PROVE UFFICIALI DEGLI ANNI PASSATI

IMAT 2023

A B C D E

FAC-SIMILE DA SVOLGERE

Risposte in ordine casuale e foglio delle risposte

WHAT'S IN THIS DOCUMENT

Prova di ammissione IMAT 2023, 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 questions laid out by TestBuddy, with the answers in random order
- The answer sheet
- The answer key

Reading skills and knowledge acquired during studies	4 questions
Logical reasoning and problem-solving	3 questions
Questions	44 questions
Biology	1 questions
Chemistry	2 questions
Physics and Mathematics	5 questions
Total	**59 questions**

This version has **59 of the 60 questions** of the paper, the ones with our explained solution; the full paper is in the «official paper» file.

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.

READING SKILLS AND KNOWLEDGE ACQUIRED DURING STUDIES

1 **Preliminary global average temperatures taken so far in June are nearly 1C (1.8F) above levels previously recorded for the same month, going back to 1979. While the month is not yet complete and may not set a new June record, climate scientists say it follows a pattern of strengthening global heating that could see this year named the hottest ever recorded, topping 2016.**
The long-term warming conditions caused by the burning of fossil fuels will likely receive a further pulse of heat via El Niño, a naturally reoccurring phenomenon where sections of the Pacific Ocean heat up, typically causing temperatures to spike across the world.
According to the text, which one of the following is true?

- A The June temperature this year is consistent with an observed trend.
- B Temperatures in June are not related to the El Niño phenomenon.
- C The El Niño phenomenon limits the effects of burning fossil fuels.
- D This year, June will be the hottest month on record since 1979.
- E June 1979 was the hottest month to date.

2 **Which of the following pairs of character/book is wrong?**

- A Edmond Dantès – The Count of Monte Cristo
- B Florentino Ariza – Love in the Time of Cholera
- C Gregor Samsa – The Metamorphosis
- D Elizabeth Bennet – Little Women
- E Leopold Bloom – Ulysses

3 **The work known as De Bello Gallico is**

- A an opera by Richard Wagner.
- B a collection of poems on the Gallic war by Horace.
- C Julius Caesar's account of the Gallic war.
- D a painting by Eugène Delacroix.
- E a sculpture by Auguste Rodin.

4 **In a parliamentary system of government, the President of the Republic is**

- A Head of State and Head of the High Council of the Judiciary.
- B Head of Government and Head of the High Council of the Judiciary.
- C Head of Government but not Head of State.
- D Head of State but not Head of Government.
- E neither Head of State nor Head of Government.

LOGICAL REASONING AND PROBLEM-SOLVING

5 **You have 1 pair of new-born rabbits (one male and one female) that can breed when they reach maturity. You also have 3 pairs of mature rabbits (3 males and 3 females) that can start breeding immediately. They follow these rules:**
• Each mature pair of rabbits produces one new pair of offspring (one male and one female) at the end of each month
• Each offspring pair takes one month to mature
How many rabbits do you have at the end of the 3rd month?

A 14
B 36
C 42
D 28
E 18

6 **The half-life of a radioactive element is the time needed for half of the material to decay. You have a certain quantity of a mineral containing two radioactive elements X and Y, whose half-lives are 2 and 3 years, respectively. Also, no physical process can produce elements X or Y.**
If today the ratio X:Y (mass/mass) is 8:1, what will it be after 6 years?

A 4:1
B 32/1
C 16:1
D 2:1
E 1:1

7 **You want to buy a sandwich from your favourite store but are on a strict diet, so the sandwich must satisfy these requirements:**
- **protein content: at least 20 g**
- **fat content: less than 10 g**
- **energy: at least 1,300 kJ**

These are the types of sandwich available (energy, proteins, fats, salt equivalent, price):
- **Tuna: 1579 kJ, 18 g, 14 g, 1.4 g, 7.20 €**
- **Beef: 1320 kJ, 22 g, 9 g, 1.5 g, 6.90 €**
- **Chicken: 1337 kJ, 23 g, 5 g, 1.1 g, 6.80 €**
- **Vegetables: 1198 kJ, 9 g, 15 g, 1.2 g, 6.50 €**
- **Salmon: 1620 kJ, 22 g, 12 g, 2.1 g, 7.10 €**
- **Ham: 1164 kJ, 19 g, 8 g, 1.9 g, 6.60 €**
- **Turkey: 1210 kJ, 20 g, 4 g, 1.7 g, 6.70 €**

What is the minimum that you can spend for your sandwich?

