

國立清華大學 112 學年度學士後醫學系單獨招生試題

考試科目 (科目代碼): 生物與生化 (0102)

[單選題]每題 2.5 分, 共計 150 分。答錯一題倒扣 0.625 分, 未作答, 不給分亦不扣分。

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1. To define a species, the biological species concept would require information related to
 - (A) Genome sequence
 - (B) Sexual reproduction
 - (C) Phylogenic tree
 - (D) Living environment
 - (E) Morphology
2. Which of the following characteristics is unlikely due to sexual selection?
 - (A) Frog singing
 - (B) Sperm competition
 - (C) Courtship dance
 - (D) Flower fragrance
 - (E) Chameleon Camouflage
3. Visual pigment rhodopsin is a(n)
 - (A) Ion channel
 - (B) Enzyme
 - (C) Chaperone
 - (D) G protein-coupled receptors
 - (E) None of above
4. Microglia functions in
 - (A) circulating cerebrospinal fluid
 - (B) structural support for neurons
 - (C) axon myelination
 - (D) immune responses
 - (E) All of above
5. The "fight or flight" responses are mainly induced by _____ system.
 - (A) Autonomic
 - (B) Somatic
 - (C) Sympathetic
 - (D) Parasympathetic
 - (E) Enteric
6. Which hormone is induced by neonatal suckling and triggers release of milk from the mammary glands?

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- (A) Oxytocin
 - (B) Vasopressin
 - (C) Serotonin
 - (D) Insulin
 - (E) Estrogen
7. Which of the following hormone is not released from the pituitary gland?
- (A) Antidiuretic hormone
 - (B) Follicle-stimulating hormone
 - (C) Prolactin
 - (D) Adrenocorticotrophic hormone
 - (E) Thyroid hormone
8. Which of the following is not a main function of kidney
- (A) Ion balance
 - (B) Blood pressure control
 - (C) pH balance
 - (D) Thermal balance
 - (E) Hormone production
9. The offspring of horse and donkey is viable but sterile. This belongs to which of the following reproductive barriers?
- (A) Prezygotic barrier, gametic isolation
 - (B) Prezygotic barrier, reduced hybrid fertility
 - (C) Prezygotic barrier, hybrid breakdown
 - (D) Postzygotic barrier, gametic isolation
 - (E) Postzygotic barrier, reduced hybrid fertility
10. Which of the following descriptions about phosphorus cycle is **NOT** correct?
- (A) Over-enrichment of phosphate in both fresh and inshore marine waters can cause massive algae blooms that lead to eutrophication.
 - (B) In terrestrial systems, bioavailable phosphorus mainly comes from weathering of phosphorus-containing rocks
 - (C) Microbial and plant growths depend on the degradation rate of organic phosphorus to free inorganic phosphate by various enzymes such as phosphatases, nucleases and phytase.
 - (D) Human interference in the phosphorus cycle occurs by overuse or careless use of phosphorus fertilizers.
 - (E) Using animal manure in poorly drained soils to improve the soil fertility helps phosphorus cycle.

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11. Which of the following descriptions about nitrogen cycle is **NOT** correct?
- (A) The nitrogenous wastes in animal urine are broken down by denitrifying bacteria.
 - (B) Nitrous oxide (N_2O), carbon dioxide and methane are greenhouse gases that contribute to global warming.
 - (C) Nitrous oxide (N_2O) has risen in the atmosphere as a result of agricultural fertilization, biomass burning, cattle and feedlots, and industrial sources.
 - (D) Atmospheric ammonia and nitrous oxides contribute to smog and acid rain, damage plants and increase nitrogen inputs to ecosystems.
 - (E) Nitrogen cannot be utilized by phytoplankton as nitrogen gas (N_2) so it must undergo nitrogen fixation which is performed predominately by cyanobacteria.
12. Which of the following descriptions about red algae is NOT correct?
- (A) They are abundant in the warm coastal waters of tropical oceans.
 - (B) They contain phycoerythrin as their photosynthetic pigment to absorb red and blue light.
 - (C) We eat one of multicellular red algae, *Porphyra* (Japanese “nori”) as a wrap for sushi.
 - (D) Unlike other algae, they do not have flagellated gametes.
 - (E) They depend on water currents for fertilization.
13. Which of the following diseases is **NOT** insect borne?
- (A) Polio
 - (B) Japanese encephalitis
 - (C) Dengue
 - (D) Zika virus fever
 - (E) Sleeping sickness
14. Which of the following structures is **NOT** found in plant cells?
- (A) Plasmodesmata
 - (B) Middle lamella
 - (C) Phragmoplast
 - (D) Gap junction
 - (E) Tonoplast
15. Which of the following descriptions about COVID-19 virus is **NOT** correct?
- (A) The RNA-dependent RNA polymerase is a primary target for anti-COVID-19 virus drug remdesivir.
 - (B) Antigenic drift is a kind of genetic variation that can result in a new strain of COVID-19 virus particles.

