

Please choose the most appropriate terms/phrases/statements that complete or answer the questions. Attention: More than one of the choices provided may be correct.

(2.5 points for each question)

- Which one of the following descriptions are **CORRECT** ?
 - There is only one or two antigen determining sites on a big and complex protein molecule.
 - Haptens are small molecules which generally are not capable of invoking immune response by themselves in animals
 - Metabolomics is an analytical technique for measuring and comparing large numbers of metabolites with a molecular weight larger than 1500 dalton
 - NMR spectroscopy or LC-MS could be used as analytical techniques in metabolomics.
 - Metabolomics are the techniques which are used to study an entire set of transcripts in an organism.
- Please choose the following techniques which are generally used in studying proteomics?
 - ELISA
 - NMR
 - LC-MS/MS
 - Western blot
 - 2-D electrophoresis
- Which reaction in the citric acid cycle (TCA cycle) can produce ATP?
 - from citrate to isocitrate
 - from α -ketoglutarate to succinyl CoA
 - from succinyl CoA to succinate
 - from fumarate to malate
 - from malate to oxaloacetate
- The possible final products of fermentation (anaerobic reaction) in animal cells or yeast could be.
 - CO₂
 - NAD⁺
 - lactate
 - alcohol (ethanol)
 - H₂O.
- Which of the following works make the scientists to be awarded the Nobel Prize?
 - Genome editing with CRISPR/Cas9 system
 - Identification of programmed cell death protein 1 (PD-1) in cancer therapy
 - Taqman probe in real time quantitative PCR
 - Reprogramming the mature cells into pluripotent stem cells (iPS cells)
 - Phage display of peptide and antibodies

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6. Choose the descriptions which are **NOT CORRECT**:
- (A) *DNA methylation on the promoter region* is commonly associated with downregulation of *gene expression*.
 - (B) Promoter is a region at the gene where the transcriptional machinery binds.
 - (C) Enhancers are the units of regulatory sequences which spread thousands of nucleotides from only the upstream of promoter.
 - (D) Insulators are found between enhancers and some promoters to block activation of the promoter by activators.
 - (E) The function of histone acetyl transferases is adding acetyl groups to histones tails, allowing the histones to wrap the DNA more tightly.
7. Which of the following descriptions about Apoptosis are **CORRECT**?
- (A) It is a kind of programmed cell death in response to extracellular or intracellular stresses.
 - (B) Cells swell and form apoptotic body at the end of apoptosis.
 - (C) There are external and internal pathways in apoptotic signal transduction, and both activation processes converge to a common protein, caspase 9, to finally induce apoptosis.
 - (D) DNA is cleaved into small fragments with around 180 to 200 bp in size.
 - (E) Both apoptosis and autophagy share most of the regulatory mechanisms.
8. Which of the following descriptions for metal or heavy metal exposure is/are **CORRECT**?
- (A) Blood and urine concentrations usually are reflective of more recent exposures and correlate with acute adverse effects
 - (B) Hair can be useful in assessing variations in exposure to metals over the period of its growth
 - (C) The biological half-lives of arsenic in bone are 20–30 years
 - (D) The half-life of lead in blood is only a few weeks
 - (E) After inhalation of mercury vapor, at least two half-lives describe the retention in brain
9. Which of the following unit of the radiation activity is/are **CORRECT**?
- (A) The units of measurement for radioactivity are the becquerel (Bq, international unit) and the curie (Ci, U.S. unit)
 - (B) The unit used for effective dose is sievert (Sv, international unit) or rem (U.S. unit)
 - (C) A millisievert is one hundred of a sievert
 - (D) The unit for absorbed dose is the gray (Gy, international unit) or the rad (U.S. unit)
 - (E) One gray is defined as 1 joule of energy released in 1 g of tissue
10. Which of the following is/are **NOT** the protein(s) produced by fat cells under direction of the *ob* gene that can decrease appetite and increase energy expenditure?
- (A) Adiponectin
 - (B) Biotin
 - (C) Fatty acid-binding protein
 - (D) Klotho
 - (E) Leptin

11. Which of the following environment pollutants are endocrine-disrupting chemicals?
- (A) Bisphenol A
 - (B) Benzo(a)pyrene
 - (C) β -naphthoflavone
 - (D) Polychlorinated biphenyls
 - (E) 2,3,7,8-tetrachlorodibenzo-p-dioxin
12. The compound is/are formed in foods that are high in carbohydrate, but low in protein, which are subjected to processing temperatures of at least 120°C. The presence of ammonium bicarbonate as a leavening agent increases the formation of the compound. Which of the following is/are the compound?
- (A) Acyclovir
 - (B) Acrylamide
 - (C) Benzo[a]pyrene
 - (D) Furans
 - (E) Polychlorinated biphenyls
13. Which of the following is/are the occupational exposure agent classified by International Agency for Research on Cancer (IARC) as group 1 definite human carcinogen?
- (A) Beryllium
 - (B) Di(2-ethylhexyl)phthalate
 - (C) 2-Naphthylamine
 - (D) Soot
 - (E) Wood dust
14. Which of the following is/are NOT CORRECT about the core components of Metabolic Syndrome ?
- (A) Increased central obesity
 - (B) Insulin resistance
 - (C) Decreased fasting insulin (Type 1 diabetes)
 - (D) Increased blood urea nitrogen and creatinine levels
 - (E) Increased serum triglycerides and hypertension
15. Regarding to the nuclear receptor coactivators which statement(s) is (are) **CORRECT**?
- (A) The coactivator might contain the histone acetyl transferase (HAT) domain
 - (B) The coactivator may contain the RNA binding domain
 - (C) The mechanisms and activity could be the tissue-specificity to hormone-responses.
 - (D) The coactivators are unique and specific to a specific nuclear receptor.
 - (E) The co-activator might contribute to the regulation of gene expression.
16. Regarding to the applications of fluorescence labeled monoclonal antibody which statement(s) is (are) **CORRECT**?
- (A) To isolate sub-population of cells via flow cytometry

