ENTRANCE TEST
UNIVERSITAS INDONESIA

SIMAK UI

NATURAL SCIENCES TEST

- Mathematics for Natural Sciences
- Biology
- Physics
- Chemistry
- Integrated Natural Sciences

391

Universitas Indonesia
2013

GENERAL INSTRUCTIONS

1. Before you begin work on the test, check the number of questions and the page numbers in the test booklet.
The booklet consists of 11 pages.

2. Write your student test number on the space provided in the answer sheet.

3. Write the code of the test booklet on the space provided in the answer sheet. The code of this test booklet is: **391**

4. Read carefully each and every instruction on how to answer the questions.

5. Think carefully before answering every question, because incorrect answers will deduct points from your score (scoring system: correct +4, blank 0, incorrect -1).

6. Work on questions you find easy first, then continue with harder questions, so that all questions are answered.

7. Write your answers in the answer sheet provided.

8. For scrap paper, make use of the empty space in your test booklet and **do not use your answer sheet** as your answers will then fail to be processed

9. During the test, you are not allowed to ask or seek explanation about the questions being tested to anyone including the test supervisor.

10. When the test is complete, you are required to stay in your seat until the test supervisor approaches you to collect the answer sheet.

11. Make sure the answer sheet is not dirty, wet, folded, and torn.

SPECIFIC INSTRUCTIONS

INSTRUCTION A:
Choose one answer that it most appropriate

INSTRUCTION B:
The questions consist of 3 parts, i.e. STATEMENT, CAUSE, and REASON that are arranged in sequence. Choose:

(A) If the statements is correct, the reason is correct, and both show a cause and effect relationship;

(B) If the statements is correct, the reason is correct, but both do not show a cause and effect relationship

(C) If the statements is correct and the reason is incorrect

(D) If the statements is incorrect and the reason is correct

(E) If the statements and the reason are both incorrect

INSTRUCTION C:
Choose

(A) If (1), (2), and (3) are correct

(B) If (1) and (3) are correct

(C) If (2) and (4) are correct

(D) If only (4) is correct

(E) If all of them are correct

SUBJECTS	:	Mathematics for Natural Sciences, Biology, Physics, Chemistry, and Integrated Natural Sciences
EXAM DATE	:	23 JUNE 2013
TIME	:	120 MINUTES
NO. OF QUESTIONS	:	60

Remarks	:	Questions on MATHEMATICS FOR NATURAL SCIENCES number 1 to 12
		Questions on BIOLOGY number 13 to 24
		Questions on PHYSICS number 25 to 36
		Questions on CHEMISTRY number 37 to 48
		Questions on INTEGRATED NATURAL SCIENCES number 49 to 60

MATHEMATICS FOR NATURAL SCIENCES

*Use **Instruction A** to answer questions number 1 to 12.*

1. Given that the equation $f(x) + xf(1 - x) = x$ holds for every real number x. The value of $f(-1) + f(1)$ is ....

   (A) -1

   (B) 0

   (C) $\dfrac{1}{3}$

   (D) 1

   (E) $\dfrac{4}{3}$

2. If $(x - c)^2$ is a factor of $x^3 + ax + b$, then the value of $\left(\dfrac{a}{3}\right)^3 + \left(\dfrac{b}{2}\right)^2$ is ....

   (A) $-c^2$ (D) c

   (B) $-c$ (E) c^2

   (C) 0

3. If the sum of the first ten terms of the sequence $\log x, \log x^3 y^2, \log x^5 y^4, \log x^7 y^6, \ldots$ is $5(a \log x + b \log y)$, then the value of $a + b$ is ....

