1. An adrenocorticotropic hormone (ACTH) is secreted by:
A) hypothalamus
B) anterior pituitary
C) thyroid gland
D) parathyroid gland

2. At one point as a cell carried out its day-to-day activities, the nucleotides CUA were paired with the nucleotides GAU. This pairing occured:
A) during replication
B) during transcription
C) when a mRNA codon paired with a tRNA antikodon
D) when rRNA codon paired with an amino acid

3. Blood hematocrit is:
A) volume relation (%) of plasma to leukocytes
B) volume relation (%) of erythrocytes to plasma
C) volume relation (%) of erythrocytes to full blood
D) volume relation (%) of erythrocytes to rest of cells

4. Hemophilia is an X-linked recessive disease. A phenotype normal man married a phenotype normal woman. Their daughter is healthy, but their son suffers from hemophilia. What can you say about parent's genotypes?
A) it must be de novo mutation, because none of parents is a mutation carrier
B) father is a mutation carrier
C) mother is a mutation carrier
D) both parents are mutation carriers

5. If a DNA molecule contains 30% of cytosine, what percentage of adenine is present?
A) 20%
B) 30%
C) 40%
D) 60%

6. In a population with two alleles for a particular locus, A and a, the allele frequency of a is 0.4. What is the frequency of dominant homozygotes if the population is in Hardy-Weinberg equilibrium?
A) 0.6
B) 0.16
C) 0.48
D) 0.36

7. In humans, the meiotic cell division occurs in specialized organs known as:
A) gonads
B) gametes
C) epididymis
D) cell organelles

8. In Mendel's experiments, the phenotypic ratio of F2 generation is:
A) 3 : 1
B) 1 : 1
C) 1 : 2 : 1
D) 1 : 3 : 1

9. Lymph ducts drain eventually into:
A) subclavian veins
B) subclavian arteries
C) renal veins
D) portal vein

10. Mad cow disease is an example of a disease caused by:
A) viruses
B) viroids
C) prions
D) bacteriophages

11. Meiosis occurs in one from the following life cycle events:
A) wound healing
B) growth
C) body cell replacement
D) gamete formation

12. Muscles that decrease the angle between bones on two sides of a joint are:
A) extensors
B) flexors
C) abductors
D) adductors

13. Parietal cells in the gastric mucosa produce:
A) mucus
B) protein-digesting enzymes (pepsinogen)
C) hormones (gastrin, somatostatin)
D) hydrochloric acid

14. Peripheral nervous system does NOT include:
A) cranial nerves
B) spinal cord
C) somatic nervous system
D) parasympathetic nervous system

15. Photoreceptors in the retina of eye are:
A) pyramid and oval cells
B) cone and rod cells
C) bipolar and horizontal cells
D) hair and rod cells

16. Testcross means this crossing:
A) Pp x Pp
B) PP x Pp
C) Pp x PP
D) Pp x pp

17. The child has B blood group. His mother has AB blood group. What kind of genotype is EXCLUDED to be father's genotype?
A) AA
B) BB
C) AO
D) OO

18. The hereditary information contained in DNA is based on:
A) sugar backbone of the strands
B) the sequence of nitrogenous bases
C) the antiparallel nature of the strands
D) the hydrogen bonding between nitrogenous bases

19. The nitrogenous wastes are secreted by the human kidney mostly as:
A) urea
B) uric acid
C) ammonium hydroxide
D) polyurethane

20. The water balance in a human per day is:
A) 25 ml
B) 250 ml
C) 2500 ml
D) 3500 ml

21. Thomas Hunt Morgan discovered the fundamental principle of genetics:
A) the law of allele segregation into separate gametes
B) the law of linked genes on the same chromosome
C) the law of conservation of genetic material in DNA
D) the law of codominant heredity of ABO blood group

22. Vernon Ingram found that the sickle cell hemoglobin differs from the normal hemoglobin by one _____ in the beta chains of this protein.
A) nucleotide
B) nitrogenous base
C) amino acid
D) phosphate group

23. What is the probability that a heterozygote parent pair (Aa x Aa) will have a child with the recessive phenotype?
A) 25%
B) 50%
C) 75%
D) 100%

24. What kind of gamete is NOT formed by an individual with AaBb genotype?
A) AB
B) Ab
C) ab
D) Aa

25. What structure connects the skeletal muscles to the bones:
A) tendons
B) ligaments
C) joints
D) smooth muscles

26. Which organ system includes the skin, sweat glands, and nails:
A) endocrine system
B) circulatory system
C) integumentary system
D) muscular system

27. Which process is NOT involved in the genetic recombination of prokaryotic organisms?
A) conjugation
B) binary fission
C) transformation
D) transduction