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- (C) Coronaviruses are prone to undergo antigenic shift by combining two different viruses to make a novel strain.
- (D) COVID-19 mRNA vaccines contain the instructions for making the SARS-CoV-2 spike protein
- (E) COVID-19 mRNA vaccines require to be stored at an ultra-cold freezer at temperatures between -80°C and -60°C for up to 6 months.
16. Which of the following descriptions about lipopolysaccharides is **NOT** correct?
- (A) They are found in the outer membrane of Gram-negative bacteria
- (B) They are secreted as part of the normal physiological activity of membrane vesicle trafficking
- (C) They can induce defense responses in animals and plants.
- (D) The biological activity of lipopolysaccharides can be attributed to the chemical structure of the lipid A unit.
- (E) They increase the positive charge of the cell membrane and helps stabilize the overall membrane structure
17. Which of the following descriptions about V-ATPases is NOT correct?
- (A) They are ATP-dependent proton pumps.
- (B) They are present in intracellular membranes in all eukaryotes and at the plasma membrane of certain specialized cells.
- (C) They are involved in acidification of endosomes.
- (D) They generate the proton motive force as a driving force for primary transporters.
- (E) They are regulated by reversible dissociation of the V_1 and V_0 domains.
18. Which of the following descriptions about vitamins is **NOT** correct?
- (A) They are generally classified into fat soluble or water soluble
- (B) Some of them are required as coenzymes to facilitate enzymatic catalysis.
- (C) Vitamin B1 is found naturally in meats, fish, and whole grains.
- (D) Vitamin B12 is naturally present in vegetables like carrot and broccoli.
- (E) Vitamin E is chemically known as α -tocopherol and enriched in seeds and nuts.
19. Toll-like receptors (TLRs) activate innate immune responses protecting the host from infection by identifying conserved nonself molecules, Which of the following could **NOT** be recognized by TLRs?
- (A) Peptidoglycan
- (B) Flagellin
- (C) Galactose
- (D) Lipopolysaccharide

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- (E) Unmethylated CpG motifs
20. Patent Foramen Ovale (PFO), also known as a **Hole In The Heart**. Which of the following statements about PFO is **Not** true?
- (A) In the womb, the blood flows from the high-pressure right side of the heart to the lower-pressure left side keeps the foramen ovale open.
 - (B) At birth, the reversal of pressure gradients caused by the clamping of the placenta could physiologically cause the foramen ovale to snap closed.
 - (C) In a heart with PFO, venous blood leaks from the right atrium into the left atrium, then out to the body, bypassing the pulmonary circulation.
 - (D) PFO is a condition with modifiable and non-modifiable risk factors.
 - (E) Around 25% of the general population has PFO and is typically asymptomatic.
21. The CRISPR-Cas9 system is a powerful new technique for gene editing. Which of the following descriptions about the CRISPR-Cas9 system is **Not** true?
- (A) CRISPR is a natural immune system occurring in bacteria to prevent attack by virus.
 - (B) Bacterial Cas9 cuts off the viral DNA sequence and destroys the virus.
 - (C) *Streptococcus pyogenes* produces Cas nuclease.
 - (D) The CRISPR-Cas9 system can identify upto 20 base long sequence in target DNA.
 - (E) The CRISPR-Cas9 system is now deemed a safe method for treating incurable diseases.
22. Electrocardiogram, abbreviated as ECG or EKG, is a biological test used to convert the activities of the heart into electrical signals, including P wave, QRS complex, and T wave. Which part of the ECG represents the beginning of ventricle repolarization?
- (A) P wave
 - (B) Interval between P wave and QRS complex
 - (C) QRS complex
 - (D) Interval between QRS complex to T wave
 - (E) T wave
23. Which of the following cell organelles is **NOT** correctly matched with its function?
- (A) Centrosomes - organizing the microtubule and Cell division
 - (B) Golgi Apparatus - secretion and intracellular transport
 - (C) Peroxisome - the metabolism of lipids and catabolism of long-chain fatty acids

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- (D) Endoplasmic Reticulum - responsible for the cell's metabolic activities.
(E) Lysosomes - the digestion and removes wastes
24. Hydrangeas provide beauty and color to landscapes. Hydrangeas of the same genotype are planted in a large flower yard, which blooms different colored flowers. This phenomenon is caused by _____
- (A) Environmental factors such as aluminum content and soil pH
(B) The alleles being codominant
(C) Darwin's explanation of the natural selection
(D) The fact that the mutation occurred
(E) Virus infection causes color-breaking
25. Most of the Carbon dioxide being transported by blood:
- (A) is carried in the form of bicarbonate (HCO_3^-)
(B) is attached to glucose
(C) is reversibly bound to hemoglobin
(D) is dissolved in plasma
(E) is used to provide energy for the heartbeat
26. T cell activation requires the formation of a transient cell-cell contact called immunological synapse between T cell and dendritic cells (DCs). Activated T cells synthesize and secrete interleukin-2 (IL-2) for the proliferation and differentiation of T cells. What is this is an example of?
- (A) synaptic signaling
(B) autocrine signaling
(C) endocrine signaling
(D) paracrine signaling
(E) juxtacrine signaling
27. The nucleotide sequences of the p53 gene showed a single amino acid change in the tumor mass, which compromised the protein's function. Which of the following would be true?
- (A) Mutant p53 promotes adaptive responses to cancer-related stress conditions to support tumor progression.
(B) Mutant p53 facilitates the establishment of a pro-oncogenic tumor microenvironment.
(C) Mutant p53 enhances cancer cell survival under oxidative and genotoxic stress conditions.
(D) Mutant p53 induces G1 arrest and transcripts p21 after DNA damage.
(E) Mutant p53 imparts stem-like properties to cancer cells.