A 6.90 €
B 6.70 €
C 6.60 €
D 6.80 €
E 7.10 €

QUESTIONS

8 **Copernicus is the European Earth Observation Programme which was established in 1998 to monitor the many ecosystems of our planet. It uses a constellation of 6 'Sentinel' satellites as well as dozens of third-party satellites to protect us from natural and manmade disasters. It collects and makes available accurate environmental data to address climate change, pollution, and deforestation, aiding evidence-based decision-making. Copernicus fuels scientific research and plays a pivotal role in tracing disease outbreaks, tracking marine pollution, determining the quality of air and water, studying ocean levels and evaluating the melting of the arctic polar ice cap. The Copernicus European Observation Programme provides enormous social, environmental and scientific benefits, and it should continue to be funded.**
Which one of the following, if true, would most strengthen the argument above?

- A There are a number of similar projects run by other international agencies.
- B The Copernicus project requires international cooperation to be effective.
- C Some of Copernicus' benefits can be provided by other means.
- D Social and scientific advances are of equal importance.
- E The economic benefits derived from the Copernicus programme outweigh its costs.

9 **There is a commonly held belief, known as the 'Matthew effect', that students who start with poor academic attainment early in school make less progress over time than their higher-achieving peers. But recent research has shed new light on this topic. A study examined patterns of growth in literacy and numeracy among more than 150,000 young people in Australia. Researchers tested pupils regularly between year 3 and year 9. They found that students who began with high achievement in reading and numeracy tests in year 3 were not making the amount of progress to year 9 of which they were capable. On the other hand, students starting with below average test scores made more progress from year 3 to year 9 than students starting above average. This compensatory growth pattern was seen in both reading and numeracy but was especially significant in reading.**
Which one of the following can be drawn as a conclusion from the above passage?

- A Numerical skills are harder to improve than language skills.
- B It is easier to teach brighter students than those who are below average.
- C Early promise does not guarantee high achievement in the long-term.
- D Rates of improvement from a low base will always be more rapid than progress from a higher base.
- E The 'Matthew effect' is the result of low expectations by teachers.

BIOLOGY

10 **Glucose can feed into the biochemical pathways noted in the options below. Each pathway generates a net yield of ATP molecules per molecule of glucose feeding into the pathway. Rank the reactions listed below in order of the total number of net ATP molecules produced, ranked from largest to smallest?**

1. Ethyl alcohol fermentation of four molecules of glucose

2. Lactic acid fermentation of six molecules of glucose

3. The electron transport chain stage of cellular respiration following the metabolism of a single molecule of glucose through the glycolytic and citric acid cycle stages.

4. Glycolysis of seven glucose molecules

A 4-2-3-1

B 4-2-1-3

C 3-4-2-1

D 3-4-1-2

E 2-1-4-3

QUESTIONS

11 **Duchenne muscular dystrophy (DMD) is a genetic condition marked by the gradual deterioration of muscle tissue. Recent studies have revealed that DMD arises from specific changes in a vital protein called dystrophin, responsible for maintaining the integrity of muscle cells. The gene responsible for producing this protein follows an inheritance pattern known as X-linked recessive.**
Which of the following statements is wrong according to the above?

- A To develop the condition, a woman must inherit two recessive alleles of this gene.
- B To develop the condition, a man must inherit one of the recessive alleles of this gene.
- C Women are more likely to suffer from DMD than men.
- D DMD is a sex-linked inherited disease.
- E The rate at which the mutated allele spreads is influenced by the rate at which the associated X chromosome spreads within the population.

12 **In the table below, you can find the minimum, maximum and optimum pH values that are required for enzymes X, Y, Z, W, and Q to function.**

Enzyme	Minimum pH	Optimum pH	Maximum pH
X	6.4	7.1	8.2
Y	3.9	5.3	7.2
Z	4.0	6.2	8.5
W	8.0	9.1	12.1
Q	1.3	5.4	9.5

Which of the pairs of enzymes listed below cannot function together in the same environment?

