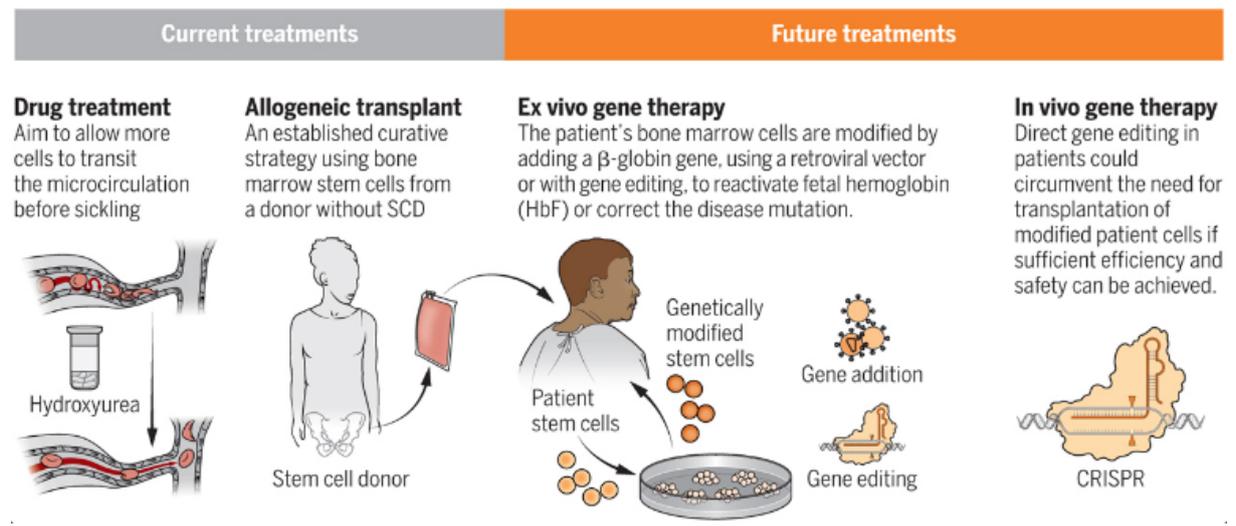


BIOLOGY

The following information refers to questions 1 and 2.

Sickle cell anemia is an inherited disorder caused by a point mutation (affecting a single nucleotide) in the gene that encodes the β -globin chain of hemoglobin (Hb β). Two β -globin chains and two α -globin chains form hemoglobin, the multisubunit protein in red blood cells that carries oxygen. The mutation results in the replacement of negatively charged glutamate by a neutral, hydrophobic valine that produces sticky patches on the protein surface. Upon delivering oxygen to the tissues, the mutant hemoglobin (HbS) polymerizes into fibers, which distort (“sickle”) red blood cells and cause blockage of the circulation, resulting in acute, severe pain called a sickle cell crisis. (...) Hydroxyurea is the first of just two U.S. Food and Drug Administration (FDA)–approved drugs to treat sickle cell disease (SCD) by inhibiting the HbS polymerization that causes sickling.



Tisdale, J.F. et al. “Treating sickle cell anemia”. *Science*. 2020 Mar 13; 367(6483): 1198–1199.

- Which of the following is/ are the currently available treatment(s) for sickle cell anemia?
 - Hydroxyurea and transplantation of genetically modified stem cells.
 - Transplantation of healthy, genetically edited stem cells from a donor.
 - Pharmacological therapy and stem cell transplant from SCD-free donor.
 - CRISPR gene editing and microcirculation drugs.
 - Allogeneic transplant of fetal hemoglobin and retroviral gene editing.
- The sickle cell anemia mutation changes directly:
 - A single nucleotide chain.
 - A β -globin chain of hemoglobin.
 - An α -globin chain of hemoglobin.
 - A single amino acid.
 - A single protein.
- Growth hormone releasing hormone (GHRH) is a hypothalamic hormone that binds to pituitary receptors to stimulate the release of growth hormone (GH). Binding to its receptor results in the activation of a linked G protein, which stimulates the production of cAMP. This intracellular

signaling results in the actual release of GH, and in somatotroph proliferation. (...) Many factors influence the production and release of GH, the two primary factors being GHRH and somatostatin – stimulating and inhibiting, respectively. (Physiology, Endocrine Hormones Miles Campbell 1, Ishwarlal Jialal 2)

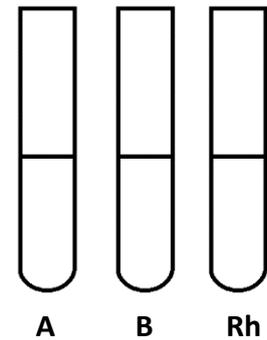
On the basis of the above information, what is true about the growth hormone?

- A. It is released by the hypothalamus.
- B. Its secretion is regulated by another hormone.
- C. It binds to a G-protein receptor.
- D. It binds to pituitary receptors.
- E. It influences the production of somatostatin.

The following information refers to questions 4 and 5.

Human blood typing is based on the following set of rules:

- The types of blood have different combinations of antigens on the surface of red blood cells. The A and B antigens are sugars, and the Rh antigens are proteins.
- Blood types have different combinations of *antibodies*, which are blood plasma molecules.
- Human blood belongs to one of eight different blood types: A Rh+, A Rh-, B Rh+, B Rh-, AB Rh+, AB Rh-, O Rh+, or O Rh-. The blood type is named after the antigens found on red blood cells.
- Attachment of antibodies to their corresponding antigens results in blood agglutination.



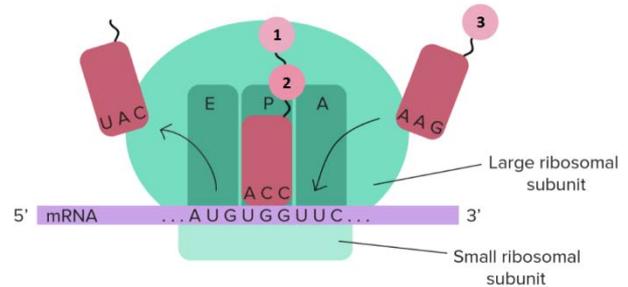
Test tubes A, B, and Rh contain solutions with A, B, and Rh antibodies, respectively.

4. You add the same amount of blood from a patient to each of the test tubes and observe agglutination in tube B. What is your patient's blood type?
- A. A Rh-
 - B. AB Rh-
 - C. B Rh-
 - D. O Rh-
 - E. A Rh+
5. What type of blood will you choose to perform a safe blood transfusion for this patient?
- A. B Rh+
 - B. O Rh-
 - C. A Rh+
 - D. AB Rh-
 - E. A Rh-
6. Albumin is a protein made by the liver. A serum albumin test measures the amount of this protein in the clear liquid portion of the blood. The normal range is 3.4 to 5.4 g/dL. Which of the following results does not fit within this range?
- A. 35 g/L
 - B. 4.2 mg/mL

- C. 35 mg/mL
- D. 4.2 g/dL
- E. 42 µg/µL

The following information refers to questions 7 to 10.

The genetic code is the correspondence between the three-nucleotide mRNA codon and an amino acid. Genetic code is 'translated' by tRNA molecules that associate a specific codon with a specific amino acid. The ribosome has three tRNA binding sites: A, P, and E. tRNA molecules move through these sites (from A to P to E) as they deliver amino acids during translation. The aminoacyl (A) site binds to the incoming aminoacyl tRNA, which carries the new amino acid to be added to the polypeptide chain. The peptidyl (P) site holds the tRNA with the growing polypeptide chain. The exit site (E) serves as a threshold. It holds tRNA without its amino acid, which is then released by the ribosome.



		Second letter				
		U	C	A	G	
First letter	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Stop UGG Trp	U C A G
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G
	A	AUU } AUC } Ile AUA } AUG Met	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } GUC } Val GUA } GUG }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G

Sources: "The genetic code", OpenStax College (2022), Biology 2e, <https://pl.khanacademy.org/science/biology/gene-expression-central-dogma/translation-polypeptides/a/trna-and-ribosomes>

7. How long (number of amino acids) would the peptide translated from this mRNA sequence be: 5'-AUGGGCUACCGA-3'?
 - A. 4
 - B. 3
 - C. 2
 - D. 6
 - E. 5
8. What is the second amino acid that is being translated? (Marked 2 in the picture above)

- A. Gly
- B. Trp
- C. Thr
- D. Pro
- E. Lys

9. Which of the following statements is correct?

A codon is a sequence of three nucleotides...

- A. Present in ribosomal RNA.
- B. Present in amino-acyl tRNA.
- C. Present in mRNA.
- D. Present in the polypeptide chain being translated.
- E. Present in DNA and translated directly into a particular amino acid.

10. What is the situation of the tRNA molecule that initially carried amino acid number 1?

- A. It is currently at the P-site.
- B. It is approaching the P-site.
- C. It is approaching the A-site.
- D. It is leaving the E-site.
- E. It is not shown in the picture.

The following information refers to questions 11 and 12.

The table below shows the number of calories burned by a person of a given weight during specific activities:

<i>Activity (1 hour)</i>	<i>Calories burned by a 60 kg person</i>	<i>Calories burned by a 75 kg person</i>	<i>Calories burned by a 85 kg person</i>	<i>Calories burned by a 100 kg person</i>
Walking slow	150	175	200	240
Walking fast	210	260	310	350
Walking very fast	300	350	400	460
Running slow	360	420	450	510
Running fast	510	540	600	650

Five friends choose the following exercise routine:

	<i>Weight</i>	<i>Activity 1</i>	<i>Activity 2</i>
Harry	85 kg	walks fast for 30 minutes	walks slow for 30 minutes
Holly	60 kg	runs fast for 20 minutes	walks slow for 10 minutes
Jessie	75 kg	runs fast for 10 minutes	runs slow for 20 minutes
Josie	100 kg	walks fast for 30 minutes	walks slow for 30 minutes
Paul	60 kg	runs slow for 20 minutes	walks fast for 20 minutes

11. Which of the friends burns the most calories during his/her routine as presented in the table above?

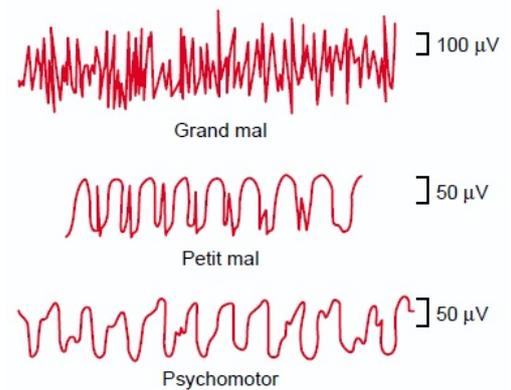
- A. Harry
- B. Holly
- C. Jessie

- D. Josie
- E. Paul

12. Mary weighs 85 kg. How many calories will she burn during the following training session: walking fast – 15 minutes, running slow – 10 minutes, running fast – 5 minutes, walking slowly - 10 minutes?
- A. 411.5
 - B. 141.5
 - C. 253.8
 - D. 235.8
 - E. 285.3

The following information refers to questions 13 and 14.