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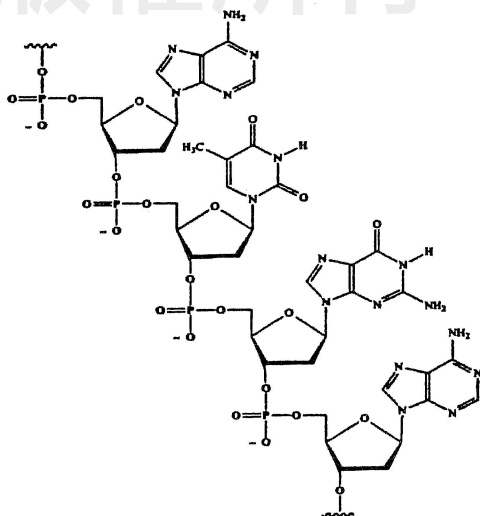
28. Which amino acids absorb ultraviolet radiation between 250 - 280 nm?
(1) His; (2) Tyr; (3) Trp; (4) Pro; (5) Phe
(A) (1)(2)
(B) (2)(3)(5)
(C) (2)(5)
(D) (1)(4)
(E) (1)(3)(5)
29. Pyruvate kinase is allosterically regulated by several effectors. Which of the following statements is **true**?
(A) Phenylalanine does not change the conformation of pyruvate kinase
(B) AMP decreases the catalytic efficiency of pyruvate kinase
(C) ATP increases the catalytic efficiency
(D) Fructose 1,6-bisphosphate decreases the K_M of pyruvate kinase
(E) Acetyl-coA increases the k_{cat} of pyruvate kinase
30. Glycosaminoglycans are involved in many extracellular functions. Which glycosaminoglycan is a natural anticoagulant?
(A) Dermatan sulfate
(B) Heparin
(C) Hyaluronate
(D) Keratan sulfate
(E) Chondroitin-4-sulfate
31. Researchers found a large and polar metabolite X is highly enriched in the extracellular matrix and has a low concentration inside cells. New evidence suggests that the metabolite X is transported from the cell to the extracellular matrix. Based on these findings, what is the possible transport mechanism?
(A) passive transport
(B) facilitated transport driven by ATP hydrolysis
(C) primary active transport powered by an ion gradient
(D) secondary active transport and the same transporter transports proton into the cell
(E) secondary active transport and the same transporter transports sodium out of the cell
32. Eukaryotic proteins are targeted for proteasome mediated degradation by the ubiquitin system. Which of the following statement about the ubiquitin system is FALSE?
(A) Ubiquitin is attached to the target protein via an isopeptide bond.

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- (B) E1 enzyme is attached to ubiquitin by consuming ATP.
 (C) Ubiquitin is transferred from E1 to a lysine residue on E2.
 (D) E3 ligase determines the substrate specificity.
 (E) Proteins with N-terminal aspartic or glutamic acid show a tRNA requirement for degradation.
33. If the following peptide sequences can form an alpha-helix, which sequence forms an amphipathic helix with basic residues on one side?
- (A) KRWMKVAKRILKRWMHP
 (B) ADVGSLVAADVQNRAP
 (C) DNLLSTNCRDLLVYWSS
 (D) DEVEDLVEELADEIDDP
 (E) STDRLKWAALKHSCEDEK
34. Which of the following antibiotics does not act as a protein synthesis inhibitor?
- (A) streptomycin
 (B) puromycin
 (C) ricin
 (D) vancomycin
 (E) cycloheximide
35. Which kind of inhibitor increases the apparent affinity of the enzyme for the substrate?
- (A) competitive inhibitor
 (B) pure noncompetitive inhibitor
 (C) uncompetitive inhibitor
 (D) irreversible inhibitor
 (E) reversible inhibitor
36. Is this a single-stranded RNA or DNA? And what is the sequence?



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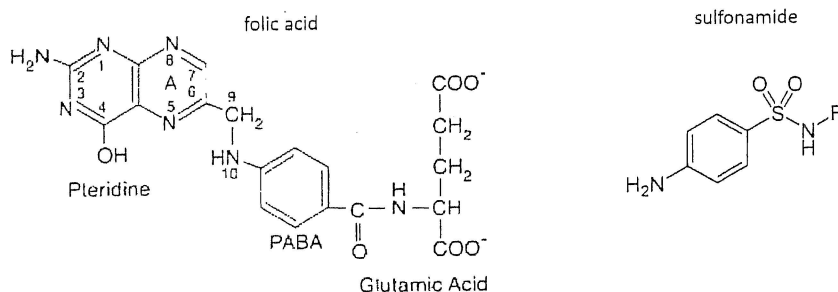
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- (A) DNA, 5' ATGA 3'
 (B) RNA, 5' AUGA 3'
 (C) DNA, 5' GTCG 3'
 (D) RNA, 5' GUAG 3'
 (E) DNA, 5' AGTA 3'
37. Which of the following phospholipases and their cleavage products are correctly paired?
- (1) Phospholipase A1, diacylglycerol
 (2) Phospholipase A2, lysophosphatidic acid
 (3) Phospholipase C, inositol phosphate
 (4) Phospholipase D, diacylglycerol
 (5) Sphingomyelinase, ceramide
- (A) 13
 (B) 34
 (C) 25
 (D) 235
 (E) 134
38. GTPases have a slow nucleotide hydrolysis rate. Which of the following statements about GTPases is TRUE?
- (A) Guanine nucleotide exchange factor (GEF) proteins promote GTP dissociation from GTPases.
 (B) Ras GTPase activating proteins (GAP) reduce the k_{cat} of Ras.
 (C) G protein coupled receptor (GPCR) proteins prefer binding to the GTP-bound $G_{\alpha\beta\gamma}$.
 (D) Regulator of G protein signaling (RGS) proteins stabilize the transition state of G_{α} to enhance GTP hydrolysis.
 (E) Ras GTPase activating proteins (GAP) increase the K_M of Ras.
39. Which of the following statements about steroid hormones is **incorrect**?
- (A) Some steroid hormones can bind to receptors on the cell membrane to regulate ion channels.
 (B) There are two -OH groups in androgen and only one -OH in estrogen.
 (C) Steroid hormones are mainly derived from cholesterol.
 (D) Many steroid hormones enter the cell and act as a transcriptional regulator.
 (E) Steroid hormones are important regulators of inflammation, sexual function, as well as water and salt balance.