28. Which sequence is arranged in the correct order by size, from smallest to largest?
A) nucleotide – nucleus – nitrogenous base – gene
B) nucleotide – nitrogenous base - gene – chromosome
C) nitrogenous base – nucleotide – gene – chromosome
D) nitrogenous base – chromosome – nucleus – gene

29. Which stage of mitosis is NOT matched correctly?
A) prophase: chromosomes condense
B) prometaphase: chromosomes attach to the mitotic spindle
C) metaphase: chromosomes separate
D) telophase: chromosomes relax

30. Which structure is mainly responsible for the rigidity of the plant cell?
A) cell wall
B) plasma membrane
C) nucleolus
D) mitochondrion

Chemistry test ID Number:

1. 2-methylpropane-2-ol is
A) less soluble in water than 2-methylpropane
B) a tertiary alcohol
C) also called isopropanol
D) an ether

2. All the following ions carry a 2- charge except
A) sulfide
B) carbonate
C) sulfate
D) nitrite

3. An isotope of sodium has a mass number of 23. What is the number of neutrons for this isotope?
A) 23
B) 34
C) 12
D) 0

4. As we increase the pH of an aqueous solution of H_2SO_3
A) the concentration of SO_3^{2-} will increase
B) the concentration of H_3O^+ will increase
C) the concentration of sulfate will decrease
D) sulfur trioxide will be released

5. Atoms of which element have the electron configuration 1s2 2s2 2p6 3s1? (provided they are neutral)
A) potassium
B) strontium
C) sodium
D) nitrogen

6. By adding 600 ml of water to 200 ml of a 20 % aqueous solution of sucrose we
A) decrease the concentration of sucrose to 3 %
B) decrease the concentration of sucrose four times
C) decrease the concentration of sucrose to 15 %
D) decrease the concentration of sucrose by one third

7. Choose the correct description of the chemical changes involved in this reaction sequence:
$HOOC\text{-}CO\text{-}CH_2\text{-}COOH \rightarrow HOOC\text{-}CH(OH)\text{-}CH_2\text{-}COOH \rightarrow HOOC\text{-}CH{=}CH\text{-}COOH \rightarrow HOOC\text{-}CH_2\text{-}CH_2\text{-}COOH$
A) addition → elimination → elimination
B) hydration → elimination → addition
C) dehydrogenation → hydrogenation → dehydrogenation
D) reduction → dehydration → reduction

8. Decreasing the pH of a dilute aqueous solution by 3 units
A) decreases the H_3O^+ concentration 100x
B) increases the H_3O^+ concentration 1000x
C) decreases the H_3O^+ concentration 3x
D) does not change the concentration of OH^-

9. Given the reaction: $NH_3 + O_2 \rightarrow N_2 + H_2O$. How many moles of N_2 are produced when 1.0 mol of NH_3 is consumed? (First you have to fill in appropriate stoichiometric coefficients.)
A) 0.50 mol
B) 1.0 mol
C) 2.0 mol
D) 4.0 mol

10. H_2S is called
A) sulfidic acid
B) dihydrogen sulfuric acid
C) hydrogen sulfide
D) hydrogen sulfate

11. How many grams of oxygen are in 328 g of calcium nitrate?
A) 53 g
B) 192 g
C) 32.8 g
D) 152 g

12. Identify the product formed from the reduction of acetone.
A) propan-1-ol
B) propan-2-ol
C) propene
D) propanal

13. If a compound contains the group -COOH it
A) was produced by a reduction of an aldehyde
B) can dissociate in water
C) is an aldehyde
D) can be oxidised to an aldehyde

14. In order to break down a molecule of a triacylglycerol to fatty acids and glycerol we need to perform:
A) hydrolysis
B) dehydrogenation
C) esterification
D) reduction

15. Increasing the temperature, at which an endothermic reaction occurs, will
A) make more products
B) make less products
C) cause the reaction to stop
D) decrease the pressure of the system

16. Lactate is
A) produced in the Krebs cycle
B) an aldehyde
C) 2-hydroxypropanoic acid
D) a component of lactose

17. One of the neurotransmitters in the human nervous system has this structural formula: CH_3-CO-O-CH_2-CH_2-$N^+(CH_3)_3$. This structure contains the following functional groups:
A) carboxylic acid group and tertiary amino group
B) ester group and quarternary ammonium group
C) carboxylic acid group and nitro group
D) ether group and amino acid group

18. Potassium will react with water to produce
A) an acid and oxygen
B) a salt and an acid
C) a salt and a hydroxide
D) a hydroxide and hydrogen

