1. Which of the following eukaryotic cells is totipotent?
   1) An adult stem cell
   2) A nerve cell
   3) A bone marrow cell
   4) A skin cell
   5) A zygote

2. A human chromosome contains all but
   1) a centrosome
   2) a centromere
   3) kinetochores
   4) chromatids
   5) DNA molecules

3. A prokaryotic flagellum
   1) is powered by ATP
   2) shows bending movement
   3) rotates
   4) is larger and with complex structure
   5) is composed of tubulin

4. Which of the following viruses is biggest?
   1) Rotavirus
   2) Rhinovirus
   3) **Herpesvirus**
   4) Influenza virus
   5) Adenovirus

5. Which of the following pair codons represent “wobble pairing”?
   1) UAG-UGA
   2) GCA-GGC
   3) AAA-UUU
   4) **GGA-GGC**
   5) AUG-UGG

6. Shingles are caused by
   1) polio virus
   2) **herpes zoster**
   3) rubeola
   4) variola major
   5) varicella zoster
7. Lateral gene transfer in prokaryotes occurring via a virus is termed
   1) transfection
   2) **transduction**
   3) transformation
   4) conjugation
   5) transposition

8. Phragmoplast is
   1) a specific form of chloroplast in plant cells
   2) a means of animal cell separation during cytokinesis
   3) a lysosomal maturation element in animal cells
   4) **a cytoskeletal complex assisting in cell plate formation in plant cells**
   5) a structure enabling the breakup of maternal fungal cells

9. The random loss of alleles in a population is called
   1) migration
   2) random selection
   3) **genetic drift**
   4) mutation
   5) gene flow

10. Among polygenic human traits is(are) included
    A) weight
    B) intelligence
    C) widow’s peak
    D) eye color
        1) A, C, D are valid
        2) only D is valid
        3) A, B, C are valid
        4) A, C are valid
        5) **A, B, D are valid**

11. A protein domain
    A) is unlimited in size
    B) occurs in proteins with quaternary structure only
    C) represents tertiary structure of the protein
    D) is an autonomous folding unit
        1) B, D are valid
        2) A, C, D are valid
        3) **C, D are valid**
        4) only D is valid
        5) A, B, C are valid
12. In eukaryotes, the start codon/s is (are)
   A) UAG
   B) UGA
   C) AUG
   D) AGU
   1) only B is valid
   2) A, C are valid
   3) only D is valid
   4) **only C is valid**
   5) C, D are valid

13. Bivalents are associated with
   1) metaphase of the 1\textsuperscript{st} meiotic division
   2) prophase of the 2\textsuperscript{nd} meiotic division
   3) prophase of both the 1\textsuperscript{st} and the 2\textsuperscript{nd} meiotic division
   4) **prophase of the 1\textsuperscript{st} meiotic division**
   5) metaphase of the 2\textsuperscript{nd} meiotic division

14. The term protoplasm was first coined by
   1) R. Hook
   2) R. Virchow
   3) L. Pasteur
   4) M. J. Schleiden
   5) **J. E. Purkynje**

15. A living unstained cell would be best observed by
   1) a magnifying glass
   2) a bright field microscope
   3) an electron microscope
   4) **a phase contrast microscope**
   5) a fluorescent microscope

16. Which gametes will result from a nondisjunction in the first meiotic division?
   1) Disomic only
   2) Monosomic only
   3) **Nullisomic and disomic**
   4) Trisomic and monosomic
   5) Nullisomic only

17. An animal cell placed into hypertonic environment will
   1) plasmolyze
   2) become flaccid
   3) **plasmoptyze**
   4) plasmorhize
   5) stay the same
18. Inheritance pattern of galactosemia and alkaptonuria is
   A) autosomal recessive
   B) autosomal dominant and autosomal recessive
   C) autosomal recessive and X-linked recessive
   D) autosomal dominant
   1) only A is valid
   2) none (A-D) is valid
   3) only D is valid
   4) only B is valid
   5) only C is valid

19. In sickle cell anemia a mutant hemoglobin is produced by
   1) a silent mutation
   2) a frame-shift mutation
   3) a missense mutation
   4) a same sense mutation
   5) a nonsense mutation