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40. Which of the following statements about Shine-Dalgarno sequence is **correct**?
- (A) It is the RNA polymerase binding site in the promoter of eukaryotic genes.
 (B) This sequence is complementary to the sequence at the 3' end of 16S rRNA.
 (C) This sequence usually contains the translation initiation codon.
 (D) It is the site of ribosome release after translation is complete.
 (E) It is the name of one of the three termination codons in mRNA.
41. Which of the following statements about AMP-activated protein kinase (AMPK) is **incorrect**?
- (A) AMPK activity is allosterically regulated by AMP and ATP.
 (B) Binding of AMP to AMPK promotes the phosphorylation of the enzyme, and thus enhances the enzyme activity.
 (C) Regulation of AMPK activity involves a pseudosubstrate sequence, which is a molecule structurally related to AMP.
 (D) Metformin, an anti-diabetic drug, exerts its effects through AMPK activation.
 (E) One of the effects of AMPK activation is stimulation of fatty acid oxidation.
42. Misfolded proteins in the cell are commonly sent to the proteasome for degradation. Which of the following statements about proteasome is **correct**?
- (A) In the cell, the proteasome is usually encapsulated in the lysosome.
 (B) The 26S proteasome of eukaryotic cells is better at breaking down proteins with less than 4 ubiquitins than those with more ubiquitins.
 (C) The core part of the 26S proteasome is the 20S tubular structure, which is responsible for catalyzing the breakdown reaction of proteins.
 (D) The 20S component also possesses an ATPase activity, which is used to provide the catalytic energy required for decomposing the target protein.
 (E) The 19S portion of the 26S proteasome is responsible for adding ubiquitin to the protein to be broken down.
43. Folic acid is required for nucleotide synthesis. Which of the following statements about folic acid is **incorrect**?



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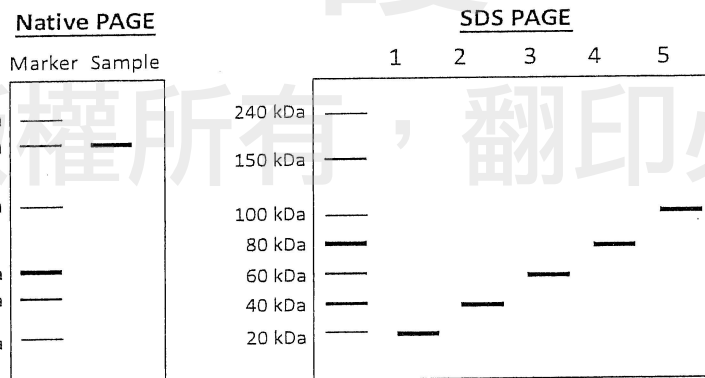
- (A) Folic acid is a cofactor in many metabolic reactions involving one-carbon (methyl-, methylene-, formyl-) functional groups.
- (B) These one-carbon functional groups are usually modified at the N5 or N10 position of folic acid.
- (C) Sulfonamide inhibits bacterial growth by inhibiting the formation of para-amino benzoic acid (PABA), a precursor of folic acid.
- (D) Tetrahydrofolate is the activated form of folic acid. The hydrogens are normally added to N5, C6, C7, and N8 of folic acid.
- (E) The cancer chemotherapeutic drug methotrexate is similar in structure to folic acid and can inhibit the synthesis of tetrahydrofolate.
44. Which of the following statements about glycogen synthesis is **incorrect**?
- (A) The initiation of glycogen synthesis is the attachment of the first glucose to the OH group of a tyrosine on a protein named glycogenin.
- (B) A chain of about seven $\alpha(1\rightarrow4)$ linked glucose molecules are typically formed by glycogenin.
- (C) Glycogen synthase uses UDP-glucose as a substrate and transfers the glucosyl residue onto the non-reducing end of the glycogen chain.
- (D) Branches of glycogen are made by an amylo-transglycosylase that catalyzes the transfer of a string of seven $\alpha(1\rightarrow4)$ linked glucosyl units of a glycogen chain to the C-2 position on a glucose of the same or a neighboring glycogen chain.
- (E) UDP-glucose is synthesized from UTP and glucose-1-phosphate by enzyme glucose-1-phosphate uridylyltransferase.
45. The $G\alpha$ subunit of GTP-binding proteins in G protein-coupled receptors (GPCRs) commonly has the following characteristics, except
- (A) Hormone binding to its target GPCR can stimulate $G\beta\gamma$ to release $G\alpha$ into the cytoplasm.
- (B) GDP binding to the $G\beta\gamma$ components is essential for the release of $G\alpha$.
- (C) Certain types of $G\alpha$ subunit can bind to adenylate cyclase and activate this enzyme to produce cAMP.
- (D) $G\alpha$ subunits typically possess relatively weak GTP hydrolysis activity.
- (E) GTP hydrolysis results in dissociation of $G\alpha$ -adenylate cyclase complex.
46. Many enzyme-catalyzed reactions involved the formation of low-barrier hydrogen bonds (LBHB). Which of the following statements about LBHB is **incorrect**?
- (A) The hydrogen atom is equally distributed between the two heteroatoms (oxygen).

