國立中山大學103學年度轉學考招生考試試題

科目名稱：普通生物學【生科系三年級】　　題號：721003

※本科目依簡章規定「不可以」使用計算機　　

(1)-(50)題為單選題，一題一分。

1) What technique would be most appropriate to use to observe the movements of condensed chromosomes during cell division?
A) light microscopy
B) scanning electron microscopy
C) transmission electron microscopy
D) confocal fluorescence microscopy
E) super-resolution fluorescence microscopy

2) 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) the nucleus
C) DNA and RNA
D) integrins
E) plasmodesmata

3) According to the fluid mosaic model of cell membranes, which of the following is a true statement about membrane phospholipids?
A) They can move laterally along the plane of the membrane.
B) They frequently flip-flop from one side of the membrane to the other.
C) They occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane.
D) They are free to depart from the membrane and dissolve in the surrounding solution.
E) They have hydrophilic tails in the interior of the membrane.

4) If the sodium ion concentration outside the cell increases, and the CFTR channel is open, in what direction will chloride ions and water move across the cell membrane?
A) Chloride ions will move out of the cell, and water will move into the cell.
B) Both chloride ions and water will move out of the cell.
C) Chloride ions will move into the cell, and water will move out of the cell.
D) Both chloride ions and water will move into the cell.
E) The movement of chloride ions and water molecules will not be affected by changes in sodium ion concentration outside the cell.

5) During glycolysis, when each molecule of glucose is catabolized to two molecules of pyruvate, most of the potential energy contained in glucose is
A) transferred to ADP, forming ATP.
B) transferred directly to ATP.
C) retained in the two pyruvates.
D) stored in the NADH produced.
E) used to phosphorylate fructose to form fructose 6-phosphate.

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6) What is the purpose of beta oxidation in respiration?
A) oxidation of glucose
B) oxidation of pyruvate
C) feedback regulation
D) control of ATP accumulation
E) breakdown of fatty acids

7) When oxygen is released as a result of photosynthesis, it is a direct by-product of
A) reducing $NADP^+$.
B) splitting water molecules.
C) chemiosmosis.
D) the electron transfer system of photosystem I.
E) the electron transfer system of photosystem II.

8) Figure 10.1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis. Why are they different?
A) Green and yellow wavelengths inhibit the absorption of red and blue wavelengths.
B) Bright sunlight destroys photosynthetic pigments.
C) Oxygen given off during photosynthesis interferes with the absorption of light.
D) Other pigments absorb light in addition to chlorophyll *a*.
E) Aerobic bacteria take up oxygen, which changes the measurement of the rate of photosynthesis.

9) In which of the following ways do plant hormones differ from hormones in animals?
A) Plant hormones interact primarily with intracellular receptors.
B) Plant hormones may travel in air or through vascular systems.
C) Animal hormones are found in much greater concentration.
D) Plant hormones are synthesized from two or more distinct molecules.
E) Animal hormones are primarily for mating and embryonic development.

10) Why is apoptosis potentially threatening to the healthy "neighbors" of a dying cell?
A) Cell death would usually spread from one cell to the next via paracrine signals.
B) Lysosomal enzymes exiting the dying cell would damage surrounding cells.
C) Released cellular energy would interfere with the neighbors' energy budget.
D) Bits of membrane from the dying cell could merge with neighbors and bring in foreign receptors.
E) Neighboring cells would activate immunological responses.

11) At the M phase checkpoint, the complex allows for what to occur?
A) Separase enzyme cleaves cohesins and allows chromatids to separate.
B) Cohesins alter separase to allow chromatids to separate.
C) Kinetochores are able to bind to spindle microtubules.
D) All microtubules are made to bind to kinetochores.
E) Daughter cells are allowed to pass into G_1.

12) A research team began a study of a cultured cell line. Their preliminary observations showed them that the cell line did not exhibit either density-dependent inhibition or anchorage dependence. What could they conclude right away?
A) The cells originated in the nervous system.
B) The cells are unable to form spindle microtubules.
C) They have altered series of cell cycle phases.
D) The cells show characteristics of tumors.
E) They were originally derived from an elderly organism.