20. Cytochrome c is associated with
   1) the plasma membrane
   2) Golgi complex
   3) the inner membrane of mitochondria
   4) the endoplasmic reticulum
   5) the mitochondrial matrix

21. Agar is found in the cell wall of
   1) prokaryotes
   2) plant cells
   3) fungi
   4) diatoms
   5) algae

22. Gamete formation in multicellular eukaryotic animals is called
   1) parthenogenesis
   2) binary fission
   3) schizogony
   4) gametogenesis
   5) oncogenesis
23. Mitochondrial DNA
   A) is exonic
   B) floats free in matrix
   C) is naked
   D) is circular
   1) A, C are valid
   2) all (A-D) are valid
   3) A, B, D are valid
   4) B, C, D are valid
   5) B, C are valid

24. Which type of mutation changed GGA codon to UGA?
   1) Transposition
   2) Translocation
   3) Tautomery
   4) Inversion
   5) Transversion

25. The famous fossil “Lucy” belonged to
   1) Homo ergaster species
   2) Homo habilis species
   3) Homo sapiens species
   4) Ramapithecus ramidus species
   5) Australopithecus afarensis species
26. 2,3-Dihydroxypropanal
   A) could be reduced to glycerol
   B) could form esters
   C) contains a chiral atom in its molecule
   D) could be oxidized to an acid
   1) only D is valid
   2) A, C are valid
   3) B, D are valid
   4) all (A-D) are valid
   5) B, C are valid

27. How many mL of the NaOH solution (c=0.5 mol/L) are needed to react completely with 40 mL of the H₂SO₄ solution (c=0.02 mol/L)?
   1) 2.5
   2) 0.8
   3) 1.6
   4) 4.0
   5) 3.2

28. H₃N-CH₂-CH₂-CH₂-NH₂
   A) could be named propane-1,3-diamine
   B) is a diamide
   C) could react with organic acids to form the amide bond
   D) is a secondary amine
   1) A, D are valid
   2) B, C are valid
   3) A, C are valid
   4) only B is valid
   5) C, D are valid

29. Choose (a) true statement/s on the reaction: iron(II) chloride + potassium dichromate + hydrochloric acid → iron(III) chloride + chromium(III) chloride + potassium chloride + water
   A) chromium in potassium dichromate is an acceptor of electrons
   B) stoichiometric coefficients are 6,1,14 → 6, 2, 2, 7
   C) it is an example of precipitation reaction
   D) this reaction is impossible in the direction given
   1) only D is valid
   2) A, C are valid
   3) A, B, C are valid
   4) only C is valid
   5) A, B are valid
30. Lead(II) iodide is prepared by reaction of potassium iodide with lead(II) nitrate. How many grams of potassium iodide would you weigh to prepare 45.5 g of lead(II) iodide. The yield of the reaction is 85 %. (a.w.: Pb=207; K=39; I =127)

1) 16.38
2) 32.77
3) 19.27
4) 38.55
5) 27.75

31. What is/are typical property/ies of ethyne?
   A) sp hybridization of carbon atoms
   B) presence of double bond
   C) it prefers addition reactions
   D) sp$^2$ hybridization of carbon atoms

1) B, C, D are valid
2) A, B, C are valid
3) A, C are valid
4) B, C are valid
5) only A is valid

32. The concentration of [H$_3$O$^+$] cations in an aqueous solution was 5x10$^{-4}$ mol/L. Calculate the concentration of [OH$^-$] anions in this solution (in mol/L).

1) 5x10$^{-9}$
2) 2x10$^{-9}$
3) 5x10$^{-10}$
4) 2x10$^{-11}$
5) 2x10$^{-10}$

33. Which of the following salts does make the most alkaline solution when added to distilled water?

1) calcium sulfate
2) potassium permanganate
3) potassium bromide
4) sodium carbonate
5) silver iodide

34. Glycosidic linkage is typical of
   A) lactose
   B) cellulose
   C) rubber
   D) nucleic acids

1) all (A-D) are valid
2) only B is valid
3) only D is valid
4) A, B, D are valid
5) A, B, C are valid
35. Purine
   A) is a heterocycle
   B) contains an atom of oxygen in its molecule
   C) could be substituted to form thymine
   D) contains 4 nitrogen atoms in its molecule
   1) A, B, C are valid
   2) A, D are valid
   3) all (A-D) are valid
   4) A, C are valid
   5) only B is valid

