PROVE UFFICIALI DEGLI ANNI PASSATI

IMAT 2026

PROVA UFFICIALE MUR

Con le risposte

ALLENATI SULL'APP TESTBUDDY

TESTBUDDY.IT

WHAT'S IN THIS DOCUMENT

Prova di ammissione IMAT 2026, pubblicata dal Ministero dell'Università e della Ricerca (accessoprogrammato.mur.gov.it). Versioni, soluzioni e commenti di TestBuddy, che non è collegata al Ministero.

- The official paper published by the Ministry, unchanged
- The correct answers and the explained solutions, with the letters of the paper

Reading skills and knowledge acquired during studies	1 questions
Questions	43 questions
Logical reasoning and problem-solving	5 questions
Biology	1 questions
Chemistry	6 questions
Physics and Mathematics	4 questions
Total	**60 questions**

HOW TO USE IT

1 · TIMED

Give yourself about a minute and a half per question, no notes, as in the exam.

2 · CHECK

Mark the wrong answers and read why each one is wrong, not only the right one.

3 · REVIEW

Go back to the topics where you made most mistakes and redo the questions in the app.

Ministero dell'Università e della Ricerca

CALL FOR APPLICATIONS FOR ADMISSION TO THE NATIONAL RESTRICTED ACCESS SINGLE-CYCLE DEGREE PROGRAMMES IN MEDICINE AND SURGERY AND IN DENTISTRY AND DENTAL PROSTHODONTICS

Anno Accademico 2026/2027

Per ogni domanda, la risposta esatta è quella evidenziata

Reading skills and knowledge acquired during studies

1. ***Fake news is not a new problem in communication. Deceptive communication has always existed: after the first sin recounted in the Bible, Adam and Eve clumsily try to hide their transgression from God; soon afterwards, Cain once again tries to deceive God about the murder of his brother Abel. The insightful scholar Gregory Bateson (1972; Italian trans. 1976, pp. 160–161) observed that animals communicate with a naturalness and innocence that human beings have lost, since human behaviour "is corrupted by deceit — even self-deceit — by purpose, and by self-consciousness." The capacity to lie is therefore bound up with the superior cognitive abilities of human beings and presupposes a high degree of awareness and reflexivity. This makes human communication immensely richer and more multifaceted than animal communication, but at the same time more demanding, opaque, duplicitous, and exposed to the risk of domination and deception.***

   Tracing back through the history of fake news, the historian Robert Darnton (2017) assembled a selection of cases ranging from the early Middle Ages to eighteenth-century France, among which the malicious rumours that shaped the reputation and fate of Queen Marie Antoinette are particularly striking. Again with reference to France, the historian of the Revolution Georges Lefebvre devoted a famous book to the phenomenon of the "Great Fear", which spread with lightning speed through certain rural regions in the summer of 1789 on the basis of unchecked rumours about an aristocratic conspiracy, an imminent foreign invasion, and bands of brigands who were killing people and destroying crops; these rumours led the peasants to arm themselves and rise up against the aristocracy (1932).

   But all ages have had their share of fake news, including important cases, such as the forged Donation of Constantine, a medieval apocryphal document used to legitimise the temporal power of the Church and only debunked many centuries later, in 1517, by the humanist Lorenzo Valla on the basis of its historical and linguistic inconsistencies.

   Translated from G. Gili e G. Maddalena, *Post-verità e fake news: radici, significati attuali, inattesi protagonisti e probabili vittime*, in Media Education. Studi, ricerche e buone pratiche, 9 (2018), pp. 1-16

   According to the text, the phenomenon of fake news:

   A) Has always existed, albeit in different forms
   B) Is the result of a historical process that began in the Middle Ages
   C) Is due to the human capacity to always distinguish the truth
   D) Acquired a different role in the modern age, because only in the modern age have people come to understand that human beings and animals are distinct
   E) Has deep historical roots, but technically began in 1789

2. **Read the text and answer the question only on the basis of the information it contains explicitly or implicitly and not on what you already know about the topic.**

Why is it that we worship sacrifice in a mother? Where did this inhuman idea of maternal self-immolation come from? From mother to daughter, for centuries, servitude has been handed on. It is a monstrous chain. At some point in life, all of us become conscious of all that the woman who bore us did for our sake; and with that consciousness comes the remorse of not having adequately repaid her total sacrifice. Then we lavish upon our children all that we did not give our mothers, denying ourselves and offering a fresh example of mortification, of self-annihilation. If only, once and for all, that fatal chain were broken, and a mother did not suppress the woman within herself, and a child were to behold in her an example of dignity. Then one would begin to understand that the duty of parents begins long before the birth of their children, and that their responsibility must be felt beforehand, precisely at that moment when selfish life presses most imperiously, most seductively.

Translated from S. Aleramo, Una Donna, Feltrinelli, Milano, 2002

In which of the following does Aleramo identify the reason why mothers' self-sacrifice is perpetuated?

A) From one generation to the next, women hand down a condition of servitude associated with motherhood
B) From one generation to the next, women deny their own children and offer an example of mortification
C) From one generation to the next, a condition is handed down that leads daughters to rebel against their mothers
D) From one generation to the next, children learn from their mothers an example of dignity
E) From one generation to the next, parental responsibility, especially that of mothers, begins before a child is born

3. **Read the text and answer the question only on the basis of the information it contains explicitly or implicitly and not on what you already know about the topic.**

"[…] The enduring European pre-eminence of Italian literature has coincided with its ability to act as a crossroads of cultures. We forget this too often, just as we forget the fact that the very first book printed in Arabic type was produced not in Syria or Egypt, but in Rome in 1514. […] It is the cities that have been the pivot around which the history of our country has turned, and not only its literary history. If books are readily written in villas, it is in the bustle of urban centres that people meet and ideas spread."

Translated from Luzzatto, Pedullà, Atlante della letteratura italiana, Introduzione, Einaudi, Torino, 2010-2012

The polycentric character of Italian culture is primarily due to:

A) The flourishing of cities, where people meet and ideas spread.
B) both the flourishing of cities and the tranquillity of villas outside the city
C) the flourishing of cities, where people meet and books are written
D) the possibility of writing in peace in order to sustain literary life in the cities
E) the spread of ideas between town and countryside

4. **The economic system in which digital technologies, the Internet and ICT (nformation and Communication Technologies) are central to production, distribution and exchange is commonly referred to as:**

A) The digital economy
B) The technological economy
C) The global economy
D) The big data economy
E) The mobile systems economy

Logical reasoning and problem-solving

5. In the sequence 1, 2, 5, x, 29, 70, 169, …, what is the value of x?

A) 12
B) 24
C) 8
D) 16
E) 11

6. Which of the following is a true logical proposition?

A) A hexagon has nine diagonals
B) A triangle has two diagonals
C) A square has three diagonals
D) A pentagon has six diagonals
E) An octagon has eighteen diagonals

7. If $s = 3t$ and $t = 9u$ then:

A) $u = s/27$
B) $s = 18u$
C) $u = 27s$
D) $s = 3u$
E) $t = 27s$

8. 20% of a company's employees work part-time. The rest work full-time. At the end of the year, 20% of the full-time employees receive a bonus. If 48 employees received the bonus, how many employees does the company have?

A) 300
B) 600
C) 1200
D) 150
E) 96

9. Based on the statements:
"Some felines are carnivores. Carnivores eat meat."
Which of the following statements is correct?

A) Some animals are carnivores
B) All animals eat meat
C) Not all animals eat meat
D) Meat is the favourite food of animals
E) Animals cannot survive without meat

Biology

10. What is the main function of red blood cells in the blood?

A) To transport oxygen to the tissues
B) To regulate body temperature
C) To fight infections
D) To clot the blood
E) To transport CO_2 to the liver

11. Which structure of the respiratory system is the primary site of gas exchange?

A) Alveoli
B) Trachea
C) Diaphragm
D) Aorta
E) Left atrium of the heart

12. What is the primary function of flagella in prokaryotic cells?

A) To allow the cell to move
B) To help the cell adhere to other cells
C) To facilitate the exchange of genetic material between cells
D) To transport materials within the cell
E) To aid in cell division

13. What is the primary digestive function of the stomach?

A) To break down food using enzymes and acids
B) To absorb nutrients
C) To filter toxins
D) To produce bile
E) To transport food to the large intestine

14. What is the primary site of protein translation in prokaryotic cells?

A) On ribosomes in the cytoplasm
B) On the plasma membrane
C) In the nucleus
D) In the flagellum
E) Between the plasma membrane and the cell wall

15. Which main components make up the plasma membrane?

A) Phospholipids and proteins
B) Carbohydrates and DNA
C) RNA and amino acids
D) Fatty acids and sugars
E) Lipids and glycogen

16. What is the primary function of channel proteins in the cell membrane?

A) To permit specific substances to pass through the membrane
B) To store energy for active transport
C) To catalyse protein synthesis
D) To regulate membrane fluidity
E) To transfer DNA out of the cell

17. What is the primary function of a tendon?

A) To connect muscles to bones
B) To protect the heart
C) To transmit nervous impulses to the muscle
D) To store energy for the muscle
E) To control the production of actin

18. Restriction enzymes are:

A) Endonucleases
B) Isomerases
C) Oxidoreductases
D) Ligases
E) Transferases

19. A bacterium is said to be transformed when:

A) It has taken up foreign DNA directly from the environment
B) It is engulfed by a macrophage through phagocytosis
C) It has a cell wall similar to that of plant cells
D) It is able to grow under anaerobic conditions
E) It undergoes gene mutations caused by mutagens