   (A) 18 (D) 30

   (B) 20 (E) 38

   (C) 28

4. Given the matrix $A = \begin{bmatrix} 2 & a \\ 0 & 1 \end{bmatrix}$, the matrix $A^n = ...$

   (A) $\begin{bmatrix} 2^n & 2^n a \\ 0 & 1 \end{bmatrix}$

   (B) $\begin{bmatrix} 2^n & (2^n - 1)a \\ 0 & 1 \end{bmatrix}$

   (C) $\begin{bmatrix} 2n & (2^n - 1)a \\ 0 & 1 \end{bmatrix}$

   (D) $\begin{bmatrix} 2^n & (2^n - 1)a \\ 1 & 0 \end{bmatrix}$

   (E) $\begin{bmatrix} 2^n & 2^n a \\ 1 & 0 \end{bmatrix}$

5. Given the equation $\sin \alpha - \cos \alpha = |k|$, then $|\sin \alpha + \cos \alpha| = ...$

   (A) $\sqrt{2 - k^2}$

   (B) $\sqrt{k^2 - 2}$

   (C) $|k|$

   (D) $\sqrt{2} - |k|$

   (E) $|k| - \sqrt{2}$

6. Let R be the region enclosed by the x-axis, the curve $y = x^2$, and the tangent to the curve at $x = a$, where $a > 0$. If the area of R is $\dfrac{2}{3}$, then the value of a is ....

   (A) 1

   (B) $\dfrac{3}{2}$

   (C) 2

   (D) 3

   (E) $\dfrac{5}{2}$

7. A cube $ABCD.EFGH$ has sides of length 3 cm. Points P, Q, and R divides sides AE, FG, and CD respectively, such that the ratio $AP : PE = FQ : QG = CR : RD = 2 : 1$. The area of triangle PQR is ....

(A) $\dfrac{7\sqrt{3}}{2}$

(B) $7\sqrt{3}$

(C) $\dfrac{\sqrt{42}}{4}$

(D) $\dfrac{7\sqrt{2}}{2}$

(E) $\dfrac{7\sqrt{3}}{4}$

8. Let p, q be the solutions of the quadratic equation $x^2 - 2mx - 5n = 0$ and let m, n be the solutions of $x^2 - 2px - 5q = 0$. If $p \neq q \neq r \neq s$, then the value of $p + q + m + n$ is ....

(A) 15

(B) 30

(C) 75

(D) 150

(E) 225

9. The straight line $y = a^2bx + 2ab$ intersects the parabola $y = ax^2 + x + ab$ at two points, where a, b are real numbers. The sum of the product of their abscisses and $2b$ is ....

(A) $-2ab$

(B) $-b$

(C) 0

(D) b

(E) $2ab$

10. If the value of the function $f(x) = |x - 2|$ is always less than or equal to the value of the function $g(x) = 4 - x^2$ for every real number x, then the value of x satisfies ....

(A) $-1 \leq x \leq 2$

(B) $-3 < x < 2$

(C) $-1 < x < -2$

(D) $x > -3$

(E) $-3 < x < 2$ or $x > 2$

11. Let L be a line that passes through the origin and the point of the curve $y = \sin x$ which its abscissa is $\dfrac{\pi}{2}$. If the x-axis is reflected with respect to L, and α be the angle between x-axis and its reflection, then the value of $\cos \alpha$ is ....

(A) $\dfrac{2}{\pi}$

(B) $\dfrac{\pi}{\sqrt{4 + \pi^2}}$

(C) $\dfrac{4\pi}{4 + \pi^2}$

(D) $\dfrac{\pi^2 - 4}{4 + \pi^2}$

(E) $\dfrac{2}{\sqrt{4 + \pi^2}}$

12. The rate of change of the gradient of the tangent of the curve $x^3 - y^3 + axy = a^3$ at the point $(a, -a)$ is ....

(A) $-\dfrac{7}{a}$

(B) $-\dfrac{1}{a}$

(C) 0

(D) $\dfrac{1}{a}$

(E) $\dfrac{7}{a}$

BIOLOGY

*Use **Instruction A** to answer questions number 13 to 22.*

13. Female gametangium, or ... , produces an egg; male gametangium, or ... , produces sperm cells.

    (A) archegonium; megaphyll
    (B) antheridium; archegonium
    (C) megasporangium; antheridium
    (D) archegonium; antheridium
    (E) megasporangium; megaphyll

14. The primary function of the spongy mesophyll in the leaf is ....

    (A) to reduce water loss from the leaf surface
    (B) to diffuse water within the leaf
    (C) to diffuse gases within the leaf
    (D) to prevent the leaf falling from its own weight
    (E) to deter herbivores

