

Integrated Masters in Medicine

Model Exam | Special Admissions

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Biology

Duration: 90 minutes

Compensation time: 30 minutes

Instructions:

- The exam is evaluated from 0 to 200 points.
- The exam is based on 30 questions, 25 multiple-choice and 5 essay questions.
- Each multiple-choice question is marked out of 5.0 points and each essay question is marked out of 15.0 points.
- Only a blue or black pen may be used.
- The use of a broker is not allowed.
- All questions must be answered on the exam sheet.

1. Carefully read the following text:

Some antibiotics work by activating cellular respiration, which leads to the production of free radicals (oxidizing toxic substances). These radicals can cause the death of bacteria through the destruction of proteins, lipids, and DNA.

In four unrelated bacterial species, *Bacillus anthracis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Escherichia coli*, the enzymes of the hydrogen sulphide (H₂S) synthesis pathway were inactivated, either chemically or by mutation of their genes. In the bacteria that underwent these procedures, the production of H₂S was inhibited. These bacteria survived with great difficulty in the presence of antibiotics.

Subsequently, the mutated strain of *E.coli* (inhibited from the production of H₂S) and the wild strain of *E.coli* (non-mutated and producing H₂S) were subjected to the action of three different antibiotics. It was found that, in bacteria unable to produce hydrogen sulfide, the DNA was cut into fragments.

The recent sequencing of numerous bacterial genomes has changed the idea that H₂S would be an excretory product since this substance can block the formation of free radicals and can also stimulate the activity of antioxidant enzymes.

1.1. The hypothesis being tested in these experiments was that

- (A) the free radicals produced cause the death of bacteria.
- (B) hydrogen sulfide compromises the effectiveness of antibiotics.
- (C) enzymes are necessary for the production of hydrogen sulfide.
- (D) antibiotics prevent the production of hydrogen sulfide.

1.2. According to the data, hydrogen sulphide can act

- (A) increasing ATP production.
- (B) inhibiting antioxidant enzymes, which activate cellular respiration.
- (C) inhibiting cell multiplication.
- (D) activating enzymes that facilitate the destruction of free radical.

1.3. Antibiotics act on DNA, whose molecule has a

- (A) $(A + T) / (C + G) = 1$, cutting it into fragments by an oxidation process.
- (B) $(A + T) / (C + G) = 1$, cutting it into fragments by a reduction process.
- (C) $(A + C) / (T + G) = 1$, cutting it into fragments by an oxidation process.
- (D) $(A + C) / (T + G) = 1$, cutting it into fragments by a reduction process.

1.4. The bacteria that produce H_2S have, in relation to those that do not produce this gas,

- (A) increased resistance to antibiotics.
- (B) lower respiratory activity.
- (C) increased respiratory activity.
- (D) less resistance to antibiotics.

1.5. Some antibiotics act on membrane proteins responsible for the active transport of Na^+ and K^+ ions, directly interfering

- (A) in the diffusion of these ions through the phospholipid bilayer.
- (B) in the diffusion of ions through proteins such as permeases.
- (C) maintenance of the concentration difference between intra and extracellular media.
- (D) in the maintenance of isotony that occurs between the intra and extracellular environments.

1.6. The gene expression for the synthesis of the antioxidant enzymes referred to in the text

- (A) implies the translation of mRNA in the rough endoplasmic reticulum.
- (B) implies the transcription of DNA into pre-messenger RNA molecules.
- (C) implies the transcription of DNA to deoxyribonucleotide molecules.
- (D) implies the translation of the RNA codon sequence by ribosomes.

1.7. Match each of the descriptions of enzyme synthesis in Column I with the corresponding designation in Column II.

Column I	Column II
(a) A molecule having a ribonucleotide sequence complementary to a codon.	(1) DNA polymerase
(b) Polyribonucleotide that contains information for the synthesis of a polypeptide.	(2) Gene
(c) Deoxyribonucleotide sequence that contains information for the synthesis of an enzyme.	(3) mRNA
	(4) tRNA
	(5) rRNA

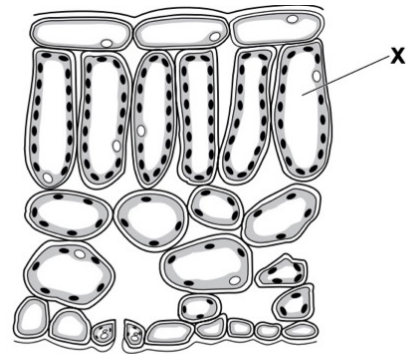
1.8. Why is understanding food webs important in the context of human health and disease ecology?

- (A) It helps identify which animals are most nutritious for human consumption.
- (B) It allows for better agricultural crop yield predictions.
- (C) It explains how food preferences evolve in different cultures.
- (D) It aids in predicting how disruptions in ecosystems can influence the spread of zoonotic diseases.

2. The diagram shows a cross-section of part of a leaf.

2.1. What is the name of the cell labelled X?

- (A) Epidermal cell
- (B) Guard cell
- (C) Palisade mesophyll cell
- (D) Spongy mesophyll cell



2.2. Which part of a plant cell controls the movement of substances into and out of the cell?

- (A) Cell membrane
- (B) Cell wall
- (C) Cytoplasm
- (D) Vacuole

3. Analyze the figure below and choose the most correct option, marking it with an X, for the legend of the same:



- (A) 1. Plant cell; 2. Animal cell; 3. Bacterial cell
- (B) 1. Bacterial cell; 2. Animal cell; 3. Plant cell
- (C) 1. Animal cell; 2. Animal cell; 3. Plant cell
- (D) 1. Bacterial cell; 2. Plant cell; 3. Animal cell

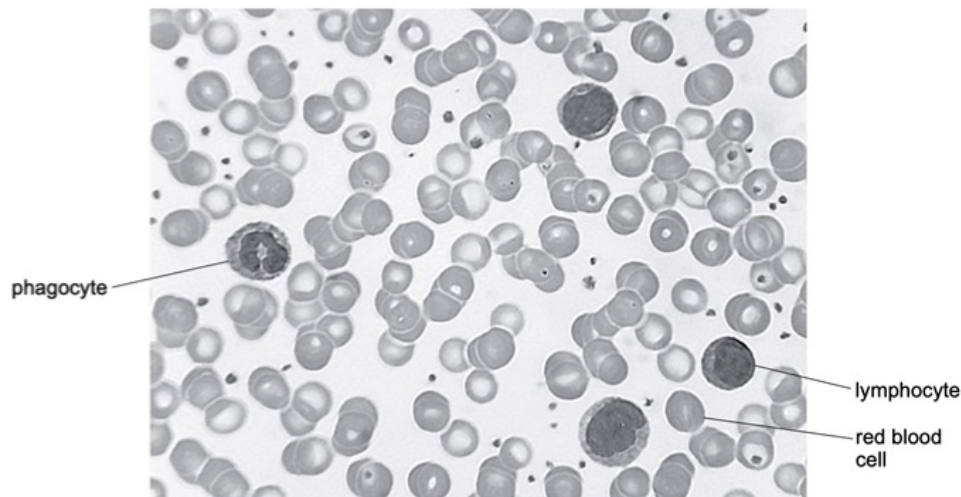
4. Consider the following statements:

- I. Biological molecules with energy reserve function.
- II. Biological molecules that store the cell's genetic information.
- III. Biological molecules with cellular structure and defense function.
- IV. Biological molecules with immediate energetic function.