20. The epiglottis is primarily composed of:

A) Cartilage
B) A gland
C) A nerve
D) A vertebra
E) A muscle

21. Which hormone primarily stimulates uterine contractions during labour?

A) Oxytocin
B) Thyrotropin
C) Luteinising hormone
D) Insulin
E) Follicle-stimulating hormone

22. What is the primary role of carbohydrates in cellular catabolism?

A) They are broken down to produce energy for cellular activities
B) They are used exclusively for protein synthesis
C) They are used only as an energy reserve
D) They are not involved in energy metabolism
E) They are converted into fats for storage

23. Which of the following statements about metabolism is true?

A) It includes both catabolism and anabolism
B) It is a process that occurs only in animal cells
C) It does not involve chemical reactions
D) It focuses only on the synthesis of molecules
E) It occurs only in the presence of sunlight

24. What is the main function of enzymes in metabolic reactions?

A) To speed up reactions without being consumed
B) To increase the reaction temperature
C) To be transformed into substrates
D) To provide chemical energy for the reactions
E) To be consumed during the process

25. Photosynthesis takes place in which cell organelle?

A) Chloroplast
B) Mitochondrion
C) Nucleus
D) Ribosome
E) Endoplasmic reticulum

26. Which organelles are the main site of cellular respiration in eukaryotic cells?

A) Mitochondria
B) Chloroplasts
C) Ribosomes
D) Lysosomes
E) Endoplasmic reticulum

27. Which of the following features distinguishes meiosis from mitosis?

A) The production of genetically diverse haploid cells
B) The production of cells is identical to the parent cell
C) It occurs only in unicellular organisms
D) It requires the use of microtubules
E) It occurs in somatic cells

28. Which of the following statements about the chromosomal theory of inheritance is true?

A) Genes are located on chromosomes
B) Genes are found only in RNA
C) Chromosomes do not contain genes
D) Genes are independent of chromosomes
E) Chromosome segregation does not occur during meiosis

29. Which technique was used by Rosalind Franklin to obtain images of DNA?

A) X-ray crystallography
B) Magnetic resonance imaging
C) Electron microscopy
D) Chromatography
E) Electrophoresis

30. Which of the following statements correctly describes the structure of DNA?

A) It has a double-stranded helical structure.
B) It consists of a single chain of nucleotides
C) It has no hydrogen bonds between the bases
D) It contains only two nitrogenous bases
E) It is made up of three nucleotide strands

31. Which of the following statements about the haemoglobin in patients with sickle-cell anaemia is true?

A) Their haemoglobin has a different structure from normal haemoglobin
B) Their haemoglobin does not transport oxygen
C) Their haemoglobin is identical to that found in all individuals
D) Their haemoglobin is produced in greater quantities
E) Their haemoglobin does not undergo mutations

32. Which of the following statements about the structure of messenger RNA is true?

A) mRNA consists of a single polynucleotide strand
B) mRNA consists of two polynucleotide strands
C) mRNA contains the nitrogenous base thymine
D) mRNA is longer than DNA
E) mRNA does not carry information for protein synthesis

Chemistry

33. Which of the following statements about the Mg^{2+} ion is correct?

A) The ion has 8 electrons in its outermost electron shell
B) The Mg^{2+} ion has a larger radius than the Mg atom
C) The ion has two more electrons than the neutral atom
D) The two chemical species (the ion and the neutral atom) have the same number of protons, electrons, and neutrons
E) None of the other statements is correct

34. Balance the following reaction equation: $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$

A) 3, 8, 3, 2, 4
B) 2, 6, 3, 2, 4
C) 3, 8, 3, 2, 6
D) 3, 8, 3, 1, 4
E) None of the other options is correct

35. The rate law for the reaction A + B → C is:

A) To be determined experimentally
B) v = k [A] [B]
C) v = k [C]
D) v = k [A] [B] / [C]
E) v = k [C] / ([A] [B])

36. How many valence electrons does the Cl^- anion have?

A) 8
B) 7
C) 6
D) 17
E) 35

37. When sodium bromide is dissolved in water, the result is:

A) A neutral aqueous solution
B) A weakly acidic aqueous solution
C) A weakly basic aqueous solution
D) A strongly acidic aqueous solution
E) A strongly basic aqueous solution

38. When sodium acetate is dissolved in water, the result is:

A) A basic aqueous solution
B) An acidic aqueous solution
C) A neutral aqueous solution
D) An alcoholic solution
E) No solution is formed because it does not dissolve

39. Balance the following redox equation: $PbBr_2 + FeBr_3 \rightarrow PbBr_4 + FeBr_2$

A) $PbBr_2 + 2\ FeBr_3 \rightarrow PbBr_4 + 2\ FeBr_2$
B) $2\ PbBr_2 + FeBr_3 \rightarrow 2\ PbBr_4 + FeBr_2$
C) $PbBr_2 + 3\ FeBr_3 \rightarrow PbBr_4 + 3\ FeBr_2$
D) $3\ PbBr_2 + FeBr_3 \rightarrow 3\ PbBr_4 + FeBr_2$
E) $2\ PbBr_2 + 3\ FeBr_3 \rightarrow 2\ PbBr_4 + 3\ FeBr_2$

40. Balance the following disproportionation reaction: $KIO_2 \rightleftharpoons KI + KIO_3$

A) $3\ KIO_2 \rightleftharpoons KI + 2\ KIO_3$
B) $3\ KIO_2 \rightleftharpoons 2\ KI + KIO_3$
C) $4\ KIO_2 \rightleftharpoons 3\ KI + KIO_3$
D) $4\ KIO_2 \rightleftharpoons 2\ KI + KIO_3$
E) $5\ KIO_2 \rightleftharpoons 3\ KI + 2\ KIO_3$

41. HClO is:

A) An oxyacid
B) An acidic oxide
C) A hydrohalic acid
D) An acidic hydroxide
E) An acid anhydride

42. Substance A has a higher boiling point than Substance B if:

A) The intermolecular forces in A are stronger than those in B
B) The intermolecular forces in A are weaker than those in B
C) The intramolecular forces in A are stronger than those in B
D) The intramolecular forces in A are weaker than those in B
E) The intramolecular forces in A are stronger than those in B, but the intermolecular forces in A are weaker than those in B

43. Pentanones are:

A) Ketones
B) Lactones
C) Alcohols
D) Hydroxyketones
E) Carboxylic acids

44. Ethene is:

A) An alkene
B) An alkyne
C) A diene
D) An alkenyne
E) A non-existent molecule

45. C_3H_6O can be:

A) An alcohol, an aldehyde, or a ketone
B) An alcohol or an aldehyde, but not a ketone
C) An alcohol or a ketone, but not an aldehyde
D) An aldehyde or a ketone, but not an alcohol
E) An alcohol, but neither an aldehyde nor a ketone

46. For an ideal gas undergoing an isothermal process, what happens as the volume increases?

A) The pressure decreases in inverse proportion
B) The pressure decreases in direct proportion
C) The pressure increases in direct proportion
D) The temperature increases
E) The pressure remains unchanged

47. In an exothermic reaction:

A) The products have lower chemical potential energy than the reactants
B) The reactants have lower chemical potential energy than the products
C) The products have the same chemical potential energy as the reactants
D) Heat is absorbed from the surroundings
E) The reaction rate is always very high

Physics and Mathematics

48. Which physical quantity measures how quickly a point particle changes its position over time?

A) Velocity
B) Acceleration
C) Centripetal acceleration
D) Frequency
E) Natural angular frequency

49. In which case of relative motion between two observers are Galilean transformations valid?

A) Uniform rectilinear motion of one observer relative to the other
B) Uniformly accelerated rectilinear motion of one observer relative to the other
C) Rotational motion of one observer relative to the other at constant angular velocity
D) Combined rotational and translational motion of one observer relative to the other
E) Non-uniform rectilinear motion of one observer relative to the other

50. What is the kinetic energy of an object of mass 20 kg moving at 36 km/h?

A) 1000 J
B) 2000 J
C) 2500 J
D) 720 J
E) 200 J

51. If a point particle slides down an inclined plane with friction, its mechanical energy:

A) decreases
B) increases
C) remains constant
D) doubles
E) becomes zero

52. To what depth must one dive in the sea for the pressure to double relative to that at the surface?

A) Approximately 10m
B) Approximately 2m
C) Approximately 5m
D) Approximately 15m
E) Approximately 20m

53. What is the electric charge of a hydrogen atom?

A) 0 C
B) +1 nC
C) +2 nC
D) +1 mC
E) −2 pC

54. Two waves are said to be coherent if:

A) their phase difference remains constant over time
B) the phase difference varies randomly over time
C) their wavelength lies in the visible region
D) they have the same intensity
E) they have the same amplitude

55. Which is the solution to the inequality $x^2 - 6x + 5 \leq 0$?

A) $1 \leq x \leq 5$
B) $x \leq 1$; $x \geq 5$
C) $x \leq -5$; $x \geq -1$
D) $-5 \leq x \leq -1$
E) None of the other options are correct

56. Given $f(x) = e^x$, which of the following gives the solutions to the inequality $f(x) > 0$?

A) All real numbers
B) No real numbers
C) All positive real numbers
D) All real numbers greater than or equal to 1
E) All real numbers greater than 1

57. A circle has the equation $x^2 + y^2 + 5x + 4y = 0$. Which of the following statements is true?

A) It passes through the origin
B) It has its centre at the origin
C) It has zero radius
D) It is centred on the *y*-axis
E) It is centred on the *x*-axis

58. A bag contains 12 balls that are indistinguishable by touch, 5 of which are red. Two balls are drawn without replacement. What is the probability that no red ball is drawn?