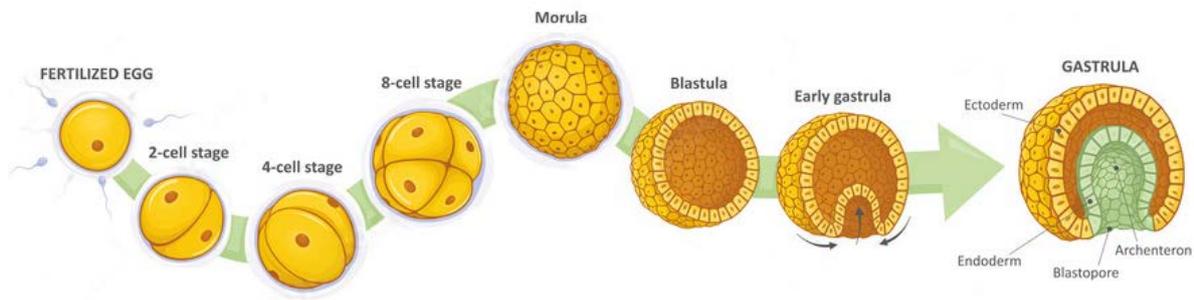
Seizures involve excessive and uncontrolled activity of parts or the entire central nervous system. Epilepsy is a disorder of the central nervous system in which the patient is prone to seizures. The disorder shows increased frequency among the families of affected individuals, but does not show genotypes or heritability associated with classic Mendelian patterns. There are three main types of seizures: grand mal, petit mal, and psychomotor. An epileptic who is subject to grand mal seizures is believed to have an ongoing intrinsic overexcitability of the affected neurons in the brain. The actual seizure might be generated by a variety of external stimuli.



Source: https://www.brainkart.com/article/Epilepsy_19786/

13. Which of the following is NOT characteristic of epilepsy?
- A. Increased excitability of neurons in the central nervous system.
 - B. Seizures induced by external stimuli.
 - C. Seizures of several identifiable patterns.
 - D. Identifiable homozygous and heterozygous states.
 - E. Epileptics may suffer various types of seizures.
14. Epilepsy is a disorder of the central nervous system. Human nervous system, however, consists also of peripheral nervous system. Which of the following is NOT a part of the peripheral nervous system?
- A. Cranial nerves
 - B. Spinal cord
 - C. Spinal nerves
 - D. Neuromuscular junctions
 - E. Peripheral nerves

HUMAN EMBRYONIC DEVELOPMENT



Source: <https://stock.adobe.com/pl/images/human-embryonic-development-or-human-embryogenesis-from-zygote-to-gastrula-zygote-2-cell-morula-blastula-gastrula/432759383>

15. After a period of cleavage, what is the developing organism first called?

- A. Zygote
- B. Morula
- C. Blastula
- D. Gastrula
- E. Blastopore

The following information refers to questions 16 and 17.

The germ layers formed during gastrulation constitute the source of all organs and tissues of the body. Endoderm gives rise to the inner linings of the respiratory tract and the esophagus, the stomach, the small and large intestines, and the organs that are outgrowths of the digestive track (pancreas, gall bladder, and liver). The ectoderm is the source of the epidermis, the eye, and the nervous system. The mesoderm is the origin of connective tissue, heart, blood cells, and the urogenital system.

16. All of the following structures arise from the ectoderm except:

- A. Sweat glands
- B. The nervous system
- C. The excretory system
- D. The structures of the eye
- E. Spinal chord

17. Which of the following structures derives from the same germ layer as the heart?

- A. Liver
- B. Spinal cord
- C. Bone
- D. Retina
- E. Stomach

The following information refers to questions 18 and 19.

A bacterium may acquire a genome different from that of its parents through one of the three recombinant processes: transformation, conjugation, or transduction. Transformation involves the addition and incorporation of genetic material, usually pieces of DNA from lysed bacteria, into the genome of a bacterium from its surroundings. The genetic material that it receives may be prokaryotic or eukaryotic. In relation to its genetic content, the recipient bacterium is said to be transformed. During conjugation, a plasmid called the F factor (fertility) facilitates the transfer of DNA from one bacterium to another. The third recombinant mechanism is transduction; in this mechanism, a virus transfers DNA from one bacterium to another.

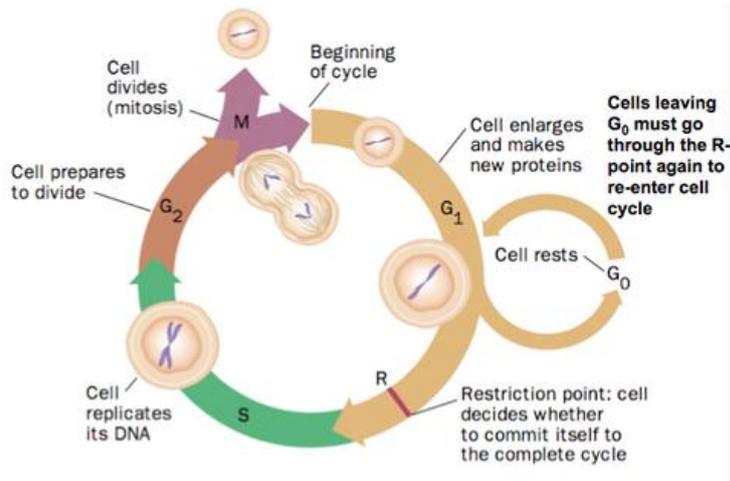
Age	Fluoride Ion Level Present in Drinking Water		
	<0.3 ppm*	0.3-0.6 ppm	>0.6 ppm
≤6 months	None	None	None
6 months–3 years	0.25 mg/day†	None	None
3-6 years	0.50 mg/day	0.25 mg/day	None
6-16 years	1 mg/day	0.50 mg/day	None

* 1 ppm = 1 mg/L.
† 2.2 mg sodium fluoride contains 1.0 mg fluoride ion.
ppm: part per million.
Source: Reference 13.

18. Which of the following recombinant processes depends on the F-factor plasmid?
- Transduction
 - Binary fission
 - Conjugation
 - Transfection
 - Crossing over
19. Which of the following recombinant processes is carried out by a virus?
- Transduction
 - Transformation
 - Transfection
 - Conjugation
 - Binary fission
20. Supplemental fluoride can be prescribed in the form of drops, lozenges, or chewable tablets. Prescription fluoride products are dosed as "mg of fluoride ion." However, pharmacists can see that the healthcare provider writes the prescription stating the dose of fluoride dose as "mg sodium fluoride." What conclusions can be drawn from the information given above?
- Children over the age of six months should receive fluoride supplementation.
 - The maximum daily dose of fluoride ions for all ages is 0.6 ppm.
 - Children aged 3-6 who drink water with fluoride ion content below 0.3 ppm should take 0.5 mg of sodium fluoride a day.
 - Children who use fluoride-containing toothpaste do not need fluoride supplementation.
 - Children between 6 months and 3 years of age who drink water with fluoride ion content below 0.3 ppm should supplement 0.55 mg of sodium fluoride a day.
21. A dose of 4500 mg of medication was ordered for a patient. The medication comes in 5 g/0.3 mL. What volume will you administer to the patient?
- 270 ml
 - 27ml
 - 2.7 ml
 - 270µl
 - 27µl

22. A child weighs 15 kg and is prescribed a medication with a dose of 2 mg/kg/day in equal doses every 4 hours. How many mg will you administer per dose?
- 7.5 mg
 - 5 mg
 - 0.5 mg
 - 0.75 mg
 - 50 mg

The following image refers to questions 23 and 24.



Source: http://www.genxspan.com/pathways.html?class_id=12

23. The cell cycle phase associated with the replication of the cell genome is:
- The S-phase of the interphase
 - Mitosis
 - The G₂ period of interphase
 - The G₀ phase
 - The R point in the G₁ phase.
24. Which phase is associated with intensive cell growth?
- S
 - G₂
 - G₁
 - M
 - G₀
25. There are two types of digestion: mechanical and chemical. The mechanical type begins with shredding, grinding, and chewing (mastication). Then it continues with churning in the stomach. Chemical digestion occurs by means of enzymes produced throughout the digestive system. Which of the following does not participate in chemical digestion?
- Mouth
 - Esophagus
 - Stomach
 - Pancreas
 - Small intestine

The following text refers to questions 26 and 27.

Single-entity injectable drug products

www.fda.gov

The FDA is requiring the removal of ratio expressions of strength from the labeling of single-entity injectable drug products (i.e., drug products that contain only one active ingredient) and replacement with the amount per unit of volume (e.g., mg/mL). For example, Epinephrine Injection 1:1,000 will now be labeled as Epinephrine Injection 1 mg/mL. The Institute for Safe Medication Practices (ISMP) cited incidents of confusion and serious medication errors in which undiluted epinephrine 1:1,000 (1 mg/mL) was administered intravenously to patients instead of the 1:10,000 (0.1 mg/mL) concentration. Ratio expressions may be hard to differentiate since 1,000 may easily look like 10,000 in small print, especially when typed without the comma (1:1000 and 1:10000). ISMP also found that healthcare providers misunderstood the concentrations represented by ratios. Thirty percent of the cases specifically stated that the ratios contributed to the errors. The errors resulted in serious adverse outcomes, including death.

26. Based on the information above, indicate which of the following statements is true:
- A. The FDA requires that the amount of drug per unit be replaced with the expression of the ratio.
 - B. The misunderstanding of the concentration represented by the expression of the ratio has led to medical errors.
 - C. Injectable drug products must not be used by healthcare professionals with poor vision.
 - D. Thirty percent of medical errors resulted in death.
 - E. Only undiluted epinephrine should be administered to a patient.
27. Administering 1 ml of undiluted epinephrine (1:1000) instead of 1 ml of 1:10000 concentration to a patient, means that the patient received an epinephrine dose (compared to intended dose):
- A. Ten times higher
 - B. Ten times lower
 - C. Equivalent
 - D. Two times higher
 - E. Two times lower

The following text refers to questions 28 through 31

Dental Students' Perception and Anxiety Levels during their First Local Anesthetic Injection.

Chandrasekaran B et al. *Al. Malays J Med Sci.* 2014 Nov-Dec;21(6):45-51.