13) Eukaryotic sexual life cycles show tremendous variation. Of the following elements, which do all sexual life cycles have in common?
I. Alternation of generations
II. Meiosis
III. Fertilization
IV. Gametes
V. Spores
A) I, IV, and V
B) I, II, and IV
C) II, III, and IV
D) II, IV, and V
E) I, II, III, IV, and V

14) Which of the following best describes the frequency of crossing over in mammals?
A) ~50 per chromosome pair
B) ~2 per meiotic cell
C) at least 1-2 per chromosome pair
D) ~1 per pair of sister chromatids
E) a very rare event among hundreds of cells

15) The individual with genotype *AaBbCCDdEE* can make many kinds of gametes. Which of the following is the major reason?
A) segregation of maternal and paternal alleles
B) recurrent mutations forming new alleles
C) crossing over during prophase I
D) different possible alignments of chromosomes
E) the tendency for dominant alleles to segregate together

16) In each generation of this family after generation I, the age at diagnosis is significantly lower than would be found in nonfamilial (sporadic) cases of this cancer (~ 63 years). What is the most likely reason?
A) Members of this family know to be checked for colon cancer early in life.
B) Hereditary (or familial) cases of this cancer typically occur at earlier ages than do nonfamilial forms.
C) This is pure chance; it would not be expected if you were to look at a different family.
D) This cancer requires mutations in more than this one gene.
E) Affected members of this family are born with colon cancer, and it can be detected whenever they are first tested.

17) Males are more often affected by sex-linked traits than females because
A) male hormones such as testosterone often alter the effects of mutations on the X chromosome.
B) female hormones such as estrogen often compensate for the effects of mutations on the X chromosome.
C) X chromosomes in males generally have more mutations than X chromosomes in females.
D) males are hemizygous for the X chromosome.
E) mutations on the Y chromosome often worsen the effects of X-linked mutations.

18) In 1956 Tijo and Levan first successfully counted human chromosomes. What is the reason it took so many years to do so?
A) Watson and Crick's structure of DNA was not done until 1953.
B) Chromosomes were piled up on top of one another in the nucleus.
C) Chromosomes were not distinguishable during interphase.
D) A method had not yet been devised to halt mitosis at metaphase.
E) Chromosomes were piled up on top of one another in the nucleus, chromosomes were not distinguishable during interphase, and a method had not yet been devised to halt mitosis at metaphase.

19) Which of the following investigators was/were responsible for the following discovery?
In DNA from any species, the amount of adenine equals the amount of thymine, and the amount of guanine equals the amount of cytosine.
A) Frederick Griffith
B) Alfred Hershey and Martha Chase
C) Oswald Avery, Maclyn McCarty, and Colin MacLeod
D) Erwin Chargaff
E) Matthew Meselson and Franklin Stahl

20) If a cell were unable to produce histone proteins, which of the following would be a likely effect?
A) There would be an increase in the amount of "satellite" DNA produced during centrifugation.
B) The cell's DNA couldn't be packed into its nucleus.
C) Spindle fibers would not form during prophase.
D) Amplification of other genes would compensate for the lack of histones.
E) Pseudogenes would be transcribed to compensate for the decreased protein in the cell.

21) Transcription in eukaryotes requires which of the following in addition to RNA polymerase?
A) the protein product of the promoter
B) start and stop codons
C) ribosomes and tRNA
D) several transcription factors (TFs)
E) aminoacyl synthetase

22) In order for a eukaryotic gene to be engineered into a bacterial colony to be expressed, what must be included in addition to the coding exons of the gene?
A) the introns
B) eukaryotic polymerases
C) a bacterial promoter sequence

D) eukaryotic ribosomal subunits
E) eukaryotic tRNAs

23) A mutation that inactivates the regulatory gene of a repressible operon in an *E. coli* cell would result in
A) continuous transcription of the structural gene controlled by that regulator.
B) complete inhibition of transcription of the structural gene controlled by that regulator.
C) irreversible binding of the repressor to the operator.
D) inactivation of RNA polymerase by alteration of its active site.
E) continuous translation of the mRNA because of alteration of its structure.

24) If she moves the promoter for the *lac* operon to the region between the *beta galactosidase* gene and the *permease* gene, which of the following would be likely?
A) Three structural genes will no longer be expressed.
B) RNA polymerase will no longer transcribe permease.
C) The operon will no longer be inducible.
D) Beta galactosidase will be produced.
E) The cell will continue to metabolize but more slowly.

25) A gene that contains introns can be made shorter (but remain functional) for genetic engineering purposes by using
A) RNA polymerase to transcribe the gene.
B) a restriction enzyme to cut the gene into shorter pieces.
C) reverse transcriptase to reconstruct the gene from its mRNA.
D) DNA polymerase to reconstruct the gene from its polypeptide product.
E) DNA ligase to put together fragments of the DNA that code for a particular polypeptide.

26) Scientists developed a set of guidelines to address the safety of DNA technology. Which of the following is one of the adopted safety measures?
A) Microorganisms used in recombinant DNA experiments are genetically crippled to ensure that they cannot survive outside of the laboratory.
B) Genetically modified organisms are not allowed to be part of our food supply.
C) Transgenic plants are engineered so that the plant genes cannot hybridize.
D) Experiments involving HIV or other potentially dangerous viruses have been banned.
E) Recombinant plasmids cannot be replicated.