The molecules referred to in each sentence are:

- (A) I - Lipids; II - Nucleic acids; III - Proteins; IV - Carbohydrates
- (B) I - Carbohydrates; II - Proteins; III - Lipids; IV - Nucleic acids
- (C) I - Proteins; II - Carbohydrates; III - Nucleic acids; IV - Lipids
- (D) I - Nucleic acids; II - Lipids; III - Carbohydrates; IV - Proteins

5. The figure below shows a photomicrograph of human blood.



5.1. Describe the differences in appearance and the functions of the three cells labelled in the figure.

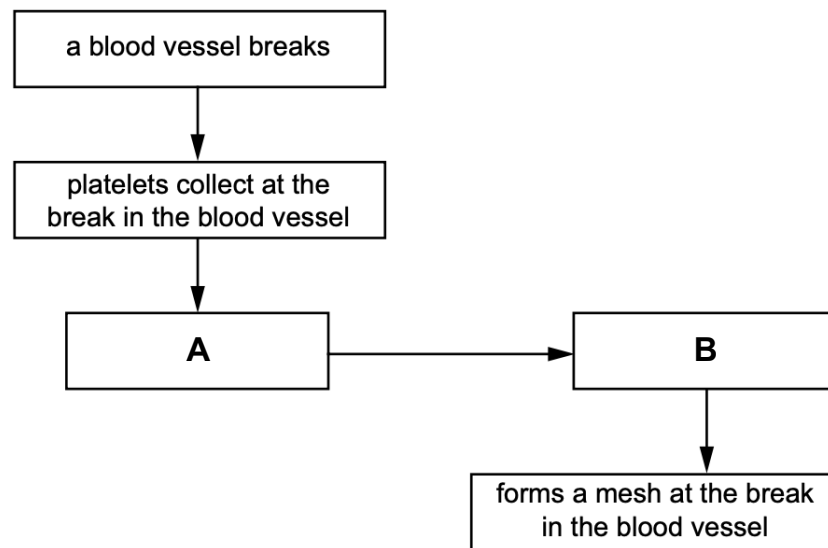
5.2. Blood plasma transports many substances including excretory products and hormones. Identify the names of two excretory products in humans:

- (A) Carbon dioxide and Urea
- (B) Amino acids and Cellulose
- (C) Urea and Oxygen
- (D) Glucose and Lipase

6. The cholera bacterium toxin causes dehydration and loss of salts from the blood in humans. Which statement explains the reason for this?

- (A) Chloride ions are secreted into the small intestine which causes water to move into the intestine by osmosis.
- (B) Chloride ions are secreted into the small intestine which causes water to move out of the intestine by osmosis.
- (C) Chloride ions are secreted into the small intestine where they increase the water potential.
- (D) Chloride ions are secreted into the small intestine which causes the water potential of the blood to decrease.

7. The figure below shows some of the stages of blood clotting.



7.1. Complete the figure by filling in the two empty boxes (A and B) in the figure.

7.2. State two roles of blood clotting.

8. Carefully read the following text:

Serra da Estrela (a mountain range in Portugal) is characterized by having a wide variety of habitats, which provides a high biodiversity, including some species that occur exclusively there (endemic species). Noteworthy is the plant *Silene foetida foetida*, which develops in fissures and small depressions in the rocks, with a distribution restricted to this mountain range, at altitudes above 1400 meters. River trout (*Salmo trutta fario*) and, due to the vulnerability of their populations, the Lusitanian salamander (*Chioglossa lusitanica*), an amphibian, are also mentioned.

Another plant found in the mountains, the wild thistle (*Cynara cardunculus*), is of great importance in the region's economy, as it is used in the manufacture of mountain cheese. This plant, characteristic of Mediterranean regions, grows up to 600 m altitude, has a deep root system and shows a good adaptation to environments characterized by high abiotic stress. The flower of this plant has several types of proteases (hydrolytic enzymes), such as cardosins, which accumulate in vacuoles, in the cell wall and in the extracellular space of Organs female organs of the flower.

8.1. In the plant *Silene foetida foetida*, the ions resulting from the

- (A) erosion of rocks are transported in phloem vessels.
- (B) weathering rocks are transported in the sieve vessels.
- (C) erosion of rocks are transported in the woody vessels.
- (D) weathering rocks are transported in the xylem vessels.

8.2. Make the association between the reproduction processes presented in Column I and the characteristics of Column II that may correspond to them. Each of the characteristics must be associated with only one letter and all characteristics must be used.

Write each letter in Column I on the answer sheet followed by the corresponding number or numbers (from 1 to 9).

Column I	Column II
(a) Asexual reproduction	(1) Development of the adult individual by successive mitoses. (2) Production of reproductive cells by meiosis. (3) Formation of two cells similar to each other from a single-celled organism. (4) Occurrence of genetic recombination phenomena.
(b) Sexual reproduction	(5) Formation of new organisms by the development of eggs without fertilization having taken place.
(c) Reproduction by both processes	(6) Favoring the rapid growth of a population. (7) Occurrence of mutations as a source of variability. (8) Formation of beings genetically equal to the parent. (9) Restoration of the number of chromosomes characteristic of the species.

8.3. Order the expressions identified by the letters from A to E, in order to reconstruct the sequence of events that lead to the synthesis and incorporation of cardosines in the wall and in the extracellular space of female organs of the *Cynara cardunculus* flower.

- A. Protein synthesis by ribosomes associated with the endoplasmic reticulum.
- B. Fusion of Golgian vesicles with the cytoplasmic membrane.
- C. Synthesis of a pre-messenger RNA molecule.
- D. Post-translational modifications at the level of the Golgi complex.
- E. Migration of a messenger RNA molecule into the cytoplasm.

8.4. From a Darwinian perspective, the survival of *Cynara cardunculus* in the wild in Serra da Estrela is due to the

- (A) differential reproduction of plants resistant to water stress.
- (B) need for survival in regions with high precipitation.
- (C) occurrence of mutations that allowed adaptation to granitic soils.
- (D) natural selection of plants adapted to shallow soils.

8.5. The subspecies *Silene foetida foetida* is considered endangered in the wild, according to the International Union for Conservation of Nature (IUCN).

Match the endemism of *Silene foetida foetida* with the conservation category assigned by the IUCN.

In your answer, you should refer to the genetic variability of this plant.

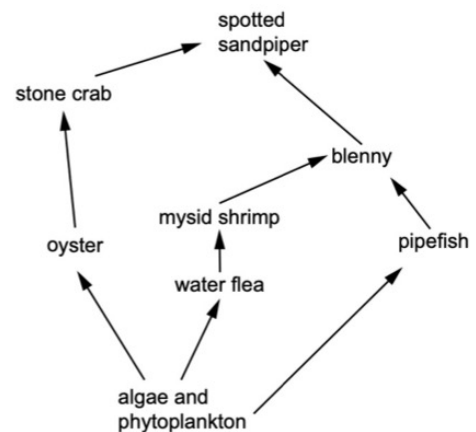
8.6. The fish *Salmo trutta fario* and the amphibian *Chioglossa lusitanica* have a digestive tract

- (A) full and simple circulation.
- (B) incomplete and double circulation.
- (C) complete and closed circulatory system.
- (D) incomplete and open circulatory system.

9. Wetlands are important ecosystems.

Researchers studied the feeding relationships between the organisms in an area of coastal wetland. The figure shows part of the food web that they studied.

Using the food web in the figure, identify one producer, one secondary consumer, and one organism that feeds at two different trophic levels.

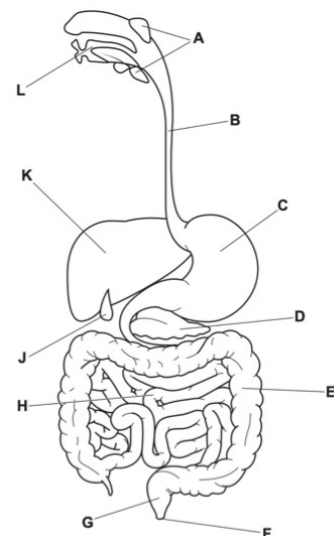


10. The figure is a diagram of the digestive system.

Each letter may be used once, more than once or not at all.

State the letter of the part shown in figure:

- i) that produces bile.
- ii) that produces gastric juice.
- iii) that produces urea.
- iv) where maltose is digested.
- v) where trypsin acts.

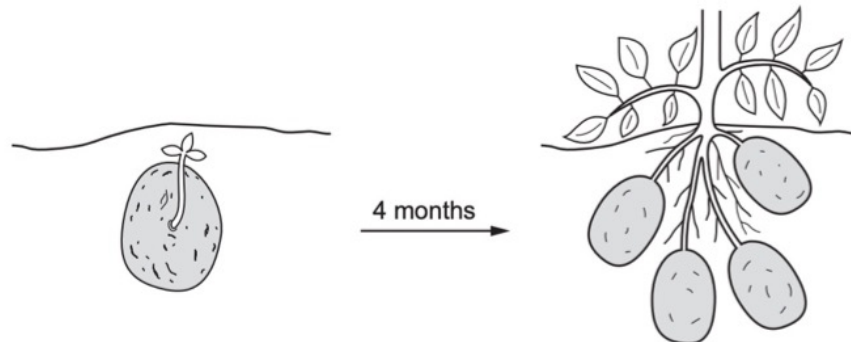


11. The horse, *Equus ferus*, and the donkey, *Equus asinus*, are able to interbreed. The offspring they produce is called a mule.

Which statement is correct?

- (A) The horse and the donkey are the same genus; the mule is infertile.
- (B) The horse and the donkey are the same genus; the mule is fertile.
- (C) The horse and the donkey are the same species; the mule is fertile.
- (D) The horse and the donkey are the same species; the mule is infertile.