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- (B) The bond order approaches 0.5 for both O-H interactions.
- (C) As the distance between the heteroatoms gets smaller, the H bonds become weaker.
- (D) The barriers that must be overcome to exchange hydrogen atoms for oxygen become lower.
- (E) The pKa values of the two heteroatoms should be similar.
47. The protonated form of the side chain in _____ has a pKa of approximately 6.0 and therefore the amino acid is often used in general acid-base catalysis.
- (A) Arginine
- (B) Aspartate
- (C) Glutamate
- (D) Lysine
- (E) Histidine
48. The most rapid method to regenerate ATP molecules during exercise is through the breakdown of:
- (A) glucose
- (B) glycogen
- (C) fatty acid
- (D) phosphocreatine
- (E) triacylglycerol
49. The native PAGE for a purified protein sample is shown below. Which lanes are likely to be the SDS PAGE profile for this protein?



- (A) 2, 5
- (B) 4
- (C) 3, 5
- (D) 1, 2, 4
- (E) 3, 4

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50. Hypoxia condition is a common microenvironment within tumor. Hypoxia might attenuate mitochondrial activity resulting to increased production of lactate. Based on your knowledge, which of the following statements can explain the mechanism correlated hypoxia condition and the production of lactate?
- (A) Low ATP production might increase phosphofructokinase activity leading to increase lactate production.
 - (B) Low ATP production promotes glycogen synthesis leading to inactivation of glycolysis.
 - (C) High ATP production promotes the carboxylation of pyruvate leading to gluconeogenesis.
 - (D) High ATP production inactivates hexokinase leading to decreased of glycolysis.
 - (E) None of the above.
51. Pyruvate kinase is one of the regulatory enzymes within glycolytic pathway. However, the genetic deficient of this enzyme might affect the normal function of red blood cells. Which of the following scenarios is likely to be observed for pyruvate kinase deficient?
- (A) The red blood cells contain high level of NADH.
 - (B) The red blood cells contain low level of 2,3-biphosphoglycerate.
 - (C) High lactate concentration in blood.
 - (D) The hemoglobin significantly loss its affinity to bind oxygen.
 - (E) The TCA cycle in blood cells will be significantly activated.
52. Which enzyme in the pentose phosphate pathway uses thiamine pyrophosphate as a cofactor?
- (A) glucose-6-phosphate dehydrogenase
 - (B) gluconolactonase
 - (C) 6-transketolase gluconate dehydrogenase
 - (D) transketolase
 - (E) phosphopentose isomerase
53. Which of the following enzyme is tightly located in the outer mitochondrial membrane?
- (A) succinate dehydrogenase
 - (B) voltage-dependent anion channel
 - (C) carnitine transporter
 - (D) malate dehydrogenase
 - (E) fumarase

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54. A patient with defect of pyruvate dehydrogenase will expect to suffer which of the following symptom?
- (A) alkalosis
 - (B) low serum alanine
 - (C) low serum pyruvate
 - (D) low serum glutamic-oxaloacetic transaminase
 - (E) high serum lactate
55. Which electron transport chain protein is the inhibitory target of rotenone?
- (A) succinate-coenzyme Q reductase
 - (B) CoQH₂-cytochrome c reductase
 - (C) NADH ubiquinone oxidoreductase
 - (D) cytochrome c oxidase
 - (E) none of the above
56. Which of the following amino acid shares the same biosynthesis pathway of purine synthesis?
- (A) Glutamate
 - (B) Histidine
 - (C) Phenylalanine
 - (D) Cystine
 - (E) Lysine
57. Lesch-Nyhan syndrome is a rare inherited disorder. This disease leads to increased uric acid in all body fluids. In the view of metabolism, the disease is caused by the deficient of
- (A) xanthine oxidase
 - (B) uricase
 - (C) xanthine oxidoreductase
 - (D) hypoxanthine-guanine phosphoribosyl transferase
 - (E) guanine deaminase
58. Which of the following DNA polymerase can be found in the eukaryotic mitochondria and is essential for mitochondrial replication?
- (A) DNA polymerase II
 - (B) DNA polymerase III
 - (C) DNA polymerase-alpha
 - (D) DNA polymerase-beta
 - (E) DNA polymerase-gamma

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59. All of the following statements regarding prokaryotic ribosome are true EXCEPT:
- (A) Prokaryotic ribosomes are composed of 35% rRNA and 65% ribosomal proteins in weight.
 - (B) Prokaryotes have 70S ribosomes consisting of a 30S subunit and a 50S subunit.
 - (C) Prokaryotic ribosomal proteins can be used for bacterial identification.
 - (D) The small subunit has the decoding function, whereas the large subunit catalyzes the formation of peptide bonds
 - (E) Ribosomal proteins are general basic.
60. Post-translational modification refers to the enzymatic modification of proteins covalently following protein biosynthesis. Which of the following instrument is the most efficiently to be used for post-translational modification detection?
- (A) Nuclear magnetic resonance spectrometry
 - (B) X-ray diffraction
 - (C) Infrared spectroscopy
 - (D) Mass spectrometry
 - (E) Liquid chromatography

