



**Precorsi per Medicina e Professioni Sanitarie**

**IMAT simulation - 09/05/2020**

**General Knowledge and Logical Reasoning**

1. ***“Muscle fibers generate tension through the action of actin and myosin cross-bridge cycling. While under tension, the muscle may lengthen, shorten, or remain the same. Although the term contraction implies shortening when referring to the muscular system, in muscle fibers it means that it generates tension with the help of motor neurons. For voluntary muscles, all contractions (excluding reflexes) occur as a result of conscious effort originating from the brain. The brain sends signals, in the form of action potentials, through the nervous system to the motor neuron that innervates several muscle fibers. In the case of some reflexes, the signal to contract can originate in the spinal cord through a feedback loop with the grey matter. Involuntary muscles such as the heart or smooth muscles in the gut and vascular system contract as a result of non-conscious brain activity or stimuli endogenous to the muscle itself. Other actions such as locomotion, breathing, and chewing have a reflex aspect to them: the contractions can be initiated consciously or unconsciously.”***

**What can be inferred from the passage?**

- A) Referring to the muscles, the term contraction doesn't imply shortening  
B) The signal to contract a muscle always originates from the brain  
C) The stimulus to contract a muscle cannot originate inside the muscle itself  
D) Some muscular actions can be both conscious and unconscious  
E) The brain is not always involved in muscular contraction
2. ***“In physiology, respiration (often confused with breathing) is defined as the transport of oxygen from the outside air to the cells within tissues, and the transport of carbon dioxide in the opposite direction. This is in contrast to the biochemical definition of respiration, which refers to the cellular one, that is to say the metabolic process by which an organism obtains energy by making oxygen react with glucose to give water, carbon dioxide and ATP (energy). Although physiologic respiration is necessary to sustain cellular respiration and thus life, in animals the processes are distinct: cellular respiration takes place in individual cells of the organism, while physiologic respiration concerns the bulk flow and transport of metabolites between the organism and the external environment.”***

**Physiologic and cellular respirations differ:**

- A) Only in terms of environment where they take place  
B) Only in terms of metabolic products they result in  
C) Only in terms of processes involved  
D) Only in terms of transport of metabolites  
E) All of the previous terms are correct
3. ***“Action has to be taken now to stop the spread of bovine tuberculosis (TB). Experts agree that reducing the number of badgers in the most heavily infected areas will help to break the cycle of infection between badgers and cattle and begin to reduce TB in both species. Although badgers can be vaccinated, there is no vaccine available to protect our cattle, and best estimates suggest it will be ten years before one is available. The only way to stop bovine TB spreading is to kill badgers.”***

**Which one of the following, if true, most strengthens the above argument?**

- A) Five annual vaccinations are necessary to fully protect a badger against bovine TB  
B) Shooting large numbers of badgers is more expensive than vaccinating them  
C) In a trial, killing ten thousand badgers reduced the TB rate in cattle by only fifteen percent  
D) When efforts are made to remove badgers, many are injured rather than outright killed



- E) Ethically, many people do not support this solution
4. **60% of the people registered in a sports center do swimming and 70% play tennis. The total people registered in the sports center are 200; how many of them do both swimming and tennis?**  
A) 30  
B) 40  
C) 80  
D) 130  
E) 60
5. **A 400g packet of snacks has the following nutritional values: it contains 10.86g of protein per 100 g and 1.5g of protein per snack. How many snacks does the package contain?**  
A) 29  
B) 30  
C) 25  
D) 13  
E) 33
6. **Two runners, Liz and Rory, are training for a competition. Rory passes the start point every 9 minutes. Liz passes the start point every 15 minutes. They have just set off on their routes. How long will it be before they meet up at the start point again?**  
A) 45 minutes  
B) 1 hour  
C) 30 minutes  
D) 3 hours  
E) 1 hour and a half
7. **I wish to tile an area of a wall 240cm wide by 200 cm high. Tiles are 20 cm square. I will therefore need  $12 \times 10 = 120$  tiles. Which of the following uses the same method of calculation as that above?**  
A) A ladder is 4m high, each step is 0.2m. Therefore there are 20 steps.  
B) A swimming pool is 5m by 4m. The cover costs £ 10.000 per square meter. Therefore it will cost £ 200 for the whole cover.  
C) A box containing sugar cubes is 10cm x 10 cm x 5 cm. A sugar cube has a side of 1 cm, therefore the box contains 500 cubes.  
D) Using square tables of 1.5 m on each side, I need to make up a dining table 6m x 3 m, therefore I will need 8 tables.  
E) I work 80 hours a week and I earn £ 7.00 an hour. Therefore in one month (considered as 4 weeks) I will earn £ 2240.
8. **The figures below show the results of a survey of 1000 people on the sizes of their current and previous car:**