12. Potatoes are stem tubers. A tuber can be placed in the ground to grow into another plant, which can grow many more tubers.

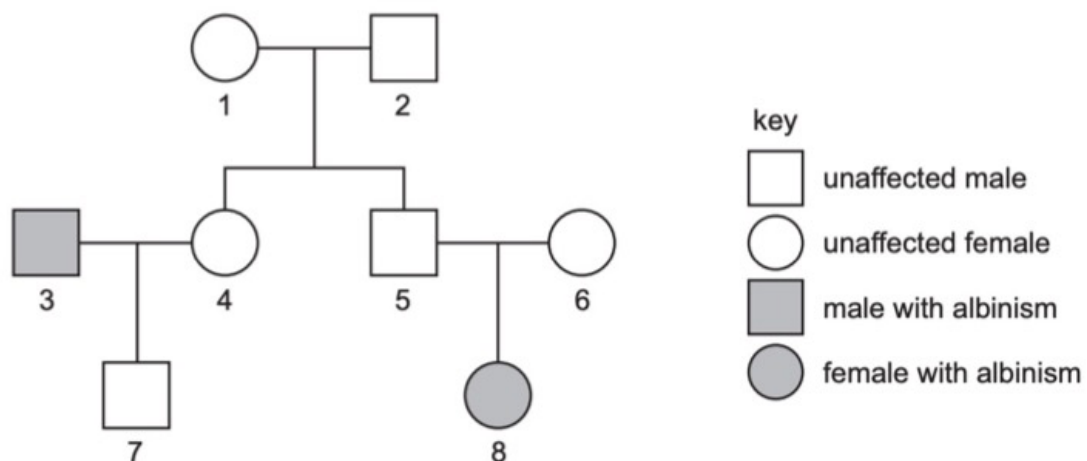


The diploid number of the potato plant is 24.

How many chromosomes will there be in the cells of the stem, the leaf and the pollen?

	stem	leaf	pollen
(A)	24	24	12
(B)	48	12	24
(C)	24	12	48
(D)	48	48	12

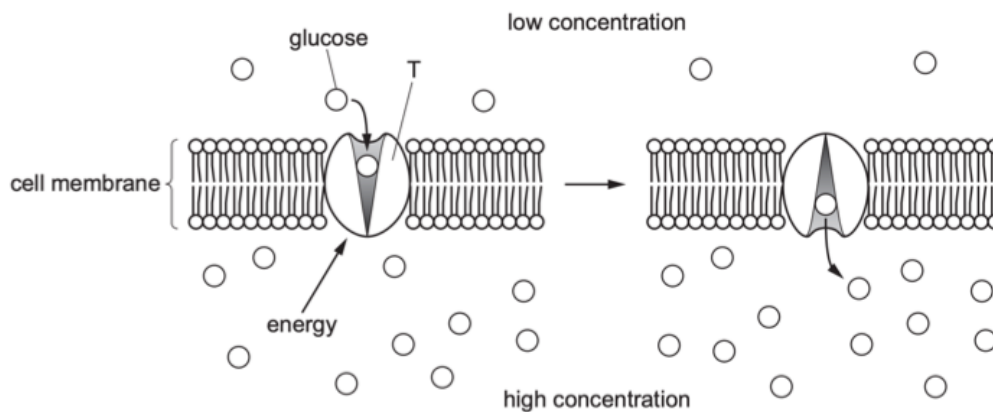
13. The diagram shows the inheritance of albinism in one family. Albinism is an inherited condition caused by a recessive allele.



Which individuals must be heterozygous for this condition?

- (A) 1 and 2
- (B) 4 and 7
- (C) 5, 6 and 7
- (D) 5 and 6 only

14. The diagram shows the movement of glucose molecules across a cell membrane.



Which statement describes molecule T?

- (A) It is a fat molecule used to transport glucose down a concentration gradient.
- (B) It is a protein molecule used to transport glucose against a concentration gradient.
- (C) It is a protein molecule used to transport glucose down a concentration gradient.
- (D) It is a fat molecule used to transport glucose against a concentration gradient.

15. Some cells are specialised to perform a particular function. Column I show the names of some specialised cells and Column II show the functions of some specialised cells.

Write each letter in Column I on the answer sheet followed by the corresponding number of Column II

Column I - Specialised cells	Column II - Functions
(a) ciliated cell	(1) absorption of water
(b) neurone	(2) transport of oxygen
(c) palisade mesophyll cell	(3) conduction and support
(d) red blood cell	(4) conduction of impulses
(e) root hair cell	(5) movement of mucus
	(6) photosynthesis

END

Integrated Masters in Medicine

Model Exam | Special Admissions

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Biology

Duration: 90 minutes

Compensation time: 30 minutes

ANSWERS

Question	Correct Option
1.1	B
1.2	D
1.3	C
1.4	A
1.5	C
1.6	D
1.7	(a) – (4); (b) – (3); (c) – (2)
1.8	D
2.1	C
2.2	A
3	B
4	A
5.2.	A
6	C
8.1	D
8.2	(a) – (3), (5), (6), (8) (b) – (2), (4), (9) (c) – (1), (7)

Question	Correct Option
8.3	C, E, A, D, B
8.4	A
8.6	C
10	i) K; ii) C; iii) K; iv) H; v) H
11	A
12	B
13	B
14	D
15	(a) – (5); (b) – (4); (c) – (6); (d) – (2); (e) – (1)

5.1. Answer topics:

red blood cell:

appearance: biconcave (disc / shape) / no nucleus / red blood cells smaller than (named) white blood cell(s) / ora

function: transports oxygen

lymphocyte:

appearance: little cytoplasm / large(r) nucleus / nucleus fills most of the cell

function: ref. to active immunity / responds to, antigen(s) or vaccine(s) / produces antibodies / ref. to memory cells

phagocyte:

appearance: lobed / irregular-shaped / C-shaped / AW, nucleus

function: engulf pathogens / phagocytosis / AW

7.1. Answer topics:

fibrinogen → fibrin

7.2. Answer topics:

prevent blood loss; prevent entry of (named), pathogens / microbes

8.5. Answer topics:

It relates the restricted geographic distribution (endemism) of *Silene foetida foetida* with the reduced number of individuals that interbreed (A) and relates the reduced genetic variability with the low adaptability, which may affect the survival of the plant (danger of extinction) (B).

(A) *Silene foetida foetida* has a distribution restricted to Serra da Estrela, so crosses are established between a small number of individuals.



(B) The reduced genetic variability leads to a low ability to adapt to environmental changes, putting the plant in danger of extinction.

9. Answer topics:

Producer – algae / phytoplankton

Secondary consumer – stone crab / mysid shrimp / blenny

Animal that feed at two trophic levels – blenny / spotted sandpiper

Integrated Masters in Medicine

Model Exam | Access for International Students

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Mathematics

Date: 2/2026 and 6/2026

Duration: 90 minutes

Compensation time: 30 minutes

Instructions:

- The exam is based on 20 questions, 10 multiple-choice and 10 essay questions.
- Each multiple-choice question is marked out of 0.5 values and each essay question is marked out of 1.5 values.
- Only a blue or black pen may be used.
- The use of a broker is not allowed.
- All questions must be answered on the exam sheet.
- The use of a scientific calculator is all

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1. A box contains 3 red balls and 2 green balls. Two balls are drawn one after the other without replacement. If a green ball is drawn first, find the probability that the second ball is red.

2. A fair die is rolled once. What is the probability of obtaining a number greater than 4?

- a) ☐ $1/6$ b) ☐ $1/3$ c) ☐ $1/2$ d) ☐ $2/3$

—

3. Given that $\sin(\theta) = 1/2$ and $0^\circ \leq \theta \leq 180^\circ$, find the value of $2\cos(\theta)$.

- a) ☐ $\sqrt{3}$ b) ☐ $-\sqrt{3}/2$ c) ☐ $1/2$ d) ☐ $-1/2$

4. An arithmetic sequence has first term $a_1 = 4$ and common difference $d = 3$. Find the 15th term.

5. Find the equation of the line passing through the points A(2, -1) and B(6, 7).

6. Which of the following functions is strictly increasing for all real x not equal to zero?

- a) ☐ $f(x) = -x^2$ b) ☐ $f(x) = x^3$ c) ☐ $f(x) = -2x + 1$ d) ☐ $f(x) = 5 - x^2$

7. Solve the inequality: $x^2 - 4x - 5 \leq 0$

8. A circle has radius 7 cm. What is its area? (Use $\pi = 22/7$)

- a) ☐ 44 cm^2 b) ☐ 154 cm^2 c) ☐ 308 cm^2 d) ☐ 616 cm^2

9. Given the function $f(x) = x^2 - 2x - 3$, find the coordinates of the vertex.



10. Let $z = 3+3i$. Write z in polar form.

11. One of the solutions of the equation $x^2 - 4x + 13 = 0$ is:

- a) ☐ $2+3i$ b) ☐ $2+4i$ c) ☐ $-2+3i$ d) ☐ $-2-3i$

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12. The function $f(x) = \frac{e^{3x}-5x^2}{4x}$ is given. Write the expression of the first derivative of $f(x)$.

