Associazione
Studenti e Professori di Medicina Uniti Per

In collaborazione con Ufficio Tutor della Scuola di Medicina
dell'Università degli Studi di Padova

Precorsi per Medicina e Professioni Sanitarie

IMAT simulation – 1st August 2020

General Knowledge and Logical Reasoning

1. Before the ancient-DNA revolution, researchers had to rely on examining skeletons — or, more rarely, mummies — for visible evidence of disease, spotting the telltale signs of leprosy or syphilis, for instance, and cross-referencing with historical records. But many infections don't leave visible marks on bone. Other, indirect clues to the age of some diseases have come from estimating the age and geographical distribution of protective mutations in humans: people whose red blood cells lack the 'Duffy antigens', for example, enjoy some protection against the malaria parasite Plasmodium vivax. (Smallpox and other viruses plagued humans much earlier than suspected, www.nature.com, July 23rd 2020). Which of these statements is not supported directly nor indirectly by this paragraph?
A) Some diseases or genetic polymorphisms can have a role in preventing some diseases.
B) It is not possible to observe physical signs of infectious disease on human archeological finds for some pathogens.
C) Modern DNA-sequencing techniques have given researchers a new tool in studying ancient epidemics.
D) People lacking the Duffy antigen are immune to malaria infections.
E) Plasmodium vivax causes malaria.

2. Among 30 people from a university class, 1 in 6 of them are Italian and 1 in 3 are European. The overall average GPA of the university class is 28 and the GPA of European students is 27/30. Assuming the grade point average (GPA) of Italian students is exactly 26 out of 30, what is the GPA for non-Italian students?
A) Less than 26
B) Between 26 and 27
C) Between 27 and 28
D) Between 28 and 29
E) Above 29

3. 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) 200
D) 150
E) 185

4. I wish to tile an area of a wall 240cm wide by 200 cm high. Tiles are 20 cm square. I will therefore need 12x10=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) I work 80 hours a week and I earn £ 7.00 an hour. Therefore in 4 weeks I will earn £ 2240
E) Using square tables of 1.5 m on each side,I need to make up a table 6mx3m, I'll need 8 tables.

5. Fill in the blanks to complete the proportion.

_____:bowel=_____:backbone

A) Brain, kidney
B) Thyroid, lung
C) Intestine, vertebral column
D) Cerebral cortex, spine
E) Jaw, teeth

6. In order to succed in academic examinations it is necessary to study. Therefore, if a student workshard in a particular subject, he or she should do well when it comes the time of the examination.Which of the following best describes the flaw in the argument?
A) It overstimates the value of studying in preparation for examinations
B) It ignores the fact that some subjects are more academic than others
C) It assumes that studying hard is a sufficient condition for academic success
D) It ignores the fact that some students do not need to study very much in order to succed
E) It assumes that it is necessary to study in order to succed.

7. Action has to be taken now to stop the spread of bovine tuberculosis (TB). Experts agree thatreducing the number of badgers in the most heavily infected areas will help to break the cycle ofinfection between badgers and cattle and begin to reduce TB in both species. Although badgers can bevaccinated, there is no vaccine available to protect our cattle, and best estimates suggest it will be tenyears before one is available. The only way to stop bovine TB spreading is to kill badgers. Which oneof the following, if true, most strengthens the above argument?
A) Five annual vaccinations are necessary to protect a badger fully 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 per cent
D) When efforts are made to remove badgers, many are injured rather than killed outright
E) Less efforts are made to remove badgers, many are injured rather than killed outright

8. Two runners, Liz and Rory, are training for a competition. Rory passes the start point every 9minutes. Liz passes the start point every 15 minutes. They have just set off on their routes. Howlong 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

9. 60% of the people registered in a sports centre do swimming and 70% play tennis. The total peopleregistered in the sports centre are 200; how many of them do both swimming and tennis?
A) 30
B) 40
C) 80
D) 130
E) 60