- A Y and W
- B W and Q
- C X and Y
- D Y and Z
- E X and Z

13 **Which of the following is absent from the genome of a virus that utilizes DNA as its primary molecule?**

- A Adenine
- B Deoxyribose
- C Guanine
- D Thymine
- E Uracil

14 **In which of the following events do hormones secreted by the adrenal gland and pancreas play a role together?**

1. Balancing the amount of calcium in the bone and blood.
2. Accelerating sodium absorption in the renal tubules.
3. Balancing the glucose level in the blood.

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

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15 **Which of the following examples represent conditions regulated by homeostasis in the body?**

1. Blood glucose concentration
2. Body temperature
3. Water levels
4. Body weight

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

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16 **Which of the following structures in a plant cell are surrounded by a double membrane?**

A Mitochondria, Vacuole, Golgi Apparatus
B Nucleus, Plastid, Golgi Apparatus
C Plastid, Endoplasmic Reticulum, Vacuole
D Plastid, Mitochondria, Nucleus
E Golgi Apparatus, Ribosome, Mitochondria

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17 **Listed below are three different families with genotypes related to colour blindness which is an X-linked recessive disorder.**

Family	Mother	Father
1	X^RX^r	X^RY
2	X^rX^r	X^RY
3	X^RX^r	X^rY

Among the families, which ones can have a colour-blind daughter?

A 3
B 1
C 2
D 1 and 2
E 2 and 3

---

18 **Which of the following conditions is necessary for a mutation to play a role in the process of evolution?**

A Formation by the effect of X-rays
B Having a dominant mutation
C Occurrence in body cells
D Having a recessive mutation
E Occurrence in germ cells

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19 **Redox reactions play a vital role in many cellular processes. Which of the following statements and examples best describes redox reactions in living things?**

A Redox reactions involve the absorption of light, where the molecule that gains light is reduced, and the molecule that loses light is oxidized.
B Redox reactions involve the formation of covalent bonds, where the molecule that gains bonds is reduced, and the molecule that loses bonds is oxidized.
C Redox reactions involve the transfer of electrons, where the molecule that gains electrons is reduced, and the molecule that loses electrons is oxidized.
D Redox reactions involve the destruction of molecules, where the molecule that gains fragments is reduced, and the molecule that loses fragments is oxidized.
E Redox reactions involve the absorption of energy, where the molecule that gains energy is reduced, and the molecule that loses energy is oxidized.

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20 **Study the following table which shows the genotypes of individuals in a population for a specific genetic trait. The trait is determined by a single gene with two alleles, A and a.**

Individual	Genotype
1	AA
2	Aa
3	Aa
4	aa
5	AA

Based on the given data, what is the frequency of the A allele in this population?

A 0.8
B 0.6
C 0.4
D 0.2
E 1.0

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21 **Which of the following anatomical structures is responsible for regulating the circadian rhythm?**

A Thalamus
B Amygdala
C Hippocampus
D Corpus callosum
E Pineal gland

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22 **Photosynthesis is a vital process in which plants and some other organisms convert light energy into chemical energy. Which of the following represents the balanced equation for the overall reaction of photosynthesis?**

A $C_6H_{12}O_6 + 6CO_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$
B $6CO_2 + 6H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + 6O_2$
C $C_6H_{12}O_6 + 6CO_2 + \text{energy} \rightarrow 12CO_2 + 6H_2O$
D $C_6H_{12}O_6 + 6CO_2 + \text{energy} \rightarrow 6CO_2 + 6H_2O$
E $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6CO_2 + \text{energy}$

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23 **What is the correct order of the following events that occur immediately after acetylcholine binds to postsynaptic receptors of a muscle fibre, causing the muscle to contract?**

1) Ca^{2+} **ions diffuse into the sarcoplasm.**
2) The muscle fibre membrane is depolarised.
3) The myosin binding site on the actin filament is uncovered.

- A 3, 2, 1
- B 2, 1, 3
- C 2, 3, 1
- D 1, 2, 3
- E 1, 3, 2

24 **What percentage of the three base codons that can be made using the standard genetic code are stop codons?**

- A 18.8%
- B 7.8%
- C 4.7%
- D 9.4%
- E 14.1%

25 **Which of the following statements accurately describes prokaryotic DNA?**

- A Prokaryotic DNA contains introns and exons within its coding regions.
- B Prokaryotic DNA is highly condensed and organized into chromatin fibers.
- C Prokaryotic DNA is associated with histone proteins and undergoes meiotic cell division during replication.
- D Prokaryotic DNA is linear, with multiple chromosomes contained within a nuclear membrane.
- E Prokaryotic DNA consists of circular chromosomes located within the cytoplasm.