13. The sum of the first 10 terms of the arithmetic sequence $u_n = 5n + 1$ is:

- a) ☐ 260 b) ☐ 275 c) ☐ 285 d) ☐ 270

14. Let $f(x) = x^3 + \ln(2x)$, $x > 0$. Compute $f''(1)$.

15. For the function $h(\theta) = 2 - 3\cos\theta$, the value of θ when $h = 2$ is:

- a) ☐ $\frac{\pi}{6}$ b) ☐ $\frac{\pi}{3}$ c) ☐ $\frac{\pi}{4}$ d) ☐ $\frac{\pi}{2}$

16. Find the vertical and horizontal asymptotes of the function $g(x) = \frac{2x-1}{x+3}$.

17. The first derivative of the function $f(x) = \ln(2x) + 5e^{4x}$ at $x = 1$ is:

- a) ☐ $1+20e^4$ b) ☐ $2+20e^4$ c) ☐ $1/2+20e^4$ d) ☐ $1+5e^4$

18. Let $p(x) = 4x^2 + \ln(x)$, $x > 0$. Determine the x -coordinate of the inflection point, if it exists.



19. Find the exact value of θ ($\theta > 0$) such that $2 + 3\sin\theta = 5$. The value of $\cos\theta$ is:

a) ☐ $\frac{\sqrt{3}}{2}$

b) ☐ $\frac{1}{2}$

c) ☐ 0

d) ☐ $-\frac{1}{2}$

20. The complex number $z = 5e^{(\frac{\pi}{4}i)}$ in algebraic form is:

a) ☐ $5+5i$

b) ☐ $5\frac{\sqrt{2}}{2} + 5\frac{\sqrt{2}}{2}i$

c) ☐ $\sqrt{5} + \sqrt{5}i$

d) ☐ $5\sqrt{2} + 5\sqrt{2}i$

Integrated Masters in Medicine

Model Exam - Resolution | Access for International Students

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Mathematics

Date: 2/2026 and 6/2026

Duration: 90 minutes

Compensation time: 30 minutes

1. G = Green ball draw

R = Red ball draw

$$P(G) = 2/5 \quad P(R) = 3/5 \quad P(R|G) = P(R \cap G)/P(G) = (2/5 * 3/4)/(2/5) = 3/4$$

2. Option b)

3. Option a)

4. In an arithmetic sequence $a_n = a_1 + (n-1)d$.

$$a_1 = 4 \text{ and } d = 3 \text{ then } a_n = 4 + (n-1) \times 3. \quad A_{15} = 4 + (15-1) \times 3 = 46$$

5. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7+1}{6-2} = 2$ $y = mx + b \Leftrightarrow 7 = 2 \times 6 + b \Leftrightarrow b = -5$

$$y = 2x - 5$$

6. Option b)



7. $x^2 - 4x - 5 = (x-5)(x+1)$

$$\begin{array}{ccccccc} & -\infty & & -1 & & 5 & & +\infty \\ (x-5)(x+1) & + & & 0 & & - & & 0 & & + \end{array}$$

$$x \in [-1, 5]$$

8. Option b)

9. vertex coordinates = $(-b/2a; f(-b/2a))$

$$x_{\text{vertex}} = 2/2 = 1$$

$$y_{\text{vertex}} = 1^2 - 2 \cdot 1 - 3 = -4$$

vertex coordinates : $(1, -4)$.

10. $\rho = \sqrt{3^2 + 3^2} = \sqrt{18} = 3\sqrt{2}$

$$\tan(\theta) = \frac{3}{3} = 1 \quad \theta = \frac{\pi}{4} \quad (\text{because } \theta \text{ is an angle of 1st quadrant})$$

$$z = 3\sqrt{2}e^{(\frac{\pi}{4}i)}$$

11. Option a)

12. $f(x) = \frac{e^{3x-5x^2}}{4x}$

$$f'(x) = \frac{(e^{3x-5x^2})' \cdot 4x - (e^{3x-5x^2}) \cdot (4x)'}{(4x)^2} = \frac{(3e^{3x-10x}) \cdot 4x - (e^{3x-5x^2}) \cdot 4}{16x^2} =$$

$$\frac{(3e^{3x-10x}) \cdot x - (e^{3x-5x^2})}{4x^2} = \frac{(3xe^{3x-10x^2}) - e^{3x+5x^2}}{4x^2} = \frac{(3xe^{3x-5x^2}) - e^{3x}}{4x^2} = \frac{(3x-1)e^{3x-5x^2}}{4x^2}$$

13. Option c)

14. $f(x) = x^3 + \ln(2x)$

$$f'(x) = 3x^2 + \frac{1}{x} \quad f''(x) = 6x - \frac{1}{x^2} \quad f''(1) = 6 \cdot 1 - \frac{1}{1} = 6 - 1 = 5$$

15. Option d)

16. $g(x) = \frac{2x-1}{x+3} \quad (x+3) = 0 \Leftrightarrow x = -3$

$$(2x-1) : (x+3) = 2 + \frac{-7}{x+3}$$

Vertical asymptote: $x = -3$, Horizontal asymptote: $y = 2$

17. Option a)

18. $p(x) = 4x^2 + \ln(x) \quad p'(x) = 8x + \frac{1}{x} \quad p''(x) = 8 - \frac{1}{x^2} \quad 8 - \frac{1}{x^2} = 0 \Leftrightarrow \frac{8-x^2}{x^2} = 0$

$$8 - x^2 = 0 \text{ e } 8 - x^2 \neq 0 \Leftrightarrow x^2 = 1/8 \Leftrightarrow x = \pm \frac{\sqrt{2}}{4}$$

$$\text{Como } x > 0, x = \frac{\sqrt{2}}{4}$$

19. Option c)

20. Option b)

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Academic Year: 2026/2027

Exam: Physics

Duration: 90 minutes

Compensation time: 30 minutes

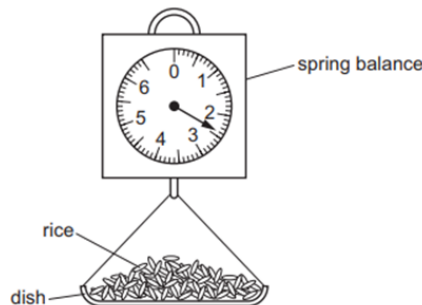
Instructions:

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- The exam is based on 20 questions, 15 multiple-choice and 5 essay questions.
- Each multiple-choice question is marked out of 10.0 points and each essay question is also marked out of 10.0 points.
- Only a blue or black pen may be used.
- The use of a broker is not allowed.
- All questions must be answered on the exam sheet.
- To solve the exam, you must consult the form and the table of constants found on the last 2 pages.
- The use of a scientific calculator is allowed.

Group I

(15 multiple-choice questions)

1. A shopkeeper pours rice into a dish that hangs from a spring balance. He records the reading.

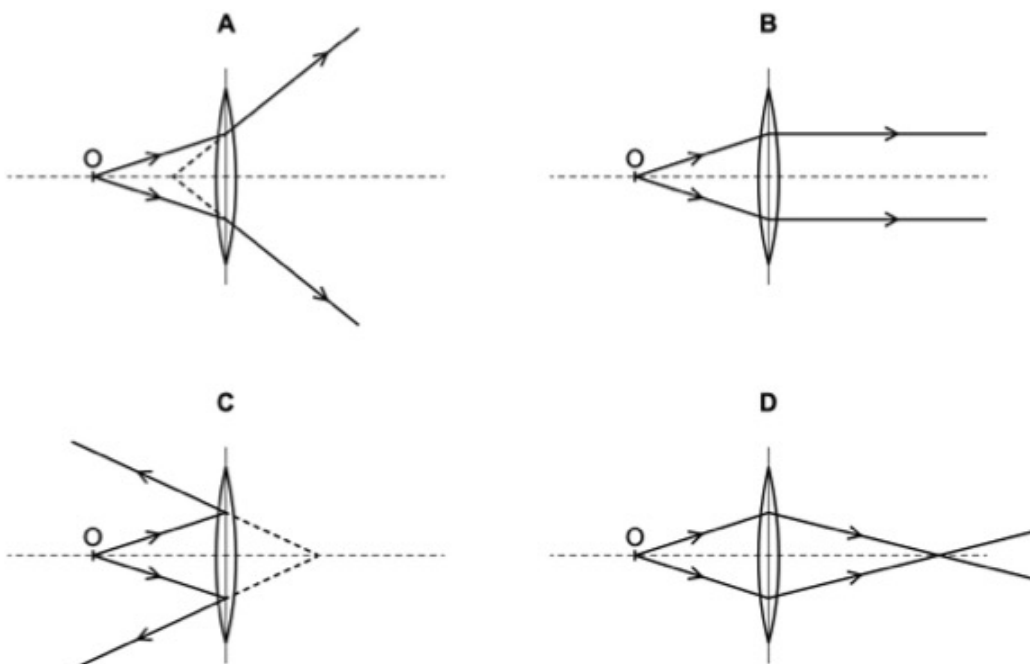


A customer buys some pasta. The shopkeeper notices that the reading on the spring balance, with just pasta in the dish, is the same as it was with just rice in the dish.