Administering local anesthesia (LA) is a technique-sensitive process that requires meticulous skills and mastery of the maneuver. There are various methods for teaching LA, including demonstration on cadavers and dry human skulls, practice on simulation models, and live human subjects. Among these, LA student-to-student administration is most often practiced in dental schools around the world and

continues to be the standard teaching modality. (...) 0.5 mL of 2 % lignocaine with 1:80000 epinephrine was used as the LA agent. (...) The results illustrate that only 39.7% of the operators could make the patient comfortable during the procedure. 42.9% had difficulty determining the insertion point, although 33.3% of the students completely agreed that their hands did not shiver while administering the injection. Majority of the operators (42.9%) felt that they needed supervision in the forthcoming injection procedures as well. (...) It was revealed that, as operators, 46% of the students were 'a little nervous' before and during the injection procedure, and 57.1% of them became calm and relaxed after the procedure. 34.9% of the recipients were calm and relaxed before the procedure, but their level of anxiety increased significantly during the injection procedure (50.8%) and most of them became relaxed (81%) after the injection.

28. Based on the information above, indicate which of the following statements is true:

- A. Most of the recipients were nervous before the procedure.
- B. Minority of the students were calm and relaxed after the procedure.
- C. One third of the students agreed that their hands shivered when they administered the injection.
- D. Almost half of the students-operators were found to be nervous before and during the injection procedure.
- E. Less than half of the operators were calm and relaxed after the procedure.

29. According to the authors, the student-to-student LA administration is which of the LA teaching methods?

- A. Demonstration on a cadaver
- B. Demonstration on a dry human skull
- C. Practice on simulation model
- D. Practice on a live human subject
- E. None of the above is true.

30. Part of the LA injection recipient group:

- A. was anxious during the injection procedure.
- B. had difficulties in determining the insertion point.
- C. observed that their hands shivered during injection.
- D. was nervous after the injection procedure.
- E. felt that they needed supervision in the forthcoming procedures.

31. The LA agent used in the above study was a 2% lignocaine (lidocaine) solution. Determine the amount of lidocaine received by each student, given that one ml of solution contains 20 mg of lidocaine and the injected dose volume was 0.5 ml:

- A. 1 mg
- B. 2 mg
- C. 5 mg
- D. 10 mg
- E. 20 mg

32. The 1% drug X solution contains 10 mg of drug X per 1 ml. The maximum allowable dose of this medication is 4.5 mg/kg of body weight. How many ml of this solution can be administered to a 70 kg male patient without exceeding the maximum permissible dose?
- A. 9 ml
 - B. 14 ml
 - C. 15.75 ml
 - D. 20 ml
 - E. 31.50 ml

The following text refers to questions 33 through 36

Caffeine addiction: Need for awareness, research, and regulatory measures.

Jain S., et al. Asian J Psychiatr. 2019 Mar;41:73-75.

Caffeine is a psychoactive constituent of various widely available products, e.g., Cola, energy drinks, chocolates, tea, coffee, analgesics, etc. It is the most widely used psychoactive substance (80% population worldwide). In the US, 61% of the general population consumed an average of 210-238 mg/day, while in the UK 25% of the general population and 50% of people with psychiatric illness consumed more than 500 mg/day. A school-based survey of 300 Indian students reported 97% of adolescents consumed on average 98 mg of caffeine/day, which is higher than used by the US adolescents and the Canadian recommendations for adolescents (85 mg/day), while 6% used more than 300 mg/day which has been considered harmful. ICD-10 recognized caffeine as a dependence-producing substance (World Health Organization, 1992), and a number of studies since 1993 have acknowledged the addictive potential of caffeine (...) Regular use has been found to be associated with higher trait anxiety and depression. Caffeine has been associated with increased stress, sleep disturbance, anger, violence, and behavior disorder among adolescents. Excessive intake may lead to psychological consequences (e.g. anxiety, headache, nausea, restlessness, insomnia, relapse/exacerbation of bipolar and psychosis, withdrawal-related fatigability, irritability & drowsiness) as well as physical consequences (e.g. hypertension, cardiovascular, neurological, gastrointestinal, and renal problems, overdose death). Studies have reported that moderate caffeine consumption (<300 mg/day) is not associated with health-related consequences. Rather psychological (e.g. mental alertness, concentration) as well as physical (e.g. vigor, glucose tolerance (...)) benefits have also been reported.

33. Based on the information above, indicate which of the following statements is true?
- A. Daily consumption of 500 mg of caffeine is considered moderate.
 - B. Regular use of caffeine is associated with sedation and sleepiness.
 - C. Moderate caffeine consumption is not associated with health benefits.
 - D. Caffeine is the most popular psychoactive substance worldwide.
 - E. The recommended daily caffeine intake for adolescents exceeds 300 mg.

34. Which of the below-mentioned effects is not associated with moderate caffeine consumption:

- A. Restlessness
- B. Vigor
- C. Concentration
- D. Glucose tolerance
- E. Mental alertness

35. Excessive caffeine consumption:

- A. is required to treat insomnia.
- B. is beneficial for health.
- C. is extremely rare among adults.
- D. is recommended by WHO.
- E. may lead to hypertension and cardiovascular problems.

36. One cup of brewed coffee contains about 95 mg of caffeine on average. How many cups can be consumed per day without exceeding the total amount of caffeine considered moderate consumption?

- A. 1 cup
- B. 2 cups
- C. 3 cups
- D. 4 cups
- E. 5 cups

The following text refers to questions 37 through 39

The following Table (Fig.1) presents dosages and delivery routes of some non-steroidal anti-inflammatory drugs (NSAIDs) commonly used in pain management:

Drug	Dosage per day	Route of administration
Conventional NSAIDs (non-selective COX inhibitors)		
• Ketorolac	10-30 mg four times daily	Orally or iv
• Ibuprofen	400 mg three times daily	Orally
• Ketoprofen	50 mg four times daily	Orally or iv
• Diclofenac	75 mg twice daily	Orally or iv
	50 mg three times daily	Orally or iv
	100 mg twice daily	Rectally
COX-2 selective inhibitors		
• Meloxicam	15 mg once per day	Orally
• Lornoxicam	4-8 mg twice daily	Orally or iv
• Celecoxib	200 mg once per day	Orally
• Parecoxib	40 mg once or twice daily	iv form only

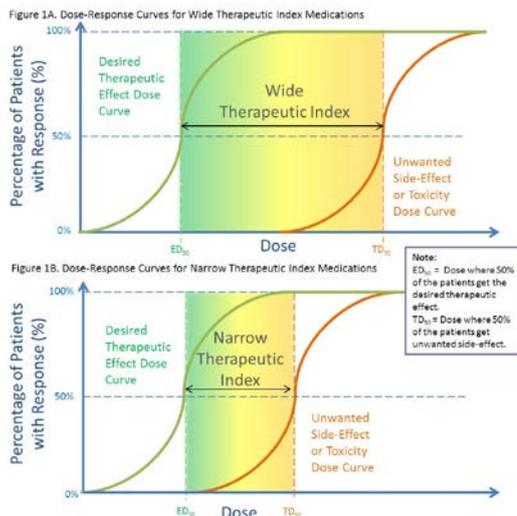
NSAID = non-steroidal anti-inflammatory drug; iv = intravenous.

Fig.1. Non-steroidal anti-inflammatory drugs: typical daily doses and administration

37. The maximum daily amount of Ketorolac for oral intake is:
- A. 10 mg
 - B. 30 mg
 - C. 40 mg
 - D. 80 mg
 - E. 120 mg
38. Which of the listed drugs has the lowest maximum daily dose?
- A. Meloxicam
 - B. Lornoxicam
 - C. Ketorolac
 - D. Ketoprofen
 - E. Parecoxib
39. Based on the information above, indicate which of the following statements is true?
- A. The maximum daily doses for Diclofenac taken orally and rectally are the same.
 - B. Most of the listed drugs have to be administered more than three times a day.
 - C. Maximum daily doses for Ketoprofen and Celecoxib are equal.
 - D. The maximum daily dose of Ibuprofen is two times higher than Celecoxib.
 - E. Each of the listed drugs can be taken orally.
40. If a single dose of drug X is 25 mg/kg of body weight and the medication must be taken three times a day, the total daily amount of the drug X that should be administered to a 45 kg person is:
- A. 1125 mg
 - B. 1250 mg
 - C. 2500 mg
 - D. 3375 mg
 - E. 4525 mg

The following text refers to questions 41 through 43

The therapeutic index (TI) is the range of doses in which a medication is effective without unacceptable adverse events. Therapeutic Index (TI) refers to the ratio of the dose of drug that causes adverse effects at an incidence/severity not compatible with the targeted indication (TD_{50}) to the dose that leads to the desired pharmacological effect (ED_{50}) – $TI = TD_{50}/ED_{50}$. The higher the TI value, the safer the drug. The Figure below presents dose-response curves for two types of medications – with a wide TI (drug A) and a narrow TI (drug B). The ED_{50} values are identical for both drugs – 20 mg, TD_{50} equals 200 mg for drug A and 80 mg for drug B.



<https://www.healthxchange.sg/medicine-first-aid/medicine/five-tips-narrow-therapeutic-index-medication-warfarin>

41. The TI for drug B compared to the TI of A is:
- 5-fold lower
 - 2.5-fold lower
 - The same
 - 2.5 times higher
 - 5-fold higher
42. Based on the information above, indicate which of the following statements is true?
- At the same dose, drug A is more effective than drug B.
 - Drug B is less toxic than drug A.
 - Drug A is safer than drug B.
 - The toxicities of both drugs A and B are comparable.
 - All statements are true.
43. Taking into account a dose yielding therapeutic effects in 95% of patients,
- the toxic effects of drug A can be expected in most patients.
 - it is unlikely that toxic effects occur in patients taking drug B.
 - most patients taking drug B will experience unwanted or toxic effects.
 - toxic effects can occur in a low percentage of patients taking drug B.
 - 50% of patients taking drug A experience toxic effects.
44. Drug X is degraded by enzyme E. Drug Y inhibits the enzymatic activity of E. The effectiveness of drug action depends on its concentration in plasma. When comparing the effects of therapy with drug X alone to a therapy with drug X and Y together, we can expect the following:

- A. The effectiveness of drug X will not be affected.
- B. Plasma concentration of drug X will remain unchanged.
- C. Plasma concentration of drug X will increase.
- D. The effectiveness of drug X will decrease.
- E. Drug X will be degraded to a greater extent.