26 **A fragment of double-stranded DNA molecule contains 12 phosphates and 2 adenines. Given this information, what is the total number of purine bases, deoxyribose sugars and hydrogen bonds respectively, present in the described DNA molecule?**

- A 6, 16, 12
- B 6, 12, 16
- C 12, 24, 28
- D 4, 12, 12
- E 6, 12, 20

27 **Which of the following statements accurately describes the surface area-to-volume ratio and cell growth?**

A The surface area-to-volume ratio varies randomly during cell growth.
B The surface area-to-volume ratio is unrelated to cell growth.
C The surface area-to-volume ratio increases as the cell grows larger.
D The surface area-to-volume ratio decreases as the cell grows larger.
E The surface area-to-volume ratio remains constant during cell growth.

28 **Which of the following statements regarding the Golgi apparatus is correct?**

A The Golgi apparatus processes and packages proteins to be exported from the cell.
B There is no Golgi apparatus in neuronal cells.
C Lysosomes digest the vesicles released from the Golgi apparatus so the proteins can be released from the cell.
D The Golgi apparatus processes lipid molecules as they enter the cell.
E Before exiting the cell, the proteins packaged in the Golgi apparatus are transported to the nucleus for translation verification.

29 **In which reactions of glycolysis are isomerase enzymes involved?**

A To convert fructose 1-6-diphosphate to glyceraldehyde 3-phosphate and dihydroxy-acetone phosphate.
B During the phosphorylation of both glucose and fructose-1-phosphate.
C When four enzyme-catalysed reactions convert each triose phosphate molecule to a molecule of pyruvate.
D In the steps in which dehydrogenase enzymes are involved.
E When glucose-6-phosphate is changed to fructose-6-phosphate.

30 **Given the polynucleotide sequence AUGCCGC, can you tell which is the 5’ end?**

A Yes, the 5' end begins with the start codon AUG.
B No, unless you know the position of the phosphate group, you cannot differentiate the 3' end from the 5' end.
C No, you cannot tell without the sequence of the complementary strand.
D Counting the number of hydrogen bonds between the nitrogenous bases provides sufficient information to determine the 5' end.
E There is no difference between the 5’ and 3’ ends of a single strand of DNA.

31 **Which statement or set of statements about oxidative phosphorylation is correct?**

1. Complex I of the electron transport chain transfers electrons from $FADH_2$ to coenzyme Q.

2. ATP synthase utilises the energy of the proton gradient to catalyze the conversion of ADP to ATP.

3. Oxygen serves as an electron acceptor in complex III.

4. Complex IV receives electrons from NADH.

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

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32 **The 19th century monk Gregor Johann Mendel conducted simple hybridisation experiments and established a series of laws of inheritance. Which of the points listed below accurately reflect Mendel's laws?**

1. Alternative forms of genetic characteristics can be inherited from parents.

2. Specific heritable factors or traits are inherited independently of other heritable factors.

3. Gametes are created by random segregation.

4. If one allele is dominant over another allele, the phenotype reflects the dominant allele.

5. Individuals with heritable traits more suited to the environment will have an increased chance of survival.

- A 1, 2 and 3
- B 1, 2, 3 and 4
- C All the statements are correct
- D 1 and 5
- E 4 and 5

CHEMISTRY

33 **A simple ion of element A can be represented:**
$^{2x+2}_{x}A^{2+}$
How many electrons are present in this ion?

A $x + 2$
B $2x$
C x
D $x - 2$
E $2x + 4$

34 **A sample of n moles of an ideal gas is contained in a closed system of fixed volume V m^3 at pressure P Pa and temperature 27.0 °C.**
If the gas is heated to 327.0 °C, what will be the pressure, in Pa, at this new temperature?
Assume absolute zero is at -273.0 °C

A $\frac{P}{2}$
B $\frac{27}{327}P$
C $2P$
D $\frac{327}{27}P$
E P

QUESTIONS

35 **A pH meter is used to test $0.1\ \text{mol L}^{-1}$ aqueous solutions of the following compounds:**

1. CH_3COOH

2. $NaCl$

3. H_2SO_4

4. $Ba(OH)_2$

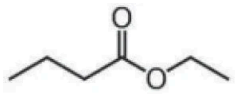
5. HNO_3

Which of the following correctly lists these solutions in order of increasing pH?