15. Which of the following is NOT characteristic of birds?

    (A) hollow bones
    (B) ectothermy
    (C) amnion
    (D) high metabolic rate
    (E) reptilian-like scales on legs

16. The levels of organization in ecology range from ....

    (A) cells to organisms
    (B) individuals to biospheres
    (C) biological communities to biomes
    (D) abiotic factors to biotic factors
    (E) populations to ecosystems

17.
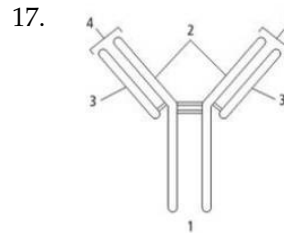
    The diagram shows the basic structure of an antibody. Which part of the diagram corresponds to the antigen binding site?

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

18. Which are two blood components most closely associated with the clotting process?

    (A) platelets and antibodies
    (B) red blood cells and platelets
    (C) platelets and fibrinogen
    (D) white blood cells and antibiotics
    (E) platelets and plasma

19. Roundworms (nematods) are abundant and diverse because ....

    (A) they are both parasitic and free-living and eat a wide variety of foods.
    (B) they are able to molt their exoskeletons.
    (C) their thick cuticle enables them to move in complex ways.
    (D) their body cavity is a pseudocoelom.
    (E) their segmented bodies enable them to live in many different places.

20. Chromosome duplication takes place during ....

    (A) Metaphase   (D) Interphase
    (B) Prophase   (E) Anaphase
    (C) Telophase

21. Which of the following does NOT belong to domain Archaea?

    (A) bacteria that produce methane from carbon dioxide and hydrogen

    (B) thermophiles

    (C) halophiles

    (D) bacteriophages

    (E) prokaryotes with cell walls that lack Peptidoglycan

22. Which of the following processes does not participate in seed germination?

    (A) Growth of the radicle

    (B) Imbibition of water

    (C) Metabolic changes

    (D) Mobilization of nutrient reserves

    (E) Extensive mitotic divisions

Use **Instruction B** to answer questions number 23 .

23. Membranes usually have a negative charge on their outer surface.

    BECAUSE

    A membrane consists of an inner and outer dense phospholipid layer surrounding a thicker but less dense protein layer.

Use **Instruction C** to answer questions number 24 .

24. Which enzyme(s) is/are involved in DNA replication?

    (1) DNA helicase

    (2) DNA ligase

    (3) DNA polymerase

    (4) RNA primase

PHYSICS

*Use **Instruction A** to answer questions number 25 to 36.*

25. An ice cube having a mass of 50 grams and an initial temperature of -10 degrees Celsius is placed in 400 grams of 40 degrees Celsius water. The specific heat of ice is 2060 J/kg°C. The specific latent heat of fusion is 334,000 J/kg. The total heat needed by the ice to melt to become water with the temperature 0 °C is ....

    (A) 1,030 J
    (B) 5,670 J
    (C) 16,700 J
    (D) 17,730 J
    (E) 18,760 J

26. The quartz crystal used in an electric watch vibrates with frequency of 32.768 Hz. The period of the crystal motion is ....

    (A) 30.5 s
    (B) 30.5 ms
    (C) 30.5 μs
    (D) 30.5 ns
    (E) 30.5 ps

27. A particle of mass 5 g is placed in a downward-directed electric field of magnitude 800 N/C. (g= 9.8 m/s^2). To keep the particle stationary, the sign and magnitude of the charge should be ....

    (A) Negative and 0.0000613 C
    (B) Positive and 0.0000613 C
    (C) Neutral and 0.0000613 C
    (D) Negative and 0.0000613 μC
    (E) Positive and 0.0000613 μC

28. A light source of wavelength λ illuminates a metal and ejects photoelectrons with a maximum kinetic energy of 1.00 eV. A second light source of wavelength $\dfrac{\lambda}{2}$ illuminates a metal and ejects photoelectrons with a maximum kinetic energy of 4.00 eV. The work function of the metal is ....

    (A) 1.0 eV
    (B) 1.5 eV
    (C) 2.0 eV
    (D) 2.5 eV
    (E) 3.0 eV

29. Photons of wavelength 450 nm are incident on a metal. The most energetic electrons ejected from the metals are bent into a circular arc of radius 20.0 cm by a magnetic field with a magnitude of 2.00 $\times 10^{-5}$ T. (1 eV= 1.6 $\times 10^{-19}$ J). The work function of the metal is ....