10. Mark has got three red hats and two white hats. He invites John, Mike and Tom to play a game. Heblindfolds them and invites them to take a seat so that they can see one another. He puts a hat on theirheads so that any of them can see the others' hats but his own. Mark hides the two remaining hats anduncovers his friends. Finally, he asks each of them to find out the color of his own hat. Neither Johnnor Mike can answer. Tom:
A) is sure he wears a red hat, even blindfolded

B) is sure he wears a white hat, even blindfolded
C) can't answer, even uncovered
D) can answer only after seeing his friends' heads
E) is not sure whether he wears a red hat

11. What's the capital city of New Zealand?
A) Old Russell/Okiato
B) Auckland
C) Wellington
D) Christchurch
E) Dunedin

12. When was the Magna Carta libertatum agreed to?
A) 1234
B) 1302
C) 1215
D) 1198
E) 1220

13. 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

14. 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

15. Metaphysics is one of the principal works of:
A) Socrates
B) Copernicus
C) Aristotle
D) Kepler
E) Pythagoras

16. Luis Sepùlveda, famous writer that, among other novels, wrote "The story of a seagull and the catwho taught her to fly", was born in:
A) Peru
B) Spain
C) Colombia
D) Chile
E) Argentina

17. 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

18. Who produced and detected X-rays in 1895?
A) Wihelm Conrald Röntgen
B) Guglielmo Marconi
C) Albert Einstein
D) David Hilbert
E) Marie Curie

19. What happened on March 3rd 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

20. In which of the following States there is higher percentage of Christians than the others?
A) Pakistan
B) North Korea
C) China
D) Sudan
E) Ethiopia

21. In which year the independence of United States was declared?
A) 1846
B) 1918
C) 1687
D) 1776
E) 1492

22. In the 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

Biology

23. Cholesterol is a lipid that can be found in:
1. **Eukaryotic cells**
2. **Prokaryotic cells**
3. **Viruses**

Choose the correct answer:
A) 1 and 2
B) 2 only
C) 1 only
D) 2 and 3
E) all of them

24. Which of the following mutations usually leads to a truncated protein?

    1. Nonsense mutation
    2. Missense mutation
    3. Silent mutation
    4. Frameshift mutation

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

25. Which of the following cellular structures are involved in the synthesis of secreted glycoproteins:
    1.   The lysosome
    2.   The RER
    3.   The Golgi apparatus
Choose the correct answer:
A) All of them
B) 1 and 2 only
C) 1 and 3 only
D) 2 and 3 only
E) None

26. Which of the following options are correct about beta oxidation?
    1.   It is involved in nucleic acids' metabolism
    2.   It takes place in mitochondria
    3.   Ends with the production of acetyl-CoA
    4.   Doesn't occur in human organisms
    5.   It is involved in proteins' metabolism
A) 1, 2, 3 only
B) None
C) 2 and 3 only
D) 1, 3, 4 only
E) 2, 3, 5 only

27. Which of the following are water-soluble vitamins?
    1.   Vitamin D
    2.   Tocopherol
    3.   Ascorbic acid
    4.   Vitamin B9

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

28. An affected woman has two children: a boy and a girl, both affected by the same disease; the offspring of the two is composed by an affected son from the daughter's side and two healthy daughters from the son's. How is that possible?
A) The disease is caused by an *ex novo* mutation of a gene on chromosome X
B) The disease is caused by and *ex novo* mutation of a gene on a sexual chromosome
C) The mother bears a reciprocal translocation on sexual chromosome

D) The mother bears a mutation on most mitochondrial chromosomes

E) The mother bears a reciprocal translocation on chromosome X

29. **Which of the following statements is/are correct for all enzyme inhibitors?**
    1. **they alter the shape of the active site**
    2. **they denature the enzyme**
    3. **they increase the activation energy of the reaction**
    4. **they reduce the rate of the enzyme catalysed reaction**