		Current car			Total
		Large	Medium	Small	
Previous car	Large	100	120	20	<b>240</b>
	Medium	80	200	80	<b>360</b>
	Small	40	160	200	<b>400</b>
	Total	<b>220</b>	<b>480</b>	<b>300</b>	<b>1000</b>

**If the table is representative of those who are looking to change their car at present, what percentage of car buyers would you expect to trade up to a larger car than their present one?**





- A) 12%
- B) 22%
- C) 24%
- D) 28%
- E) 70%

9. A jeweller sells a watch with a 18 % reduction on the price, that is a 36 dollar reduction. What was the price of the watch?

- A) \$ 160
- B) \$ 210
- C) \$ 185
- D) \$ 200
- E) \$ 150

10. In order to succeed in academic examinations it is necessary to study. Therefore, if a student works hard in a particular subject, he or she should do well when the time of the examination comes. Which of the following best describes the flaw in the argument?

- A) It assumes that it is necessary to study in order to succeed.
- B) It overestimates the value of studying in preparation for examinations
- C) It ignores the fact that some subjects are more academic than others
- D) It assumes that studying hard is a sufficient condition for academic success
- E) It ignores the fact that some students do not need to study very much in order to succeed

11. Which one of the following was the author to a series of short stories, namely "Dubliners"?

- A) William Shakespeare
- B) Rudyard Kipling
- C) James Joyce
- D) Charles Baudelaire
- E) William Turner

12. Who produced and detected X-rays in 1895?

- A) Wihelm Conrald Röntgen
- B) Guglielmo Marconi
- C) Albert Einstein
- D) David Hilbert
- E) Marie Curie

13. What happened on the 3rd of March, 1918?

- A) The end of World War I
- B) Treaty of Brest-Litovsk
- C) The end of World War II
- D) Night of the Long Knives
- E) March on Rome

14. In which of the following States there is there an higher percentage of Christians than other religious groups?

- A) Pakistan
- B) North Korea
- C) China
- D) Sudan





E) Ethiopia

**15. In which year was the independence of United States declared?**

- A) 1846
- B) 1918
- C) 1687
- D) 1776
- E) 1492

**16. What's the capital city of New Zealand?**

- A) Old Russell/Okato
- B) Auckland
- C) Wellington
- D) Christchurch
- E) Dunedin

**17. When was the Magna Carta libertatum document agreed to?**

- A) 1234
- B) 1302
- C) 1215
- D) 1198
- E) 1220

**18. Which of the following branches of the European Union has Ursula von der Leyen as President?**

- A) The European Commission (EC)
- B) The European Central Bank (EBC)
- C) The European Parliament
- D) The Council of the European Union
- E) The European Committee of the Regions

**19. Who is the author of "The Rime of the Ancient Mariner"?**

- A) W. Wordsworth
- B) S.T. Coleridge
- C) J. Keats
- D) G.G. Byron
- E) P.B. Shelley

**20. In ancient times, the pigment "Purpura" was obtained from:**

- A) A type of shellfish
- B) A Mediterranean plant
- C) The eggs of a bird living in Tunisia
- D) A mixture of different pigments coming from India
- E) Mineral sources