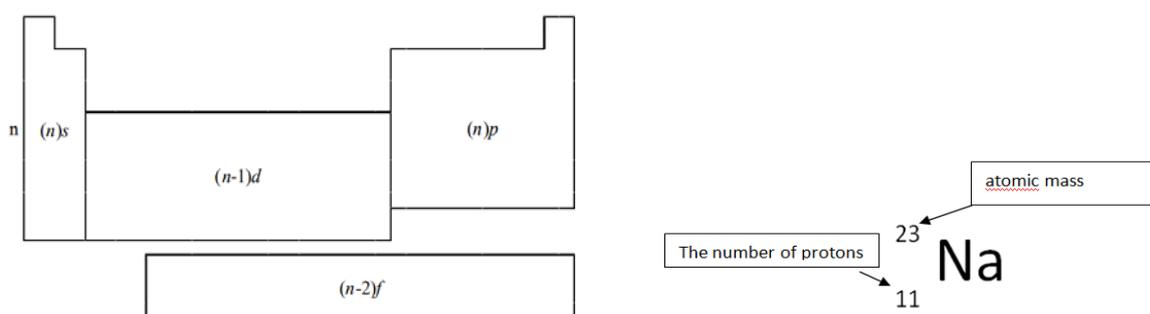
45. The patient is to receive 1500 ml of saline solution administered intravenously at the rate of 125 ml/hour. How long will it take for them to receive the whole dose?

- A. 8 h
- B. 9 h
- C. 10 h
- D. 12 h
- E. 15 h

CHEMISTRY

The following text refers to questions 46 through 48

A wave function for an electron in an atom is called an atomic orbital; this atomic orbital describes a region of space in which there is a high probability of finding the electron. There are n^2 orbitals (subshells) for each energy level. For $n=1$, there is 1^2 or one orbital. For $n = 2$, there are 2^2 or four orbitals. All orbitals that have the same value of n are said to be in the same shell (level). The shells are labeled alphabetically with the letters used (starting from the closest to the nucleus, we have: K, L, M, N, O, P, Q). To calculate the maximum number of electrons in each shell, formula $2n^2$ can be used (*Dan Berger Re: Why do electron shells have set limits ? madsci.org, 17 March 1999*). Each electron subshell can contain a certain amount of electrons, $s = 2$, $p = 6$, $d = 10$, and $f = 14$. Electrons fill the shell and subshell levels in a semi-regular process. After filling the first shell level (with only an s subshell), electrons move into the second-level s subshell and then into the p subshell before starting on another shell level. Because of its lower energy state, the $4s$ orbital fills before the $3d$ (*Encyclopaedia Britannica*). The electrons in the outermost shell (the ones with the highest value of n) are the most energetic, and are the ones which are exposed to other atoms. This shell is known as the valence shell (*Martin S. Silberberg, Chemistry: The Molecular Nature of Matter and Change, 2nd ed. Boston: McGraw-Hill, 2000, p. 277-284, 293-307*).



Atoms are made up of particles called protons, electrons, and neutrons. Protons carry a positive electrical charge, electrons carry a negative electrical charge, and neutrons carry no electrical charge. The atom is electrically neutral, and the vast majority of its mass is concentrated in its nucleus.

46. Indicate the correct notation of the electron configuration of Se atom in the ascending order of orbital energies:

- A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4$
- B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$
- C. $[\text{Ar}] 4s^2 4p^6$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$
- E. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}$

47. Indicate the correct number of neutrons in Se atom:

- A. 30
- B. 47
- C. 45
- D. 34
- E. 78

48. Indicate the number of valence electrons present in Se atom:

- A. 4
- B. 10
- C. 8
- D. 6
- E. 18

The following text refers to questions 49 through 50

In chemistry, chemical reactions are frequently written as equations using chemical symbols. The reactants are shown on the left side of the equation, and the products are shown on the right.

Stoichiometry is the field of chemistry that is concerned with the relative quantities of reactants and products in chemical reactions and the calculation of those quantities. It describes the relationship between the amounts of reactants and products in a reaction. To balance an equation, it is necessary that there are the same number of atoms on the left side of the equation as on the right. One can do this by raising the coefficients.

(Stoichiometry and Balancing Reactions. (2020, August 15).

<https://chem.libretexts.org/@go/page/240>)

49. For the equation: $N_2 + 3 H_2 = 2 NH_3$, how many moles of nitrogen should be used to obtain 24 moles of ammonia:

- A. 24
- B. 12
- C. 26
- D. 36
- E. 46

50. $X CH_3COOH + Y KOH = Z CH_3COOK + Q H_2O$

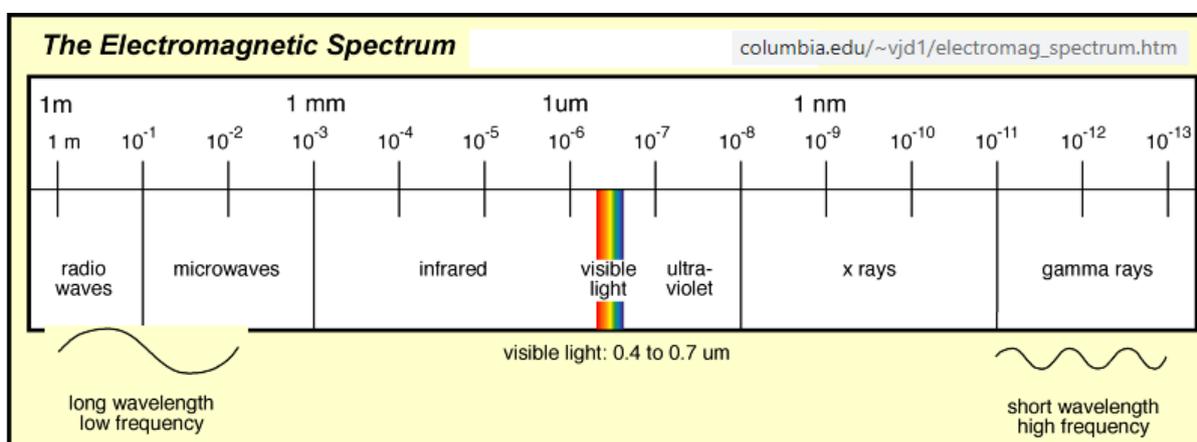
For the presented equation, X,Y,Q, and Z stand for:

- A. 1; 1; 1; 2
- B. 2; 1; 2; 1
- C. 1; 1; 1; 1

- D. 0; 1; 0; 0
E. 2; 1; 2; 2

The following text refers to questions 51 through 52

Spectrophotometric methods are based on the ability of certain compounds to selectively absorb electromagnetic radiation. They are used to detect, identify, and quantify the examined compounds. Absorption spectrophotometry in the range of ultraviolet and visible light is used most commonly in practice. The main purpose of the qualitative analysis is to determine the relationship between **absorbance (A)**, which is a measure of the change in the intensity of light after passing through an absorbing component, and the wavelength of light (λ). The basis for the quantitative evaluation of the absorbance measurement is **the Lambert-Beer law** $\rightarrow A = c \cdot l \cdot \epsilon_{\lambda}$. This law defines the dependence of the absorbance - A, (no units) of light for a certain wavelength (λ) on the thickness of a homogeneous component - l, [cm] containing a light-absorbing component at concentration - c[M] where ϵ_{λ} is a constant called molar absorption coefficient [$M^{-1}cm^{-1}$] for the given wavelength.



1 nm = 10^{-9} m; 1 um = 10^{-6} m; 1 mm = 10^{-3} m, m - meter

51. The visible light within the range of electromagnetic radiation is between:

- A. 400 – 700 nm
B. 200 – 400 nm
C. 700 – 1000 nm
D. 100 – 200 nm
E. 415 – 420 nm

52. Calculate the molar concentration of solution X if the measured absorbance (A_{420}) is equal to 0.1. $\epsilon_{\lambda} = 10^4 M^{-1}cm^{-1}$ and the thickness of the cuvette was 1 cm.

- A. 10^{-5} M
B. 10^{-10} M
C. $0.1 M^{-1}$

D. $10^{-4} \text{ M}^{-1}\text{cm}^{-1}$

E. 0.4 M

53. 0.9% sodium chloride for injection contains 9 NaCl g/L; 1 g = 1000 mg and 1L = 1000 mL

Choose the statement that is correct in relation to the above information:

A. The 0.5% sodium chloride injection contains 9 NaCl g/L

B. 1% sodium chloride injection contains 9 NaCl mg / mL

C. 0.5% sodium chloride injection contains 0.45 NaCl g/L

D. The 0.45% sodium chloride injection contains 4.5 NaCl mg/mL

E. 0.045% sodium chloride injection contains 4.5 NaCl mg/L

54. Mepivacaine is a local anesthetic used in medical treatment. The range of its action depends on the concentration of the solution used. Its solutions act as follows:

- 0.5% - anesthesia of small surface sensory nerves;
- 1% - blocking conduction in sensory and sympathetic nerves;
- 1.5% - complete anesthesia and partial tracheal block in nerve cell motions;
- 2% - complete block in nerve cell movements.

Source: https://bazalekow.mp.pl/leki/doctor_subst.html?id=541

You have 0.5 ml of Mepivacaine solution that completely blocks cell movements, but you need to anesthetize only the small surface sensory nerves. How many ml of sterile injectable water should be added to your Mepivacaine solution to obtain the proper concentration?

A. 0.25 ml

B. 0.5 ml

C. 1 ml

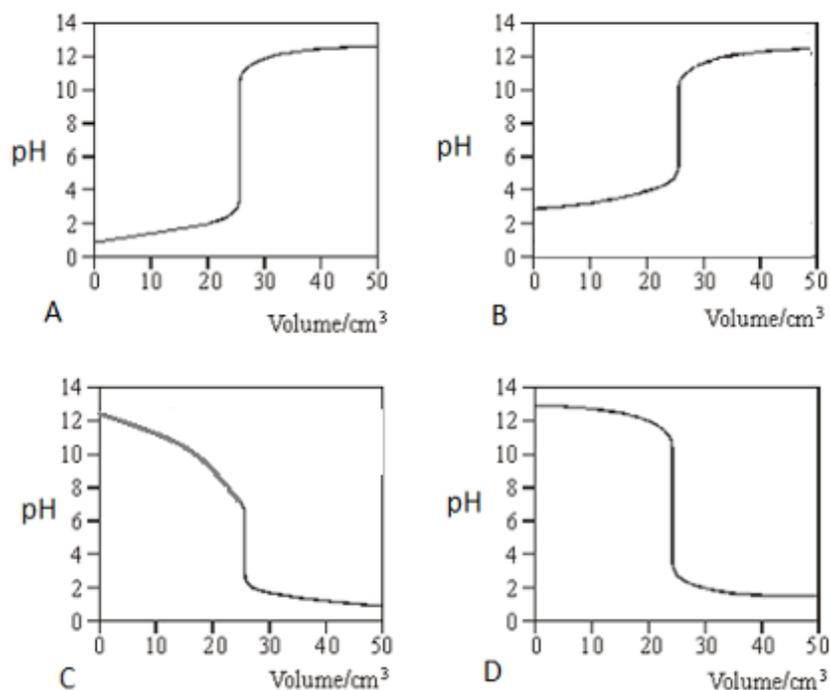
D. 1.5 ml

E. 2 ml

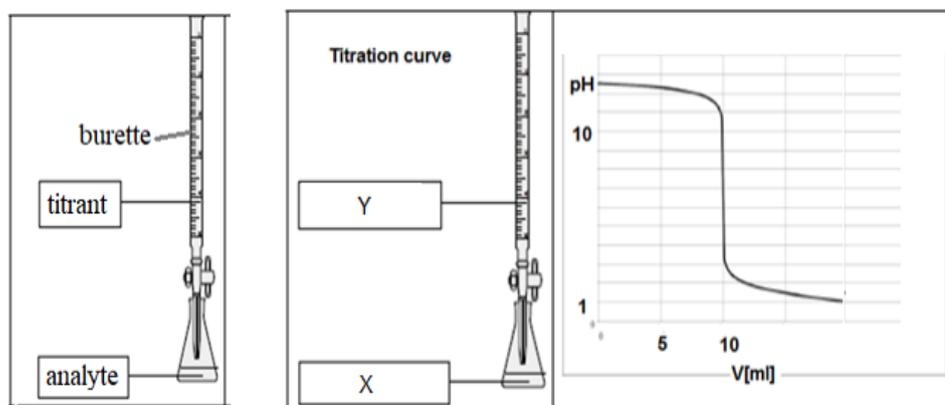
The following text refers to questions 55 through 56