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- (B) To identify specific RNA expression via real time Q-PCR
 - (C) To identify specific protein for immunofluorescence (IF) image.
 - (D) To quantify the protein level via Western blotting
 - (E) To identify a specific DNA adduct
17. What are the paired colors to show the colocalization of two fluorescent probes or two pseudo-colors in a specimen?
- (A) Alexa Fluor 488 and Cy3: orange and yellow
 - (B) eGFR and DsRed: Blue
 - (C) Blue and Red: Magenta
 - (D) Blue and Green: Cyan
 - (E) Green and Red: Yellow
18. Regarding to the high throughput techniques and the "Omics", which pairs are CORRECT?
- (A) RNA-seq: Transcriptomics
 - (B) Bisulfite sequencing: Epigenetics
 - (C) Image-based high content analysis (HCA): Cytomics
 - (D) LC-MS/MS: Proteomics
 - (E) Q-PCR: Phosphoproteomics
19. Regarding to the statements of the onco-immunology (IO), which are CORRECT?
- (A) PD1/PDL1 is the immune checkpoint pathway
 - (B) Antibody to stimulate the PD1 has shown the therapeutic benefit for cancer patients
 - (C) Activation or up-regulation of PDL1 in tumor cells could inhibit the T-cell activation
 - (D) Lower level of PDL1 in tumor tissues might show the better outcome of patients with cancer immunotherapy (e.g., Pembrolizumab)
 - (E) The adverse effects of the cancer immunotherapies include interstitial pneumonitis
20. Which is (are) the RNA virus (has RNA as its genetic material)?
- (A) Human Papillomavirus
 - (B) Influenza B virus
 - (C) Severe Acute Respiratory Syndrome Coronavirus 2
 - (D) Hepatitis B virus
 - (E) Human Immunodeficiency virus
21. Which abbreviation of the following amino acids are CORRECT?
- (A) Y= Tyrosine
 - (B) Q= Glutamic acid
 - (C) W= Tryptophan
 - (D) E= Aspartic acid
 - (E) K= Lysine

22. Monoclonal antibody (mAb) is a powerful research tool and a drug for treating diseases. Regarding mAb which statements are **NOT CORRECT**?

- (A) mAb can be used to kill tumor cells or to block the binding of viruses or bacteria to host cells
- (B) The development and production of mAb is much cheaper than small molecule inhibitor drugs
- (C) Hybridoma technology is still the only way to generate mAbs
- (D) mAbs for immune checkpoint blockade such as CTLA-4 and PD-1 are successfully used for treating autoimmune diseases
- (E) mAbs can be used to target molecules located on the cell surface and inside the cells

23. Mitochondria are the power plant of the cells that produce ATP for maintain cell homeostasis. Other than bioenergy what else do mitochondria do in the cells.

- (A) Regulate signal transduction
- (B) Regulate apoptosis
- (C) Regulate the functions of immune cells
- (D) Regulate reactive oxygen species
- (E) Regulate metabolism

24. CRISPR-Cas9 is a breakthrough of technology for genome editing. Which statements regarding CRISPR-Cas9 are **NOT CORRECT**?

- (A) Cas9 is an RNase originally identified in bacteria
- (B) CRISPR sequences can be served as a guide to recognize and cleave specific strands of DNA
- (C) The mechanism of CRISPR-Cas9-mediated genome editing is working through dsDNA break and induced repair system in the host cells
- (D) CRISPR-Cas9 can only be used to generate knockout mice but not knockin mice
- (E) CRISPR-Cas9 can target multiple genes at a time

25. Regarding reverse transcriptase, which statements are **NOT CORRECT**?

- (A) It has DNA-dependent RNA polymerase activity
- (B) It has RNA-dependent DNA polymerase activity
- (C) It is an important enzyme for doing polymerase chain reaction (PCR)
- (D) It has no proof-reading activity and therefore is error-prone
- (E) It was originally identified in Adenovirus

26. Molecules involved in cell cycle controls cell growth. Which statements regarding cell cycle are **CORRECT**?

- (A) There are 5 different phases, namely G0, G1, S, G2, and M
- (B) DNA content in both G2 and M phase is twice as much as G1
- (C) There are two major checkpoints namely G1/S and G2/M checkpoints which ensure that everything is ready for DNA synthesis and mitosis, respectively
- (D) CDK is inactive in the absence of cyclin

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(E) DNA damage-induced cell cycle arrest is due to the induction of p53 and its downstream genes such as CDK inhibitors.