**21. Luis Sepùlveda, the famous writer that, among other novels, wrote "The story of a seagull and the cat who taught her to fly", was born in:**

- A) Peru
- B) Spain
- C) Colombia
- D) Chile





E) Argentina

**22. The type of government that runs in China at the moment is:**

- A) People's Republic, governed by the Democratic Party
- B) Monarchy
- C) Federal Republic
- D) People's Republic, governed by the Communist Party
- E) Dictatorship

**Biology**

**23. The extracellular matrix:**

- 1) provides support and connects the cells
- 2) is also known as a glycocalyx
- 3) is secreted by animal cells and many bacteria
- 4) is present only in plant cells

**Choose the correct answer:**

- A) All of them
- B) 1,2 and 3
- C) 1,3 and 4
- D) 3 only
- E) 2 and 4 only

**24. Which of the following statements about DNA is false?**

- A) it is a polymer
- B) two polynucleotide strands wound around each other in a double helix, held together by covalent bonds
- C) it involves 4 different bases
- D) Rosalind Franklin's work led to the discovery of the DNA double helix
- E) it contains a pentose sugar, nitrogen-containing bases and phosphate groups

**25. Which of the following processes is/are catabolic reactions:**

- 1) Photosynthesis
- 2) Glycolysis
- 3) Protein synthesis
- 4) Fermentation

- A) all of them
- B) 1 and 4 only
- C) 1,3 and 4
- D) 2 only
- E) 2 and 4 only

**26. In case of hyperglycemia an excessive amount of glucose circulates in the blood plasma. In order to bring blood sugar back to normal:**

- A) the liver converts glycogen in glucose
- B) the body needs sugar
- C) insulin stimulates the entry of glucose into the cells
- D) glucagon stimulates glycogenolysis
- E) nothing happens





27. In which of the following cells the number of chromosomes is equal or less than a female haploid cell:

- 1) Hepatocytes
- 2) Erythrocytes
- 3) Sperm

Choose the correct answer:

- A) 1 only
- B) 1,2 and 3
- C) 1 and 3 only
- D) 3 only
- E) none of them

28. Four medical students, Clara, Giacomo, Valentina and Filippo, recorded different structures that they thought were found in a healthy animal red blood cell, a liver cell and a typical maple leaf cell.

Med Students	red blood cell RBC	maple leaf cell	liver cell
Clara	Centrioles	80s ribosomes	Well-defined core
Giacomo	Hemoglobin	70s ribosomes	Vacuole
Valentina	DNA strands	Chloroplasts	Cell wall
Filippo	Hemoglobin	Plasmodesmata	Mitochondria

Which students gave totally correct answers?

- A) Clara and Filippo
- B) Giacomo only
- C) Filippo only
- D) Valentina and Giacomo
- E) None of them

29. Which of the following hereditary diseases is autosomal recessive:

- 1) Albinism
- 2) Achondroplasia or dwarfism
- 3) Huntington disease
- 4) Sickle cell anemia

Choose the correct answer:

- A) none of them
- B) 1 and 2
- C) 3 and 4
- D) 2 only
- E) 1 and 4

30. The first metabolic intermediate that is common to the aerobic metabolism of glucose and fatty acids is:

- A) acetyl COA
- B) beta-hydroxybutyrate
- C) pyruvate
- D) citrate
- E) glyceraldehyde 3-phosphate





**31. The Duchenne muscular dystrophy is caused by a mutation of the dystrophin gene located on the short arm of the X chromosome. Which of the following statements are false?**

- A) Females typically are carriers of the genetic trait while males are affected.
- B) The daughter of a carrier mother has a 50% chance of being a carrier
- C) The DMD is a degenerative neuromuscular pathology
- D) The son of a carrier mother has a 50% chance of inheriting the defective gene from his mother.
- E) The son has a 25% chance of inheriting the disease from his father