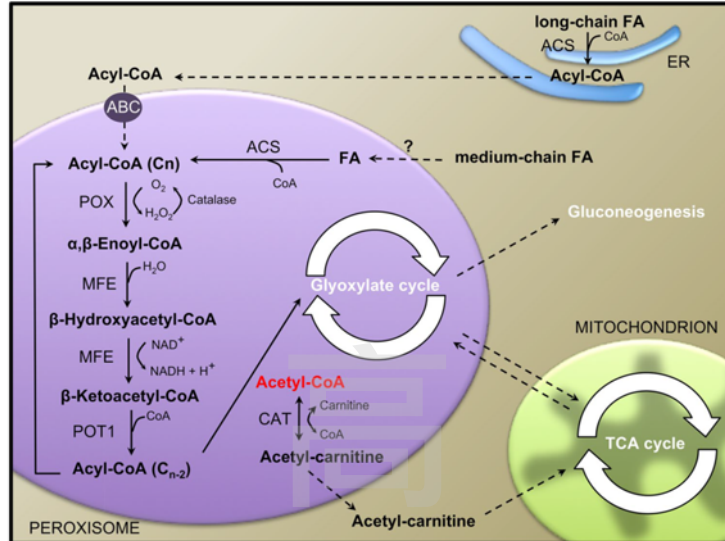
國立清華大學 112 學年度學士後醫學系考試 各科試題參考答案

科目名稱:【0102 生物與生化】

題號	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
答案	B	E	D	D	C	A	E	D	E	E	A	B	A	D	C
題號	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
答案	E	D	D	C	D	E	D	D	A	A	B	D	B	D	B
題號	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
答案	D	C	A	D	C	A	D	D	B	B	C	C	C	D	B
題號	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
答案	C	E	D	D	A	D	D	B	E	C	B	D	E	A	D

國立清華大學 112 學年度學士後醫學系招生考試試題答案疑義釋疑公告

科目	題號	釋疑答覆	釋疑結果
0102 生物與生化	22	<p>ECG 為復合波，心室去極化開始在 QRS-T segment。</p> <p>Action potential phases 0: Upstroke 1: Early-fast repolarization 2: Plateau 3: Repolarization 4: Diastole</p> <p>ECG Callouts: P-Wave: Depolarization of atria in response to SA node triggering. PR Interval: Delay of AV node to allow filling of ventricles. QRS Complex: Depolarization of ventricles, triggers main pumping contractions. ST Segment: Beginning of ventricle repolarization, should be flat. T-Wave: Ventricular repolarization</p>	維持原答案 (D)
	23	<p>(C) 在動物細胞中，peroxisomes 通過 β-氧化作用氧化脂肪酸，long chain and very long chain fatty acids (LCFAs and VLCFAs) 優先被過氧化物酶體氧化。J Biol Chem. 1999 Jul 2;274(27):19228-36 ; Proc. Natl. Acad. Sci. U. S. A., 73 (1976), pp. 2043-2046 ; Annu. Rev. Nutr., 14 (1994), pp. 343-370 ; Neurochem. Res., 24 (1999), pp. 551-563。</p>	維持原答案 (D)



World J Microbiol Biotechnol (2017) 33:194。

(D) Endoplasmic Reticulum - the production of lipids and proteins

26

題目提及活化的 T 細胞會合成分泌大量 IL-2，IL-2 作用在自身上為 T 細胞增殖所需，這個現象稱為 Autocrine action。T 細胞活化需要樹突細胞提供 2 個訊號：(1) MHC:peptide (DC) to TCR (T)；(2) CD80/CD86 (DC) to CD28 (T)。

維持原答案 (B)

27

Stem cell-like cancer cell(幹細胞樣癌細胞)，同時具有幹細胞和癌細胞的特徵，並保有自我更新和分化能力。細胞能跳脫細胞週期限制而不斷增生，不能就被稱為 Stem cell-like。

原題目指出定序後發現 p53 單一胺基酸改變，p53 可能失去正常功能或獲得非預期功能進而促使癌症產生，能促使癌細胞適應自身與環境壓力及增加存活。

最為合適的答案為(A)、(C)

在 *Membranes* 2022, 12(2), 202 ; *Front Oncol.* 2020; 10: 595187 也指出：Mutant p53 通過改變正常的細胞分泌組，藉由旁分泌/自分泌信號、ECM 重塑、吸引基質細胞進入癌組織等機制協助促癌腫瘤微環境的建立。因此(B)也可。

(A)、(B)、(C) 均可

44

答案(B)是問 glycogenin 可以形成約七個葡萄糖的鏈。考生提出的證據是指後續如要增加醣鏈的長度

維持原來的答案(D)

	時，需要原有多少個醣的醣鏈，跟題目的原意不同。 原來答案沒有問題(考生可參考如 Wikipedia 的 glycogenin)。	
45	同意考生的提問	(A)或(B) 均可
49	在 Native PAGE 中觀察到的蛋白質為 160 kDa。如果該蛋白質由一個 60 kDa 和一個 100 kDa 的 subunit 組成，則在 SDS PAGE 上可以觀察到 <u>同一條 lane 中有兩條 band，分別位於 60 kDa 和 100 kDa 位置。</u>	維持原答案 (D)