Titration is a technique used to determine the concentration of an unknown solution. A titrant, which is a solution of a known concentration, is added to a solution analyte of unknown concentration. A **titration curve** is a graphical representation of the pH of a solution during a titration. The following titration curves present the changes in pH versus volume of the added solution for combinations of different acids and bases. Among others, for strong acids, we can name: HCl, HBr, or HNO_3 ; for strong base: NaOH, KOH or LiOH; for weak acids: CH_3COOH , HCOOH , or HNO_2 ; and for weak bases: $\text{NH}_3 \cdot \text{H}_2\text{O}$.

In the picture below, graph A represents the titration of strong acid with a strong base, graph B weak acid with a strong base, graph C weak base with strong acid, and graph D strong base with strong acid.



55. Choose the proper set of acid and base for X and Y; $1\text{cm}^3=1\text{ml}$.



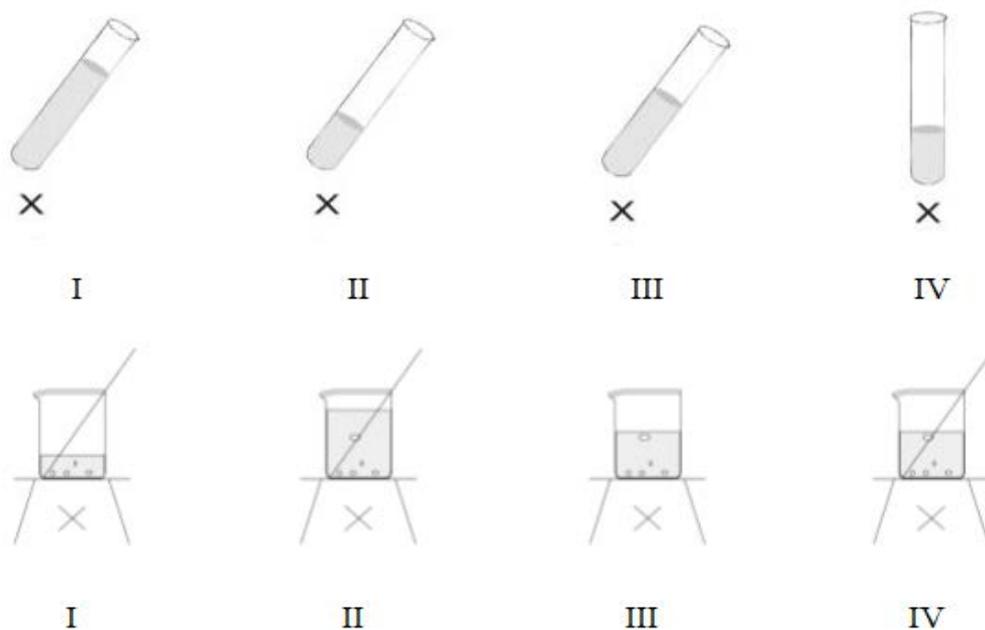
- A. X - $\text{NH}_3 \cdot \text{H}_2\text{O}$; Y - HNO_3
- B. X - KOH ; Y - HCl
- C. X - HCl ; Y - CH_3COOH
- D. X - HBr ; Y - NaOH
- E. X - LiOH ; Y - HCOOH

56. What will be the volume of titrant added to the analyte at the $\text{pH} = 10$?

- A. 1 ml
- B. 5 ml
- C. 10 ml

- D. 15 ml
- E. 20 ml

57. In a chemistry laboratory, strict safety rules apply. Certain safety procedures must be followed when performing chemical experiments. An example is heating a liquid on a gas burner. A liquid can be heated in a beaker filled to half its volume with the presence of a glass rod. If too much liquid is used, it can overflow and put out the burner, and if too little liquid is used the vessel may overheat and burn/burst under the temperature if the liquid evaporates. The test tube in which the liquid is heated should be held in an angled position with the outlet pointing away from your face.



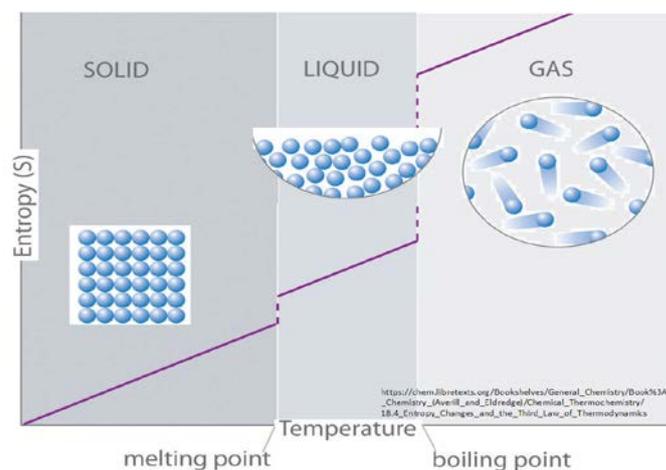
Indicate the images showing the correct heating of the liquid in the beaker and in the test tube over a burner:

- A. test tube – I, beaker – III
- B. test tube – IV, beaker – IV
- C. test tube – II, beaker – I
- D. test tube – I, beaker – III
- E. test tube – III, beaker – IV

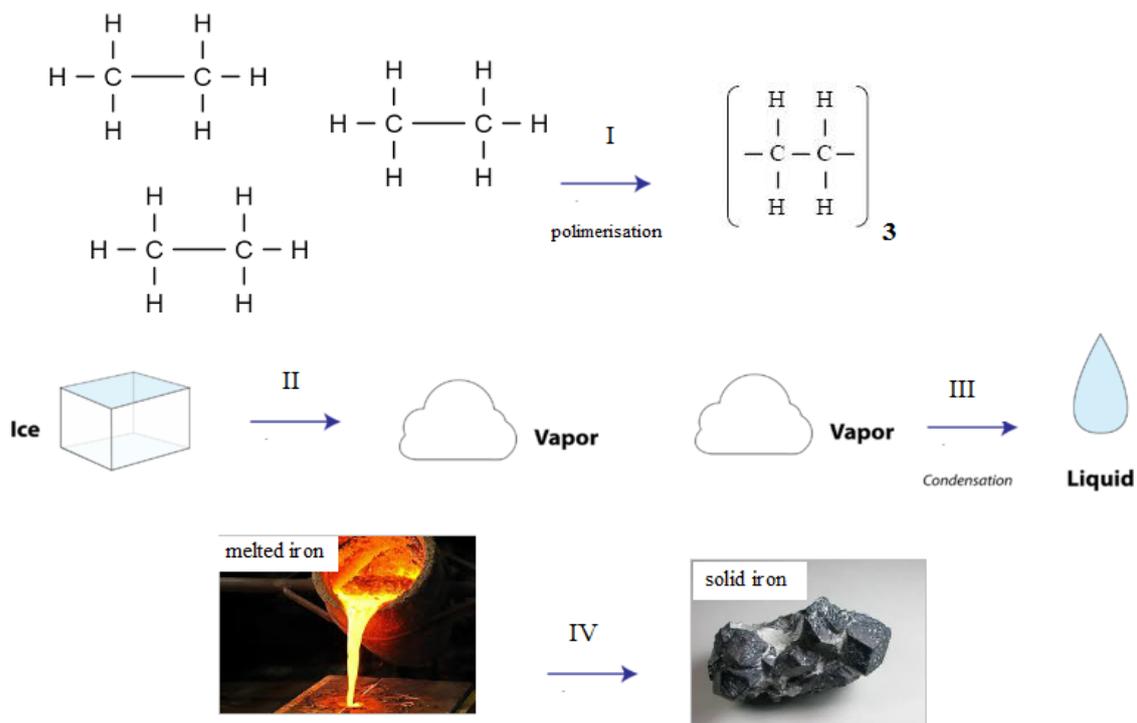
The following text refers to questions 58 through 59

The entropy - ΔS - is defined as a thermodynamic quantity representing the unavailability of the thermal energy of a system for conversion into mechanical work, often interpreted as the degree of disorder or randomness in the system. As the entropy of a system increases, it becomes less ordered, meaning there is an increase in disorder of system components.

(https://www.researchgate.net/publication/305856192_Thermodynamics_and_Cognition_Towards_a_Lawful_Explanation_of_the_Mind)



58. Indicate the process(es) in which the entropy increases.



- A. only I
- B. only II
- C. only IV
- D. I and III
- E. II, III, and IV

59. Taking into consideration processes II and III from task 58, determine which state of water has the highest degree of disorder:

- A. ice > vapor > liquid
- B. vapor > liquid > ice
- C. liquid > ice > vapor

- D. vapor = liquid > ice
- E. liquid = ice < vapor

60. Evaporation is a chemical process by which an element or compound transitions from its liquid state to its gaseous state below the temperature at which it boils; such a process can be carried out by heating a suitable liquid in a ceramic vessel over a gas burner. Decantation is a process of pouring off the liquid from above the sediment that lies beneath the liquid in the vessel. Sedimentation uses gravity or a centrifuge to separate the mixture components according to density. Gravity filtration is a method of filtering impurities from solutions by using gravity to pull liquid through a filter (<https://www.britannica.com/science/evaporation> <https://sciencenotes.org/what-is-decantation-definition-and-examples-chemistry/>)<https://orgchemboulder.com/Technique/Procedures/Filtration/Filtration.shtml>)

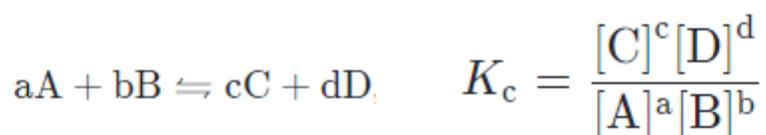


Choose the correct name for the process.