**32. Which of the following molecules contain only carbon, hydrogen and oxygen?**

- 1) cellulose
- 2) hemoglobin
- 3) amylase
- 4) a triglyceride
- 5) DNA

**Choose the correct answer:**

- A) 1 and 4 only
- B) 2 and 5 only
- C) 3 and 5 only
- D) 1 and 3 only
- E) 2 and 4 only

**33. The Krebs Cycle is carried out:**

- 1) In the mitochondrial matrix of eukaryotic cells
- 2) In the mitochondrial matrix of prokaryotic cells
- 3) In the cytoplasm of eukaryotic cells
- 4) In the cytoplasm of prokaryotic cells

**Choose the correct answer:**

- A) 1 and 2
- B) 3 and 4
- C) 1 and 4
- D) 1 and 3
- E) all of them

**34. Which of the following options are true about mitochondrial genetic diseases?**

- 1) ATP metabolism may be affected
- 2) They can't be inherited by male sons
- 3) They can't be inherited by female daughters
- 4) They can't be inherited from sick fathers
- 5) They can be inherited from sick mothers

- A) 1,2 and 4
- B) 3, 4 and 5
- C) 1, 3 and 5
- D) 1, 4 and 5
- E) 1, 2, 4 and 5

**35. DNA replication:**

- A) Is fully conservative
- B) Is absent in cells infected with viruses
- C) Happens in the first phase of mitosis
- D) Involves different enzymes, such as transferases
- E) Leads to different DNA strands





**Human Anatomy and Physiology**

**36. Which of the following structure is/are part of the electrical conduction system of the heart?**

1. SA node
  2. AV node
  3. His bundle
  4. Purkinje cells
- A) 1 and 2  
B) 1,2 and 3  
C) 3 only  
D) 2 only  
E) 1,2,3 and 4

**37. Choose the right answer. The osteoclasts...**

- A) Have the same cytologic origin as the osteoblasts  
B) Are a type of osteoblasts that, following an excess in bone production, enter a quiescent state  
C) Produce and secrete the unmineralized organic portion of the bone matrix, called "osteoid"  
D) Are usually more active than the osteoblasts  
E) Come from the same precursors as the macrophages

**38. Which of the following statements about the adrenal gland are correct?**

1. It is located beneath and slightly median to the kidney
  2. It is divided in two sections, the cortex and the medulla
  3. The medulla secretes stress hormones like cortisol
  4. The cortex can also secrete aldosterone in response to the stimuli of the RAAS
- A) 2 only  
B) 2 and 4  
C) 2 and 3  
D) 1 and 2  
E) 3 only

**39. Which WBC are elevated during allergic reactions?**

1. Eosinophils
  2. Basophils
  3. Neutrophils
  4. Lymphocytes
- A) 1 only  
B) 1 and 2  
C) 3 only  
D) 3 and 4  
E) all

**40. Which of the following statements about the liver is/are correct?**

1. The liver is an organ which detoxifies various metabolites
  2. The liver is an organ which synthesizes proteins
  3. The liver is an organ which produces biochemicals necessary for digestion and growth
  4. It is located in the right upper quadrant of the abdomen, below the diaphragm
- A) 1 only  
B) 1 and 2  
C) 3 only  
D) 3 and 4  
E) all