19. The conversion of CH_3CHO to CH_3CH_2OH is
A) a reduction
B) dehydrogenation
C) hydration
D) hydrolysis

20. The conversion of ethanol to acetaldehyde is:
A) oxidation
B) dehydration
C) hydrogenation
D) reduction

21. The conversion of Fe^{2+} to Fe^{3+} is a
A) reduction
B) oxidation
C) ionization
D) dissociation

22. The name of the isotope containing one proton and one neutron is:
A) protium
B) deuterium
C) tritium
D) neutrium

23. The pH of 100 mmol/l solution of a strong hydroxide is
A) higher than the pH of a 1 mol/l strong hydroxide
B) 2
C) 12
D) higher than the pH of 100 mmol/l weak hydroxide

24. What do tyrosine and butyric acid have in common?
A) contain an amino group
B) contain a carboxyl group
C) are aromatic
D) contain a hydroxyl group

25. What is the concentration of a solution made out of 20 g of sodium chloride and 60 g of water?
A) 33 %
B) 30 %
C) 25 %
D) 20 %

26. What is the formula of magnesium nitrite?
A) Mg_3N_2
B) $Mg(NO_2)_3$
C) $Mg(NO_3)_2$
D) $Mg(NO_2)_2$

27. When ethanol burns in oxygen, how many molecules of oxygen are consumed per molecule of ethanol?
A) 1.5
B) 3
C) 2
D) 4

28. Which of the following amino acids has an acidic side chain?
A) glutamate
B) glycine
C) lysine
D) isoleucine

29. Which of the following compounds is the least soluble in water?
A) acetic acid
B) propan-1-ol
C) vinylbenzene
D) methanol

30. Which of the following structural features is NOT associated with cis-trans isomerism?
A) double bonds
B) ring systems
C) triple bonds
D) all three are associated with cis-trans isomerism

1. What is the length of leg (cathetus) of an isosceles right-angled triangle (i.e. both legs - catheti - are equal) whose area is 18?
A) 6
B) 3
C) $3\sqrt{2}$
D) $2\sqrt{3}$

2. A cylinder of volume V_0 has been modified such that its radius is now three times the original radius and its height has been reduced to one half of the original value. The volume of the modified cylinder is:
A) 1.5 V_0
B) 2/3 V_0
C) 1.5π V_0
D) 4.5 V_0

3. A group of patients consists of 25 men and 25 women. Find the chance that in a sample of 3 randomly chosen patients are all the people of the same gender?
A) 50 %
B) 23.5 %
C) 76.5 %
D) 6.25 %

4. A line passes through the points (1; 2) and (–1; –2). What is its slope?
A) 2
B) -1
C) 3
D) 4

5. Calculate the following sum of 100 terms of a sequence: 100 – 99 + 98 – 97+ ... + 4 –3 + 2 – 1
A) 50
B) 99
C) 0
D) 1

6. Choose the combination of two perpendicular vectors:
A) (2;3) and (4;6)
B) (3;0) and (-6;0)
C) (-3;2) and (4;6)
D) (3;2) and (2;3)

7. How many integers satisfy the inequality: $\frac{5|x-4|}{2} < 4$
A) 5
B) 0
C) 1
D) 3

8. Choose the correct statement for the function: $f(x) = x(x+3)$ **on the interval (-∞, 0)**
A) has minimum at x = -1.5
B) is decreasing
C) is increasing
D) has maximum at x = -3

9. How many permutations of 4 different letters (i.e. repetition is not allowed) can be made from 26 letters of the alphabet?
A) about 360 thousand
B) about 960 thousand
C) about 15 thousand
D) about 86 thousand

10. How many solutions of the equation $2 \cdot |5 \cdot |x| + 4| = 8$ **are there in domain R?**
A) 1
B) 2
C) 4
D) none

11. In a box, there are 8 red, 7 blue and 6 green balls. What is the probability that one randomly selected ball is neither red nor green?
A) 3/4
B) 8/21
C) 9/21
D) 1/3

12. Let i is the imaginary unit defined as $i^2 = -1$. The value of the expression of $-i^8 + 1$ equals to:
A) 2
B) 0
C) $1 - i$
D) $1 + i$

13. Simplify the following expression
$$3 + \log_b(b^3 . \sqrt[3]{b}) + \log_{10}\left(\frac{10^b}{100}\right)$$
A) b+4+1/3
B) 3
C) b-2
D) 10b-1