    (A) 5.345 eV
    (B) 4.500 eV
    (C) 3.345 eV
    (D) 2.500 eV
    (E) 1.345 eV

30. A 1.25 kg mass is attached to the end of a 80 cm string. The system is whirled in a horizontal circular path. The maximum tension that the string can withstand is 400 N. The maximum angular velocity of the system is ....
    ($g = 9.8$ ms^{-2})

    (A) 20.00 rad/s
    (B) 5.00 rad/s
    (C) 2.00 rad/s
    (D) 0.50 rad/s
    (E) 0.05 rad/s

31. A 10 kg box moves at 5 m/s on a horizontal, frictionless surface runs into a light spring of force constant 10,000 N/m. By using the work energy theorem, the maximum compression of the spring is ....
    ($g = 9.8$ ms^{-2})

    (A) 16 nm
    (B) 16 μm
    (C) 16 mm
    (D) 16 cm
    (E) 16 dm

32. A box sits on a horizontal wooden board. The coefficient of static friction between the box and the board is 0.5. You grab one end of the board and lift it up, keeping the other end of the board on the ground. The angle between the board and the horizontal direction when the box begins to slide down the board is ....

    (A) $\tan^{-1}(0.5)$
    (B) $\sin^{-1}(0.5)$
    (C) $\cos^{-1}(0.5)$
    (D) $\sec^{-1}(0.5)$
    (E) $\operatorname{cosec}^{-1}(0.5)$

33. Initially, a sphere A has a charge of $-50e$ and a sphere B has a charge of $+20e$. The spheres are made of conducting materials and are identical in size. If the spheres then touch each other, the resulting charge on sphere A is ....

    (A) $-50e$
    (B) $-20e$
    (C) $-15e$
    (D) $+15e$
    (E) $+20e$

34. Two long straight wires are carrying the same current I and separated by a distance r exert a force F on each other. The ratio of force between two wires before and after changes is 96. If the current is increased to $4I$, the separation between the two wire is reduced to ....

    (A) $\dfrac{r}{6}$
    (B) $\dfrac{r}{16}$
    (C) $\dfrac{r}{24}$
    (D) $\dfrac{r}{96}$
    (E) $\dfrac{r}{144}$

35. In a Millikan oil drop experiment a student sprayed oil droplets with a density of 780 kg/m^3 between two horizontal parallel plates that were 6.0 cm apart. The student adjusted the potential difference between the plates to 5000 V so that one of the drops became stationary. The diameter of this drop was measured to be 3×10^{-6} m. The magnitude of the charge on the drop is ....

    (A) 1.10×10^{-18} C
    (B) 1.06×10^{-17} C
    (C) 1.10×10^{-15} C
    (D) 1.06×10^{-13} C
    (E) 1.10×10^{-12} C

36. A person stands 40 m away from a flag pole. With a protractor at eye level, he finds the angle between the line from the top of the flag pole to his eyes and the horizontal is 25.0 degrees. The distance from his feet to his eyes is 1.8 m. The high of the flag pole is ....
    ($\tan 25° = 0.466$)

    (A) 15.0 m
    (B) 16.8 m
    (C) 18.0 m
    (D) 18.6 m
    (E) 20.4 m

CHEMISTRY

*Use **Instruction A** to answer questions number 37 to 46.*

37. An atom of which element has the highest third ionization energy is ....

    (A) Na

    (B) Ca

    (C) Al

    (D) Ga

    (E) Mg

38. Which of the following compound containing carbon atom does not have sp^2 hybridisation?

    (A) propene

    (B) benzene

    (C) acetone

    (D) graphite

    (E) CO_2

39. An organic compound has a composition of 36% carbon, 4% hydrogen, 28% nitrogen and the rest of oxygen. What is the empirical formula of the compound?