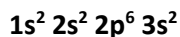
Chemistry

41. In an experiment 10 cm<sup>3</sup> of carbon monoxide and 10 cm<sup>3</sup> of oxygen are mixed. The gases react as shown in the equation below.  
 $\text{CO (g)} + \text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)}$   
What will be the total volume of gas present, in cm<sup>3</sup>, at the end of the reaction? (All gas volumes are measured at the same temperature and pressure)
- A) 10  
B) 15  
C) 20  
D) 15  
E) 30
42. What is the freezing point depression of a solution of 0.16 moles of Na<sub>2</sub>CO<sub>3</sub> in 100 mL of ethanol? [K<sub>f</sub> = 1.99 K×kg/mol; density of ethanol = 789 kg/m<sup>3</sup>]
- A) 4 K  
B) 1,2 K  
C) 9,6 K  
D) 12 K  
E) 3,2 K
43. Which of the following is/are NOT redox?
1.  $4 \text{ H}_3\text{PO}_3 \rightarrow 3 \text{ H}_3\text{PO}_4 + \text{PH}_3$
  2.  $2 \text{ H}_3\text{PO}_4 + 3 \text{ CuO} \rightarrow \text{Cu}_3(\text{PO}_4)_2 + 3 \text{ H}_2\text{O}$
  3.  $\text{KMnO}_4 + \text{KI} + \text{H}_2\text{SO}_4 \rightarrow \text{MnSO}_4 + \text{I}_2 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$
- A) 1 only  
B) 2 only  
C) 2 and 3 only  
D) 1 and 2 only  
E) 1 and 3 only
44. Many elements in nature can have different isotopes. Although one isotope commonly predominates due to stability, the other isotopes can affect the overall mass of the element. Suppose a certain element has two main isotopes: isotope A has a molar mass of 128 g/mol and isotope B has a molar mass of 132 g/mol. One mole of this element, when found naturally, weighs 128.8 grams. What are the percentages of isotopes A and B when found in nature?
- A) 50% A and 50% B  
B) 60% A and 40% B  
C) 20% A and 80% B  
D) 80% A and 20% B  
E) 30% A and 70% B
45. Which of the following configurations represents the correct and most stable structure of ammonia and phosphine (phosphorus trihydride)?
- A) AX<sub>2</sub> – linear geometry  
B) AX<sub>4</sub> – tetrahedral structure  
C) AX<sub>2</sub>E<sub>2</sub> – bent structure  
D) AX<sub>3</sub>E – trigonal pyramidal structure  
E) AX<sub>3</sub>E<sub>2</sub> – trigonal bipyramidal structure





**46. Which of the elements listed has the following electron configuration:**



- A) Mg
- B) Mn
- C) Cl
- D) Se
- E)  $Al^{-1}$

**47. Which one of the following molecules is a structural isomer of cycloheptane?**

- A) Heptyne
- B) 2,4-dimethyl-2-pentene
- C) Methylcyclohex-2-yne
- D) Benzene
- E) 2-ethylpentane

**48. Consider the redox reaction  $NaI + 3HClO \rightarrow NaIO_3 + 3HCl$**

**Which of the following statements is/are correct?**

- 1. Chlorine gains electrons**
- 2. NaI is the oxidizing agent**
- 3. The oxidation number of the iodine is +5 in the sodium iodate**

- A) 3 only
- B) 2 and 3 only
- C) 1 and 3 only
- D) 1 and 2 only
- E) 1, 2 and 3

**49. A solution of nitric acid contains 0.01 moles of  $HNO_3$  in 100 mL of pure water. If you dilute 10 mL of this solution in enough water to make up a solution of 1L, what is the pH of the obtained solution?**

- A) 11
- B) 2
- C) 0
- D) 8
- E) 3

**50. Which of the following molecules can have cis-trans isomerism?**

- 1. But-2-ene**
- 2. Butenedioic acid**
- 3. 2-butyne**

- A) 1 and 2 only
- B) 3 only
- C) 1, 2 and 3
- D) 2 only
- E) 1 and 3 only

**51. Five of the ions of vanadium are listed below:**

- 1.  $VO_3^-$**
- 2.  $V^{3+}$**
- 3.  $V^{2+}$**
- 4.  $VO^{2-}$**
- 5.  $VO_2^+$**





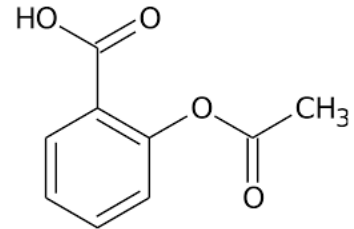
Which two ions have vanadium in the same oxidation state?