- A. 1- gravity filtration, 2 – sedimentation, 3 - decantation
- B. 1- sedimentation, 2 – evaporation, 3 – gravity filtration
- C. 1- decantation, 2 – evaporation, 3 - sedimentation
- D. 1- gravity filtration, 2 – evaporation, 3 - decantation
- E. 1- decantation, 2 – sedimentation, 3 - decantation

The following text refers to questions 61 through 63

Reversible reactions tend towards equilibrium state. In a chemical **equilibrium**, the forward and reverse reactions occur at equal rates, and the **concentrations** of products and reactants remain constant. The position of equilibrium depends on the properties of the reactants and products. For the given reaction, the equilibrium constant – K_c presents as follows:



where [A], [B], [C], and [D] refer to the concentrations at equilibrium.

Equilibrium shifts towards one side or another (forward or reverse) depending on: concentration, temperature, pressure, and volume. Given this reaction at equilibrium: $N_2 + 3H_2 \rightleftharpoons 2NH_3$, if H_2 reactant

is added, the reaction will shift toward products to reduce the added H_2 . If a NH_3 product is added, the reaction will shift toward substrates to reduce the added NH_3 . If the product NH_3 is removed, the reaction will shift toward products to replace the removal of the product.

61. Write the K_c formula for the reaction equation: **$2 ADP = ATP + AMP$**

- A. $K_c = [ATP][AMP] / [ADP]^2$
- B. $K_c = [ATP]^2[AMP] / [ADP]$
- C. $K_c = [ATP][AMP] / 2[ADP]$
- D. $K_c = [ADP]^2 / [ATP][AMP]$
- E. $K_c = [ADP]^2 / [ATP]^2[AMP]^2$

62. What is the K_c of the following reaction: **$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$** when concentrations in equilibrium are equal to: $SO_2(g)=0.9M$, $O_2(g)=0.35M$, $SO_3(g)=1.1M$

- A. 1.1
- B. 0.0
- C. 4.6
- D. 6.8
- E. 11.2

63. Given the reaction in equilibrium: $N_2 + 3H_2 \rightleftharpoons 2NH_3$ what will happen after adding N_2 ?

- A. The reaction will stay in equilibrium.
- B. The reaction will shift to substrates to replace product removal.
- C. The reaction will shift to substrates to reduce the added NH_3
- D. The reaction will shift to products to reduce the loss of substrates.
- E. The reaction will shift to products to reduce the added N_2 .

The following text refers to questions 64 through 68

Hydrocarbons can be divided into the following groups:

Saturated
alkanes



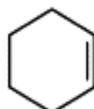
cycloalkanes



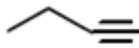
alkenes



cycloalkenes



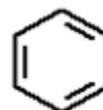
Unsaturated
alkynes



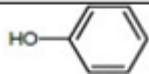
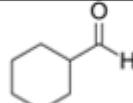
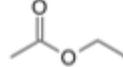
cycloalkynes



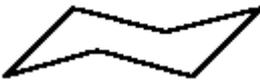
arenes (aromatic)



The functional groups among the organic compounds, together with the exemplary formulas of the organic compounds and the names of the classes of the compounds, are listed in the table.

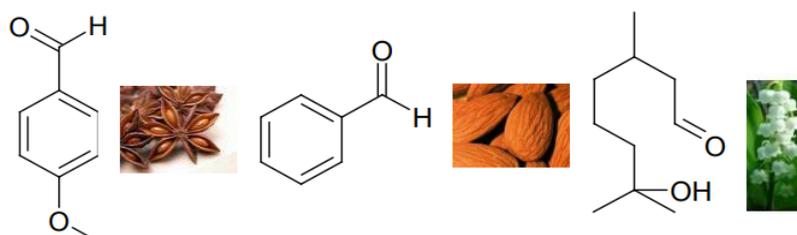
Functional group	Class of compound	Examples
Hydroxyl R-OH	Alcohols	
Hydroxyl Ar-OH	Phenols	
Thiol -SH	Thiols	
R' - O - R''	Ethers	
Amino -NH ₂	Amines	 primary  secondary  tertiary
Carbonyl -HC=O	Aldehydes	
Carbonyl -C=O	Ketones	
Carboxyl -COOH	Carboxylic acids	
Ester -COOR	Esters	
Amide -CONH ₂	Amides	

*R- aliphatic side chain; Ar – aromatic chain, R', R'' aliphatic or aromatic side chain

64. What type of compound is presented in the picture  ?

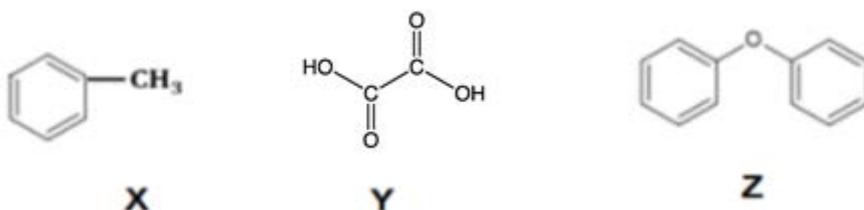
- A. Cycloalkane
- B. Benzene
- C. Arene
- D. Alkene
- E. Cycloalkyne

65. Indicate the type of compound responsible for the fragrances presented below:



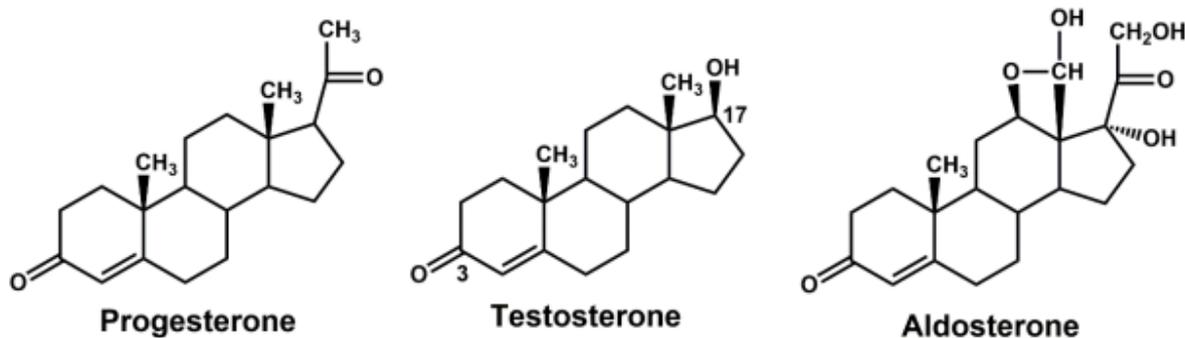
- A. Ketones
- B. Thiols
- C. Carboxylic acids
- D. Aldehydes
- E. Esters

66. What classes of compounds do X, Y, and Z represent?



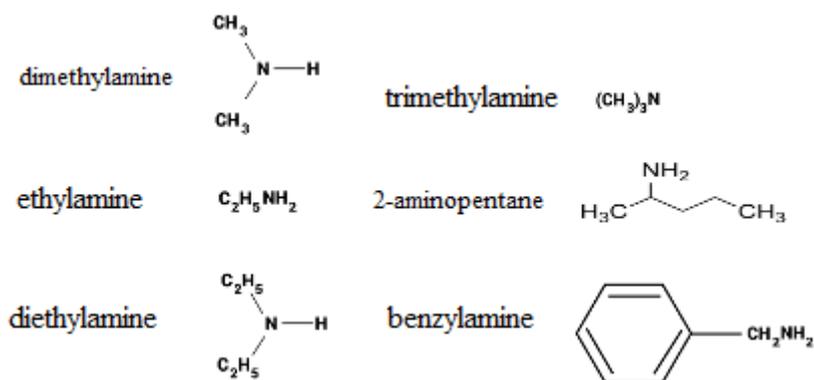
- A. X – Arene; Y – Dicarboxylic acid; Z - Ester
- B. X – Alkane; Y – Aldehyde; Z - Ether
- C. X – Cycloalkane; Y – Carboxylic acid; Z - Ketone
- D. X – Cycloalkyne; Y – Aldehyde; Z - Alcohol
- E. X – Arene; Y – Dicarboxylic acid; Z – Ether

67. Cholesterol is a steroid that is the precursor of vitamin D and many important steroid hormones such as estrogen, testosterone, and progesterone. What is true about the structure of the compounds in the picture? (<https://arxiv.org/ftp/arxiv/papers/1901/1901.09944.pdf>; DOI: 10.1016/j.anaerobe.2006.08.002)



- A. All three compounds have the double-bond characteristic of alkenes.
- B. The cycloalkane ring is a component of each of the formulas.
- C. Both Testosterone and Aldosterone have a hydroxyl group characteristic of alcohols.
- C. Progesterone and Aldosterone have a ketone group connected to aliphatic chain.
- D. All answers are correct

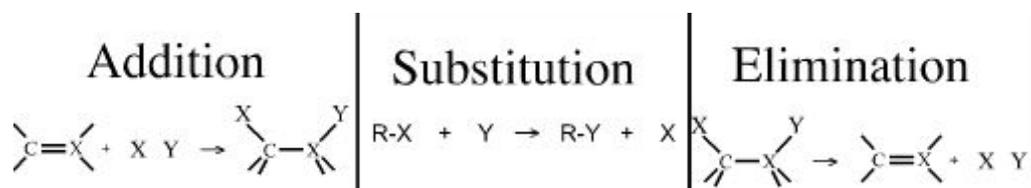
68. Choose all the formulas representing secondary amines:



- diethylamine, dimethylamine
- trimethylamine, diethylamine, and dimethylamine
- ethylamine and diethylamine
- benzylamine and trimethylamine
- only 2-aminopentane

The following text refers to questions 69 through 70

The schematic equations for the three main classes of organic reactions are listed as addition, elimination, and substitution.



R – aliphatic/aromatic side chain

Source of the graphic representation of the reactions

<https://pl.pinterest.com/pin/375135843934504666/>

Substitution will be the characteristic type of the reaction for arenes, while the addition reaction will occur in the presence of a classic double bond in the substrate.