    (A) $C_2H_4N_2O_3$

    (B) $C_3H_4N_2O_2$

    (C) $C_2H_4N_3O_3$

    (D) $C_3H_4N_2O_3$

    (E) $C_2H_4N_3O_2$

40. The combustion of 0.100 mol of liquid carbon disulfide, CS_2, produced CO_2 (g) and SO_2 (g) and releases 107.5 kJ of heat. What is ΔH_f° for CS_2 (l) in kJ. mol^{-1}?
    ($\Delta H_f^\circ CO_2$ is 393.5 kJ. mol^{-1}, $\Delta H_f^\circ SO_2$ is 296.8 kJ. mol^{-1})

    (A) –375.0

    (B) –87.9

    (C) +87.9

    (D) +375.0

    (E) +2062.0

41. The number of bromide ions in a solution made by dissolving 4.7 gr of AgBr in 100 cm^3 water at 25 °C is ....
    (Ksp of AgBr is 4.9×10^{-13} and Ar Ag = 108 gr/mol, Br = 80 gr/mol) Avogadro number N = 6×10^{23}.

    (A) 7.35×10^{10}

    (B) 2.94×10^{11}

    (C) 1.05×10^{16}

    (D) 4.20×10^{16}

    (E) 1.50×10^{23}

42. The following interaction of compounds which has strongest intermolecular forces is ....

    (A) Na^+ with H_2O

    (B) Mg^{2+} with H_2O

    (C) Hydrogen bond of H_2O

    (D) Dipole-dipole bond between SO_2 molecule

    (E) Interaction of I_2 molecules

43. A 230 mL sample of N_2 is collected over water at 25 °C and 740 mmHg pressure. Which expression represents the set-up to find the volume of dry N_2 at 0 °C and 1 atmosphere? Vapor pressure of water at 25 °C is 24 mmHg

    (A) $V = \dfrac{230 \times (740 - 24) \times 273}{760 \times 298}$

    (B) $V = \dfrac{230 \times (740 + 24) \times 273}{760 \times 298}$

    (C) $V = \dfrac{230 \times (740 - 24) \times 298}{760 \times 273}$

    (D) $V = \dfrac{230 \times (740 + 24) \times 298}{760 \times 273}$

    (E) $V = \dfrac{230 \times (740 - 24) \times 298}{760 \times 298}$

44. A solution made of 5.4 gr $M(OH)_2$ dissolved in 500 gr water boils at 100.156 °C. If the ionization degree of the base is 0.75 and the value Kb for water is 0.52°C/m, what is the atomic weight of its metal?

    (A) 90

    (B) 56

    (C) 52

    (D) 40

    (E) 24

45. When the compounds CH_3COOH, CF_3COOH, and CCl_3COOH are arranged in order of increasing acidity in aqueous solution, which order is CORRECT?

    (A) $CH_3COOH < CCl_3COOH < CF_3COOH$

    (B) $CCl_3COOH < CH_3COOH < CF_3COOH$

    (C) $CF_3COOH < CH_3COOH < CCl_3COOH$

    (D) $CF_3COOH < CCl_3COOH < CH_3COOH$

    (E) $CCl_3COOH < CF_3COOH < CH_3COOH$

46. A solution of $Cr(NO_3)_3$ is electrolyzed using platinum electrode for 10 minutes. What current is needed to obtain 0.78 gr of chromium?
    (Ar Cr = 52 ; N = 14 ; O = 16, 1 Faraday = 96,500 C)

    (A) 1.26 A   (D) 7.24 A
    (B) 3.45 A   (E) 9.65 A
    (C) 5.79 A

*Use **Instruction C** to answer questions number 47 to 48.*

47. Which molecule(s) is/are polar?

    (1) SF_2
    (2) SO_2
    (3) SF_4
    (4) SO_3

48. Consider the following aqueous equilibrium:
    $AgCl (s) \rightleftharpoons Ag^+ (aq) + Cl^- (aq)$
    Which addition of the following compounds will increase the solubility of AgCl?

    (1) NaCl
    (2) diluted NaOH
    (3) $AgNO_3$
    (4) excesses NH_3

INTEGRATED NATURAL SCIENCES

MAKING ROCKS INTO MAGNETS

If you heat up a rock, most likely, what you will get is a hot rock. But if you heat up the right type of stone to just the right temperature and you could end up with a magnet, scientists now report.