Which quantity must be the same for the rice and for the pasta?

- (A) density
- (B) temperature
- (C) volume
- (D) weight

2. Which diagram shows the formation of a real image of an object O placed in front of a converging lens?

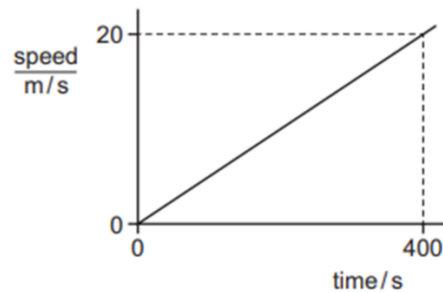




3. The graph represents the motion of a vehicle.

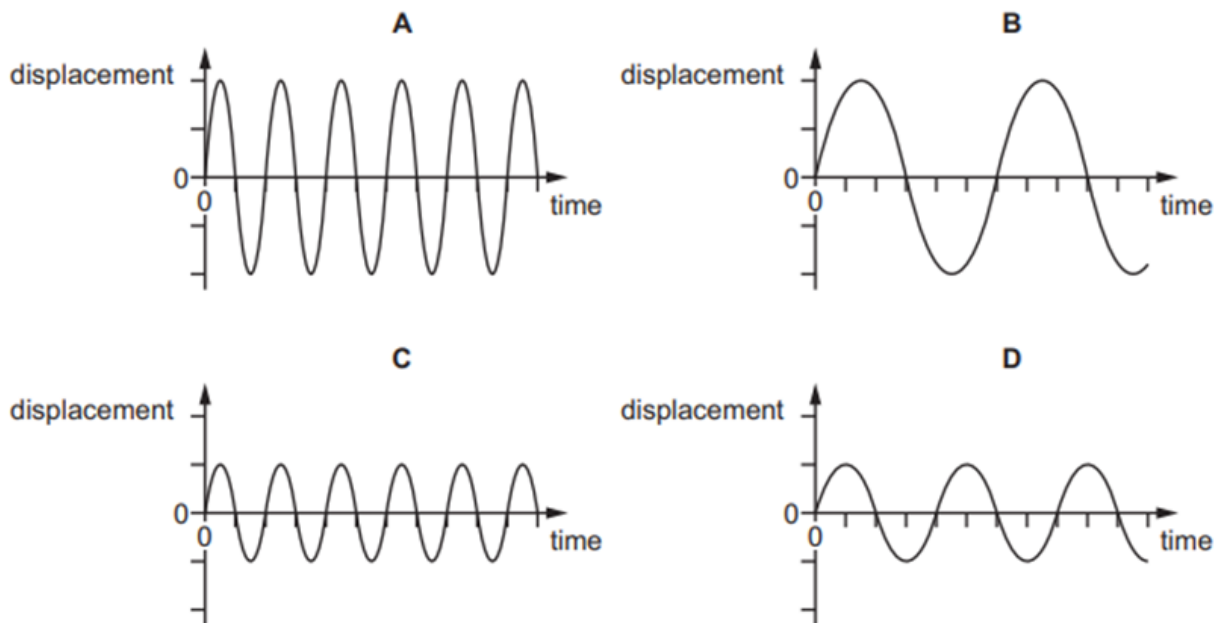
What is the distance travelled by the vehicle in 400 s?

- (A) 20 m
- (B) 400 m
- (C) 4000 m
- (D) 8000 m



4. The diagrams show graphs of displacement against time for four sound waves. All the graphs are drawn to the same scale.

Which wave has the largest amplitude and the highest frequency?

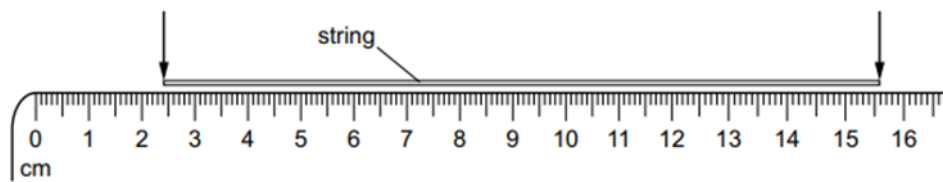


5. A ball is at rest at the top of a hill. The ball rolls down the hill. At the bottom of the hill the ball hits a wall and stops.

Which energy changes occur?

- (A) gravitational potential energy $\rightarrow$ internal energy $\rightarrow$ kinetic energy
- (B) gravitational potential energy $\rightarrow$ kinetic energy $\rightarrow$ internal energy
- (C) kinetic energy $\rightarrow$ gravitational potential energy $\rightarrow$ internal energy
- (D) kinetic energy $\rightarrow$ internal energy $\rightarrow$ gravitational potential energy

6. A length of string is measured between two points on a ruler.



When the length of string is wound closely around a pen, it goes round six times.



What is the distance once round the pen?

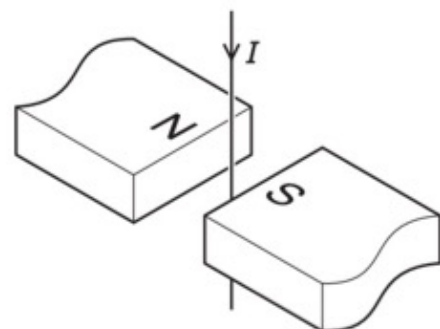
- (A) 2.2 cm
- (B) 2.6 cm
- (C) 13.2 cm
- (D) 15.6 cm

7. A rocket is launched into space. According to Newton's Third Law, which of the following correctly explains why it rises?

- (A) The rocket rises because the air below it pushes it upward.
- (B) The rocket rises because its propulsive force is greater than the force of gravity.
- (C) The rocket rises because it expels gases downward, and these gases exert an equal and opposite force upward.
- (D) The rocket rises because the atmosphere exerts a greater pressure on the base of the rocket than on the top.

8. The diagram shows a vertical wire carrying a current I placed between the poles of a magnet.

What is the direction of the force on the wire exerted by the magnetic field?

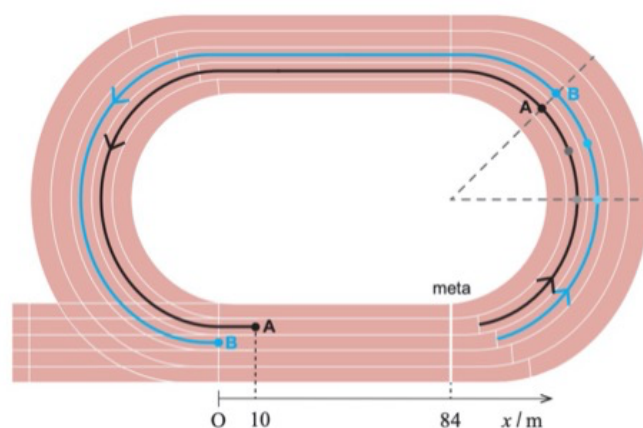


- (A) from N to S
- (B) from S to N
- (C) horizontal and at right angles to the direction from N to S
- (D) parallel to the wire

9. In air, sound is a wave

- (A) electromagnetic and transverse.
- (B) electromagnetic and longitudinal.
- (C) mechanical and transverse.
- (D) mechanical and longitudinal.

10. Consider the curved section of the track highlighted on the right side of the figure, in which the athletes stand side by side, describing circular arcs of different radii with uniform circular motion.



