AKFA UNIVERSITY

Entrance Exam Paper

Subjects: Biology, Chemistry, Mathematics
Date:
Time:

Do not turn over this cover page
until instructed to do so by the supervisor.

1. You have exactly 2 hours to solve a total of 60 questions. It is at your discretion to allocate the proper amount of time to each of the 3 subjects.

2. All answers must be written using non-erasable blue or black pen. If you make a mistake, you simply draw a double line across the mistake. You are not allowed to use correction fluids. Answers written with a pencil will not be marked.

3. The 2 hour exam session will continue without a break. Nobody is allowed to leave the exam room until the end.

4. You are not allowed to bring anything except ID card (Passport) and pen to exam room.

5. You should not borrow any kind of materials from other examinees. In case your pen runs out of ink, you can request a replacement from the supervisor.

6. Examinees who talk, whisper, look around or look at other examinee's exam paper will be expelled from the exam room.

7. If you are found to have any kind of exam related material and caught cheating, you will be expelled from the exam room.

YOUR ID:＿＿＿＿＿＿＿＿＿＿＿＿＿

Biology

◆ Write your answer in the open box provided for each question. Please, note that answers written outside of the open boxes will not be marked.

1. The following question is about a cellular organelle. Find its name.

It is made from complexes of RNAs and proteins. It has no membrane structure and synthesize proteins via polypeptide binding according to the codons of mRNA

3 points

2. The following question is about homeostasis. Find what A is.

A is the control center of homeostasis. Homeostasis is maintained by A through the nervous and endocrine systems. It operates via negative feedback and antagonism.

3 points

[3-4] Read the following information. And Solve the questions 3 and 4.

- Both parent karyotypes are normal.

- The son, born with fertilization of normal ovum by spermatozoon with nondisjunction, has red-green color blindness and Klinefelter syndrome.

- Other conditions than chromosomal abnormalities and color blindness are not considered.

- Normal allele located on the X is dominant to the allele located on the X' responsible for color blindness.

3. [Color-blindness] Determine whether the father is.

5 points

4. [Nondisjunction] When does a nondisjunction in sperm occur?

6 points

5. Write down how a virus can multiply and adapt to the environment within the host cell.

| |
| |

5 points

6. In genetics, what tool involves the breeding of an individual with a phenotypically recessive individual, in order to determine the zygosity of the former by analyzing proportions of offspring phenotypes?

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| |

3 points

7. Find the mechanism that can be defined by following sentences.

- it is catalyzed by enzymes.
- it releases and consumes energy.
- it is subdivided into catabolism and anabolism.

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| |

5 points

8. What is the mechanism that explains the origins of mitochondria and chloroplasts?

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| |

6 points

9. What is produced by the liver and helps digesting and absorbing fat? (not enzyme)

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| |

5 points

10. The NaK pump moves sodium and potassium ions across cell membrane. How is the energy for the active transport process provided?

| |
| |

6 points

11. Read the following information. What is the probability to give birth to a son affected by A?

- The genetic disease, A, is linked to the X chromosome.

- A is considered recessive.

- The father is not affected and the mother is a carrier.

- Other chromosomal crossovers or mutations are not taken into account.

6 points

12. How is called the primary immune response that occurs when we are exposed to antigens for the first time?

6 points

13. How are called, in photosynthesis, the reactions taking place in the thylakoid membranes that absorbs light energy to create ATP and NADPH?

6 points

14. How is called the maximum population size of a biological species that an environment can sustain indefinitely, given the necessities available?

6 points

15. What is a symbiosis in which members of one species gain benefits while those of the other species neither benefit nor are harmed?

3 points

16. How does the number of chromosomes change during the first stage of meiosis?

5 points

17. If a number of DNA base pair is 100 and there are 45 A (anine), what is the number of G (guanine)? (Use Chargaff law, Watson-Crick model)

6 points

18. What is the physical mechanism responsible for O_2 and CO_2 exchanges between pulmonary alveoli and blood vessels?

6 points

19. What is the phenomenon that explains the evolution of peppered moths in the UK (white before the industrial revolution -> black after -> then white again)?

6 points

20. How is named the kind of cell from which originates animal life?
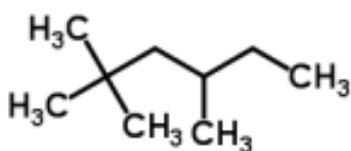

3 points

Chemistry

◆ Write your answer in the open box provided for each question. Please, note that answers written outside of the open boxes will not be marked.

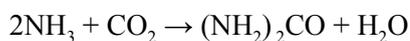1. Identify the oxidizing and reducing agents in the reaction.

$3 SO_2(g) + 2 HNO_3(aq) + 2 H_2O(l) \rightarrow 3 H_2SO_4(aq) + 2 NO(g)$

3 points

2. Give the IUPAC name of the following compounds.

5 points

3. Consider the following reaction:

$2NH_3 + CO_2 \rightarrow (NH_2)_2CO + H_2O$

In one process, 510 g of ammonia (NH_3) are treated with 1100 g of carbon dioxide (CO_2).

What is the mass of reactant that remains unreacted?

(Molar mass: NH_3 : 17, CO_2 : 44, $(NH_2)_2CO$: 60, H_2O : 18)

5 points

4. Write formula of Copper(Ⅱ) bisulfate

3 points

5. Ethylene glycol is 38.7% C, 9.7% H, and 51.6% O by mass.

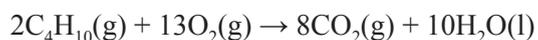(Ethylene glycol molar mass : 62.1g/mol)

What is its molecular formula?