A) $\frac{7}{22}$

B) $\frac{49}{144}$

C) $\frac{49}{132}$

D) $\frac{25}{132}$

E) $\frac{15}{22}$

59. The parabola with equation $y = kx^2 - x + 30$ passes through the point (5,0). What is the value of k?

A) −1

B) 1

C) 2

D) −2

E) 3

60. Which is the solution to the following equation: $log_{10}x = 6$?

A) 1000000

B) 100000

C) 10000

D) 60

E) 600

********** FINE DELLE DOMANDE **********

ANSWERS AND EXPLAINED SOLUTIONS

The letters are those of the official paper above. In the Ministry paper the correct answer is always A.

1 **Fake news is not a new problem in communication. Deceptive communication has always existed: after the first sin recounted in the Bible, Adam and Eve clumsily try to hide their transgression from God; soon afterwards, Cain once again tries to deceive God about the murder of his brother Abel. The insightful scholar Gregory Bateson (1972; Italian trans. 1976, pp. 160–161) observed that animals communicate with a naturalness and innocence that human beings have lost, since human behaviour "is corrupted by deceit — even self-deceit — by purpose, and by self-consciousness." The capacity to lie is therefore bound up with the superior cognitive abilities of human beings and presupposes a high degree of awareness and reflexivity. This makes human communication immensely richer and more multifaceted than animal communication, but at the same time more demanding, opaque, duplicitous, and exposed to the risk of domination and deception.**

Tracing back through the history of fake news, the historian Robert Darnton (2017) assembled a selection of cases ranging from the early Middle Ages to eighteenth-century France, among which the malicious rumours that shaped the reputation and fate of Queen Marie Antoinette are particularly striking. Again with reference to France, the historian of the Revolution Georges Lefebvre devoted a famous book to the phenomenon of the "Great Fear", which spread with lightning speed through certain rural regions in the summer of 1789 on the basis of unchecked rumours about an aristocratic conspiracy, an imminent foreign invasion, and bands of brigands who were killing people and destroying crops; these rumours led the peasants to arm themselves and rise up against the aristocracy (1932).

But all ages have had their share of fake news, including important cases, such as the forged Donation of Constantine, a medieval apocryphal document used to legitimise the temporal power of the Church and only debunked many centuries later, in 1517, by the humanist Lorenzo Valla on the basis of its historical and linguistic inconsistencies.

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According to the text, the phenomenon of fake news:

Correct answer: A · Has always existed, albeit in different forms

The text states that deceptive communication has always existed and notes that all eras have experienced similar phenomena. Historical examples from biblical narratives to medieval forgeries demonstrate that misleading information has consistently emerged in various contexts. Human cognitive traits enable complex interaction but also introduce risks of manipulation. Therefore, the issue reflects a pattern of historical continuity rather than a recent development.

Why the other answers are wrong

- **B) Is the result of a historical process that began in the Middle Ages**: The text traces misleading narratives back to pre-medieval accounts like Genesis. Attributing the origin solely to the Middle Ages ignores these earlier documented cases.
- **C) Is due to the human capacity to always distinguish the truth**: The passage associates misleading information with the human ability to lie, not with an innate skill to identify facts. It emphasizes reflexivity and purposeful behavior instead.
- **D) Acquired a different role in the modern age, because only in the modern age have people come to understand that human beings and animals are distinct**: This choice misinterprets the comparison between humans and animals. The author uses animal communication to highlight lost innocence, not to define modern self-awareness or assign a new role to falsehoods.
- **E) Has deep historical roots, but technically began in 1789**: The option incorrectly claims a technical starting point in 1789. The text explicitly provides earlier instances that prove this anachronistic start is inaccurate.

2 **Read the text and answer the question only on the basis of the information it contains explicitly or implicitly and not on what you already know about the topic.**

Why is it that we worship sacrifice in a mother? Where did this inhuman idea of maternal self-immolation come from? From mother to daughter, for centuries, servitude has been handed on. It is a monstrous chain. At some point in life, all of us become conscious of all that the woman who bore us did for our sake; and with that consciousness comes the remorse of not having adequately repaid her total sacrifice. Then we lavish upon our children all that we did not give our mothers, denying ourselves and offering a fresh example of mortification, of self-annihilation. If only, once and for all, that fatal chain were broken, and a mother did not suppress the woman within herself, and a child were to behold in her an example of dignity. Then one would begin to understand that the duty of parents begins long before the birth of their children, and that their responsibility must be felt beforehand, precisely at that moment when selfish life presses most imperiously, most seductively.

Translated from S. Aleramo, Una Donna, Feltrinelli, Milano, 2002

In which of the following does Aleramo identify the reason why mothers' self-sacrifice is perpetuated?

Correct answer: A · From one generation to the next, women hand down a condition of servitude associated with motherhood

The text explains that **servitude** passes from mother to daughter, establishing a continuous **cycle**. Daughters experience **remorse** regarding past sacrifices and **repeat** the same pattern of self-denial when they have children.

Why the other answers are wrong

- **B) From one generation to the next, women deny their own children and offer an example of mortification**: The passage explicitly states that women deny themselves rather than denying their children.
- **C) From one generation to the next, a condition is handed down that leads daughters to rebel against their mothers**: The described cycle involves remorse and repetition across generations, not active rebellion against mothers.
- **D) From one generation to the next, children learn from their mothers an example of dignity**: Showing dignity is framed as a potential outcome that would only occur once the historical chain is broken.
- **E) From one generation to the next, parental responsibility, especially that of mothers, begins before a child is born**: Acknowledging responsibility before birth is proposed as a preventive measure to break the cycle, not as the cause of its continuation.

3 **Read the text and answer the question only on the basis of the information it contains explicitly or implicitly and not on what you already know about the topic.**
"[...] The enduring European pre-eminence of Italian literature has coincided with its ability to act as a crossroads of cultures. We forget this too often, just as we forget the fact that the very first book printed in Arabic type was produced not in Syria or Egypt, but in Rome in 1514. [...] It is the cities that have been the pivot around which the history of our country has turned, and not only its literary history. If books are readily written in villas, it is in the bustle of urban centres that people meet and ideas spread."
Translated from Luzzatto, Pedullà, Atlante della letteratura italiana, Introduzione, Einaudi, Torino, 2010-2012
The polycentric character of Italian culture is primarily due to:

Correct answer: A · The flourishing of cities, where people meet and ideas spread.

The passage identifies **cities** as the pivot of Italian history. In urban centres, people **meet** and **ideas spread**, which explains the polycentric character of Italian culture.

Why the other answers are wrong

- **B) both the flourishing of cities and the tranquillity of villas outside the city**: Villas are mentioned as places where books may be written, not as an equal source of cultural exchange. The passage presents cities as the places where people meet and ideas spread.
- **C) the flourishing of cities, where people meet and books are written**: The passage associates writing books with villas, while cities are where people meet and ideas spread.
- **D) the possibility of writing in peace in order to sustain literary life in the cities**: The passage does not say that peaceful writing sustains literary life in cities. It contrasts writing in villas with the meetings and exchange of ideas in urban centres.
- **E) the spread of ideas between town and countryside**: The passage describes ideas spreading in urban centres, not between cities and the countryside.

4 **The economic system in which digital technologies, the Internet and ICT (nformation and Communication Technologies) are central to production, distribution and exchange is commonly referred to as:**

Correct answer: A · The digital economy

The **digital economy** describes a system where **digital technologies**, the **Internet**, and **ICT** drive core market activities. This framework covers how goods and services are produced, distributed, and exchanged.

Why the other answers are wrong

- **B)** The technological economy is a vague label that does not specifically denote systems reliant on internet and communication networks.
- **C)** The global economy refers to international trade and financial flows across borders, without emphasizing the specific role of digital infrastructure.
- **D)** The big data economy highlights the commercial value of massive datasets, which represents only one application within the wider digital framework.
- **E)** The mobile systems economy is not a recognized academic term for this concept.

5 **In the sequence $1, 2, 5, x, 29, 70, 169, \ldots$, what is the value of x?**

Correct answer: A · 12

The sequence follows a **recurrence relation** where each term equals **twice the previous term plus the one before it**. Applying this rule confirms $5 = 2(2) + 1$. Calculating the unknown position gives $x = 2(5) + 2 = 12$. The pattern remains consistent with $29 = 2(12) + 5$ and $70 = 2(29) + 12$.

Why the other answers are wrong

- **B) 24**: Substituting the terms into $2(5) + 2$ yields 12, ruling out 24.
- **C) 8**: Following the established rule produces 12, leaving 8 as an invalid choice.
- **D) 16**: Computing $2(5) + 2$ results in 12, which does not equal 16.
- **E) 11**: The expression $2(5) + 2$ evaluates to 12, so 11 is incorrect.

6 **Which of the following is a true logical proposition?**

Correct answer: A · A hexagon has nine diagonals

The general **polygon** diagonal count follows the **formula** $n(n-3)/2$. Substituting $n = 6$ for a **hexagon** yields $6(6-3)/2 = 9$, confirming nine diagonals.

Why the other answers are wrong

- **B) A triangle has two diagonals**: A triangle uses $n = 3$, resulting in $3(3-3)/2 = 0$ diagonals instead of two.
- **C) A square has three diagonals**: A square uses $n = 4$, resulting in $4(4-3)/2 = 2$ diagonals instead of three.
- **D) A pentagon has six diagonals**: A pentagon uses $n = 5$, resulting in $5(5-3)/2 = 5$ diagonals instead of six.
- **E) An octagon has eighteen diagonals**: An octagon uses $n = 8$, resulting in $8(8-3)/2 = 20$ diagonals instead of eighteen.