14. Sum of all interior angles in a regular pentagon is
A) 540°
B) 360°
C) 900°
D) 108°

15. The equation of a circle with the center C= (2; -1) and radius of 2 is:
A) $x^2 + y^2 - 4x + 2y + 1 = 0$
B) $x^2 + y^2 + 2x + 4y + 4 = 0$
C) $x^2 + y^2 - 2x + y + 4 = 0$
D) $x^2 + y^2 - 2x - y - 4 = 0$

16. The first term of a geometric sequence is 1 and the fifth term is 25. What is the common ratio of this geometric sequence?
A) 25
B) 5
C) $\sqrt{5}$
D) $5.\sqrt{5}$

17. The function $f(x) = x + \sin(x)$ is:
A) odd
B) neither even, nor odd, nor monotonic
C) monotonic
D) even

18. The diameter of the circumscribed circle of a regular hexagon is 2 cm. What is the perimeter of this hexagon?
A) 12 cm
B) 6 cm
C) 4π cm
D) 8π cm

19. The surface area of the cube C is 60. What is the surface area of the sphere S whose radius equals to the edge length of the cube C?
A) 40π
B) 60π
C) 60
D) 30π

20. There are 10 different types of subunits that can be combined to create a structure. How many combinations of 3 different subunits exist?
A) 720
B) 1000
C) 120
D) 30

21. There are 6 black, 4 white, 5 red and 3 yellow beads in a bowl. How many beads do we need to take out of the bowl to make sure we have at least two beads of the same color?
A) 6
B) 2
C) 4
D) 5

22. There is just one solution of the quadratic equation $px^2 + 2x + 2 = 0$ if the value of the parameter *p* is:
A) 0.5
B) 1
C) -4
D) -2

23. Volume of a cone is given by the formula:
A) $\frac{1}{3}\pi hr^2$
B) πhr^2
C) $\frac{4}{3}\pi hr^2$
D) $2\pi hr$

24. What are coordinates of the midpoint M of a line segment AB if A = (-7; 3) and B = (5; 1)?
A) M=(-1,2)
B) M=(-6,2)
C) M=(-5,-1)
D) M=(2,-6)

25. What is the (minimal) period of the following function: $f(x) = \frac{4}{3} . \sin(\frac{3}{4}x)$
A) 6π
B) $\frac{8\pi}{3}$
C) $\frac{6\pi}{4}$
D) π

26. What is the domain of function:
$f(x) = 20 . \log_{10}(\frac{x}{20} . 10^6)$
A) All positive real numbers
B) All real numbers
C) $(20 \cdot 10^{-6}; \infty)$
D) (-20; ∞)

27. What is the surface area of a sphere if we know that its center has coordinates C=(-5; 0; 3) and one point of the sphere has coordinates (0; 5;-3) ?
A) 100π
B) 1024π
C) 344π
D) 16π

28. What is the total area of the metallic surface of an open cylindrical water container (i.e. there is no top cover of the container) whose diameter is 60 cm and height is 1 m?
A) 0.69π m^2
B) 0.6 m^2
C) 0.99π m^2
D) 0.9 m^2

29. Which of the following statements is true for the mean and median of any 101 consecutive integers?
A) The mean is less than the median.
B) The mean is greater than the median.
C) There is not enough information to determine the relationship between the mean and the median.
D) The mean is equal to the median.

30. What is the range of function (the set of all value of the function): $f(x) = 4 - \cos(\frac{x}{4})$
A) ⟨3;5⟩
B) $\langle -\frac{1}{4}; \frac{1}{4} \rangle$
C) (3.75; 4.25⟩
D) (-∞; ∞)

Physics test ID Number:

1. A constant electric current of 100 mA flows through an electric device when plugged to a voltage of 25 V. What time is necessary to transmit an electric charge of 5 C in this case?
A) 50 s
B) 5 s
C) 25 s
D) 2.5 min

2. A lift is capable to bring a 250-kg package to the height of 3 m in 5 s. What is the power of its engine?
A) 3.75 kW
B) 7.5 kW
C) 2.5 kW
D) 1.5 kW

3. One millionth of a kilogram equals to
A) 1 μg
B) 1 mg
C) 1 g
D) 1000 g

4. A tropical cyclone must have maximum sustained wind of at least 251 km/h to be classified as a hurricane of Category 5 according to the Saffir–Simpson hurricane wind scale (SSHWS). Such a speed is equivalent to:
A) 70 m/s
B) 251 m/s
C) 25 m/s
D) 118 m/s

5. An 800 kg car needed the distance of 40 m for a complete stop from the initial speed of 20 m/s. What force was used to stop this car?
A) 4000 N
B) 8000 N
C) 20 kN
D) 80 kN