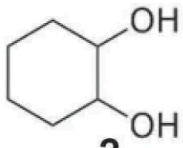
- **A** 2, 1, 4, 5, 3
- **B** 3, 4, 1, 5, 2
- **C** 3, 5, 1, 2, 4
- **D** 5, 3, 1, 2, 4
- **E** 4, 2, 1, 5, 3

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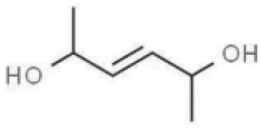
36 **Which of the following compounds are structural isomers of hexanoic acid?**



1.



2.



3.

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

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37 **Consider the reaction:**

$H_2SO_4 + HNO_3 \rightarrow HSO_4^- + H_2NO_3^+$

Which of the following terms describes the role of HNO_3 in this reaction?

- **A** An acid
- **B** A base
- **C** A catalyst
- **D** A reducing agent
- **E** An oxidising agent

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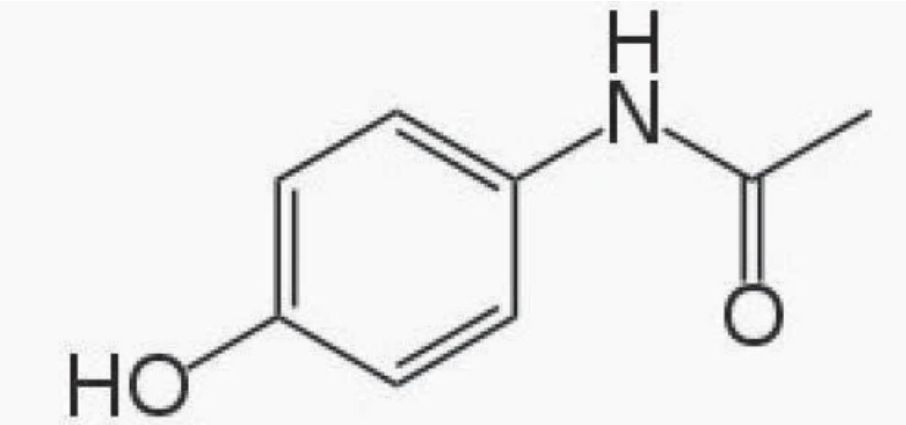
38 **Which one of the following is a gaseous compound (at room temperature and pressure) that exists as linear molecules and reacts with water to form an acidic solution?**

- A Carbon dioxide
- B Nitrogen dioxide
- C Sulfur dioxide
- D Sulfur trioxide
- E Silicon dioxide

39 **Which of the following statements about 1Kg of water is correct?**

- A Liquid water has a greater volume than ice as the particles have more kinetic energy
- B Ice has a greater volume than liquid water as the particles have more kinetic energy
- C Ice has a greater volume than liquid water as the particles are further apart
- D Liquid water has a greater volume than ice as the particles are further apart
- E Liquid water and ice have the same volume, which explains why ice partially floats in water

41 **The structure of paracetamol is shown below:**
Which one of the following functional groups is present in paracetamol?



- A Carboxylic acid
- B Aldehyde
- C Ketone
- D Amide
- E Amine

42 **The formulae of the five most abundant substances in air are shown:**

N_2 O_2 Ar CO_2 H_2O

How many of these five substances are elements and how many of these five substances are made of molecules?

A Elements = 1, molecules = 2
B Elements = 3, molecules = 2
C Elements = 5, molecules = 4
D Elements = 1, molecules = 4
E Elements = 3, molecules = 4

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43 **Which of these elements has the highest first ionisation energy?**

A Sodium ($Z = 11$)
B Neon ($Z = 10$)
C Lithium ($Z = 3$)
D Argon ($Z = 18$)
E Potassium ($Z = 19$)

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44 **Which of these molecules has an overall dipole moment?**

A SF_6
B BeF_2
C CF_4
D PF_5
E PF_3

---

45 **This reaction is used in the extraction of titanium from its ore.**

$TiO_2 + 2Cl_2 + 2C \rightarrow TiCl_4 + 2CO$

Which substances is/are the reducing agent(s) in this reaction?