7 **If $s = 3t$ and $t = 9u$ then:**

Correct answer: A · $u = s/27$

Substitute $t = 9u$ into $s = 3t$ to obtain $s = 3(9u) = 27u$. **Divide** both sides by 27 to isolate u, yielding $u = s/27$.

Why the other answers are wrong

- **B)** $s = 18u$: Incorrect because $3 \times 9 = 27$, not 18.
- **C)** $u = 27s$: Incorrect because the derived relationship is $s = 27u$, not $u = 27s$.
- **D)** $s = 3u$: Incorrect because the combined multiplication **factor** is 27, not 3.
- **E)** $t = 27s$: Incorrect because the initial condition $s = 3t$ means $t = s/3$, contradicting any scaling upward.

8 **20% of a company's employees work part-time. The rest work full-time. At the end of the year, 20% of the full-time employees receive a bonus. If 48 employees received the bonus, how many employees does the company have?**

Correct answer: A · 300

Since 80% of employees work full-time and 20% of those receive a bonus, bonus recipients make up $0.80 \times 0.20 = 0.16$ of all employees. The company has $48/0.16 = 300$ employees.

Why the other answers are wrong

- **B) 600**: With 600 employees, $600 \times 0.16 = 96$ would receive a bonus, not 48.
- **C) 1200**: With 1200 employees, $1200 \times 0.16 = 192$ would receive a bonus, not 48.
- **D) 150**: With 150 employees, $150 \times 0.16 = 24$ would receive a bonus, not 48.
- **E) 96**: With 96 employees, $96 \times 0.16 = 15.36$ would receive a bonus, not 48.

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9 **Based on the statements:**
"Some felines are carnivores. Carnivores eat meat."
Which of the following statements is correct?

Correct answer: A · Some animals are carnivores

The premises state that **some felines** are **carnivores**. Since felines belong to the broader class of **animals**, this logical chain proves that a portion of animals share that trait. Consequently, the only valid inference is that **some animals** meet the description.

Why the other answers are wrong

- **B) All animals eat meat**: The original text only defines traits of carnivores, so it cannot justify a universal claim covering every animal.
- **C) Not all animals eat meat**: The provided statements give no information about non-carnivore diets, leaving the question of meat avoidance completely unresolved.
- **D) Meat is the favourite food of animals**: Describing a behavioral habit does not establish an emotional preference or favorite status.
- **E) Animals cannot survive without meat**: Biological survival needs are never introduced in the premises, making any claim about necessities a pure assumption.

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10 **What is the main function of red blood cells in the blood?**

Correct answer: A · To transport oxygen to the tissues

Red blood cells contain **hemoglobin** to bind **oxygen** in the lungs. This specialized protein delivers the gas efficiently to peripheral tissues for cellular metabolism.

Why the other answers are wrong

- **B) To regulate body temperature**: Thermoregulation relies on general blood volume shifts near the skin, not a direct erythrocyte function.
- **C) To fight infections**: Pathogen defense is strictly managed by leukocytes and associated immune cells.
- **D) To clot the blood**: Coagulation requires activated platelets and soluble clotting factors in plasma.
- **E) To transport CO_2 to the liver**: Erythrocytes carry $\mathrm{CO_2}$ but direct it toward pulmonary exhalation instead of hepatic processing.

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11 Which structure of the respiratory system is the primary site of gas exchange?

Correct answer: A · Alveoli

The **alveoli** are microscopic air sacs located at the terminal branches of the respiratory tree. They are densely enveloped by pulmonary capillaries and possess exceptionally thin epithelial layers. This anatomical configuration enables rapid diffusion of oxygen into the circulation and carbon dioxide removal from the blood.

Why the other answers are wrong

- **B) Trachea**: The trachea acts only as a rigid conductive tube that transports inspired air toward the bronchi.
- **C) Diaphragm**: The diaphragm provides the mechanical force needed for lung inflation during ventilation cycles.
- **D) Aorta**: The aorta carries oxygenated blood from the left ventricle to the systemic circulation and lacks any respiratory function.
- **E) Left atrium of the heart**: The left atrium collects oxygen-rich blood returning via the pulmonary veins to forward it to the left ventricle.

12 What is the primary function of flagella in prokaryotic cells?

Correct answer: A · To allow the cell to move

Flagella are long, rotating structures that **propel** prokaryotic cells through their environment. Their primary biological role is to enable cellular **motility** for navigating chemical gradients and seeking nutrients.

Why the other answers are wrong

- **B) To help the cell adhere to other cells**: Surface attachment relies on **fimbriae**, which are short adhesive fibers distinct from the long helical tails used for propulsion.
- **C) To facilitate the exchange of genetic material between cells**: DNA exchange requires specialized **conjugation pili** that form temporary physical bridges between donor and recipient cells during bacterial mating.
- **D) To transport materials within the cell**: Intracellular trafficking depends on vesicular transport and cytoplasmic motors, whereas flagella operate exclusively outside the plasma membrane as mechanical drives.
- **E) To aid in cell division**: Flagella do not participate in partitioning cellular components. Cellular reproduction relies on internal protein rings and peptidoglycan synthesis rather than external appendages.

13 What is the primary digestive function of the stomach?

Correct answer: A · To break down food using enzymes and acids

The stomach mixes food with **gastric acid** and **digestive enzymes**, beginning its chemical breakdown, especially of proteins.

Why the other answers are wrong

- **B) To absorb nutrients**: Most nutrient absorption occurs in the **small intestine**.
- **C) To filter toxins**: Detoxification of toxins is primarily a function of the **liver**.
- **D) To produce bile**: Bile is produced by the **liver**, not by the stomach.
- **E) To transport food to the large intestine**: The stomach passes partially digested food to the **small intestine**, not the large intestine.

14 What is the primary site of protein translation in prokaryotic cells?

Correct answer: A · On ribosomes in the cytoplasm

Prokaryotic cells synthesize proteins on **ribosomes** located freely in the **cytoplasm**. The absence of a **nucleus** allows transcription and translation to proceed simultaneously. Free **mRNA** binds directly to these complexes for immediate peptide assembly.

Why the other answers are wrong

- **B) On the plasma membrane**: Although some ribosomes anchor to the membrane for secretory pathways, free cytoplasmic ribosomes handle the vast majority of protein production.
- **C) In the nucleus**: Prokaryotes completely lack membrane-bound organelles, eliminating any nuclear compartment for genetic processing.
- **D) In the flagellum**: Flagella serve exclusively for cellular motility and do not contain translational machinery.
- **E) Between the plasma membrane and the cell wall**: The region between the membrane and cell wall facilitates nutrient exchange and osmoregulation, not ribosomal translation.

15 Which main components make up the plasma membrane?

Correct answer: A · Phospholipids and proteins

The plasma membrane is primarily composed of a **phospholipid bilayer** with **proteins** embedded within or attached to it. Phospholipids provide the fundamental structural barrier, while proteins facilitate essential functions like molecular transport and cellular signaling.

Why the other answers are wrong

- **B)** Carbohydrates appear on the outer surface but are not primary components, whereas DNA remains confined to the nucleus and never forms membrane structures.
- **C) RNA and amino acids**: Neither RNA nor free amino acids build the membrane; amino acids act only as protein building blocks, and RNA handles genetic expression.
- **D)** Fatty acids and sugars modify certain lipids, yet this combination ignores the critical protein component and misses the defining bilayer structure.
- **E) Lipids and glycogen**: While lipids are abundant, glycogen serves exclusively as a cytoplasmic energy reserve and plays no role in membrane architecture.

16 What is the primary function of channel proteins in the cell membrane?

Correct answer: A · To permit specific substances to pass through the membrane

Channel proteins form **selective pores** through the lipid bilayer, allowing specific ions or molecules to cross down their **electrochemical gradient** via passive diffusion.

Why the other answers are wrong

- **B) To store energy for active transport**: They do not store energy; active transport relies on carrier proteins like ATP-driven pumps.
- **C) To catalyse protein synthesis**: Protein synthesis occurs on ribosomes, not at membrane channels.
- **D) To regulate membrane fluidity**: Membrane fluidity depends primarily on lipid composition and cholesterol concentration.
- **E) To transfer DNA out of the cell**: Transporting DNA is not performed by channel proteins, which only move small solutes.

17 What is the primary function of a tendon?

Correct answer: A · To connect muscles to bones

A **tendon** connects a **muscle** to a **bone** and transmits the **force** generated by **contraction**. This arrangement enables movement of the skeleton.

Why the other answers are wrong

- **B) To protect the heart**: Protecting the heart is not a physiological function of tendons. Organ shielding belongs to the rib cage and surrounding tissues.
- **C) To transmit nervous impulses to the muscle**: Nerves transmit electrical impulses to muscles. Tendons do not handle nervous signaling.
- **D) To store energy for the muscle**: Tendons can temporarily store elastic energy, but their primary function is to connect muscles to bones. Energy retention is a secondary mechanical property.
- **E) To control the production of actin**: Tendons do not control the synthesis of this muscle protein. Actin production is regulated by cellular machinery inside muscle fibers.

18 Restriction enzymes are:

Correct answer: A · Endonucleases

Restriction enzymes recognize specific DNA sequences and cleave **phosphodiester bonds** within the nucleic acid strand. This internal cutting activity classifies them as **endonucleases**.

Why the other answers are wrong

- **B)** Isomerases drive intramolecular rearrangements that reposition atoms within a single compound.
- **C)** Oxidoreductases mediate redox reactions by shuttling electrons from donors to acceptors.
- **D)** Ligases synthesize covalent bonds to attach separate DNA fragments rather than severing them.
- **E)** Transferases catalyze the transfer of functional groups between distinct molecules.