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生物學

張劍鴻(張芸潔)老師提供

清華大學 112 學年度 學士後醫學系 生物試題命題範疇分析

- ◆ 在清華大學後醫系連兩年的生物與生化試卷中，生物試題均一半的配分比，題目難易適中，唯今年度的第20題為新生兒病理學領域、第22題為臨床心電圖領域，超過生物學太多，不易得分。
- ◆ 30 題的試題中，多數為生物學課本 Campbell 的生物領域概念，若能循正規的方式準備，確實熟悉Campbell生物學之概念，該75分要有60以上的表現並不困難。

生物各試題命題範疇分析

1	Unit 8 演化學	Separation, 完全命中 正課講義: Chap34 物種起源, page 58-65 複習課程: Unit 8 Evolution, page 19-21
2	Unit 8 演化學	Sexual selection, 完全命中 正課講義: Chap33 演化機制, page 86-87 複習課程: Unit 8 Evolution, page 18
3	Unit 2 動物生理學	Rhodopsin, 完全命中 正課講義: Chap 7 感覺, page 87-89 複習課程: Unit 2 Animal Physiology, page 15
4	Unit 2 動物生理學	Glial cells, 完全命中 正課講義: Chap 5 神經元和突觸, page 13 複習課程: Unit 2 Animal Physiology, page 9
5	Unit 2 動物生理學	Autonomic nervous system, 完全命中 正課講義: Chap 6 神經系統, page 105-109 複習課程: Unit 2 Animal Physiology, page 12

6	Unit 2 動物生理學	Oxytocin, 完全命中 正課講義: Chap 10 內分泌, page 50-51 複習課程: Unit 2 Animal Physiology, page 33
7	Unit 2 動物生理學	Pituitary gland, 完全命中 正課講義: Chap 10 內分泌, page 60-63 複習課程: Unit 2 Animal Physiology, page 33
8	Unit 2 動物生理學	Mammalian excretory system, 命中 正課講義: Chap 12 排泄系統, page 94-99 複習課程: Unit 2 Animal Physiology, page 41-48
9	Unit 8 演化學	Separation, 完全命中 正課講義: Chap34 物種起源, page 51-56 複習課程: Unit 8 Evolution, page 21
10	Unit 9 生態學	Phosphorus cycle, 完全命中 正課講義: Chap38_生態系, page 19 複習課程: Unit 9 Ecosystems, page 12
11	Unit 9 生態學	Nitrogen cycle, 完全命中 正課講義: Chap38_生態系, page 19 and 40 複習課程: Unit 9 Ecosystems, page 12
12	Unit 6 微生物免疫學	Protists, 完全命中 正課講義: Chap27 微生物, page 198-199 複習課程: Unit 6 Microbiology and Immunology, page 30
13	Unit 6 微生物免疫學	Insect borne diseases, 完全命中 正課講義: Chap27 微生物, page 125 複習課程: Unit 6 Microbiology and Immunology, page 23
14	Unit 1 細胞生物學	Intercellular junctions, 完全命中 正課講義: Chap 1 細胞構造和功能, page 58 複習課程: Unit 1 Cell Biology, page 4
15	Unit 6 微生物免疫學	COVID-19 virus, 完全命中 正課講義: Chap27 微生物, page 137 複習課程: Unit 6 Microbiology and Immunology, page 22
16	Unit 6 微生物免疫學	Gram-negative bacteria, 完全命中 正課講義: Chap27 微生物, page 26 複習課程: Unit 6 Microbiology and Immunology, page 15

17	生化範疇	
18	生化範疇	
19	Unit 6 微生物免疫學	Toll-like receptor, 完全命中 正課講義: Chap 26 感染之防禦, page 18 複習課程: Unit 6 Microbiology and Immunology, page 3
20	Unit 2 動物生理學	Patent Foramen Ovale, 先天性心臟病範疇, 是首次出現的入學考試概念。
21	Unit 5 生物科技	CRISPR-Cas9 system, 完全命中 正課講義: Chap 24 DNA 科技, page 74-78 複習課程: Unit 5 Biotechnology, page 6
22	Unit 2 動物生理學	ECG, 偏刁專的心電圖概念。 正課講義: Chap 9 運輸系統, page 46-47 複習課程: Unit 2 Animal Physiology, page 24
23	Unit 1 細胞生物學	Endoplasmic reticulum, 完全命中 正課講義: Chap 1 細胞構造和功能, page 26-30 複習課程: Unit 1 Cell Biology, page 2-3
24	Unit 4 分子生物學	Norm of reaction, 完全命中 正課講義: Chap 19 孟德爾, page 66 複習課程: Unit 4 Molecular Biology, page 14
25	Unit 2 動物生理學	CO ₂ transport, 完全命中 正課講義: Chap 9 運輸系統, page 148 and 155 複習課程: Unit 2 Animal Physiology, page 31
26	Unit 6 微生物免疫學	Interleukin-2, 命中 正課講義: Chap 26 感染之防禦, page 61 複習課程: Unit 6 Microbiology and Immunology, page 14
27	Unit 4 分子生物學	RNA splicing- for split genes, 完全命中 正課講義: Chap 23 基因表現控制, page 101-102 複習課程: Unit 4 Molecular Biology, page 38
28	生化範疇	
29	生化範疇	
30	Unit 2 動物生理學	Heparin, 命中 正課講義: Chap 9 運輸系統, page 99