A none of these substances - it is not a redox reaction
B Cl_2
C C and Cl_2
D C
E TiO_2

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46 **Iron is made by reduction of iron oxide using carbon monoxide.**

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

50 g of iron is made in a reaction from 80 g of iron oxide.

What is the percentage yield of iron in this reaction? (M_r Fe_2O_3 = 160, A_r Fe = 56)

A $\frac{50}{56} \times 100$

B $\frac{50/56}{80/160} \times 100$

C $\frac{25/112}{80/160} \times 100$

D $\frac{25}{80} \times 100$

E $\frac{50}{80} \times 100$

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47 **Which of these is a weak, diprotic acid?**

A $\mathrm{HO-S(=O)_2-OH}$

B $\mathrm{HO-C(=O)-C(=O)-OH}$

C $\mathrm{HO-CH_2-CH_2-OH}$

D $\mathrm{H-C(=O)-OH}$

E $\mathrm{H-C(=O)-C(=O)-H}$

PHYSICS AND MATHEMATICS

48 **Consider this function, defined for every $x > 1$ (where "ln" indicates the natural logarithm): $f(x) = 2\ln(x) - 2\ln(x-1)$. Which of these is an expression for its inverse function $f^{-1}(y)$?**

A $\frac{e^{y/2}}{e^{y/2}-1}, \quad y > 1$
B $\frac{e^{y/2}}{e^{y/2}-1}, \quad y > 0$
C $\frac{1}{e^{y/2}-1}, \quad y > 1$
D $\frac{1}{e^{y/2}-1}, \quad y > 0$
E $\frac{1}{e^{y/2}-1}, \quad y \neq 0$

49 **Find the set of real solutions of this inequation:**
$2x^2 - 6x + 5 > 0$

A $\{1, 2\}$
B $(1, 2)$
C $(-\infty, 1) \cup (2, +\infty)$
D $\varnothing$
E $\mathbb{R}$

50 **The ratio of sugar to flour in a mixture is $1:5$. After 1kg of sugar and 2kg of flour are added to the mixture, the ratio has changed to $2:5$.**
A further 1kg of sugar and 2kg of flour are added to the mixture.
What is the new ratio of sugar to flour?

A $3:5$
B $4:7$
C $3:7$
D $11:25$
E $14:25$

51 **Two standard six-sided dice numbered 1 to 6 are rolled. What is the probability that the product of the two numbers obtained is the square of a prime?**

A $5/36$
B $7/36$
C $4/36$
D $6/36$
E $3/36$

52 **How many solutions are there in the range $0^\circ \leq x \leq 360^\circ$ to the equation $\sin^4\left(\frac{x+90^\circ}{10}\right) = \frac{1}{16}$?**

A 40
B 20
C 4
D 1
E 2

QUESTIONS

53 **What is the complete set of values of x for which $100 - 99x \leq 98 - 97x$ and $96 + 95x > 94 + 93x$?**

A $x > 1$
B $x > -1$
C $-1 < x \leq 1$
D $x \geq 1$
E $x \leq -1$ or $x > 1$

54 **What is the minimum distance of the circle given by the equation $x^2 - 10x + y^2 + 12y + 57 = 0$ from the coordinate axes?**

A 3
B 1
C 5
D 4
E 2

55 **The expression $\sqrt{\frac{16^x + 8^x}{4^x + 2^x}}$ simplifies to which of the following?**

A 2^{2x}
B $(\sqrt{2})^x$
C 2
D $\sqrt{2^x}$
E 2^x

56 **A point mass A with mass m moves at a constant speed v on a horizontal frictionless plane and collides with another point mass B with mass 2m that is at rest. The collision is elastic. After the collision, point mass A is moving with a speed v_A and point mass B with a speed v_B.**
What are v_A and v_B, in terms of v?