6. Archimedes' principle, atmospheric pressure and Bernoulli's equation are three important topics in physics of fluids. Capillarity (observed e.g. as an elevated water surface in a thin glass tube) is a phenomenon that can be explained by
A) Archimedes' principle
B) Atmospheric pressure
C) None of those
D) Bernoulli's equation

7. Choose the scalar quantity
A) force
B) velocity
C) acceleration
D) pressure

8. How many nucleons are in one nucleus of Iodine isotope, whose atomic number is 53 and atomic mass number is 131?
A) 131
B) 53
C) 78
D) 66

9. Humans are most sensitive to sounds with frequencies between 2000 and 5000 Hz. What is the wavelength of a 3 kHz tone in air?
A) 11 cm
B) 100 cm
C) 3 cm
D) 77 cm

10. Choose the material where light propagates at the highest speed
A) vacuum
B) water
C) diamond
D) glass

11. Metals are good conductors of electricity due to their
A) ferromagnetism
B) high melting point
C) high density
D) large number of free electrons

12. Sound propagates at different speeds in different media. Select the answer where the environments are ranked in order of INCREASING speed of sound propagation
A) Bone, air and water
B) Air, water and bone
C) Water, bone and air
D) Bone, water and air

13. The charge of one alpha particle is
A) 3.204×10^{-19} C
B) +2 eV
C) none
D) 4 C

14. The focal length of a converging lens is 12.5 cm. The optical power of this lens is
A) +8 D
B) -0.125 D
C) +12.5 D
D) -1.25π D

15. The key element in laparoscopy is the use of a long fiber optic cable system. Light is kept inside the optical fiber by the phenomenon of
A) total internal reflection
B) polarization
C) diffraction
D) interference

16. The power of a heating pad operated at 20 V with the current of 200 mA is
A) 100 W
B) 10 W
C) 4 W
D) 20 W

17. The value of normal atmospheric pressure corresponds approximately to
A) the hydrostatic pressure evoked by a 10m high water column
B) normal systolic blood pressure
C) 1 kPa
D) 100 000 N

18. Two isotopes of an element contain
A) the same number of neutrons but different number of protons
B) the same number of protons but different number of neutrons
C) the same number of neutrons as well as electrons
D) the same number of nucleons

19. Typical temperature in a kitchen freezer used to store frozen food is about
A) 255 K
B) 5 K
C) 0 K
D) -18 K

20. Water flows with a velocity of 20 cm/s in a pipe of diameter 40 cm. What is the velocity in a part of the pipe where the diameter is reduced to 20 cm?
A) 0.2 m/s
B) 0.4 m/s
C) 0.8 m/s
D) 0.1 m/s

21. What amount of energy is necessary to heat 200 ml of water from 22°C to 47°C ($c = 4200\ J \cdot kg^{-1} \cdot K^{-1}$)?
A) 2.5 kJ
B) 42 kJ
C) 5 kJ
D) 21 kJ

22. What is the area of a piston if 150 N acting on it evokes a pressure of 5 kPa in the liquid bellow the piston?
A) 300 cm^2
B) 750 cm^2
C) 30 cm^2
D) 1500 cm^2

23. What is the expected distance traveled by an ambulance car in 24 min, if its average speed in the city is 70 km/h?
A) 28 km
B) 17 km
C) 7 km
D) 21 km

24. Which of the following is a kind of electromagnetic radiation?
A) infrared ray
B) beta ray
C) cathode ray (stream of electrons emitted from a cathode)
D) ultrasound wave

25. What is the final pressure of ideal gas whose temperature increased from 25°C to 125°C if its initial pressure was 300 kPa and the volume of gas was not changed in the process?
A) 3 MPa
B) 0.4 MPa
C) 1.5 MPa
D) 750 kPa

26. What is the mass of a titanium implant if its total volume is 2 cm^3 and density of titanium is 4506 kg/m^3?
A) 9 g
B) 22.5 g
C) 0.09 kg
D) 0.225 kg

27. What is the rotational frequency of an object that rotates with a radius of 20 cm and one rotation takes 0.10 min?
A) 0.10 Hz
B) 0.20 Hz
C) 0.17 Hz
D) 0.05 Hz

28. What must be the initial speed of an upward thrown object, which returns back in 8 s (assuming negligible air resistance)?
A) 39 m/s
B) 8 m/s
C) 19 m/s
D) 79 m/s

29. Which of the following is NOT one of the particles emitted from the nucleus during radioactive decay?
A) photon
B) helium nucleus
C) positron
D) hydrogen nucleus

30. Which of the particles is NOT deflected from its original trajectory by the magnetic field?
A) all three types of particles are deflected by magnetic field
B) proton
C) alpha particle
D) beta particle