27. Signal transduction is the process by which a chemical or physical signal is transmitted through a cell as a series of molecular events. Which of the following statements regarding signal transduction are **CORRECT**?

- (A) Intracellular signals can be triggered by proteins with enzymatic activity such as kinases or phosphatases
- (B) Proteins can be phosphorylated at histidine, tyrosine or serine residues
- (C) Adaptor proteins usually undergo phosphorylation and provide a docking sites for other signal mediators
- (D) Src homology domain 2 (SH2) binds to proline-rich containing proteins
- (E) Calcium is a well-known second messenger

28. Apoptosis is a programmed cell death that plays a key role in physiology and pathology. Which statements regarding apoptosis is **NOT CORRECT**?

- (A) Starvation is a trigger for the extrinsic pathway of apoptosis
- (B) Bcl2 is anti-apoptotic molecule in intrinsic pathway of apoptosis
- (C) Caspase 3 is the initiator caspase for both intrinsic and extrinsic pathways of apoptosis
- (D) Cytochrome c release from mitochondria is a hallmark for intrinsic pathway
- (E) Apoptotic cells will be rapidly engulfed by macrophages and induce inflammation

29. Red-green (RG) color blindness is one of the most common X-linked recessive disorders. If a mother is a carrier of RG color blindness, what would be the probability of her kids to show the symptom?

- (A) 100% for all baby boys
- (B) 50% for all baby boys
- (C) 100 % for baby girls
- (D) 50 % for baby girls
- (E) 0 % for baby girls

30. Biomembrane provides a margin and a fixed environment for a cell or an organelle inside the cell. Which of the following statements regarding biomembrane are **CORRECT**?

- (A) Usually a biomembrane consists of a lipid bilayer with embedded proteins
- (B) The biomembrane of mitochondria and ER are unique in that they have double membranes
- (C) The distribution of phospholipid in the inner and outer leaflet of the plasma membrane is arranged in a symmetric manner
- (D) Autophagy is an adaptation process in which cell components are removed through autophagolysosome which contains double membrane

(E) When cells undergo apoptosis phosphatidyl serine will be exposed to outer leaflet of plasma membrane

31. Which of the following(s) is/are **NOT** the isotype(s) of antibodies?

- (A) IgA
- (B) IgM
- (C) IgH
- (D) IgB
- (E) IgG

32. Which of the following organism(s) is/are **NOT** used as biological model(s) in studying biology *in vivo*?

- (A) Zebra fishes
- (B) Chimpanzees
- (C) Guinea pigs
- (D) Human
- (E) Fruit flies

33. Which of the following description(s) is/are **CORRECT**?

- (A) A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease.
- (B) There are four types of COVID-19 vaccines in clinical trials: whole virus particles, protein subunits, viral vector and nucleic acids.
- (C) COVID-19 is an infectious disease caused by the SARS-CoV-2 virus.
- (D) Bacteria, viruses, fungi, parasitic worms, insects and snakes are all belonged to pathogens.
- (E) Allergy is a kind of immune disease.

34. Which of the following technique(s) need to use monoclonal antibodies?

- (A) Flow cytometry
- (B) Enzyme-linked immunosorbent spot (ELISpot)
- (C) Polymerase chain reaction (PCR)
- (D) Immunoprecipitation (IP)
- (E) Western blotting

35. Which of the following technique(s) can be used to detect genes?

- (A) Western blotting
- (B) Southern blotting
- (C) Polymerase chain reaction (PCR)
- (D) Gel electrophoresis
- (E) High performance liquid chromatography (HPLC)

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36. Which of the following cell type(s) is/are NOT immune cells?
- (A) Nature killer cells
 - (B) B cells
 - (C) Macrophages
 - (D) Fibroblasts
 - (E) Adipocytes
37. Which of the following strategies can be used to control cancer?
- (A) Antibiotic treatment
 - (B) Surgery
 - (C) Immune checkpoint blockade
 - (D) Stem cell transplants
 - (E) Dendritic cell vaccines
38. Which of the following response(s) is/are NOT immune response(s)?
- (A) Mitosis
 - (B) Killing cancer cells
 - (C) Nutrition transport
 - (D) Production of antibodies
 - (E) Secretion of inflammatory cytokines
39. Which of the following organ(s) is/are belonged to mucosal system(s)?
- (A) Lung
 - (B) Liver
 - (C) Gut
 - (D) Nose
 - (E) Kidney
40. Which of the following technique(s) can be used to edit genome?
- (A) Reverse transcript polymerase chain reaction
 - (B) Gel shift
 - (C) Electrophoresis
 - (D) CRISPR/Cas9
 - (E) Restriction enzyme digestion