A $v_A = \frac{1}{3}v; \quad v_B = \frac{1}{2}v$
B $v_A = \frac{1}{2}v; \quad v_B = \frac{1}{3}v$
C $v_A = \frac{1}{2}v; \quad v_B = \frac{1}{2}v$
D $v_A = \frac{2}{3}v; \quad v_B = \frac{1}{3}v$
E $v_A = \frac{1}{3}v; \quad v_B = \frac{2}{3}v$

57 An ideal gas is trapped in a metal cylinder by a free-moving piston and is at equilibrium in a room at $25^{\circ}\mathrm{C}$.
The piston is pulled slowly to the right so that the volume of the trapped gas increases isothermally. The piston is now fixed in position.
The metal cylinder is then placed in a location where thermal energy is transferred from the trapped gas until the pressure of the gas is halved.
To the nearest degree Celsius, what is the final temperature of the gas?

A $25^{\circ}\mathrm{C}$
B $-124^{\circ}\mathrm{C}$
C $-149^{\circ}\mathrm{C}$
D $13^{\circ}\mathrm{C}$
E $50^{\circ}\mathrm{C}$

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58 A metal jug of negligible thermal capacity contains a mass M of water at a temperature T_1.
A dry block of ice (specific latent heat of fusion = L_f) of mass m at $0\ ^{\circ}\mathrm{C}$ is dropped into the water (specific heat capacity = c) and begins to melt. At thermal equilibrium, there is no ice in the jug and the temperature of all the water is T_2.
There is no thermal energy transfer between the atmosphere and the water or between the atmosphere and the ice.
Which expression is used to calculate m?

A $\frac{McT_1}{L_f+cT_2}$
B $\frac{Mc(T_1-T_2)}{L_f+cT_1}$
C $\frac{Mc(T_1-T_2)}{L_f}$
D $\frac{McT_1}{L_f}$
E $\frac{Mc(T_1-T_2)}{L_f+cT_2}$

---

59 A vehicle travels east for 6km, then south for 8km without stopping. If the trip takes 15 minutes, what is the magnitude of the average velocity in km/h?

A 20
B 56
C 8
D 14
E 40

---

60 **Two perfectly insulating spheres charged respectively with Q_1 and Q_2 and with a respective radius of R_1 and R_2 are placed in contact.**
What will the charge on the sphere of radius R_1 now be?

A $\frac{Q_1R_1^2+Q_2R_2^2}{R_1^2+R_2^2}$

B Q_1

C Q_2

D 0

E $\frac{Q_1R_1+Q_2R_2}{R_1+R_2}$

ANSWER SHEET

Fill in one box per question, as in the exam. The key is on the next page.

1	A B C D E	21	A B C D E	42	A B C D E
2	A B C D E	22	A B C D E	43	A B C D E
3	A B C D E	23	A B C D E	44	A B C D E
4	A B C D E	24	A B C D E	45	A B C D E
5	A B C D E	25	A B C D E	46	A B C D E
6	A B C D E	26	A B C D E	47	A B C D E
7	A B C D E	27	A B C D E	48	A B C D E
8	A B C D E	28	A B C D E	49	A B C D E
9	A B C D E	29	A B C D E	50	A B C D E
10	A B C D E	30	A B C D E	51	A B C D E
11	A B C D E	31	A B C D E	52	A B C D E
12	A B C D E	32	A B C D E	53	A B C D E
13	A B C D E	33	A B C D E	54	A B C D E
14	A B C D E	34	A B C D E	55	A B C D E
15	A B C D E	35	A B C D E	56	A B C D E
16	A B C D E	36	A B C D E	57	A B C D E
17	A B C D E	37	A B C D E	58	A B C D E
18	A B C D E	38	A B C D E	59	A B C D E
19	A B C D E	39	A B C D E	60	A B C D E
20	A B C D E	41	A B C D E		

ANSWER KEY

Valid for this TestBuddy version: the answers are in a different order from the official paper.

1	A	21	E	42	E
2	D	22	B	43	B
3	C	23	B	44	E
4	D	24	C	45	D
5	B	25	E	46	A
6	A	26	B	47	B
7	D	27	D	48	B
8	E	28	A	49	E
9	C	29	E	50	D
10	C	30	B	51	A
11	C	31	E	52	D
12	A	32	B	53	D
13	E	33	D	54	A
14	B	34	C	55	E
15	E	35	C	56	E
16	D	36	E	57	B
17	A	37	B	58	E
18	E	38	A	59	E
19	C	39	C	60	B
20	B	41	D		

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