19 A bacterium is said to be transformed when:

Correct answer: A · It has taken up foreign DNA directly from the environment

Bacterial transformation occurs when a microorganism acquires **foreign DNA** directly from its surroundings. This genetic material can integrate into the host chromosome or function as an independent plasmid, enabling new traits without sexual reproduction.

Why the other answers are wrong

- **B) It is engulfed by a macrophage through phagocytosis**: This mechanism involves host immune cells internalizing pathogens, representing defensive consumption rather than bacterial uptake of external nucleic acids.
- **C) It has a cell wall similar to that of plant cells**: Structural composition varies across kingdoms because bacterial surfaces utilize peptidoglycan while plant tissues rely on cellulose, making wall chemistry irrelevant to genetic exchange.
- **D) It is able to grow under anaerobic conditions**: Surviving without oxygen depends on alternative metabolic pathways, which describe physiological adaptation instead of environmental DNA import.
- **E) It undergoes gene mutations caused by mutagens**: Treatments with harmful agents trigger random changes in the existing nucleotide sequence, a process defined as mutation rather than horizontal gene transfer.

20 The epiglottis is primarily composed of:

Correct answer: A · Cartilage

The epiglottis is primarily composed of **elastic cartilage**. This flexible tissue forms a protective flap that prevents food and liquids from entering the airway during swallowing.

Why the other answers are wrong

- **B) A gland**: Glands produce and release substances, whereas the epiglottis is a cartilaginous structure.
- **C) A nerve**: Nerves transmit electrical signals and do not form the structural framework of the epiglottis.
- **D)** A vertebra is a bone belonging to the spinal column and does not constitute the epiglottis.
- **E) A muscle**: Muscles can help move the epiglottis, but they are not its primary component.

21 Which hormone primarily stimulates uterine contractions during labour?

Correct answer: A · Oxytocin

Oxytocin stimulates **uterine smooth muscle** contractions during labour. Cervical stretching increases oxytocin secretion, which maintains the contraction cycle via **positive feedback**.

Why the other answers are wrong

- **B)** Thyrotropin activates the thyroid gland to produce thyroid hormones and serves no function in parturition.
- **C)** Luteinising hormone induces ovulation and regulates steroid hormone synthesis without affecting labour contractions.
- **D)** Insulin controls blood glucose metabolism and does not influence uterine activity.
- **E)** Follicle-stimulating hormone initiates follicular maturation in the ovaries and is unrelated to contractile mechanisms.

22 What is the primary role of carbohydrates in cellular catabolism?

Correct answer: A · They are broken down to produce energy for cellular activities

During cellular **catabolism**, carbohydrates enter metabolic routes like **glycolysis** to yield **ATP**. These high-energy molecules directly sustain physiological work.

Why the other answers are wrong

- **B) They are used exclusively for protein synthesis**: Incorrect because catabolic breakdown targets ATP generation instead of feeding amino acid assembly or peptide chain construction.
- **C) They are used only as an energy reserve**: Incorrect because stored polysaccharides must be rapidly hydrolyzed to provide immediate phosphorylating capacity rather than persisting as passive deposits.
- **D) They are not involved in energy metabolism**: Incorrect because carbohydrates function as primary fuels that directly initiate metabolic cascades rather than remaining metabolically inert.
- **E) They are converted into fats for storage**: Incorrect because lipid accumulation activates only during caloric surplus, while immediate oxidative breakdown defines the central catabolic mandate.

23 Which of the following statements about metabolism is true?

Correct answer: A · It includes both catabolism and anabolism

Metabolism encompasses all **chemical reactions** inside a **cell** or **organism**. It links **catabolism** that degrades compounds with **anabolism** that synthesizes them.

Why the other answers are wrong

- **B) It is a process that occurs only in animal cells**: Plants, fungi, and microorganisms also carry out metabolism.
- **C) It does not involve chemical reactions**: Metabolism fundamentally consists of chemical reactions.
- **D) It focuses only on the synthesis of molecules**: Metabolism also includes the breakdown of molecules alongside synthesis.
- **E) It occurs only in the presence of sunlight**: Many metabolic reactions occur without sunlight.

24 What is the main function of enzymes in metabolic reactions?

Correct answer: A · To speed up reactions without being consumed

Enzymes are **biological catalysts** that lower the **activation energy** of metabolic reactions. This speeds up the reactions without consuming the enzymes.

Why the other answers are wrong

- **B) To increase the reaction temperature**: Enzymes speed up reactions without increasing the reaction temperature.
- **C) To be transformed into substrates**: Enzymes act on substrates; they are not transformed into substrates.
- **D) To provide chemical energy for the reactions**: Enzymes catalyse reactions, but they do not supply the chemical energy for them.
- **E) To be consumed during the process**: Enzymes are not consumed during the process. They remain available for reuse after a reaction.

25 Photosynthesis takes place in which cell organelle?

Correct answer: A · Chloroplast

Photosynthesis takes place in **chloroplasts**, which contain **chlorophyll** to capture solar energy. This pigment absorbs light to drive chemical reactions that convert carbon dioxide and water into glucose.

Why the other answers are wrong

- **B) Mitochondrion**: These structures carry out cellular respiration to produce ATP instead of conducting photosynthesis.
- **C) Nucleus**: This region stores DNA and regulates gene expression while having no role in light-driven reactions.
- **D) Ribosome**: These organelles synthesize proteins for cellular functions instead of performing photosynthesis.
- **E) Endoplasmic reticulum**: This network assists in synthesizing and transporting proteins and lipids without capturing solar energy.

26 Which organelles are the main site of cellular respiration in eukaryotic cells?

Correct answer: A · Mitochondria

Mitochondria host the **citric acid cycle** and **oxidative phosphorylation**, which generate most of the cell's **ATP**. These coupled pathways define them as the primary location for aerobic respiration in eukaryotes.

Why the other answers are wrong

- **B) Chloroplasts**: They capture solar energy to fix carbon dioxide during photosynthesis in autotrophic organisms.
- **C) Ribosomes**: They focus exclusively on translating genetic code into polypeptides rather than harvesting energy.
- **D) Lysosomes**: They function as intracellular recycling units that degrade damaged organelles and debris.
- **E) Endoplasmic reticulum**: They specialize in folding nascent proteins and manufacturing membrane lipids.

27 Which of the following features distinguishes meiosis from mitosis?

Correct answer: A · The production of genetically diverse haploid cells

Meiosis produces **haploid** cells with half the parent cell's chromosome number. **Crossing over** and **independent assortment** make these cells **genetically diverse**, unlike the cells produced by mitosis.

Why the other answers are wrong

- **B) The production of cells is identical to the parent cell**: Mitosis generally produces daughter cells genetically identical to the parent cell, whereas meiosis does not.
- **C) It occurs only in unicellular organisms**: Meiosis occurs in multicellular organisms, including humans, rather than only in unicellular organisms.
- **D) It requires the use of microtubules**: Both meiosis and mitosis use microtubules to separate chromosomes during division.
- **E) It occurs in somatic cells**: Mitosis occurs in somatic cells, while meiosis occurs in cells that give rise to gametes.

28 Which of the following statements about the chromosomal theory of inheritance is true?

Correct answer: A · Genes are located on chromosomes

According to the chromosomal theory of inheritance, **genes** are specific DNA segments situated on **chromosomes**. This physical positioning explains how traits follow predictable patterns as chromosomes divide and pass to offspring.

Why the other answers are wrong

- **B) Genes are found only in RNA**: Genes consist of DNA sequences instead of RNA, and both are carried on chromosomes.
- **C) Chromosomes do not contain genes**: Chromosomes are physical structures that directly contain genes.
- **D) Genes are independent of chromosomes**: Genes cannot act independently because they are physically located on chromosomes.
- **E) Chromosome segregation does not occur during meiosis**: Homologous chromosomes physically segregate during meiosis I.

29 **Which technique was used by Rosalind Franklin to obtain images of DNA?**

Correct answer: A · X-ray crystallography

Rosalind Franklin used **X-ray crystallography**, specifically X-ray diffraction, to obtain images of DNA fibres. The diffraction patterns provided evidence for DNA's **helical structure**.

Why the other answers are wrong

- **B)** Magnetic resonance imaging uses magnetic fields to image structures; Franklin did not use it for DNA.
- **C)** Electron microscopy uses electrons to form images; Franklin's DNA images came from X-ray diffraction.
- **D)** Chromatography separates components of a mixture; it was not the technique used to image DNA.
- **E)** Electrophoresis separates molecules by their movement in an electric field; it did not produce Franklin's DNA images.

30 **Which of the following statements correctly describes the structure of DNA?**

Correct answer: A · It has a double-stranded helical structure.

DNA consists of two nucleotide strands twisted into a **double helix**. Complementary bases on opposite sides are linked by **hydrogen bonds**.

Why the other answers are wrong

- **B) It consists of a single chain of nucleotides**: False because DNA is naturally composed of two paired nucleotide chains rather than a single strand.
- **C) It has no hydrogen bonds between the bases**: False because complementary bases are specifically connected by hydrogen bonds across the two strands.
- **D) It contains only two nitrogenous bases**: False because the genetic molecule contains four distinct nitrogenous bases: adenine, thymine, cytosine, and guanine.
- **E) It is made up of three nucleotide strands**: False because the stable biological configuration is a double helix formed by exactly two strands, not three.

31 **Which of the following statements about the haemoglobin in patients with sickle-cell anaemia is true?**

Correct answer: A · Their haemoglobin has a different structure from normal haemoglobin

HbS has a **different structure** from normal haemoglobin because a mutation in the β-globin gene replaces glutamic acid with valine. At low oxygen levels, HbS can form long fibres.