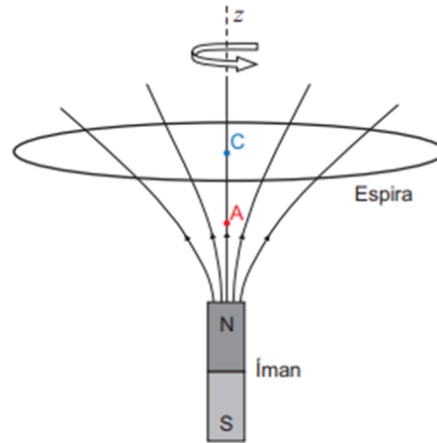
10.1. In this excerpt, the intensity of the resultant of the forces acting on each of the athletes is

- (A) zero, and the speed modules of both are equal.
- (B) zero, and the angular speed modules of both are equal.
- (C) nonzero, and the speed modules of both are equal.
- (D) nonzero, and the angular speed modules of both are equal.

10.2. When athlete B enters the finish line, 84 m away, athlete A is 10 m ahead of him, as shown in the figure. Consider that, at this instant, the speed modules of both athletes are 6.5 m s^{-1} and that, until reaching the finish line, athlete A maintains a rectilinear and uniform motion, while athlete B moves in a rectilinear direction with a constant acceleration of module 0.10 m s^{-2} . Considering the reference frame Ox represented in the figure, the equations of motion of the two athletes are:

- (A) $x_A = 10 + 6.5t$ e $x_B = 6.5t + \frac{1}{2} \times 0.10t^2$
- (B) $x_A = 6.5t + \frac{1}{2} \times 0.10t^2$ e $x_B = 10 + 6.5t$
- (C) $x_A = 10 + 0.10t$ e $x_B = 6.5t + \frac{1}{2} \times 10t^2$
- (D) $x_A = 0.10 + \frac{1}{2} \times 6.5t^2$ e $x_B = 6.5 + 10t$

11. A circular loop near a fixed magnet rotates in the same horizontal plane, around a vertical axis, z , which passes through the center of the loop, C , as shown in the figure.



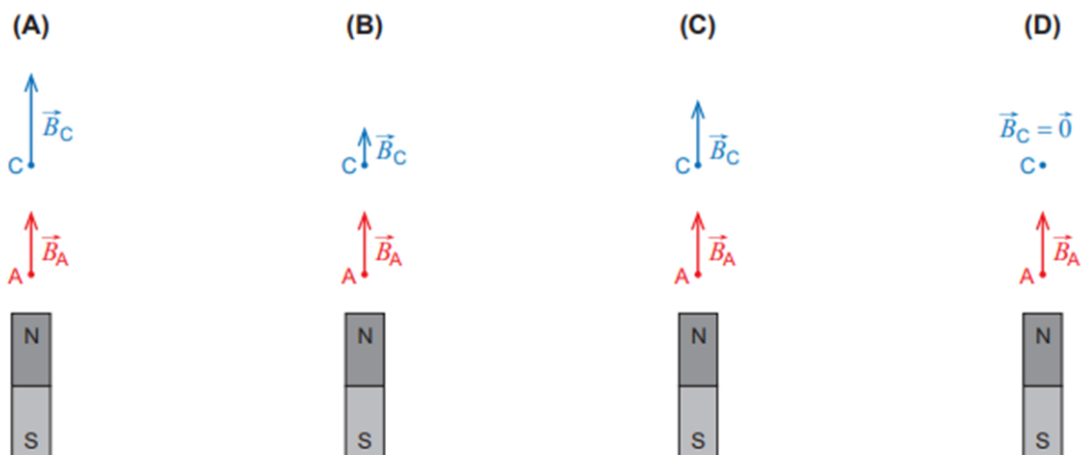
11.1. In the situation described, the magnetic flux through the flat surface bounded by the loop _____, and the electromotive force induced in the loop _____ zero.

- (A) varies ... is
- (B) varies ... is not
- (C) does not vary ... is
- (D) does not vary ... is not

11.2. Points A and C belong to the same magnetic field line.

The following figures represent the magnetic field created by the magnet at point A, $\vec{B}_A$.

In which of the figures can the magnetic field created by the magnet at point C, $\vec{B}_C$, be represented?





12. A rock of weight 50 N falls a vertical distance of 7.0 m from rest.

What is the change in the gravitational potential energy store of the rock?

- (A) decrease of 7.1 J
- (B) decrease of 350 J
- (C) increase of 7.1 J
- (D) increase of 350 J

13. Copper is a type of metal. A block of copper has a mass of 2.0 kg. The block of copper absorbs 12000 J of thermal energy. The specific heat capacity of copper is $385 \text{ J / (kg}^\circ\text{C)}$.

What is the temperature rise of the copper?

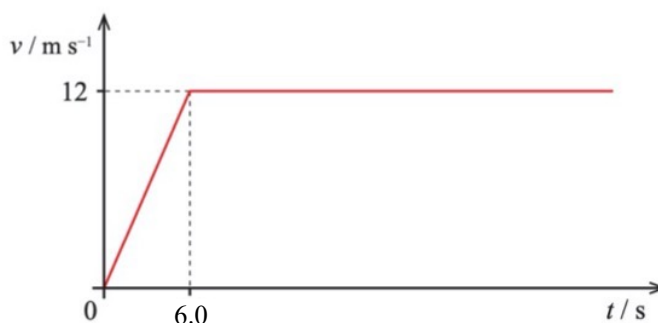
- (A) 15.6°C
- (B) 31.2°C
- (C) 46.8°C
- (D) 62.4°C

Group II

(5 essay questions)

Show all the resolution steps

14. A car with a mass of 1000 kg is stopped near a traffic light. At the moment the car starts moving, it is overtaken by a motorcycle with a mass of 150 kg, which is moving in the same direction and sense, at a constant speed of 10 m s^{-1} , which it maintains throughout the entire route under analysis. Consider that the trajectory described by both vehicles is rectilinear and horizontal and that they can be represented by their center of mass, according to the material particle model. The figure below shows the graph of the car's speed as a function of time.



14.1. Suppose that, in the first 6.0 s of movement, the car transformed 90% of the energy supplied to it into translational kinetic energy, dissipating the rest. Determine the energy supplied to the car in this time interval. Present all calculations performed.

14.2. Determine the distance traveled by the two vehicles before they met again. Present all calculations performed.

15. A simple pendulum with a mass of 0.8 kg and a length of 2 m describes a trajectory that corresponds to an angle of 30° in relation to the vertical. Neglecting air resistance, determine:

15.1. The gravitational potential energy of the pendulum at the highest point of its trajectory.

15.2. The kinetic energy of the pendulum when it passes through the lowest point of its trajectory.

15.3. The speed of the pendulum at the lowest point

END

Form

Temperature Conversion (from Celsius to Kelvin)	$T = \theta + 273,15$
Density	$\rho = \frac{m}{V}$
Energy (J) and Power (w)	$E = P \times t$
Energy gained or lost by a body due to its temperature variation	$E = mc\Delta T$
Temporal rate of energy transfer in the form of heat, by conduction	$\frac{Q}{\Delta t} = k \frac{A}{l} \Delta T$
Wave-length	$\lambda = \frac{v}{f}$
Equations of circular motion with linear speed of constant magnitude	$a_0 = \frac{v^2}{r}$ $v = \frac{2\pi r}{T}$ $\omega = \frac{2\pi}{T}$
Equations of rectilinear motion with constant acceleration	$x = a_0 + v_0 t + \frac{1}{2} at^2$ $v = v_0 + at$
Translational kinetic energy	$E_C = \frac{1}{2} mv^2$
Gravitational Potential Energy	$E_P = mgh$



Table of Constants

Speed of propagation of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
Magnitude of the gravitational acceleration of a body near the Earth's surface	$g = 10 \text{ m s}^{-2}$
Universal Gravitation Constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Avogadro's constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

Integrated Masters in Medicine

Model Exam | Access for International Students

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Physics

Duration: 90 minutes

Compensation time: 30 minutes

ANSWERS

Group I

(15 multiple-choice questions)

Question	1	2	3	4	5	6	7	8	9	10.1
Correct Option	D	D	C	A	B	A	C	C	D	A

Question	10.2	11.1	11.2	12	13
Correct Option	A	C	B	B	A



Group II

(5 essay questions)

14.