36. CH₃-COO-CH₃
   A) is named dimethyl ketone
   B) is formed in the reaction of two molecules of ethanoic acid
   C) is an anhydride
   D) is named methylmethanoate
   1) only A is valid
   2) none (A-D) is valid
   3) B, C are valid
   4) B, D are valid
   5) only D is valid

37. Carbon dioxide
   A) oxidizes Fe²⁺ in hemoglobin
   B) is a strong oxidizing agent
   C) is a product of metabolism of nutrients in mammals
   D) forms carbonic acid
   1) A, D are valid
   2) A, B, D are valid
   3) C, D are valid
   4) only C is valid
   5) A, C are valid

38. The compound with the summary formula C₃H₆O
   A) could contain a double bond in its molecule
   B) could be named ethylmethyl ether
   C) could be named propanol
   D) could be named propanal
   1) only D is valid
   2) only B is valid
   3) A, D are valid
   4) B, C are valid
   5) only C is valid
39. Choose (an) element/s that can exist in the oxidation state +VII:
   A) chromium
   B) manganese
   C) phosphorus
   D) iodine
   1) A, B, C are valid
   2) C, D are valid
   3) B, D are valid
   4) A, C are valid
   5) all (A-D) are valid

40. Decarboxylation of 3-oxobutanoic acid results in
   A) acetone
   B) methoxyethane
   C) an aldehyde
   D) a ketone
   1) only A is valid
   2) only B is valid
   3) A, B are valid
   4) A, D are valid
   5) only C is valid

41. Elemental analysis revealed that 4.00 g of yellow crystals with acrid odour contain 2.18 g of iodine and the rest is chlorine. Choose the correct formula. (a.w.: Cl=35.5; I=127.0)
   1) ICl₅
   2) Cl₃I
   3) ICl
   4) ICl₂
   5) ICl₃

42. The pair ethenol – ethanal is an example of
   A) stereo isomerism
   B) cis-trans isomerism
   C) tautomerism
   D) optical isomerism
   1) only A is valid
   2) none (A-D) is valid
   3) only D is valid
   4) only B is valid
   5) only C is valid
43. You have to prepare 250 g of the H₂O₂ solution (c= 3 % w/w). You will dilute the stock solution of H₂O₂ (c= 27 % w/w) with distilled water. How many grams of the stock solution do you weigh?
   1) 55.56
   2) 27.78
   3) 25.00
   4) 13.90
   5) 41.68

44. Let us have the reaction Zn + 2 AgNO₃ → Ag + Zn(NO₃)₂. Choose (a) true statement/s:
   A) zinc acts as a reducing agent
   B) zinc nitrate is not soluble in aqueous solution
   C) Zn and Ag are transition elements
   D) it is an example of neutralization reaction
   1) only B is valid
   2) A, C are valid
   3) A, B, C are valid
   4) A, C, D are valid
   5) A, B are valid

45. Choose the compounds with the same number of oxygen atoms in their molecules:
   A) 2,4,6-trinitrophenol
   B) 2-hydroxy-1,2,3-propanetricarboxylic acid
   C) 2,3-dihydroxybutanedioic acid
   D) potassium sulfate
   1) A, B, D are valid
   2) A, C are valid
   3) all (A-D) are valid
   4) C, D are valid
   5) A, B are valid

46. Choose (an) anion/s that is/are the example of the strong conjugated base (according to the Brønsted-Lowry concept):
   A) Cl⁻
   B) HSO₄⁻
   C) NO₃⁻
   D) CN⁻
   1) only C is valid
   2) only D is valid
   3) A, D are valid
   4) all (A-D) are valid
   5) A, B, C are valid
47. What statement is not correct from those mentioned below?
   1) H₂O₂ is an oxidizing agent
   2) mercury sublimates
   3) neutralization reaction results in the formation of water
   4) transition elements are metals
   5) nitrogen can form hydrogen bonds (bridges)