Why the other answers are wrong

- **B) Their haemoglobin does not transport oxygen**: HbS still **transports oxygen**, although affected red blood cells can impair oxygen delivery.
- **C) Their haemoglobin is identical to that found in all individuals**: HbS is not identical to normal haemoglobin because its **amino acid sequence** differs.
- **D) Their haemoglobin is produced in greater quantities**: Sickle-cell anaemia is not caused by **increased haemoglobin production**.
- **E) Their haemoglobin does not undergo mutations**: HbS results from a **mutation** in the gene encoding β-globin. Strictly, genes mutate; haemoglobin proteins do not.

32 Which of the following statements about the structure of messenger RNA is true?

Correct answer: A · mRNA consists of a single polynucleotide strand

Messenger RNA forms a **single polynucleotide chain**. This polymer carries the exact **nucleotide sequence** required to guide ribosomal translation.

Why the other answers are wrong

- **B) mRNA consists of two polynucleotide strands**: The molecule maintains a linear conformation rather than forming a **double helix** through complementary base pairing.
- **C) mRNA contains the nitrogenous base thymine**: Structural differences arise because RNA molecules substitute **uracil** instead of thymine when pairing with adenine.
- **D) mRNA is longer than DNA**: Transcription copies only specific gene segments, making the final transcript substantially shorter than the original **DNA template**.
- **E) mRNA does not carry information for protein synthesis**: It contradicts the core biological role since mRNA actively transports the **codon code** directing amino acid assembly.

33 Which of the following statements about the Mg^{2+} ion is correct?

Correct answer: A · The ion has 8 electrons in its outermost electron shell

A neutral Mg atom contains 12 electrons with the ground state **configuration** $1s^2 2s^2 2p^6 3s^2$. The ion forms when the atom **loses** its two $3s$ valence electrons. The outermost occupied energy level then becomes the second shell, which holds **eight** electrons.

Why the other answers are wrong

- **B) The Mg^{2+} ion has a larger radius than the Mg atom**: Removal of the outermost electron shell reduces electron-electron repulsion and decreases the overall size, making the cation significantly **smaller** than the original neutral atom.
- **C) The ion has two more electrons than the neutral atom**: The formation of this positive cation involves **losing** electrons rather than gaining them, so the ion actually contains two fewer electrons than the neutral species.
- **D) The two chemical species (the ion and the neutral atom) have the same number of protons, electrons, and neutrons**: Both species retain the same number of protons and neutrons, but the ion possesses two fewer electrons than the neutral atom due to the loss of valence electrons during ionization.
- **E) None of the other statements is correct**: This option is invalid because statement A accurately describes the electronic structure of the ion.

34 **Balance the following reaction equation:** $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$

Correct answer: A · 3, 8, 3, 2, 4

Balancing the equation requires 3 copper atoms and 8 nitric acid molecules, giving $3\mathrm{Cu} + 8\mathrm{HNO_3} \rightarrow 3\mathrm{Cu(NO_3)_2} + 2\mathrm{NO} + 4\mathrm{H_2O}$. Each element is properly **balanced** with matching **atoms** on both sides.

Why the other answers are wrong

- **B) 2, 6, 3, 2, 4**: Copper is incorrect since the left side has 2 Cu atoms but the product side requires 3.
- **C) 3, 8, 3, 2, 6**: Hydrogen is mismatched as the water coefficient makes 12 H atoms on the right against 8 on the left.
- **D) 3, 8, 3, 1, 4**: Nitrogen is not balanced because the right side contains only 7 N atoms instead of 8.
- **E) None of the other options is correct**: Incorrect because option A already gives the correct **coefficients**.

35 **The rate law for the reaction $A + B \rightarrow C$ is:**

Correct answer: A · To be determined experimentally

The chemical equation only shows the **stoichiometry** of the transformation. It does not reveal the **reaction mechanism** or how the **rate** depends on species concentrations. Therefore the rate law must be **determined experimentally** unless the step is explicitly labeled elementary.

Why the other answers are wrong

- **B)** $v = k[A][B]$: This rate law matches the stoichiometry only if the reaction proceeds as a single elementary step. The problem statement does not provide this information.
- **C)** $v = k[C]$: A rate depending solely on the product implies zero-order decay or autocatalysis. The given equation contains no indicators of these conditions.
- **D)** $v = k[A][B]/[C]$: The balanced equation provides no basis for placing product concentration in the denominator. Rate expressions are derived from reactant interactions during the slow step.
- **E)** $v = k[C]/([A][B])$: This functional form suggests inverse reactant dependence and direct product dependence. Such behavior cannot be deduced from the overall stoichiometric coefficients.

36 **How many valence electrons does the Cl^- anion have?**

Correct answer: A · 8

Chlorine belongs to **group 17** and holds 7 valence electrons initially. The Cl^- ion **gains** one electron to form. This completes the **outer shell** configuration, yielding 8 valence electrons.

Why the other answers are wrong

- **B)** 7 matches the valence count of neutral chlorine before the additional electron is added.
- **C)** 6 falls below the 7 valence electrons present in a neutral atom.
- **D)** 17 represents the atomic number, counting total protons instead of valence electrons.
- **E)** 35 is the approximate atomic mass and does not indicate any electron count.

37 When sodium bromide is dissolved in water, the result is:

Correct answer: A · A neutral aqueous solution

Sodium bromide fully dissociates into $\mathrm{Na^+}$ and $\mathrm{Br^-}$. These ions derive from the **strong base** NaOH and the **strong acid** HBr. Consequently, neither cation nor anion undergoes **hydrolysis**. The equilibrium concentrations of $\mathrm{H_3O^+}$ and $\mathrm{OH^-}$ remain equal. The resulting mixture is therefore **neutral**.

Why the other answers are wrong

- **B) A weakly acidic aqueous solution**: $\mathrm{Na^+}$ has negligible acidity as a closed-shell alkali metal ion. It does not interact with water molecules to release $\mathrm{H_3O^+}$.
- **C) A weakly basic aqueous solution**: $\mathrm{Br^-}$ exhibits negligible basicity because its parent compound HBr completely dissociates in aqueous media. The hydrolysis constant is effectively zero.
- **D) A strongly acidic aqueous solution**: $\mathrm{Na^+}$ is the spectator ion of a strong base and lacks any tendency to donate protons. It cannot increase the $\mathrm{H_3O^+}$ concentration.
- **E) A strongly basic aqueous solution**: $\mathrm{Br^-}$ is the conjugate base of a strong acid and does not accept protons from water. It cannot generate a significant concentration of $\mathrm{OH^-}$.

38 When sodium acetate is dissolved in water, the result is:

Correct answer: A · A basic aqueous solution

Sodium acetate dissolves completely in water. The **acetate ions** undergo **hydrolysis**, reacting with water to form acetic acid and hydroxide ions: $\mathrm{CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-}$. The released hydroxide ions increase the pH, producing a **basic** solution.

Why the other answers are wrong

- **B) An acidic aqueous solution**: Acetate acts as the conjugate base of acetic acid, so it increases the hydroxide concentration rather than the acidity.
- **C) A neutral aqueous solution**: The hydrolysis reaction generates hydroxide ions, which shift the pH away from neutrality.
- **D) An alcoholic solution**: Dissolving sodium acetate in water does not produce an alcohol.
- **E) No solution is formed because it does not dissolve**: Sodium acetate is highly soluble in water due to strong ion-dipole interactions.

39 **Balance the following redox equation:** $PbBr_2 + FeBr_3 \rightarrow PbBr_4 + FeBr_2$

Correct answer: A · $PbBr_2 + 2\ FeBr_3 \rightarrow PbBr_4 + 2\ FeBr_2$

Lead increases its **oxidation** state from $+2$ to $+4$ and releases two **electrons**. Each **iron** ion decreases from $+3$ to $+2$ and accepts one electron. Two $\mathrm{FeBr_3}$ units must react with one $\mathrm{PbBr_2}$ unit to satisfy charge conservation. The total number of bromine atoms remains equal on both sides.

Why the other answers are wrong

- **B)** $2\ PbBr_2 + FeBr_3 \rightarrow 2\ PbBr_4 + FeBr_2$: The coefficients use two $\mathrm{PbBr_2}$ units losing four electrons while a single $\mathrm{FeBr_3}$ unit gains only one electron. The electron exchange does not match.
- **C)** $PbBr_2 + 3\ FeBr_3 \rightarrow PbBr_4 + 3\ FeBr_2$: The coefficients pair one $\mathrm{PbBr_2}$ unit losing two electrons with three $\mathrm{FeBr_3}$ units gaining three electrons. The charge transfer remains unequal.
- **D)** $3\ PbBr_2 + FeBr_3 \rightarrow 3\ PbBr_4 + FeBr_2$: The coefficients employ three $\mathrm{PbBr_2}$ units dropping six electrons while a single $\mathrm{FeBr_3}$ unit captures only one electron. The mismatch invalidates the equation.
- **E)** $2\ PbBr_2 + 3\ FeBr_3 \rightarrow 2\ PbBr_4 + 3\ FeBr_2$: The coefficients involve two $\mathrm{PbBr_2}$ units releasing four electrons but only three $\mathrm{FeBr_3}$ units accepting three electrons. The redox balance fails.

40 **Balance the following disproportionation reaction:** $KIO_2 \rightleftharpoons KI + KIO_3$

Correct answer: A · $3\ KIO_2 \rightleftharpoons KI + 2\ KIO_3$

In $\mathrm{KIO_2}$, iodine has an **oxidation state of** $+3$. It **gains four electrons** to form KI with iodine at -1, while another iodine **loses two electrons** to form $\mathrm{KIO_3}$ at $+5$. Therefore, one KI molecule forms for every two $\mathrm{KIO_3}$ molecules. The equation $3\ \mathrm{KIO_2} \rightleftharpoons \mathrm{KI} + 2\ \mathrm{KIO_3}$ correctly balances potassium and oxygen.