14.1. Resolution steps:

- Calculate the variation in kinetic energy ($7.20 \times 10^4 \text{ J}$)
- Calculate the energy supplied to the car ($8.0 \times 10^4 \text{ J}$)

14.2. Resolution steps:

- Calculate the distance traveled by the car in the first 6 s of movement (36.0 m)
- Calculate the time at which the car and the motorcycle meet again (18.0 s or 12.0 s after time $t = 6.0 \text{ s}$)
- Calculate the distance traveled by the two vehicles until they meet again ($1.8 \times 10^2 \text{ m}$)

15.

15.1. $h = L - L \cdot \cos(30) = 0.268 \text{ m}$

$$E_p = m \cdot g \cdot h = 0.8 \times 9.8 \times 0.268 = 2.1 \text{ J}$$

15.2. All the potential energy has been converted to kinetic energy ($E_p = E_c$), so the kinetic energy at the lowest point is also 2.1 J.

15.3. $E_c = \frac{1}{2} \cdot m \cdot v^2 \Rightarrow 2.1 = 0.5 \cdot 0.8 \cdot v^2 \Rightarrow v = 2.29 \text{ m s}^{-1}$

Integrated Masters in Medicine

Model Exam | Access for International Students

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Chemistry

Duration: 90 minutes

Compensation time: 30 minutes

Instructions:

- The exam is evaluated from 0 to 200 points.
- The exam is based on 20 questions, 15 multiple-choice and 5 essay questions.
- Each multiple-choice question is marked out of 10.0 points and each essay question is also marked out of 10.0 points.
- Only a blue or black pen may be used.
- The use of a broker is not allowed.
- All questions must be answered on the exam sheet.
- To solve the exam, you must consult the periodic table, the form and the table of constants found on the last 2 pages.
- The use of a scientific calculator is allowed.

Group I

(15 multiple-choice questions)

1. In a laboratory, a group of students titrate 25.0 cm^3 of aqueous sodium hydroxide, with a concentration of 2.0 mol dm^{-3} , with 50.0 cm^3 of dilute sulfuric acid.

The equation for the reaction is: $2\text{NaOH (aq)} + \text{H}_2\text{SO}_4 \text{ (aq)} \rightarrow \text{Na}_2\text{SO}_4 \text{ (aq)} + 2\text{H}_2\text{O (l)}$

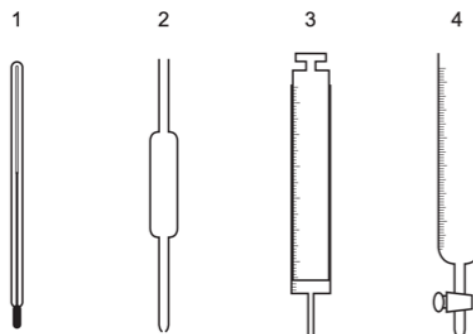
1.1. What is the concentration of the dilute sulfuric acid in mol dm^{-3} ?

- (A) 0.50 mol dm^{-3}
- (B) 1.0 mol dm^{-3}
- (C) 2.0 mol dm^{-3}
- (D) 4.0 mol dm^{-3}

1.2. The concentration of acids and alkalis can be determined by titration.

Which pieces of equipment are needed to perform a titration?

- (A) 1 and 2
- (B) 1 and 3
- (C) 2 and 4
- (D) 3 and 4



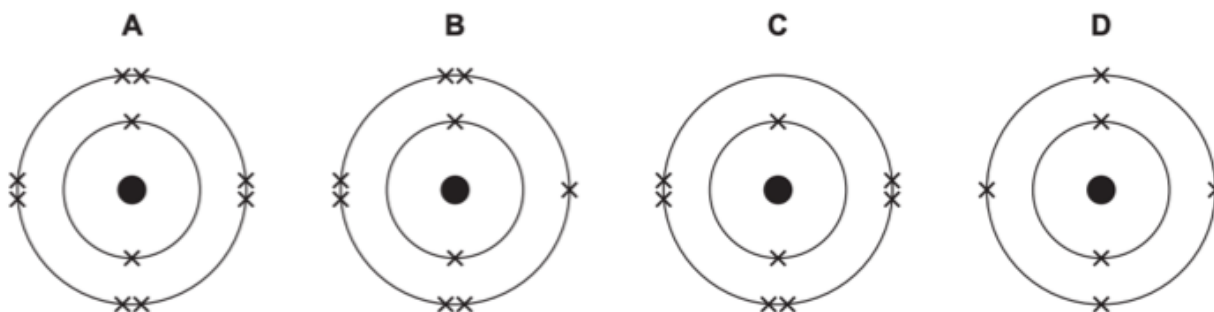
2. Four redox equations and statements about the equations are shown.

	Reaction	Statement
1	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	Carbon is oxidised
2	$\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$	Carbon dioxide is oxidised
3	$\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$	Carbon is oxidised
4	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$	Iron(III) oxide is oxidised

Which statements about the equations are correct?

- (A) 1 and 2
- (B) 1 and 3
- (C) 2 and 4
- (D) 3 and 4

3. Which diagram shows the electronic structure of a noble gas?



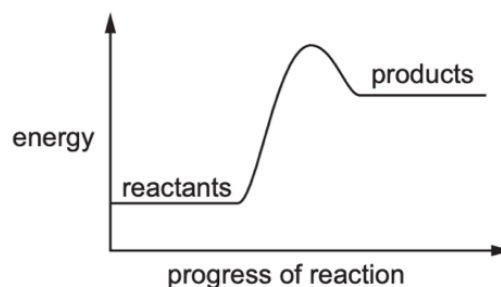
4. In an aqueous solution of sodium hydroxide (NaOH) at 25°C, the pH of the solution is 10.2. Considering complete base ionization, the concentration of NaOH is

- (A) $1.6 \times 10^{-13} \text{ mol dm}^{-3}$
- (B) $3.2 \times 10^{-3} \text{ mol dm}^{-3}$
- (C) $1.6 \times 10^{-4} \text{ mol L}^{-1}$
- (D) $6.3 \times 10^{-11} \text{ mol L}^{-1}$

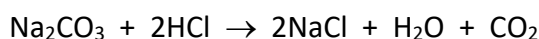
5. A reaction pathway diagram is shown.

Which statement about this reaction is correct?

- (A) The reaction rate increases during the reaction.
- (B) The temperature of the surroundings increases.
- (C) The reaction transfers thermal energy to the surroundings.
- (D) The reaction is endothermic.



6. The equation for the reaction between sodium carbonate and excess dilute hydrochloric acid is:



When 26.5 g of sodium carbonate reacts with excess dilute hydrochloric acid, what is the maximum volume of carbon dioxide produced?

- (A) 6 dm^3
- (B) 12 dm^3
- (C) 18 dm^3
- (D) 24 dm^3

7. Which pair of atoms contains the same number of neutrons?

- (A) ${}^{59}_{27}\text{Co}$ and ${}^{59}_{28}\text{Ni}$
 (B) ${}^{64}_{29}\text{Cu}$ and ${}^{65}_{29}\text{Cu}$
 (C) ${}^{64}_{29}\text{Cu}$ and ${}^{65}_{30}\text{Zn}$
 (D) ${}^{65}_{29}\text{Cu}$ and ${}^{65}_{30}\text{Zn}$

8. What is the name of the organic compound represented below, according to the IUPAC (International Union of Pure and Applied Chemistry) nomenclature?

- (A) 2-yne-pentane
 (B) 2-butyne
 (C) 2-butane
 (D) 2-butene



9. Aqueous iron(III) sulfate and aqueous sodium hydroxide react to give a precipitate of iron(III) hydroxide and a solution of sodium sulfate. What is the balanced symbol equation for this reaction?

- (A) $\text{Fe}_2(\text{SO}_4)_3 (\text{aq}) + 2\text{NaOH} (\text{aq}) \rightarrow \text{Fe}(\text{OH})_3 (\text{s}) + \text{Na}_2\text{SO}_4 (\text{aq})$
 (B) $\text{Fe}_2(\text{SO}_4)_3 (\text{aq}) + 3\text{NaOH} (\text{aq}) \rightarrow \text{Fe}(\text{OH})_3 (\text{s}) + 3\text{Na}_2\text{SO}_4 (\text{aq})$
 (C) $2\text{Fe}_2(\text{SO}_4)_3 (\text{aq}) + 6\text{NaOH} (\text{aq}) \rightarrow 4\text{Fe}(\text{OH})_3 (\text{s}) + 6\text{Na}_2\text{SO}_4 (\text{aq})$
 (D) $\text{Fe}_2(\text{SO}_4)_3 (\text{aq}) + 6\text{NaOH} (\text{aq}) \rightarrow 2\text{Fe}(\text{OH})_3 (\text{s}) + 3\text{Na}_2\text{SO}_4 (\text{aq})$

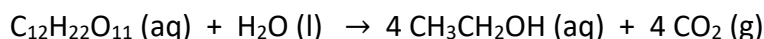
10. The diagram shows the result of dropping a purple crystal into water.