The most magnetic and common type is a lodestone. It consists of a brownish-black mineral called magnetite. Lodestones are natural compasses: Suspend one by a thread or wire and it will rotate until its magnetic field is aligned with Earth's magnetic field.

A magnetic field is the area around a material in which its magnetic forces can be detected. A material's magnetism is determined by the way its electrons move around the outside of its atoms'nuclei — particularly those electrons that aren't paired with other electrons in certain ways. If a large number of unpaired electrons rotate in the same direction, then an object's magnetic field can be strong. If all of the unpaired electrons spin in random directions, the object's magnetic field is either very weak or missing.

Some materials, such as lodestones, create a persistent magnetic field. Others with unpaired electrons, such as iron, can become magnetized when they're placed within a magnetic field and their atoms rotate and align.

Charles Aubourg is a geologist at the University of Pau and the Adour Countries in France. He and his colleagues heated samples of a type of sedimentary rock to as much as $130\,°C$ (about $266\,°F$). Sedimentary rock is made from material eroded from other rocks. The eroded materials transform into stone when exposed to high pressure deep within Earth for a lengthy period of time, sometimes millions of years.

Each sample contained large amounts of clay and silt (both of which are made of tiny particles eroded from other rocks). But importantly, the rocks also contained a small amount of an iron-bearing mineral called pyrite.

First, the team used a strong magnetic field to erase any magnetism naturally trapped in the sample. Then the researchers heated the rock inside a strong magnetic field according to a specific recipe: 25 days at $50\,°C$, then 25 days at $70°$, 25 days at $80°$, 10 days at $120°$, and a final 10 days at $130°$. This temperature range is the same as that of rocks located between 2 kilometers and 4 kilometers deep in Earth's crust.

The rocks'magnetic field rose during each stage of heating. It increased most quickly during the earliest days of each step. The growing magnetism of the samples suggests that the heat triggered reactions that caused some of the pyrite to chemically transform into magnetic minerals.

*Use **Instruction A** to answer questions number 49 to 50.*

49. The temperature of rocks located deep in Earth's crust follows roughly a function

$T(x) = \dfrac{1}{3}x^3 - \dfrac{3}{2}x^2 + A$, where A is a large positive constant and x is a distance from earth surface (in km). The maximum temperature of the rocks heated inside a strong magnetic field according to the recipe mentioned in the paragraph is located in $x = ...$

(A) 2   (D) 3.5

(B) 2.5   (E) 4

(C) 3

50. Mineral contained in stones that contributes to magnetic property of the stones is .....

(A) Pyrite   (D) Lodestone

(B) Magnetite   (E) Hematite

(C) Clay

*Use **Instruction B** to answer questions number 51 to 52.*

51. The polarity of the Earth's magnetic field changes over time from normal to reserved.

BECAUSE

The polarity changes could explain the reason of how continents move by observing the seafloor mapping.

52. An object's magnetic field can be strong, weak or missing, depend on the orientation and the amount of unpaired electrons spin.

BECAUSE

A large number of unpaired electrons which rotate in the same direction will give a very strong magnetism, and when all of the unpaired electrons spin in random directions, they will produce very weak or missing magnetic field

OZONE LEVELS HAVE SIZEABLE IMPACT ON WORKER PRODUCTIVITY

Researchers in the Department of Health Policy and Management at Columbia's Mailman School of Public Health assessed the impact of pollution on agricultural worker productivity using daily variations in ozone levels. Their results show that ozone, even at levels below current air-quality standards in most parts of the world, has significant negative impacts on worker productivity. Their findings suggest that environmental protection is important for promoting economic growth and investing in human capital in contrast to its common portrayal as a tax on producers. Results of the study are published in the American Economic Review.

Ozone pollution continues to be a pervasive global issue with much debate over optimal levels. While policy makers routinely note that regulating ozone smog leads to many health benefits like reduced hospitalizations and mortality rates, Matthew Neidell, PhD, associate professor at the Mailman School and principal investigator, set out to investigate whether lower air pollution might also affect job performance. Until this research, there had been no systematic evidence on the direct impact of pollution on worker productivity.