27) Which of the following is most important in making the typical seed more resistant to adverse conditions than the typical spore?
A) a different type of sporopollenin
B) an internal reservoir of liquid water
C) integument(s)
D) ability to be dispersed
E) waxy cuticle

28) If one were to erect a new taxon of plants that included all plants that are pollinated by animals, and only plants that are pollinated by animals, then this new taxon would be
A) monophyletic.
B) paraphyletic.
C) polyphyletic.
D) identical in composition to the phylum Anthophyta.
E) identical in composition to the phylum Cycadophyta.

29) Plants growing in a partially dark environment will grow toward light in a response called phototropism. Which of the following statements is true regarding phototropism?
A) It is caused by an electrical signal.
B) One chemical involved is ethylene.
C) Auxin causes a growth increase on one side of the stem.
D) Auxin causes a decrease in growth on the side of the stem exposed to light.
E) Removing the apical meristem enhances phototropism.

30) Plants often use changes in day length (photoperiod) to trigger events such as dormancy and flowering. It is logical that plants have evolved this mechanism because photoperiod changes
A) are more predictable than air temperature changes.
B) alter the amount of energy available to the plant.
C) are modified by soil temperature changes.
D) can reset the biological clock.
E) are correlated with moisture availability.

31) Animals that migrate great distances would obtain the greatest energetic benefit of storing chemical energy as
A) proteins.
B) minerals.
C) carbohydrates.
D) amino acids.
E) fats.

32) The absorption of fats differs from that of carbohydrates in that the
A) processing of fats does not require any digestive enzymes, whereas the processing of carbohydrates does.
B) fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine.
C) carbohydrates need to be emulsified before they can be digested, whereas fats do not.
D) most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood.
E) fats, but not carbohydrates, are digested by bacteria before absorption.

33) The circulatory system of bony fishes, rays, and sharks is similar to
A) that of birds, with a four-chambered heart.
B) the portal systems of mammals, where two capillary beds occur sequentially, without passage of blood through a pumping chamber.
C) that of reptiles, with one pumping chamber driving blood flow to a gas-exchange organ, and a

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different pumping chamber driving blood to the rest of the circulation.
D) that of sponges, where gas exchange in all cells occurs directly with the external environment.
E) that of humans, where there are four pumping chambers to drive blood flow.

34) Air-breathing insects carry out gas exchange
A) in their specialized external gills.
B) in their specialized internal gills.
C) in the alveoli of their lungs.
D) across the membranes of their cells.
E) across all parts of their thin cuticular exoskeleton.

35) The eyes and the respiratory tract are both protected against infections by
A) the mucous membranes that cover their surface.
B) the secretion of complement proteins.
C) the release of slightly alkaline secretions.
D) the secretion of lysozyme onto their surfaces.
E) interferons produced by immune cells.

36) Among the last line of defenses against prolonged exposure to an extracellular pathogen is
A) lysozyme production.
B) phagocytosis by neutrophils.
C) antibody production by plasma cells.
D) histamine release by basophils.
E) lysis by natural killer cells.

37) Birds that live in marine environments and thus lack access to fresh drinking water
A) osmoregulate without using a transport epithelium for this purpose.
B) drink seawater and secrete excess ions through their kidneys only.
C) drink seawater and secrete excess ions mainly through their nasal salt glands.
D) have plasma that is isoosmotic to ocean water.
E) obtain water by eating only osmoregulating prey.

38) Birds secrete uric acid as their nitrogenous waste because uric acid
A) is readily soluble in water.
B) is metabolically less expensive to synthesize than other excretory products.
C) requires little water for nitrogenous waste disposal, thus reducing body mass.
D) excretion allows birds to live in desert environments.

39) Prostaglandins are local regulators whose chemical structure is derived from
A) oligosaccharides.
B) fatty acids.
C) steroids.
D) amino acids.
E) nitric oxide.

40) Fight-or-flight reactions include activation of
A) the parathyroid glands, leading to increased metabolic rate.
B) the thyroid gland, leading to an increase in the blood calcium concentration.
C) the anterior pituitary gland, leading to cessation of gonadal function.
D) the adrenal medulla, leading to increased secretion of epinephrine.
E) the pancreas, leading to a reduction in the blood sugar concentration.

41) Animals with reproduction dependent on internal fertilization need not have
A) any copulatory organs.
B) a receptacle that receives sperm.
C) behavioral interaction between males and females.
D) internal development of embryos.
E) haploid gametes.