Why the other answers are wrong

- **B)** $3\ KIO_2 \rightleftharpoons 2\ KI + KIO_3$: Incorrect because oxygen is not balanced.
- **C)** $4\ KIO_2 \rightleftharpoons 3\ KI + KIO_3$: Incorrect because oxygen is not balanced.
- **D)** $4\ KIO_2 \rightleftharpoons 2\ KI + KIO_3$: Incorrect because neither potassium nor oxygen is balanced.
- **E)** $5\ KIO_2 \rightleftharpoons 3\ KI + 2\ KIO_3$: Incorrect because oxygen is not balanced.

41 **HClO is:**

Correct answer: A · An oxyacid

HClO is hypochlorous acid. Because it contains hydrogen, oxygen, and chlorine, it is an **oxyacid**.

Why the other answers are wrong

- **B) An acidic oxide**: An **acidic oxide** contains oxygen and another element but no hydrogen. HClO contains hydrogen.
- **C) A hydrohalic acid**: **Hydrohalic acids**, such as HCl, contain hydrogen and a halogen but no oxygen. HClO contains oxygen.
- **D) An acidic hydroxide**: Hydroxides contain the **hydroxide group** $\mathrm{OH^-}$, while HClO is classified as an acid.
- **E) An acid anhydride**: An **acid anhydride** is an oxide that reacts with water to form an acid. HClO is the acid itself.

42 Substance A has a higher boiling point than Substance B if:

Correct answer: A · The intermolecular forces in A are stronger than those in B

A higher boiling point indicates stronger **intermolecular forces**. More **thermal energy** is required to overcome these attractions and allow the liquid to become a gas.

Why the other answers are wrong

- **B) The intermolecular forces in A are weaker than those in B**: Diminished attractions between particles reduce the energy needed for separation, directly resulting in a lower boiling point.
- **C) The intramolecular forces in A are stronger than those in B**: Stronger chemical bonds inside molecules do not determine the temperature required to separate different molecules from each other.
- **D) The intramolecular forces in A are weaker than those in B**: Chemical bonds within individual molecules remain unchanged during vaporization, making their relative strength irrelevant to boiling point trends.
- **E) The intramolecular forces in A are stronger than those in B, but the intermolecular forces in A are weaker than those in B**: Boiling separates distinct molecules rather than breaking **internal bonds**, so stronger intramolecular forces do not raise the boiling point, while weaker intermolecular forces lower it.

43 Pentanones are:

Correct answer: A · Ketones

Pentanones are five-carbon chains containing a **carbonyl group** ($\mathrm{C=O}$) placed within the carbon backbone. This specific positioning classifies them as **ketones**, such as pentan-2-one and pentan-3-one.

Why the other answers are wrong

- **B)** Lactones are cyclic esters formed by intramolecular esterification, differing fundamentally from open-chain carbonyl structures.
- **C)** Alcohols are characterized by a hydroxyl group ($\mathrm{-OH}$) bonded to a saturated carbon, entirely lacking the internal $\mathrm{C=O}$ double bond required for pentanones.
- **D)** Hydroxyketones possess both a ketone functionality and an additional hydroxyl substituent; the name "pentanone" strictly denotes the unmodified ketone without extra oxygenated groups.
- **E)** Carboxylic acids terminate with a carboxyl group ($\mathrm{-COOH}$), which represents a fully oxidized terminal carbon rather than the internal carbonyl placement found in ketones.

44 Ethene is:

Correct answer: A · An alkene

Ethene ($\mathrm{C_2H_4}$) contains a **double bond** between carbon atoms. Molecules with this feature are classified as **alkenes**. Its structure matches this category exactly.

Why the other answers are wrong

- **B)** An alkyne features a carbon–carbon triple bond instead of a double bond.
- **C)** A diene requires two carbon–carbon double bonds, unlike ethene which has only one.
- **D)** An alkenyne includes both a double bond and a triple bond in the same molecule.
- **E) A non-existent molecule**: Ethene is a real molecule that exists independently, contrary to the claim.

45 C_3H_6O **can be:**

Correct answer: A · An alcohol, an aldehyde, or a ketone

The molecular formula C_3H_6O indicates one degree of unsaturation, allowing multiple structural isomers. These isomers include allyl alcohol ($\mathrm{CH_2=CHCH_2OH}$), which is an **alcohol**. They also include propanal ($\mathrm{CH_3CH_2CHO}$), an **aldehyde**, and propanone ($\mathrm{CH_3COCH_3}$), a **ketone**. Consequently, the formula represents any of these three functional classes.

Why the other answers are wrong

- **B) An alcohol or an aldehyde, but not a ketone**: This option incorrectly excludes ketones. Propanone is a valid ketone structure that matches the given molecular formula.
- **C) An alcohol or a ketone, but not an aldehyde**: This option incorrectly excludes aldehydes. The molecular formula accommodates propanal, which contains a terminal carbonyl group.
- **D) An aldehyde or a ketone, but not an alcohol**: This option incorrectly excludes alcohols. The isomer prop-2-en-1-ol exists within this formula and functions as an unsaturated alcohol.
- **E) An alcohol, but neither an aldehyde nor a ketone**: This option incorrectly excludes aldehydes and ketones. The formula actually produces propanal as an aldehyde and propanone as a ketone.

46 **For an ideal gas undergoing an isothermal process, what happens as the volume increases?**

Correct answer: A · The pressure decreases in inverse proportion

In an isothermal process the **temperature** remains **constant**. For a fixed mass of ideal gas $PV = nRT$ yields a constant product, so $P \propto 1/V$. As volume expands, pressure **decreases** following an **inversely proportional** trend.

Why the other answers are wrong

- **B) The pressure decreases in direct proportion**: States linear linkage, whereas the governing equation defines a reciprocal relationship between the two variables.
- **C) The pressure increases in direct proportion**: Asserts a rise, but gas law dictates that volume expansion causes pressure to fall.
- **D) The temperature increases**: Implies warming, yet the term isothermal strictly forbids thermal variation.
- **E) The pressure remains unchanged**: Claims stability, but constant temperature forces a simultaneous decline in pressure as space widens.

47 **In an exothermic reaction:**

Correct answer: A · The products have lower chemical potential energy than the reactants

An exothermic reaction releases energy to the surroundings. This energy loss ensures the products retain lower **chemical potential energy** than the reactants.

Why the other answers are wrong

- **B) The reactants have lower chemical potential energy than the products**: Claiming reactants hold less energy reverses the fundamental direction, which actually characterizes an endothermic pathway.
- **C) The products have the same chemical potential energy as the reactants**: The energies cannot match because the system emits energy, creating a clear difference between the two states.
- **D) Heat is absorbed from the surroundings**: An exothermic process by definition moves **thermal energy** outward instead of absorbing it.
- **E) The reaction rate is always very high**: The quantity of released energy affects thermodynamics, not the **reaction speed** itself.

48 Which physical quantity measures how quickly a point particle changes its position over time?

Correct answer: A · Velocity

Velocity measures the rate at which a point particle changes its **position** over **time**. It combines both the speed of motion and its specific direction.

Why the other answers are wrong

- **B)** Acceleration quantifies how fast velocity changes over time instead of tracking direct location shifts.
- **C)** Centripetal acceleration tracks velocity changes directed toward the centre of a curved path, not the displacement rate.
- **D)** Frequency counts how many cycles occur per unit time without indicating spatial movement.
- **E)** Natural angular frequency defines the angular rate of a system during free oscillations, unrelated to linear translation.

49 In which case of relative motion between two observers are Galilean transformations valid?

Correct answer: A · Uniform rectilinear motion of one observer relative to the other

Galilean transformations apply to **inertial frames** moving at **constant relative velocity**. Uniform rectilinear motion satisfies this requirement. Spatial coordinates transform as $x' = x - vt$ while time remains **invariant** $t' = t$. These equations preserve classical mechanics without introducing fictitious forces.

Why the other answers are wrong

- **B) Uniformly accelerated rectilinear motion of one observer relative to the other**: Uniform acceleration violates the constant velocity condition. A linearly accelerating frame introduces fictitious forces that require revised mathematical relations.
- **C)** Rotational motion creates a non-inertial environment even at constant angular velocity. Continuous directional changes produce centripetal acceleration that breaks inertial assumptions.
- **D) Combined rotational and translational motion of one observer relative to the other**: The combined motion inherits the rotational component directly. That specific aspect alone prevents the system from functioning as an inertial reference frame.
- **E)** Non-uniform rectilinear motion involves variable speed over time. Any change in velocity generates acceleration, which excludes the frame from Galilean compatibility.

50 What is the kinetic energy of an object of mass 20 kg moving at 36 km/h?

Correct answer: A · 1000 J

Convert the speed to standard units: $36\ \mathrm{km/h} = 10\ \mathrm{m/s}$. Apply the **kinetic energy** formula $E_k = \frac{1}{2}mv^2$ using the given mass and the converted velocity. The calculation produces $\frac{1}{2} \times 20\ \mathrm{kg} \times (10\ \mathrm{m/s})^2 = 1000\ \mathrm{J}$.

Why the other answers are wrong

- **B) 2000 J**: $2000\ \mathrm{J}$ equals mv^2, omitting the required factor of $\frac{1}{2}$.
- **C) 2500 J**: $2500\ \mathrm{J}$ is too high because substituting the properly converted speed of $10\ \mathrm{m/s}$ yields exactly $1000\ \mathrm{J}$.
- **D) 720 J**: $720\ \mathrm{J}$ comes from calculating 20×36, which incorrectly uses the speed in $\mathrm{km/h}$ without conversion.
- **E) 200 J**: $200\ \mathrm{J}$ is too low and does not result from the correct application of the physical formula.

