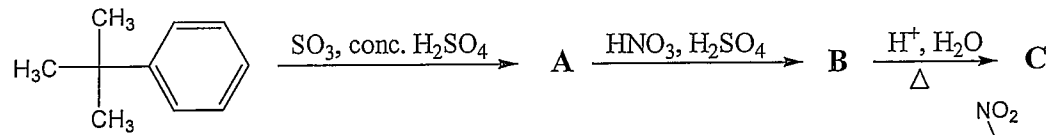
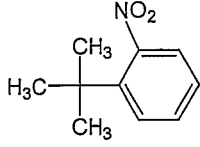
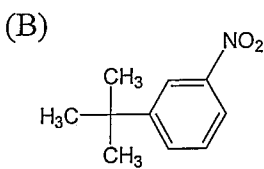
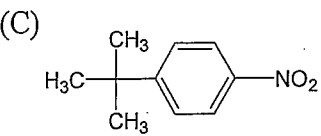
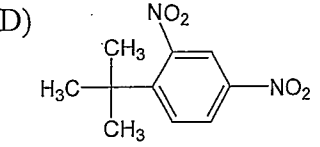
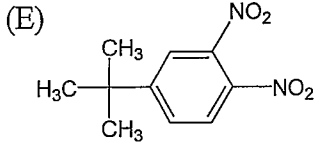
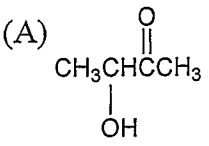
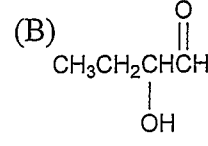
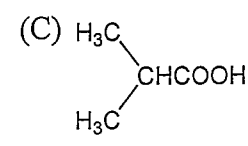
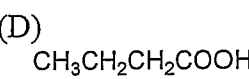
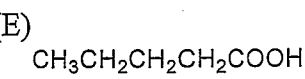
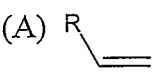
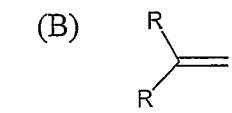
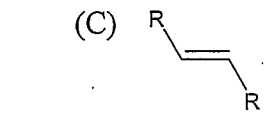
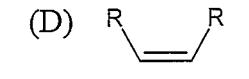
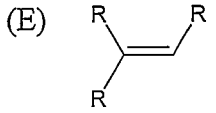
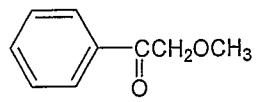
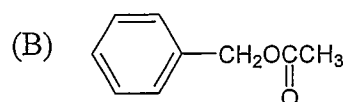
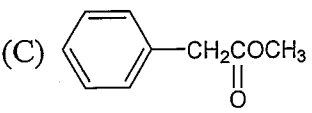
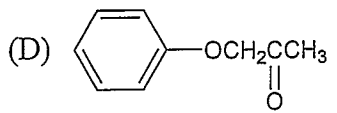
國立中山大學 104 學年度碩士暨碩士專班招生考試試題

科目名稱：有機化學【海資系碩士班丙組】

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12. 
- What is the final product C of the above reaction sequence? (A) 
- (B)  (C)  (D)  (E) 
13. Show the degrees of unsaturation (or index of hydrogen deficiency) for a compound with the molecular formula $C_{21}H_{21}BrN_2O_2$. (A) 9 (B) 10 (C) 11 (D) 12 (E) 13
14. A compound C_5H_{10} shows IR absorptions at 3030, 1660 (very weak), 1380 and 965 cm^{-1} . This compound is (A) 1-pentene (B) cyclopentane (C) *cis*-2-pentene (D) 2-methyl-2-butene (E) *trans*-2-pentene.
15. Which of the following compounds could show a molecular ion peak at $m/z = 88$ and a base peak at $m/z = 60$ in EI mass spectrum?
- (A)  (B)  (C)  (D)  (E) 
16. The mass spectrum of a compound showed a relative intensity ratio 9 : 6 : 1 for peaks of M (molecular ion), M+2 and M+4. This compound should possess (A) Br_2 (B) Cl_2 (C) BrCl (D) Br_2Cl (E) $BrCl_2$ in the molecular formula.
17. The ^{13}C NMR spectrum of a compound with the molecular formula C_6H_{14} showed four peaks at δ 9, 29, 30 and 37 ppm, respectively. The peak at 29 ppm is much larger than the others, whereas the peak at 30 ppm is very weak. What is this compound? (A) 2,3-Dimethylbutane (B) 2,2-Dimethylbutane (C) 3-Methylpentane (D) *n*-Hexane (E) 2-Methylpentane
18. The 1H NMR spectrum of a compound $C_{10}H_{20}$ shows two peaks at δ 0.97 (18H, s) and δ 5.30 (2H, s) ppm. How many carbon signals of this compound could be found in its ^{13}C NMR spectrum? (A) 2 (B) 3 (C) 4 (D) 5 (E) 6
19. Which of the following compounds would you expect to have IR absorptions at 910 and 990 cm^{-1} ?
- (A)  (B)  (C)  (D)  (E) 
20. A compound showed 1H NMR signals at δ 2.0 (3H, s), δ 5.1 (2H, s) and δ 7.3 (5H, br s) ppm. The structure of this compound is (A)  (B) 
- (C)  (D)  (E) 