A) 3 only

B) 4 only

C) 1, 2 and 3 only

D) 1, 2 and 4 only

E) 2 and 4 only

30. **In oxidative phosphorylation:**

    1. The final electron acceptor molecule is CO2

    2. The final electron acceptor molecule is 02

    3. NADH and FADH2 are oxidised to produce ATP

    4. Protons are pumped inside the mitochondrial matrix

A) 2 and 3

B) 1 and 3

C) 1, 3 and 4

D) 2, 3 and 4

E) only 3

31. **Trp operon:**

A) Uses direct sunlight to produce its final molecule

B) Needs to be induced by its inductor in order to start the transcription

C) Can be found in human genome

D) Is an example of a repressible operon

E) Is repressed by the enzymes it codes for

32. **A baby is taken to the hospital with muscular weakness, immunological defects and metabolic acidosis. Your suspect is a mitochondrial disease, which the DNA sequencing proves to be right. However, both parents are healthy, nor do they show any mutation. That is probably because...**
    A) The man is not their real father
    B) The woman is not their real mother
    C) The mitochondrion developed an *ex novo* mutation
    D) Their father's mitochondrial genome bears a reciprocal mutation
    E) Their mother's mitochondrial genome bears a reciprocal mutation

33. **Which of the following functions are carried out in peroxisomes?**
    1. **Synthesis of bile acids**
    2. **Detoxification**
    3. **Synthesis of steroids**

A) 1, 2 and 3

B) 1 and 2

C) 2 and 3

D) 1 and 3
E) none of them

34. Ribosomes are cellular organelles that can be found:
    1. Attached to the nuclear membrane
    2. Attached to the cellular membrane
    3. Free, scattered in the cytoplasm
    4. Attached to the endoplasmic reticulum

A) all of the above
B) 2, 3 and 4
C) 1 and 2
D) 3 and 4
E) 2 and 4

35. Which of the following statements is correct about epistatic genes?
A) Their expression is silenced by another gene
B) They code for epiphyses
C) They are a form of non-Mendelian inheritance
D) They're frequently involved in hemostasis
E) None of these

Human Anatomy and Physiology

36. Which of the following is a part of the central nervous system?
A) Spinal cord
B) Cranial nerves
C) Spinal nerves
D) Eye
E) Vomer

37. Which of the following blood vessels vascularize the heart?
    1. Vertebral arteries
    2. Aorta
    3. Vena cava
    4. Coronary arteries
A) 1 only
B) 1 and 2
C) 2 and 3
D) 2 and 4
E) 4 only

38. Which of the following bones articulate with the proximal epiphysis of the humerus?
    1. Scapula
    2. Clavicle
    3. Radius
    4. Ulna
    1 and 2
A) 1 only
B) 3 only
C) 3 and 4
D) 4 only

39. **Which of the following are hematopoietic organs??**
    1. **Bone Marrow**
    2. **Liver**
    3. **Spleen**
    4. **Thymus**
    A) 1 only
    B) 1 and 2
    C) 3 only
    D) 1,2 and 3
    E) all

40. **What do parietal cells of the stomach wall secrete?**
    A) Pepsinogen
    B) Castle's intrinsic factor
    C) Mucus
    D) Pepsin
    E) Major Basic Protein

Chemistry

41. **Naturally occurring chlorine consists of the two isotopes listed in the following table:**

Isotope	Exact mass (uma)	Percent abundance (%)
^{35}Cl	34,70 u	76
^{37}Cl	36,97 u	24

   Determine the atomic mass of chlorine.
    A) 35,1 u
    B) 36,8 u
    C) 34,2 u
    D) 36,7 u
    E) 35,5 u

42. **What is the oxidation number of chromium in calcium dichromate? ($CaCr_2O_7$)**
    A) 0
    B) +1
    C) -2
    D) +6
    E) +4