51 If a point particle slides down an inclined plane with friction, its mechanical energy:

Correct answer: A · decreases

The sliding particle encounters a **frictional force** that performs **negative work** along the path. This interaction transforms part of the **mechanical energy** directly into **thermal energy**. As a result, the total mechanical energy steadily **decreases**.

Why the other answers are wrong

- **B) increases**: Boosting mechanical energy requires net positive work from external agents or active sources. Sliding with resistive forces strictly drains the system rather than adding to it.
- **C) remains constant**: Conservation laws hold only when non-conservative forces vanish. Kinetic friction breaks this condition by converting orderly mechanical work into disordered heat.
- **D) doubles**: Passive dissipation cannot amplify the energy budget. Friction actively drains mechanical energy instead of generating additional amounts.
- **E) becomes zero**: Friction continuously extracts energy from motion, but the removal stops once the particle comes to rest. The remaining amount depends on the instantaneous speed and height at that moment, so reaching exactly zero is highly improbable without specific initial conditions.

52 To what depth must one dive in the sea for the pressure to double relative to that at the surface?

Correct answer: A · Approximately 10m

At depth h, the **total pressure** equals atmospheric pressure plus hydrostatic pressure. To **double** the surface value, the **water column** must supply exactly one atmosphere. Solving $\rho g h = P_{\text{atm}}$ with standard constants yields $h \approx 10\ \text{m}$. This matches option A.

Why the other answers are wrong

- **B) Approximately 2m**: The added hydrostatic pressure is far too small to reach the required one atmosphere.
- **C) Approximately 5m**: The added water pressure amounts to only about half an atmosphere, leaving the total near $1.5\ \text{atm}$.
- **D) Approximately 15m**: The added pressure exceeds one atmosphere, so the absolute pressure more than doubles.
- **E) Approximately 20m**: The added pressure reaches roughly two atmospheres, making the **total** pressure about three times the surface value.

53 What is the electric charge of a hydrogen atom?

Correct answer: A · 0 C

A hydrogen atom contains one proton with charge $+e$ and one electron with charge $-e$. These equal and opposite values **cancel** completely. The resulting **net** electric charge is $0\ \mathrm{C}$.

Why the other answers are wrong

- **B) +1 nC**: Assigning a fixed positive charge implies an electron deficit or ionization. Standard atomic models assume exact **neutrality** through balanced constituent counts, leaving zero excess charge.
- **C) +2 nC**: No valid subatomic configuration yields a nanocoulomb surplus. The strict cancellation between proton and electron removes any chance of a residual positive amount.
- **D) +1 mC**: A single atom cannot sustain a millicoulomb magnitude. The **elementary** charge $e \approx 1.60 \times 10^{-19}\ \mathrm{C}$ operates at microscopic scales, and internal contributions offset each other perfectly.
- **E) –2 pC**: There is no mechanism for surplus negative charge in this isolated system. The single electron precisely matches the proton, ruling out any net negative outcome.

54 Two waves are said to be coherent if:

Correct answer: A · their phase difference remains constant over time

Coherent waves have a **constant phase difference** over time, so their interference pattern remains **stable**.

Why the other answers are wrong

- **B) the phase difference varies randomly over time**: A randomly varying phase difference describes incoherent waves.
- **C) their wavelength lies in the visible region**: Coherence is not limited to wavelengths in the visible region.
- **D) they have the same intensity**: Equal intensities are not required for coherence.
- **E) they have the same amplitude**: Equal amplitudes are not required for coherence.

55 Which is the solution to the inequality $x^2 - 6x + 5 \leq 0$?

Correct answer: A · $1 \leq x \leq 5$

Factor the quadratic as $x^2 - 6x + 5 = (x - 1)(x - 5)$. The equation equals zero at the **roots** $x = 1$ and $x = 5$. Since the parabola opens upward, the inequality holds between the roots, giving $1 \leq x \leq 5$.

Why the other answers are wrong

- **B)** $x \leq 1$ **;** $x \geq 5$: These represent the regions **outside** the roots, where the factored product yields non-negative values instead of negative or zero.
- **C)** $x \leq -5$ **;** $x \geq -1$: This extends to negative infinity and beyond -1, covering values like $x = 6$ that make the quadratic strictly **positive**.
- **D)** $-5 \leq x \leq -1$: This incorrectly assumes the roots are negative. The actual roots derived from factoring are 1 and 5.
- **E) None of the other options are correct**: This is false because option A correctly identifies the interval between the roots.

56 **Given $f(x) = e^x$, which of the following gives the solutions to the inequality $f(x) > 0$?**

Correct answer: A · All real numbers

The **exponential function** $f(x) = e^x$ is **always positive** for any real input. This satisfies the inequality $e^x > 0$ for **all real numbers**.

Why the other answers are wrong

- **B) No real numbers**: Incorrect because the exponential function never yields non-positive outputs. It remains strictly greater than zero for every possible real value of x.
- **C) All positive real numbers**: Incorrect because zero and negative numbers are fully valid solutions. Restricting the set to only positive reals ignores half of the actual domain.
- **D) All real numbers greater than or equal to 1**: Incorrect because inputs smaller than 1 produce valid positive results. Values below 1 clearly satisfy the original inequality.
- **E) All real numbers greater than 1**: Incorrect because $x = 1$ and any lower real number work. Limiting solutions to values above 1 arbitrarily cuts off infinite valid cases.

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57 **A circle has the equation $x^2 + y^2 + 5x + 4y = 0$. Which of the following statements is true?**

Correct answer: A · It passes through the origin

Substitute $x = 0$ and $y = 0$ into the equation $x^2 + y^2 + 5x + 4y = 0$. The calculation yields $0 = 0$, which proves that the circle **passes through the origin**.

Why the other answers are wrong

- **B) It has its centre at the origin**: The actual **centre coordinates** are $(-\frac{5}{2}, -2)$, differing from $(0, 0)$.
- **C) It has zero radius**: Completing the square reveals a **radius** of $\frac{\sqrt{41}}{2}$, not zero.
- **D) It is centred on the y-axis**: The vertical axis condition requires an x-coordinate of zero, but the centre lies at $x = -\frac{5}{2}$.
- **E) It is centred on the x-axis**: Placement on the horizontal axis would require a y-coordinate of zero, yet the centre sits at $y = -2$.

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58 **A bag contains 12 balls that are indistinguishable by touch, 5 of which are red. Two balls are drawn without replacement. What is the probability that no red ball is drawn?**

Correct answer: A · $\frac{7}{22}$

The bag initially contains 7 **non-red** balls out of 12 total. Since the selection is done **without replacement**, the composition changes after each step. The **probability** for the first draw is $\frac{7}{12}$. After removing one non-red ball, 6 favorable outcomes remain out of 11 total balls, making the second probability $\frac{6}{11}$. Multiplying these yields $\frac{7}{22}$.

Why the other answers are wrong

- **B)** $\frac{49}{144}$: This value treats the draws as independent events made with replacement, leaving both the numerator and denominator unchanged between steps.
- **C)** $\frac{49}{132}$: This mistake happens when only the total count drops to 11, while incorrectly keeping the favorable count at 7 instead of reducing it to 6.
- **D)** $\frac{25}{132}$: This fraction miscounts the reduced sample space after the first pick, failing to account correctly for the changing number of balls and remaining favorable outcomes.
- **E)** $\frac{15}{22}$: This calculates the complementary scenario, representing the likelihood of obtaining at least one red ball rather than zero red balls.

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59 **The parabola with equation $y = kx^2 - x + 30$ passes through the point (5,0). What is the value of k?**

Correct answer: A · −1

To find k, **substitute** $x = 5$ and $y = 0$ into the **equation** $y = kx^2 - x + 30$. This yields $0 = k(5)^2 - 5 + 30$, which **simplifies** to $0 = 25k + 25$. Dividing both sides by 25 gives $k = -1$.

Why the other answers are wrong

- **B) 1**: Using $k = 1$ results in $y = 1(5)^2 - 5 + 30 = 50$, which does not match the required coordinate $y = 0$.
- **C) 2**: Using $k = 2$ results in $y = 2(5)^2 - 5 + 30 = 75$, which does not match the required coordinate $y = 0$.
- **D) −2**: Using $k = -2$ results in $y = -2(5)^2 - 5 + 30 = -25$, which does not match the required coordinate $y = 0$.
- **E) 3**: Using $k = 3$ results in $y = 3(5)^2 - 5 + 30 = 100$, which does not match the required coordinate $y = 0$.

60 **Which is the solution to the following equation: $log_{10}x = 6$?**

Correct answer: A · 1000000

By the definition of a **logarithm**, $\log_{10} x = 6$ converts directly to **exponential form**. This gives $x = 10^6$. Evaluating the **power** yields $x = 1000000$, which matches option A.

Why the other answers are wrong

- **B) 100000**: The value 100000 equals 10^5, which would solve $\log_{10} x = 5$ instead of 6. It lacks exactly one zero compared to the correct solution.
- **C) 10000**: The value 10000 equals 10^4, which corresponds to $\log_{10} x = 4$. It underestimates the necessary exponential growth by two powers of ten.
- **D) 60**: The value 60 is incorrect because it treats the exponent as a simple multiplier of ten. It fails to represent the required magnitude of 10^6.
- **E) 600**: The value 600 does not satisfy the equation because it differs significantly from 10^6. It incorrectly multiplies the exponent by the base instead of applying the exponential rule.

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