48. Choose (a) strong electrolyte/s from those mentioned below:
   A) potassium nitrate
   B) urea
   C) ethanol
   D) ammonium hydroxide
   1) A, B, D are valid
   2) B, C are valid
   3) only A is valid
   4) only C is valid
   5) A, C, D are valid

49. Choose (a) reaction/s that could be typical of vinylbenzene:
   A) esterification
   B) polymerization
   C) reduction
   D) nucleophilic substitution
   1) A, D are valid
   2) B, C are valid
   3) only D is valid
   4) A, B are valid
   5) A, C are valid

50. Choose (an) element/s that react/s with HCl to produce H₂:
   A) silver
   B) aluminum
   C) zinc
   D) copper
   1) only B is valid
   2) A, B, C are valid
   3) B, C are valid
   4) all (A-D) are valid
   5) A, C, D are valid
Physics
Use only the values of constants provided in the test. Round the final result, not the partial result in the middle of your calculations. The result should be rounded to three valid digits if not specified otherwise. The results have to be presented in the main (derived SI) physical units if not specified otherwise.
Use these constants:

- \((\pi) = 3.14\)
- \(g = 9.81 \text{ m.s}^{-2}\)
- \(R = 8.314 \text{ J.K}^{-1} \cdot \text{mole}^{-1}\)
- \(k = 1.381 \times 10^{-23} \text{ J.K}^{-1}\)
- \(0 ^\circ \text{C} = 273.15 \text{ K}\)
- \(e = 1.602 \times 10^{-19} \text{ C}\)
- \(h = 6.63 \times 10^{-34} \text{ J.s}\)
- \(m_e = 9.11 \times 10^{-31} \text{ kg}\)
- relative atomic mass of oxygen = 16
- relative atomic mass of aluminium = 27
- Avogadro’s number = 6.023 \times 10^{23} \text{ mole}^{-1}
- permittivity of vacuum = 8.854 \times 10^{-12} \text{ F.m}^{-1}
- specific heat capacity of water = 4186 \text{ J.K}^{-1} \cdot \text{kg}^{-1}
- specific melting heat of ice = 334 000 \text{ J.kg}^{-1}
- density of water = 1000 \text{ kg.m}^{-3}
- density of iron = 7860 \text{ kg.m}^{-3}
- refractive index of water = 1.5
- speed of light in air = 3 \times 10^{8} \text{ m.s}^{-1}
- normal atmospheric pressure = 101.3 \text{ kPa}
51. Deduce, what size of direct current must flow through a resistor to produce the same heating power as an alternating current with a peak value (amplitude) of 3.5 A?

1) 1.75 A  
2) 2.47 A  
3) 4.26 A  
4) 2.00 A  
5) 3.50 A

52. A box can be moved up an inclined plane at constant velocity by a force of magnitude $F_1$ or down the inclined plane at constant velocity by a force of magnitude $F_2$. Find the coefficient of kinetic friction $f_k$ between the box and the inclined plane if $F_1 = 6F_2$ and both forces are parallel with the inclined plane. The angle $\alpha$ between the inclined plane and the horizontal plane is 30°.

1) 0.505  
2) 0.707  
3) 0.606  
4) 0.808  
5) 0.404

53. Let us have an aluminium (Al) weight with mass of 1 kg. Determine what is the chemical amount (amount of substance) of it?

1) 42.0 mol  
2) 27.5 mol  
3) 54.2 mol  
4) 74.0 mol  
5) 37.0 mol

54. Whole kinetic energy of an electron which was accelerated in a linear accelerator by the voltage 100 kV was changed to the energy of a photon. Calculate the frequency of this photon.

1) 242*10^{17} Hz  
2) 124*10^{18} Hz  
3) 442*10^{17} Hz  
4) 457*10^{15} Hz  
5) 424*10^{17} Hz

55. What is a centrifugal force acting on a person standing on the Equator? Assume that the Earth equatorial radius is 6378 km and the person weighs 80 kg.

1) 7.21 N  
2) 4.76 N  
3) 5.34 N  
4) 2.70 N  
5) 8.32 N
56. An air bubble with the volume of 5.0 mL rises from the bottom of a lake 100 m deep. The temperature at the bottom of the lake is 7 °C and the temperature on its surface is 27 °C. Let us assume normal atmospheric pressure above the surface. How big will be a bubble when it reaches the surface?