43. **Which of the following options represents the right oxidation sequence of organic compounds (from less to most oxidized)**
    A) Ketone – Aldehyde – Carboxylic acid – Methane
    B) Methane - Ketone – Aldehyde – Carboxyl acid – Amine
    C) Alcohol – Carbon dioxide – Amine – Aldehyde – Anhydride
    D) Methane – Alcohol – Ketone – Carboxylic Acid – Carbon dioxide
    E) Methane – Alcohol – Aldehyde – Carboxyl Acid – Carbon dioxide

44. **Calculate how many grams of CO_2 are dissolved in a one-liter bottle of sparkling water bottled at 2.4 atm and 25°C.**
    K_H (CO_2 in H_2O at 25°C) = 0.034 (mol/L)/atm [A_r values: C = 12; O = 16]
    A) 3,3 g
    B) 3,6 g

C) 0,0019 g
D) 0,6 g
E) 0,0003 g

45. **Given the reaction 3P₄ + 20HNO₃ + 8H₂O → 12H₃PO₄ + 20NO, which of the following options is not correct?**

    A) Phosphorus oxidizes itself
    B) Phosphorus' oxidation number is +5 in phosphoric acid
    C) Nitrogen loses electrons
    D) Nitrogen is the oxidizing agent
    E) Molecular phosphorus' oxidation number is 0

46. **Which of these categories is/are NOT spatial isomers?**
    1. Enantiomers
    2. Regioisomers (position isomers)
    3. Rotamers
    A) 1 only
    B) 2 only
    C) 3 only
    D) 1 and 3 only
    E) 2 and 3 only

47. **Which sample of gas contains the FEWEST molecules?**
    (Given O = 16,00u; N = 14,01u ; S = 32,07u ; He = 4,00u)
    A) A 4.4 g mass of carbon dioxide
    B) A 3.4 g mass of ammonia
    C) A 1.6 g mass of methane
    D) A 3.2 g mass of sulfur dioxide
    E) A 10.0 g mass of helium gas

48. **Which of the elements listed has the following electron configuration: $1s^2$, $2s^2$, $2p^6$, $3s^1$**
    A) Na^{-1}
    B) K
    C) Ne^{-1}
    D) Mn
    E) Cl

49. **Suppose to have a bottle of concentrated acetic acid (6.0 M). How much acetic acid do you have to use in order to obtain 200 mL of a 3.5 M solution of acetic acid?**
    A) 120 ml
    B) 0.012 l
    C) 0.16 l
    D) 80 ml
    E) 180 ml

50. **Consider the reaction 3Cl₂ + 6 NaOH → NaClO₃ + 5 NaCl + 3H₂O. Which of the following statements is/are correct?**
    1. Chlorine's oxidation number is +5 in sodium chlorate;
    2. The reaction isn't correctly balanced;
    3. The reaction is a disproportionation.
    A) 3 only
    B) 1 only

C) 2 and 3 only
D) 1 and 3 only
E) 1, 2 and 3

51. Which of the following pairs of molecules represent functional isomers?
   A) Cyclopentane and 2-pentene
   B) Cyclopentane and pentane
   C) 2-pentene and pentane
   D) Cyclopentane and cyclopentene
   E) Cyclopentene and 2-pentene

52. Dicloxacillin is a penicillin antibiotic used to treat bacterial infections by inhibiting the action of the transpeptidase enzyme belonging to the class of the PBP proteins (penicillin binding proteins). Which of the following options represents some of the chemical functions present in the molecule?
   A) Ketone, Carboxylic acid, Amide, Sulfide and Aldehyde
   B) Alcohol, Amide, Lactam, Carboxylic acid
   C) Two ketones, Sulfide, Amine and Carboxylic acid
   D) Amide, Lactam, Sulfide, Carboxiylic acid
   E) Amine, Amide, Lactam and Alcohol