69. Choose the correct type of reaction for the following example of an organic reaction:

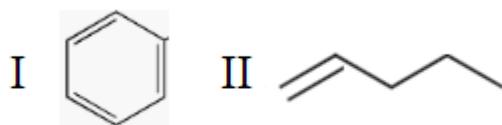
Source: Adam Renslo: *The Organic Chemistry of Medicinal Agents* www.accesspharmacy.com



- Substitution
- Addition
- Elimination

- D. Both substitution and elimination are possible.
- E. Neither

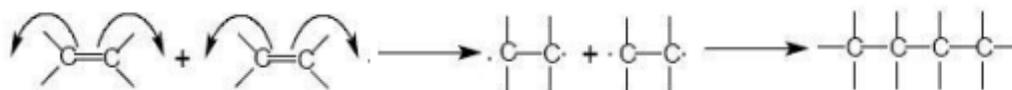
70. What will be the reaction characteristic of the given compounds?



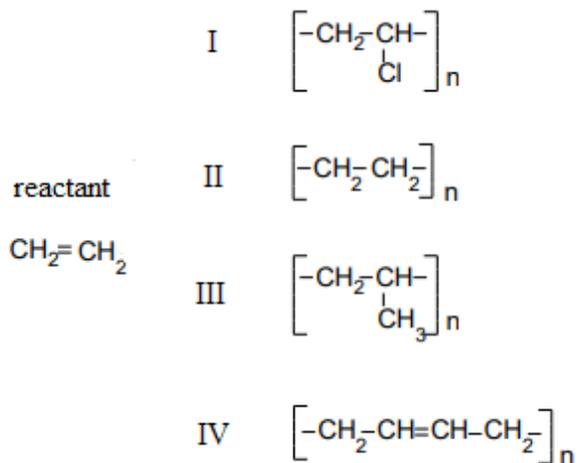
- A. I – addition, II - substitution
- B. I – substitution, II - addition
- C. I – elimination, II – addition
- D. I and II substitution
- E. I and II elimination

Question 71 refers to the following information

Chain polymerization occurs for monomers that break, allowing for the formation of radicals capable of assembling into long chains, as shown in the diagram:
http://www.chemia.odlew.agh.edu.pl/dydaktyka/Dokumenty/ChO_IMiR/Lab_niestacjonarne/polimery_teorii.pdf



71. For the given reactant, choose its polymer/polymers



- A. I
- B. II
- C. III
- D. IV
- E. II and III

The following text refers to questions 72 through 73

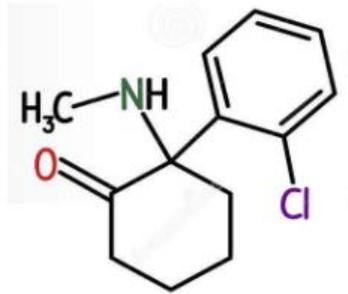
Using Polyurethanes in Medical Applications

Polyurethanes are often used in medical device applications and can be used in applications where other materials do not work. Polyurethanes' unique chemistry gives them this versatility. They are segmented polymers, meaning they have a soft segment that provides flexibility and a hard segment that provides strength. Polyurethanes are made from aromatic or aliphatic diisocyanates. Aromatic diisocyanates contain benzene rings, which create polymers that are tougher, stronger, and less costly than the aliphatic. Aliphatic diisocyanates are made with hydrocarbon backbones and contain no benzene rings. Aliphatic polyurethanes make strong polymers, but lack the chemical resistance of aromatics.

Polyurethanes used in long-term implants have their challenges. Among the first uses of polyurethane for implants were pacemaker leads. The polyurethane used was polyether-based. It performed well; however, failures occurred. Traditional polyether-based polyurethane showed signs of deterioration after being in the body for several years. Certain metals, such as cobalt, catalyze this degradation. This is particularly true in pacemaker leads, where ionic cobalt from the wire catalyzes oxidation. As the polyurethane oxidizes, it loses its physical properties. (<https://www.mddionline.com/materials/using-polyurethanes-medical-applications>)

72. What are the advantages of aromatic diisocyanates compared to aliphatic ones in terms of their usage in the medical device applications?
- A. They contain benzene rings.
 - B. They create polymers that are tougher and stronger.
 - C. They are less expensive.
 - D. They do not lack chemical resistance.
 - E. All the statements are correct.
73. Traditional polyether-based polyurethane in the pacemaker leads failed after being in the body for several years. Why is that?
- A. The polyether composition was the cause of the loss of its physical properties of the pacemaker.
 - B. The lack of cobalt ions led to continuous degradation.
 - C. The ionic cobalt from the wire caused polyurethane oxidation.
 - D. The polyurethane used had a benzene ring in its composition.
 - E. None of the above statements is correct.

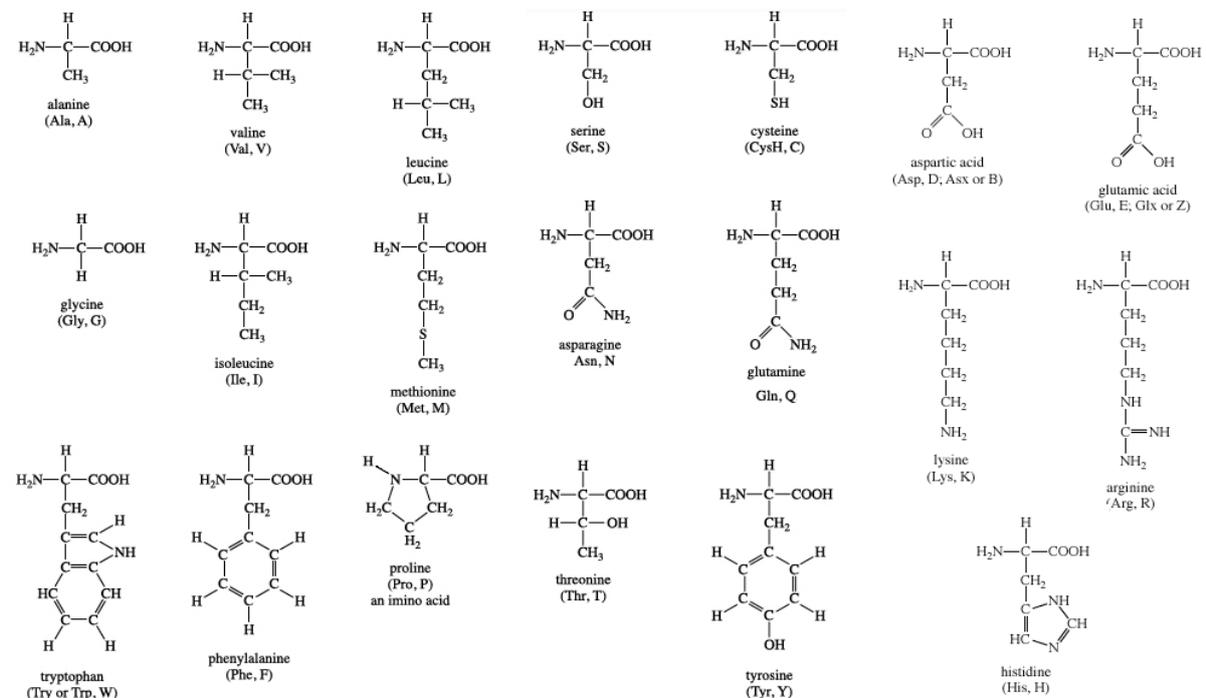
74. Ketamine molecule is used in medicine for anesthesia. A molecule model of ketamine is presented below. Indicate the chemical formula of ketamine



- A. $C_{12}H_{11}NOCl$
- B. $C_{13}H_{16}ClO$
- C. $C_{15}H_6ClNO$
- D. $C_{13}H_{16}ClNO$
- E. $C_{12}H_{22}N_2O$

The following text and pictures 1 and 2 refer to questions 75 through 78

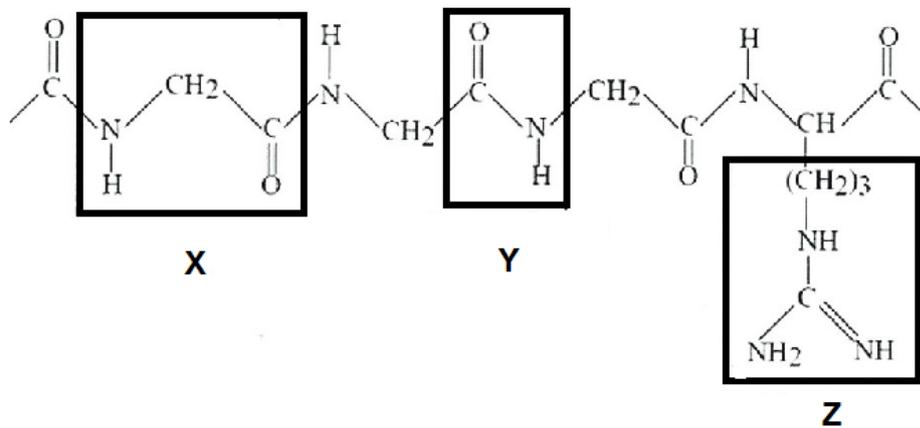
Picture 1 below shows the select formulas, names, and three-letter abbreviations of amino acids that can be present in human proteins. <https://www.britannica.com/science/amino-acid>



Picture 1. Amino acids formulas and names.

At the turn of the twentieth century, a German chemist Emil Fischer was the first to propose the linking together of amino acids, which he called the peptide bond. They can be linked by a condensation

reaction in which an -OH is lost from the carboxyl group of one amino acid along with a hydrogen from the amino group of a second amino acid, forming a molecule with an amide bond: -COHN-. (<https://www.britannica.com/science/amino-acid/Amino-acid-reactions#ref997074>).



Picture 2. Polypeptide formula.