- A) 1 and 3
- B) 2 and 5
- C) 1 and 5
- D) 3 and 4
- E) 4 and 5

52. The acetylsalicylic acid (ASA), also known as "Aspirin", is an organic compound, belonging to the NSAID (Nonsteroidal Anti-Inflammatory Drug) family, which contains two important chemical functions.

Which option identifies these two functions?

- A) Alcohol and aldehyde
- B) Ether and ketone
- C) Ketone and acid
- D) Ester and aldehyde
- E) Ester and carboxylic acid



### Math and Physics

53. Which of the following expressions is equal to  $\frac{9^{2n} \cdot 27^n}{3^n}$  for all integers  $n$ ?

- A)  $3^{3n+3}$
- B)  $3^{6n}$
- C)  $3^{2n+1}$
- D)  $3^{8n}$
- E)  $3^{6n+2}$

54. John bought a car for 18.000 £. After one year the car loses 10% of its original value, the second year loses further 15%. What is the price of the car after these two years?

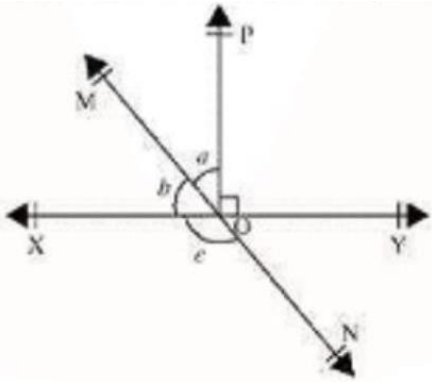
- A) 2.430 £
- B) 13.500 £
- C) 1.800 £
- D) 243 £
- E) 13.770£

55. The diameter of the wheel of a motorcycle is 63 cm. How many revolutions will it make to travel 99 km?

- A) 33.333 revolutions
- B) 50.000 revolutions
- C) 66.666 revolutions
- D) 75.000 revolutions
- E) 99.999 revolutions

56. In the given figure, lines XY and MN intersect at O. If POY forms a  $90^\circ$  angle and the ratio of  $a:b = 2:3$ , find c:





- A)  $120^\circ$
- B)  $126^\circ$
- C)  $132^\circ$
- D)  $140^\circ$
- E)  $150^\circ$

57. The two cylinders of a hydraulic press filled with an incompressible fluid have a radius of, respectively,  $r$  and  $10r$ . If a force of  $120\text{ N}$  is applied to the piston of the smaller cylinder, what is the acceleration of a car with a mass of  $1000\text{ kg}$ , placed on the plate of the bigger cylinder ( $g=10.0\text{ N}\cdot\text{m}/\text{s}^2$ )?
- A) The car doesn't move
  - B)  $10\text{ m}/\text{s}^2$
  - C)  $1\text{ m}/\text{s}^2$
  - D)  $2,0\text{ m}/\text{s}^2$
  - E)  $20\text{ m}/\text{s}^2$
58. A capacitor with an initial capacitance of  $C=C_0$  is filled by  $\frac{1}{4}$  with a dielectric medium of relative permittivity  $\epsilon=4$ . What is the final capacitance of the device?
- A)  $\frac{13}{16} C_0$
  - B)  $\frac{16}{13} C_0$
  - C)  $\frac{3}{7} C_0$
  - D)  $\frac{16}{13} C/V$
  - E)  $4 C_0$
59. Which one of the following is NOT a fundamental physical quantity?
- A) Electric current
  - B) Temperature
  - C) Time
  - D) Electric charge
  - E) Luminous intensity
60. Given two vectors,  $r$  and  $s$ , with  $|r| \neq 0$  and  $|s| \neq 0$ , which of the following options is/are necessarily correct?
1.  $(r \times s) \perp r$
  2.  $(r + s) \perp s$
  3.  $(r + s) \cdot (r \times s) = 0$
- A) Only 1
  - B) Only 2
  - C) Only 3
  - D) 1 and 3
  - E) 1, 2 and 3