Math and Physics

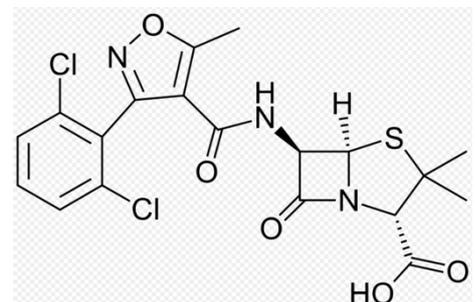**53. The fraction** $\dfrac{t^5 - t^2}{2t^2(t-1) - 3t^2(t-1)}$ **is equal to:**
   A) $t^2 + t + 1$
   B) $-t^2 - t - 1$
   C) $-t^2 + t - 1$
   D) $t^2 + 1$
   E) $-t^2 + t + 1$

54. In ΔABC, AB = 6√3 cm, AC = 12 cm and BC = 6 cm. The angle B is:
   A) 30°
   B) 45°
   C) 60°
   D) 90°
   E) None of the above

55. From a point Q, the length of the tangent to a circle is 24 cm and the distance of Q from the center is 25 cm. The radius of the circle is:
   A) 7 cm
   B) 9 cm
   C) 12 cm
   D) 15 cm
   E) 24,5 cm

56. Given a triangle inscribed in a circumference of radius r, and given that the triangle lays on the circumference diameter and that one its sides which reaches the circumference border measures r, what's the ratio between the circumference's area and the triangle area?
   A) $\dfrac{2\pi}{3}$

B) $\dfrac{\pi^2}{\sqrt{3}}$

C) $\dfrac{\pi}{2}$

D) $\dfrac{2\pi}{\sqrt{3}}$

E) $\dfrac{\sqrt{3}}{2\pi}$

57. **A coil of length 10 cm and radius 1 cm is placed in the middle of a closed conductive path of resistance R. A current of 10·t A flows inside the coil, where t represents time. What is the current flowing through the conductive path, if the coil has 100 turns and its axis is perpendicular to the plane of the path ($\mu_0=4\pi\cdot10^{-7}$ H/m)?**
   A) $4\pi\cdot10^{-7}$ A
   B) $4\pi^2\cdot10^{-5}$ A
   C) $4\cdot10^{-9}$ A
   D) $4\pi^2\cdot10^{-9}$ A
   E) $4\pi\cdot10^{-9}$ A

58. **A 5 m thick layer of ice forms on the top of the surface of a cylindrical water container of radius 10 m. The temperature of the air outside is -10°C, that of the water below the ice is 0°C, the latent heat of fusion of ice is 330 J/g and its density is 1 g/cm³. If the layer of ice has a thermal conductivity of 2 W·m^{-1}·K^{-1}, how much does it thicken in one hour?**
   A) 0,022 cm
   B) It is impossible to know
   C) 22 cm
   D) 1 m
   E) 2,2 m

59. **A 1 kg ball is tied to a spring on the top of a slope with a height of 3 m. The spring is stretched 100 mm from its resting length and has a constant of 30 N/m. The system is in equilibrium and no friction force is involved. Which of the following are correct?**
      1. The total potential energy of the ball is 30,15 J
      2. sin(α)= 0,6
      3. The spring pulls the ball with a force of 3 N

   A) Only 1
   B) Only 2
   C) 1 and 3
   D) 2 and 3
   E) 1, 2 and 3
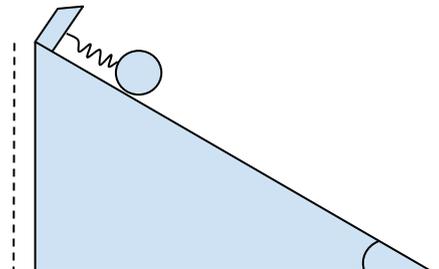
60. **A helicopter is flying at a 20 m/s speed and weights 12'000 kg. The helicopter is carrying a stock of avocados that, by itself, has a weight of 2000 kg. Due to the load not being properly fixed to the vehicle, it suddenly falls, altogether, with a speed of 10 m/s that is parallel to the speed of the helicopter and has its same direction. What is the speed of the helicopter after the load has departed from it?**
   A) 20 m/s
   B) 22 m/s
   C) 10 m/s
   D) -10 m/s
   E) None of the above