31	Unit 1 細胞生物學	Active transport, 完全命中 正課講義: Chap 2 細胞膜, page 38-42 複習課程: Unit 1 Cell Biology, page 9
32	生化範疇	
33	生化範疇	
34	Unit 6 微生物免疫學	Vancomycin, 完全命中 正課講義: Chap 27 微生物, page 55
35	Unit 3 生物化學	Uncompetitive inhibitor, 命中 正課講義: Chap 15 生物巨分子, page 127 複習課程: Unit 3 Biochemistry, page 8
36	生化範疇	
37	生化範疇	
38	生化範疇	
39	生化範疇	
40	生化範疇	
41	生化範疇	
42	生化範疇	
43	生化範疇	
44	生化範疇	
45	生化範疇	
46	生化範疇	
47	生化範疇	
48	Unit 2 動物生理學	Homeostasis, 完全命中 正課講義: Chap 8 運動, page 62
49	Unit 5 生物科技	SDS PAGE, 命中 正課講義: Chap 24 DNA 科技, page 18
50	生化範疇	
51	生化範疇	

52	生化範疇	
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生化概論

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18. Ans: D

[解析] 素食者常缺乏 vitamin B12 (B12 source: animal foods)

28. Ans: B

[解析]

1. Absorption at 280nm : **Tyr (2) and Trp (3)**
2. Absorption at 257nm: **Phe (5)**

29. Ans: D

[解析] Pyruvate kinase is activated by F-1,6-BP (Km decreased)

32. Ans: C

[解析]

1. (C)修正: Ubiquitin is transfer to a **cysteine** residue of E2
2. (E)說明: N-ter Glu of protein + Arg-**tRNA** → New N-ter Arg of protein

33. Ans: A

[解析] (A): α -helix 每一圈有 3.6 胺基酸, 所以每隔 3-4 就會出現 basic amino acids (K, R, H), 如此排列就有機會產生 amphipathic helix

37. Ans: D

[解析]

題號	修正
(1)	PLA1, 1-lysophosphatidaic acid
(4)	PLD, phosphatidic acid

39. Ans: B

[解析]

1.

題號	修正
(B)	Two -OH groups in androgen and estrogen.
2. Textbook: steroid receptor = nuclear receptor, 但有發現某些可接 membrane receptor to regulate ion channel*.
(*Javier Camacho *et al.*, Ion channel regulation by sex steroid hormones and vitamin D in cancer: a potential opportunity for cancer diagnosis and therapy, *Frontier in Pharmacology*, volume 11, Feb/2020, article 152)

41. Ans: C

[解析] Pseudosubstrate sequence:

- 1) A sequence binding to the active site in the same molecule
- 2) Pseudosubstrate sequence also called autoinhibition domain in the protein kinase. 故和受質 AMP 結構無關

42. Ans: C

[解析]

題號

修正

-
- (A) Proteasomes present in **cytosol and nucleus**.
- (B) Protein degradation signal is **more than 4 ubiquitin**-conjugated signal.
- (A) The **19S** subunit with ATPase for **unfolding** the poly-ubiquitinated protein
- (B) The **20S** with peptidase is responsible for protein degradation.

44. Ans: D

[解析]

1. (D)修正: Transfer to **C-6** of glucose at branch point of glycogen.
2. (E)說明: **UDP-glucose pyrophosphorylase*** also referred to **glucose-1-phosphate uridylyltransferase**

(*J.B. Thoden and H. M. Holden, The molecular architecture of glucose-1-phosphate uridylyltransferase, Protein Science, volume 16, 2007, p.432)

46. Ans: C

[解析] (C)修正: As the distance between the heteroatoms get smaller, the H bonds become **stronger**.

47. Ans: E

[解析]

Amino acid	pK _R (side chain pKa)
(A) Arginine	~12.5
(B) Aspartate	~3.9
(C) Glutamate	~4.3
(D) Lysine	~10.5
(E) Histidine	6.0

49. Ans: D

[解析]

1. 本題原意: 有一 protein 其分子量約 160KD (total Mr), 若使用 SDS-PAGE 分析可能出現什麼結果?

因 SDS 會變性蛋白所以可能出現:

(1) **Monomer**: $M_r = 160 \text{ KD} \times 1$

(2) **Dimer**: $M_r = 160 = 2 \times 80$ (**lane 4**)

(3) **Tetramer**: $M_r = 160 = 4 \times 40$ (**lane 2**)

(4) **Octamer**: $M_r = 160 = 8 \times 20$ (**lane 1**)

2. 但是 native PAGE 無法求取 M_r (relative molecular mass),
因 native PAGE 分析原理之變因太多(charge, size and shape)
故無法求取 M_r , 因此嚴格而言本題無法解

52. Ans: D

[解析] TPP-dependent enzymes:

1) **Transketolase (D)**

2) E1 of dehydrogenase complex:

pyruvate dehydrogenase complex;

α -ketoglutarate dehydrogenase complex;

BCAA α -ketoacid dehydrogenase complex

3) Pyruvate decarboxylase

55. Ans: C

[解析] Rotenone inhibits the complex I (also called NADH-CoQ oxidoreductase)

57. Ans: D

[解析] Lesch-Nyhan syndrome: defect of **HGPRT**

60. Ans: D

[解析] 利用分子量來得知 enzyme 身加上哪種分子

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