Which processes take place in this experiment?

	Chemical reaction	Diffusing	Dissolving
(A)	✓	✓	X
(B)	✓	X	X
(C)	X	X	✓
(D)	X	✓	✓

11. Ethanol, $\text{CH}_3\text{CH}_2\text{OH}$ ($M = 46.08 \text{ g mol}^{-1}$), can be obtained from sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ($M = 342.34 \text{ g mol}^{-1}$), extracted from sugar beet, in a process that can be, globally, translated as:



11.1. Ethanol belongs to the _____ functional group. The ethanol molecule is _____ and has, in total, _____ valence electrons.

- (A) alcohols; nonpolar; eight; ligands
- (B) alcohols; polar; eight; non-ligands
- (C) alcohols; nonpolar; four; ligands
- (D) alcohols; polar; four; non-ligands

11.2. The mass of ethanol that can be obtained, at most, from 3.0 tonnes of sugar beet, which have, on average, a sucrose content of 20% (m/m) is calculated as follows:

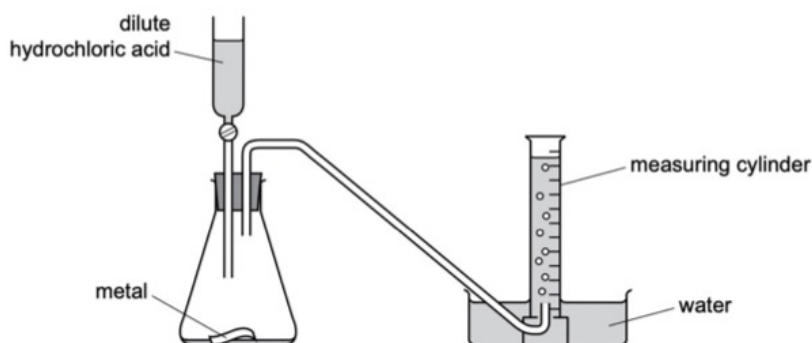
(A) $m = \frac{3 \times 10^6 \times 0.20 \times 4 \times 46.08}{342.34} \text{ g of CH}_3\text{CH}_2\text{OH}$

(B) $m = \frac{3 \times 10^6 \times 4 \times 342.34}{0.20 \times 46.08} \text{ g of CH}_3\text{CH}_2\text{OH}$

(C) $m = \frac{3 \times 0.20 \times 46.08}{4 \times 342.34} \text{ t of CH}_3\text{CH}_2\text{OH}$

(D) $m = \frac{3 \times 0.20 \times 4 \times 342.34}{46.08} \text{ t of CH}_3\text{CH}_2\text{OH}$

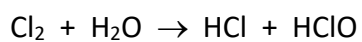
12. The diagram shows an experiment to measure the rate of a chemical reaction.



Which change decreases the rate of reaction?

- (A) Heating the flask during the reaction.
- (B) Adding water to the flask.
- (C) Using more concentrated acid.
- (D) Using powdered metal

13. When chlorine gas dissolves in water a reaction occurs:



Which row of the table identifies the oxidation number for chlorine in the chlorine-containing species?

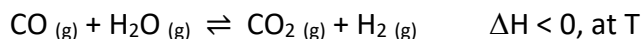
	Cl_2	HCl	HClO
(A)	-1	-1	-1
(B)	0	-1	-1
(C)	-1	+1	+1
(D)	0	-1	+1

Group II

(5 essay questions)

Show all solution steps

14. The gas phase reaction between carbon monoxide and water produces dihydrogen and carbon dioxide:



When in equilibrium at temperature T , the equilibrium constant, K_c , has a value of 1.8.

14.1. Consider that, in a closed and non-deformable reactor, with volume V , maintained at temperature T , there are, at a given instant, 0.2 mol of CO (g) , 5.0 mol of $\text{H}_2\text{O (g)}$, 4.0 mol of $\text{CO}_2 \text{ (g)}$ and 1.0 mol of $\text{H}_2 \text{ (g)}$.

Justify in which direction the equilibrium will evolve, presenting all calculations performed.

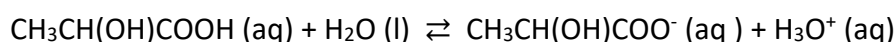
14.2. From that instant (described in question 14.1), and until chemical equilibrium is reached, all the constituents of the reaction system have changed their quantity by 0.15 mol.

Determine the quantity of CO (g) in the reactor when equilibrium is reached.

Present all calculations performed.

14.3. According to Le Chatelier's Principle, in which direction of the reaction does the system evolve when the temperature increases? Justify.

15. Lactic acid is a monoprotic acid that partially ionizes in water, according to the equation



At a temperature of 25°C , the acidity constant, K_a , is 1.38×10^{-4} .

15.1. In a laboratory, there is a flask with a handwritten label: «lactic acid (aq), pH 2.65». To confirm this information, a 50.00 mL sample of the lactic acid solution was taken from the flask and titrated with a standard NaOH solution, with a concentration of $1.00 \times 10^{-2} \text{ mol dm}^{-3}$, using 11.20 mL until reaching the equivalence point. Determine the pH of the lactic acid solution at 25°C , showing that the value shown on the label is incorrect.

Present all calculations performed.

15.2. When, at a given temperature, the pH decreases by 0.5, how does the concentration of H_3O^+ vary? Justify.

END

The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	VIII	
		1 H hydrogen 1																
		atomic number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19					10 Ne neon 20							
		13 Al aluminum 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5					18 Ar argon 40							
19 K potassium 39	20 Ca calcium 40	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80					36 Kr krypton 84							
37 Rb rubidium 85	38 Sr strontium 88	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127					54 Xe xenon 131							
55 Cs caesium 133	56 Ba barium 137	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —					86 Rn radon —							
87 Fr francium —	88 Ra radium —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —					118 Og oganeson —							

lanthanoids

actinoids

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La lanthanum 139	Ce cerium 140	Pr praseodymium 141	Nd neodymium 144	Pm promethium —	Sm samarium 150	Eu europium 152	Gd gadolinium 157	Tb terbium 159	Dy dysprosium 163	Ho holmium 165	Er erbium 167	Tm thulium 169	Yb ytterbium 173	Lu lutetium 175
Ac actinium 227	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium —	Pu plutonium —	Am americium —	Cm curium —	Bk berkelium —	Cf californium —	Es einsteinium —	Fm fermium —	Md mendelevium —	No nobelium —	Lr lawrencium —



Form

Temperature Conversion (from Celsius to Kelvin)	$T = \theta + 273,15$
Density	$\rho = \frac{m}{V}$
Solution Concentration	$c = \frac{n}{V}$
Chemical Quantity	$n = \frac{m}{M}$
Relationship between pH and H_3O^+ concentration	$pH = -\log[H_3O^+]$

Table of Constants

Avogadro's constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
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Integrated Masters in Medicine

Model Exam | Access for International Students

According to the terms of Article 4, paragraph 1., subparagraph b), of the Regulations for Access and Admission to the Integrated Masters in Medicine of the Católica Medical School

Academic Year: 2026/2027

Exam: Chemistry

Duration: 90 minutes

Compensation time: 30 minutes

ANSWERS

Group I

(15 multiple-choice questions)

Question	1.1	1.2	2	3	4	5	6	7	8	9
Correct Option	A	D	B	A	C	D	A	C	B	D

Question	10	11.1	11.2	12	13
Correct Option	D	D	A	B	D

Group II

(5 essay questions)

14.

14.1. Resolution steps:

- Calculate the reaction quotient (4.00)
- Recognize that the reaction evolves in the opposite direction (since $Q > K_c$)

14.2. Resolution steps:

- Calculate the amount of CO (g) at equilibrium (0.35 mol)

14.3. The reaction is exothermic ($\Delta H < 0$), therefore, according to Le Chatelier's Principle, when the temperature increases, the system evolves in the direction of the reverse reaction.

15.

15.1. Resolution steps:

- Calculate the concentration of the lactic acid solution ($2.24 \times 10^{-3} \text{ mol dm}^{-3}$)
- Calculate the concentration of H_3O^+ at equilibrium ($4.91 \times 10^{-4} \text{ mol dm}^{-3}$)
- Calculate the pH of the lactic acid solution (3.31)

15.2. When, at a given temperature, the pH decreases by 0.5, the concentration of H_3O^+ (aq) increases approximately threefold.