1) 27.5 mL
2) 51.9 mL
3) 5.0 mL
4) 72.5 mL
5) 57.2 mL

57. When the brake pedal of a car moving 72 km·h⁻¹ on a straight road is fully pressed, the car can stop in 50 m. How long does it take to stop?

1) 6 s
2) 5 s
3) 3 s
4) 2 s
5) 4 s

58. Let us have only capacitors of capacitance of 5 µF. How many capacitors to take and how to connect them to the system of capacitors of total capacitance of 0.25 µF?

1) 20 capacitors in parallel connection
2) 20 capacitors in serial connection
3) 10 capacitors in parallel connection
4) 10 capacitors in serial connection
5) 5 capacitors in serial connection

59. We poured 2 L of water at 15 °C in a 2000 W kettle. When the water started to boil, the kettle is turned off automatically. What time is necessary to start boiling in the ideal case? Let us assume normal atmospheric pressure.

1) 180 s
2) 360 s
3) 480 s
4) 720 s
5) 240 s

60. A plano-concave glass lens of refractive index of 1.5 is placed in the air. Its optical power is -10 D. Determine its radius of curvature.

1) 2 cm
2) 20 cm
3) 5 cm
4) 10 cm
5) 15 cm
Mathematics

61. Find the slope of the tangent to the curve described by the equation \( y = x^2 \cdot e^x + x \cdot \ln x \) at the point \((1, e)\).
   1) \(5 + e\)
   2) \(e\)
   3) \(3e + 1\)
   4) \(-3\)
   5) \(2\)

62. Divide complex numbers \((1 + 2i)/(2 - i)\)
   1) \(i\)
   2) \(1 - i\)
   3) \(3\)
   4) \(2\)
   5) \(2 + i\)

63. Calculate the volume of the sphere given in xyz coordinate system by the formula: \(x^2 - 4x + y^2 - 6y + z^2 - 2z + 5 = 0\)
   1) \(18\pi\)
   2) \(36\pi\)
   3) \(72\pi\)
   4) \(54\pi\)
   5) \(27\pi\)

64. What are possible \(y\) coordinates of the third vertex of an equilateral triangle in the \(xy\) plane if first two vertexes have coordinates \((4, 0)\) and \((10, 0)\)?
   1) \((5, \sqrt{2}), (5, -\sqrt{2})\)
   2) \((\sqrt{2}, 6), (\sqrt{2}, -6)\)
   3) \((7, 3\sqrt{3}), (7, -3\sqrt{3})\)
   4) \((7, 6), (7, -6)\)
   5) \((7, 8), (7, -8)\)

65. If a tire rotates at 200 revolutions per minute when the car is travelling 36 km/h, what is the circumference of the tire?
   1) \(1\)
   2) \(5\)
   3) \(3\)
   4) \(4\)
   5) \(2\)
66. What is the remainder when you divide \((221x^3 + 154x^2 + 228x + 41) / (17x + 4)\)
   1) \(2x\)
   2) \(-3+2x\)
   3) \(-7\)
   4) \(3x+2\)
   5) \(5\)

67. Let us have together 20 apples in a basket (10 red, 6 yellow and 4 green). What is the probability that we randomly take three apples out of a basket just in the order red, green, and yellow apple?
   1) \(6/35\)
   2) \(2/57\)
   3) \(4/37\)
   4) \(5/42\)
   5) \(3/28\)

68. How many times is it necessary to fold repeatedly in half one sheet of paper of thickness 0.1 mm to reach the thickness of the layer at least 1 m?
   1) 60
   2) 140
   3) 16
   4) 14
   5) 10000

69. Calculate the volume of a cone which is the result of rotation of the line segment with the terminal points (2, 0) and (5,10) around the x axis.
   1) \(60\pi\)
   2) \(100\pi\)
   3) \(80\pi\)
   4) \(200\pi\)
   5) \(20\pi\)

70. We throw three fair six-sided dice. What is the probability that the sum of the results is more than 4?
   1) \(98.1\%\)
   2) \(91.2\%\)
   3) \(79.6\%\)
   4) \(67.3\%\)
   5) \(54.9\%\)