6 points

6. How many milliliters (mL) of a 0.500M KOH solution are needed to neutralize 20.0 mL of a 0.100M H_2SO_4 solution?

6 points

7. Calculate the volume of O_2 (in liters) at STP(0 °C, 1atm) required for the complete combustion of 2.24 L of butane (C_4H_{10}) at STP :

$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$

5 points

8. What is the maximum number of electrons in an atom that can have the following quantum numbers?

n = 3, l = 2 .

6 points

9. Write the electron configuration for Cd^{2+}.

5 points

10. Write Lewis structure for the following molecule.

N_2F_2

6 points

11. How many protons, neutrons and electrons are in the ion below?

$^{23}_{11}Na^+$

3 points

12. Calculate the molarity of a solution made by dissolving 4.0g of sodium hydroxide (NaOH) in enough water to form 250mL of solution.

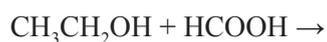Molar mass: Na:23g/mol, O:16g/mol, H=1.0g/mol

5 points

13. Draw geometric isomers of butene. Name each compound.

6 points

14. Predict the product of the following reaction.

$CH_3CH_2OH + HCOOH \rightarrow$
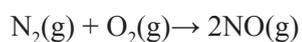

3 points

15. How many grams of copper are deposited on the cathode of an electrolytic cell if an electric current of 3.00 A is run through a solution of $CuSO_4$ for a period of 10.0 min.

6 points

16. Write four factors that influence the rate of a reaction.

6 points

17. The equilibrium constants Kp for the reaction at 2200 °C:

$N_2(g) + O_2(g) \rightarrow 2NO(g)$

If the equilibrium partial pressures of N_2, O_2, and NO are 0.2atm, 0.3atm, and 0.06atm, respectively, what is Kp?

6 points

18. A mixture of gases contains 0.50mol of He, 0.25mol of CH_4, and 0.75mol of N_2.

The total pressure is 3.00 atm. Calculate the partial pressures of the gases.

6 points

19. Write the substances NaCl, He, CH_4, CO, and H_2O in order of increasing boiling point.

(Molar mass : NaCl: 58.44g/mol, He: 4g/mol, CH4: 16g/mol, CO: 28g/mol, H_2O: 18 g/mol)

6 points

20. For the reaction of sodium sulfide (Na_2S) and zinc chloride ($ZnCl_2$), write the net ionic equation.

3 points

Mathematics

◆ Write your answer in the open box provided for each question. Please, note that answers written outside of the open boxes will not be marked.

1. Let x be a real number, and $x^2 - ax - 21 = (x+3)(x+b)$ with a, b constants. Find a and b.

3 points

2. Calculate $\frac{1}{4} - 9 - 2\frac{5}{3}$.

3 points

3. Given the matrix $A = (4\ 5\ -2\ -2\ )$, calculate the inverse matrix A^{-1}

3 points

4. Calculate the following sum.

$$\sum_{k=1}^{10} (k+1)(k-1)$$

3 points

5. Calculate the following limit

$$\frac{x^3+x-2}{x^2-1}$$

3 points

6. Let x be a real number, and $\lim_{x \to 0} \frac{a^x+b}{\ln \ln (x+1)} = \ln \ln 5$ with a,b constants and a>0. Calculate a-b.

7. Let $f(x) = x^2 + ax + b$ with a, b constants. If, $f(1) = 1$, $f'(1) = 3$,

Calculate the value of $f(3)$

5 points

8. Let $f(x) = \int \frac{x-4}{\sqrt{x}-2} dx$ with $f(1) = \frac{5}{3}$. Calculate $f(9)$

5 points

9. if $A = \{1, 3, 4\}$, $B = \{1, 5, 6\}$ are subsets of a universal set $U = \{1, 2, 3, 4, 5, 6\}$

Calculate the sum of elements of the set $\{(A \cup B) \cap (A^c \cup B)\} \cup A$.

5 points

10. Let $x^2 + mx + 15 = 0$ with 2 solutions alpha and beta. Find m (real number) so that beta-alpha=2.

5 points

11. Calculate $\sum_{k=1}^{99} \left(1 + \frac{1}{k}\right)$

6 points

12. An arc of a circle has a length L and radius r. If L+ 2r =8, find the maximum value of sector area and corresponding central angle.

> 6 points

13. Let $f(x) = x(x^2 - ax + a)$ an increasing function defined in R, with a a real number.

Find the possible range of values for a.

> 6 points

14. The solution of inequality $ax^2 + bx + c > 0$ with a, b constants, is $-2 < x < 4$.

Solve $ax^2 - bx + c > 0$.

> 6 points

15. Let $P(4, 2)$ be a point, and a circle defined by $x^2 + y^2 + 2x + 2y - 2 = 0$.

T is the intersection between the circle and a tangent line passing through P. Calculate PT distance.

> 6 points

16. Solve $2\left(\frac{\pi}{2} + x\right) + 3\sin\sin x - 3 \geq 0$ for $0 \leq x < 2\pi$

> 6 points

17. Let k be a real number. Find the possible range of k so that the functions $f(x) = \sqrt{4 - 2x}$ and

$g(x) = -x + k$ have exactly 2 intersection points.

6 points

18. Given the curve $y = x^3 + 2$ and the line tangent to the curve at the point P(1,3), find the area of the region enclosed by the curve and the line.

6 points

19. For x a real number with $0 \leq x \leq 2\pi$, find the global minimum and global maximum of the function

$f(x) = \cos\cos x + x \cdot \sin\sin x$.

6 points

20. Calculate $\lim\limits_{n \to \infty} \frac{1}{n^3} \left\{ (3n + 1)^2 + (3n + 2)^2 + (3n + 3)^2 + \cdots + (3n + n)^2 \right\}$ using integrals.

6 points