75. How many peptide bonds are present in the polypeptide fragment in Picture 2?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

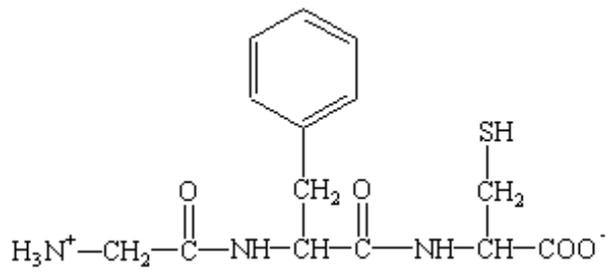
76. The **Z** frame from the Picture 2 is:

- A. Alanine
- B. Cysteine
- C. Polypeptide bond
- D. Glycine
- E. Side chain of arginine

77. Indicate which of the following amino acids have an aromatic side chain

- A. Tyrosine
- B. Phenylalanine and Tryptophan
- C. Valine and Leucine
- D. Histidine
- E. Both A and B

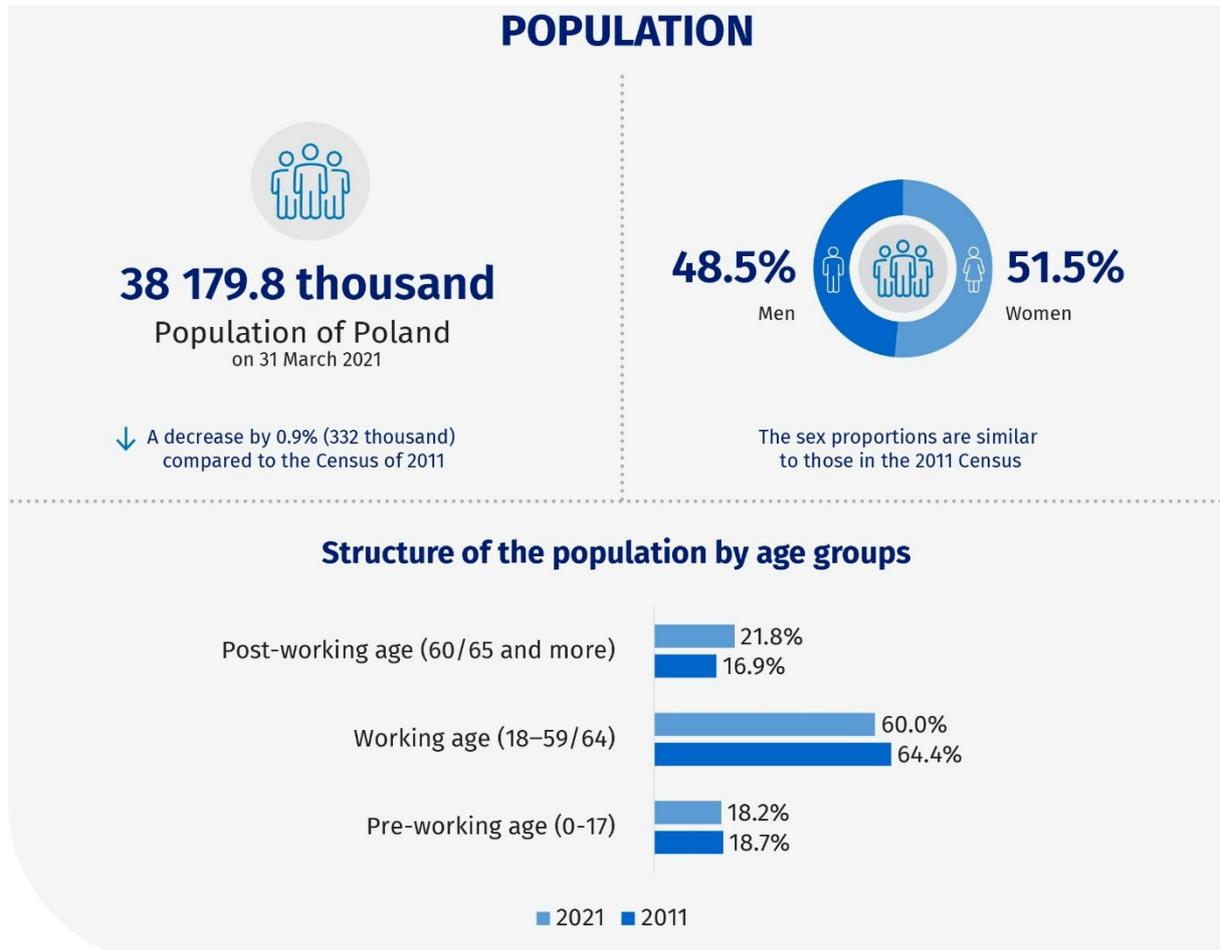
78. Choose the CORRECT tripeptide sequence:



- A. Gly -Phe -Cys
- B. Glu – Tyr – Met
- C. Cys – Phe – Gly
- D. Ala – Tyr – Cys
- E. Gly - Phe – Met

LOGIC

79. In February 2022, *Statistics Poland* published the preliminary results of the National Population and Housing Census 2021 (fig.). Look at the figure below and decide which sentence is true.



<https://stat.gov.pl/en/infographics-and-widgets/infographics/infographics-preliminary-results-of-the-national-population-and-housing-census-2021,53,1.html>

- A. The number of people in the pre-working age group decreased between 2011 and 2021.
- B. The sex structure of the population between 2011 and 2021 did not change.
- C. Post-working age in Poland starts at 65.
- D. The 2021 Census data were collected on March 31, 2021.
- E. The population size in 2021 was smaller than in 2011.

Health and Economic Costs of Chronic Diseases

Chronic diseases have significant health and economic costs in the United States. Preventing chronic diseases or managing symptoms when prevention is not possible can reduce these costs.

Nothing kills more Americans than heart disease and stroke. More than 877,500 Americans die of heart disease or stroke every year, which is one third of all deaths. These diseases also take an economic toll, costing our health care system \$216 billion per year (...).

Each year in the United States, more than 1.7 million people are diagnosed with cancer and almost 600,000 die from it, making it the second leading cause of death. The cost of cancer care continues to rise and is expected to reach almost \$240 billion by 2030.

More than 34.2 million Americans have diabetes, and another 88 million adults in the United States have a condition called prediabetes, which puts them at risk for type 2 diabetes. Diabetes can cause serious complications, including heart disease, kidney failure, and blindness.

Obesity affects 19% of children and 42% of adults, putting them at risk of chronic diseases such as type 2 diabetes, heart disease, and some cancers. Over 25% of young people aged 17 to 24 are too heavy to join the US military. Obesity costs the US health care system \$147 billion a year.

Arthritis affects 58.5 million adults in the United States, which is about 1 in 4 adults. It is a leading cause of work disability in the United States, one of the most common chronic conditions, and a common cause of chronic pain. The total cost attributable to arthritis and related conditions was about \$303.5 billion in 2013. Of this amount, nearly \$140 billion was for medical costs and \$164 billion was for indirect costs associated with lost earnings.

Alzheimer's disease, a type of dementia, is an irreversible, progressive brain disease that affects about 5.7 million Americans, including 1 in 10 adults aged 65 and older. It is the sixth leading cause of death among all adults and the fifth leading cause for those aged 65 or older. In 2020, the estimated cost of caring for and treating people with Alzheimer's disease was \$305 billion.

<https://www.cdc.gov/chronicdisease/about/costs/index.htm>

80. **The only way to reduce the economic costs of diseases is to prevent the onset of diseases.**

True False

81. **Arthritis is estimated to be responsible for 25% of all deaths in the United States.**

True False

82. **People with prediabetes are at higher risk of developing kidney disease and blindness.**

True False

83. **Dementia affects 10% of the US population.**

True False

84. **The cost of cancer care in the US is higher than the treatment of obesity.**

True False

85. **The leading causes of death in the United States are cardiovascular diseases and cancer.**

True False

86. **In 12 years, the sum of the ages of four sisters will be 94. What will the sum of ages of these sisters be in five years?**

- A. 46
- B. 66
- C. 74

- D. 87
- E. 89

The following text refer to questions 87 through 89

Five researchers: Ann, Becky, Cecile, Dorothea, and Evi met at a conference in New York. Each of them works in a different city in Europe (Barcelona, Krakow, Paris, Rome, and Vilnius) and represents different disciplines: a medical doctor, a dietitian, a cosmetician, a public health officer, and a social worker. Based on information given below, answer the questions.....

- Neither Cecile nor the citizen of Rome is a public health officer.
- Ann does not work in the west part of Europe.
- Evi, who is not a dietitian, lives in Italy.
- Neither the social worker nor Cecile work in Paris.
- The person who lives in Barcelona is neither a medical doctor nor a cosmetologist and her name is Dorothea.
- Becky is neither a medical doctor nor a public health professional.
- The Vilnius cosmetologist is not Cecile.

87. The social worker works in:

- A. Barcelona
- B. Krakow
- C. Paris
- D. Rome
- E. Vilnius

88. Evi is a:

- A. Medical doctor
- B. Dietitian
- C. Public health officer
- D. Social worker
- E. Cosmetologist

89. Who is a dietitian?

- A. Ann
- B. Becky
- C. Cecile
- D. Dorothea
- E. Evi

90. A clock is set right at 9 a.m. The clock gains 12 minutes in 24 hours. What time will the clock indicate at 3 p.m. on the following day?

- A. 3:12 p.m.
- B. 3:15 p.m.
- C. 3:12 a.m.
- D. 2:45 p.m.
- E. 2:48 p.m.

91. **Indicate the four-digit number, of which divisors are all numbers from 5 to 10?**

- A. 5571
- B. 8846
- C. 7560
- D. 8730
- E. 9000

92. **Which number completes the following sequence?**

128, 126, 123, 116, 114, 111, 104, 102, 99,

- A. 87
- B. 88
- C. 90
- D. 92
- E. 97

93. **Two goats eat 80 kg of food in four days. How much food do 6 goats eat in two days?**

- A. 80 kg
- B. 100 kg
- C. 120 kg
- D. 160 kg
- E. 240 kg

94. **If no tree is blue and some blue things are expensive, then which of the statements is always true?**

- A. There is a tree which is expensive.
- B. Some trees are neither blue nor expensive.
- C. Some blue things are not trees.
- D. All expensive things are not blue.
- E. None of the above statements is always true.

Which conclusions are true based on the statements below?

Statements: Some squares are big.

No big thing is yellow.

All big things are heavy.

95. No square is heavy.	True	False
96. Some yellow things are squares.	True	False
97. Some squares are heavy.	True	False
98. Some big things are not squares.	True	False
99. All heavy things are not yellow.	True	False
100. There are squares that are both yellow and heavy.	True	False

Key:

1.C, 2.D, 3.B, 4.C, 5.B, 6.B, 7.A, 8.B, 9.C, 10.D, 11.D, 12.D, 13.D, 14.B, 15.B, 16.C, 17.C, 18.C, 19.A, 20.C, 21.D, 22.B, 23.A, 24.C, 25.B, 26.B, 27.A, 28.D, 29.D, 30.A, 31.D, 32.E, 33.D, 34.A, 35.E, 36.C, 37.E, 38.A, 39.C, 40.D, 41.B, 42.C, 43.D, 44.C, 45.D, 46.D, 47.C, 48.D, 49.B, 50.C, 51.A, 52.A, 53.D, 54.D, 55.B, 56.C, 57.E, 58.B, 59.B, 60.D, 61.A, 62.C, 63.E, 64.A, 65.D, 66. E, 67.D, 68.A, 69.A, 70.B, 71.B, 72.E, 73.C, 74.D, 75.D, 76.E, 77.E, 78.A, 79.E, 80. FALSE, 81. FALSE, 82. TRUE, 83. FALSE, 84. FALSE, 85.TRUE, 86.B, 87.D, 88.D, 89.B, 90.B, 91.C, 92.D, 93.C, 94.E, 95. FALSE, 96.FALSE, 97. TRUE, 98. TRUE, 99. FALSE, 100. FALSE.