42) An oocyte released from a human ovary enters the oviduct as a result of
A) the beating action of the flagellum on the oocyte.
B) the force of the follicular ejection directing the oocyte into the oviduct.
C) the wavelike beating of cilia lining the oviduct.
D) movement of the oocyte through the pulsating uterus into the oviduct.
E) peristaltic contraction of ovarian muscles.

43) A human zygote undergoes its first cell division
A) 5 seconds after fertilization.
B) 30 minutes after fertilization.
C) 90 minutes after fertilization.
D) 4 hours after fertilization.
E) 24 hours after fertilization.

44) Animal development compares to plant development in that
A) plant cells, but not animal cells, migrate during morphogenesis.
B) animal cells, but not plant cells, migrate during morphogenesis.
C) plant cells and animal cells migrate extensively during morphogenesis.
D) neither plant cells nor animal cells migrate during morphogenesis.
E) plant cells, but not animal cells, undergo convergent extension.

45) In a simple synapse, neurotransmitter chemicals are received by
A) the dendritic membrane.
B) the presynaptic membrane.
C) axon hillocks.
D) cell bodies.
E) ducts on the smooth endoplasmic reticulum.

46) The botulinum toxin reduces the synaptic release of
A) acetylcholine.
B) epinephrine.

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C) endorphin.
D) nitric oxide.
E) GABA.

47) The cerebrospinal fluid is
A) a filtrate of the blood.
B) a secretion of glial cells.
C) a secretion of interneurons.
D) cytosol secreted from ependymal cells.
E) secreted by the hypothalamus.

48) The blood-brain barrier
A) is formed by tight junctions.
B) is formed by oligodendrocytes.
C) tightly regulates the intracellular environment of the CNS.
D) uses chemical signals to communicate with the spinal cord.
E) provides support to the brain tissue.

49) Tastes and smells are distinct kinds of environmental information in that
A) neural projections from taste receptors reach different parts of the brain than the neural projections from olfactory receptors.
B) the single area of the cerebral cortex that receives smell and taste signals can distinguish tastes and smells by the pattern of action potentials received.
C) tastant molecules are airborne, whereas odorant molecules are dissolved in fluids.
D) distinguishing tastant molecules requires learning, whereas smell discrimination is an innate process.
E) odorants bind to receptor proteins, but none of the tastant stimuli bind to receptors.

50) The cochlea is an organ of auditory transduction that contains
A) fluid and cells that can undergo mechanosensory transduction.
B) air and cells that produce wax.
C) air and small bones that vibrate in response to sound waves.
D) fluid with stacks of chemosensory cells.
E) air and statocysts activated by movement.

(51)題為問答題，共計 50 分。

51) 請選擇 10 種你平常在自助餐會吃到的生物，說明其：
A) 在分類體系中的歸屬 (taxonomic affiliation)
B) 生態角色(niche)
C) 棲地類型(若是馴化生物，請說明未被人類馴化前的棲地類型)
D) 所屬生態系 (ecosystem)
E) 在食物網中的角色 (role in a food web)
F) 彼此之間最可能的親緣關係(phylogenetic relationships)，以及支持這個親緣關係假說的特徵為何

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1. Describe the four major classes of biomolecules found in all living cells and the biological functions they serve. **(16 分)**

2. Answer the following questions for the peptide Asn-Lys-Cys-Pro-Glu-Ser-Trp-Gly-His-Val. **(12 分)**

(1) What amino acid is the N-terminal end?
(2) What amino acid is the C-terminal end?
(3) What amino acid has an amide side chain?
(4) What amino acid absorbs UV light?
(5) What amino acid has the smallest side chain?
(6) What amino acid has unusual cyclic structure?
(7) What amino acid is capable in forming disulfide bonds?
(8) What amino acid has a pK_a value near physiological pH?
(9) What amino acid is aromatic an amino acid?
(10) What amino acid has a positively charged side chain at physiological pH?
(11) What amino acid has a negatively charged side chain at physiological pH?
(12) What amino acid has a hydroxyl side chain?

3. Describe (1) the four organization levels of protein structure and (2) how each organization level of structure is maintained. **(20 分)**

4. Describe how (1) ion exchange chromatography, (2) size exclusion or gel filtration chromatography, and (3) affinity chromatography can be used to purify specific proteins. **(18 分)**

5. Describe how the activity of protein or enzyme is regulated through (1) allosterism, (2) covalent modification, and (3) proteolytic cleavage. **(18 分)**

6. Metabolic pathways can be organized into catabolism and anabolism. (1) Describe the contrasting features of catabolic pathways from anabolic pathways. (2) Explain why anabolic pathway and catabolic pathway differ. **(16 分)**