The researchers found that a 10 ppb (parts per billion) change in average ozone exposure results in a significant 5.5 percent change in agricultural worker productivity. "These estimates are particularly noteworthy as the U.S. EPA is currently moving in the direction of reducing federal ground-level ozone standards," said Dr.Neidell, PhD. This past September President Obama said he would not support a proposal by the Environmental Protection Agency to tighten the federal ozone standard because it would pose too heavy a burden on businesses, which stunned public health experts and environmentalists.

Dr. Neidell also points out that in developing countries where environmental regulations are less strict and agriculture plays a more dominant role in the economy, the effects reported here may have a vast detrimental impact on a country's prosperity.

*Use **Instruction A** to answer questions number 53 to 54.*

53. A water purification plant is designed using ozone as disinfectant agent placed in a 10 L container. Because of a small leakage, the ozone contained the 500 m^3 factory by 100 ppm of atmospheric pressure. The amount of ozone in the container before leaking was ....

    (A) 243.72 mol

    (B) 20.446 mol

    (C) 243.720 mol

    (D) 20.446 mol

    (E) 24.372 mol

54. Ozone (O_3) in many ways are different from diatomic oxygen molecule (O_2), EXCEPT ....

    (A) It is more powerful oxidizing agent because it consists of more atoms

    (B) It is dangerous when accidentally inhaled

    (C) It has one localized double bond in its molecular structure

    (D) It is more useful if located as a thin layer at stratosphere

    (E) It has distinguished purple colour in high concentration

*Use **Instruction B** to answer questions number 55 .*

55. Recent atmospheric studies have detected an ozone-hole, including an extremely thin area over antartica.

    BECAUSE

    The *ozone hole* forms when sulfur dioxide and nitrogen oxides combine with atmospheric moisture to create sulfuric acid and nitric acid.

*Use **Instruction C** to answer questions number 56 .*

56. Life on earth is protected by a layer of ozon (O_3). The destruction of ozone layer may be increased levels of UV radiation that linked to ....

    (1) breast cancer

    (2) cataract

    (3) retinal aplasia

    (4) skin cancer

MRI IMAGES TRANSPLANTED ISLET CELLS WITH HELP OF POSITIVELY CHARGED NANOPARTICLES

In a study to investigate the detection by MRI of six kinds of positively-charged magnetic iron oxide nanoparticles designed to help monitor transplanted islet cells, a team of Japanese researchers found that the charged nanoparticles they developed transduced into cells and could be visualized by MRI while three kinds of commercially available nanoparticles used for controls could not.

"Our data suggests that novel, positively-charged nanoparticles can be useful for MRI contrast agents to monitor islet mass after transplantation" said study co-author Hirofumi Noguchi, MD, PhD, of the Department of Gastroenterological Surgery, transplant and Surgical Oncology at the Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences. "Significant graft loss immediately after islet transplantation occurs due to immunological and non-immunological events. With MRI an attractive potential tool for monitoring islet mass in vivo, efficient uptake of MRI contrast agent is required for cell labeling."

The researchers note that recent techniques of labeling islet cells with magnetic iron oxide has allowed detection of transplanted islet cells, however commercially available magnetic nanoparticles are not efficiently transduced because the cell surface is negatively charged and the negative charge of the nanoparticles. The researchers developed positively charged nanoparticles that were efficiently transduced.

Use **Instruction A** to answer questions number 57 to 58.

57. How many ways to select 3 nanoparticles one by one without replacement from the positively-charged magnetic iron oxide nanoparticles being investigated by the researchers?

   (A) 3   (D) 120
   (B) 6   (E) 720
   (C) 20

58. A protein secreted by ... islet cells stimulates glycogenolysis in the liver and skeletal muscle.

   (A) alpha   (D) epsilon
   (B) beta   (E) delta
   (C) gamma

Use **Instruction B** to answer questions number 59 to 60.

59. The fabricated magnetic iron oxide nanoparticles were successfully detected by MRI, while the commercially available controls failed.

                BECAUSE

   The controls and the cell surfaces both have similar charge.

60. The electron configuration of iron in the oxide (Fe_2O_3) is $[Ar]3d^5$.

                BECAUSE

   Reaction of iron oxide with water result in the increase of pH solution.