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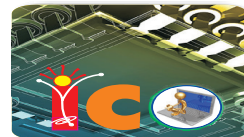
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ROUGH WORK

Instructions for the Candidate

1. You are allowed additional 10 minutes to fill the required details in the RESPONSE SHEET (OMR).
2. The question paper is made as per syllabus guidelines & pattern given in the information Booklet. The Question Paper for Classes 1 to 6 contains 40 Questions each to be answered in 60 minutes. The Question paper for classes 7 to 12 contains 60 Questions each to be answered in 60 minutes. All questions are compulsory. Further instructions are given in the instruction letter to the teacher.
3. Use the response sheet to mark your responses by darkening the required circle. The response sheet has to be returned to the foundation, duly filled in. **THE STUDENT CAN RETAIN THE QUESTION PAPER.**

GENERAL IQ

1. If selling price is doubled, the profit triples. Find the profit percent.

(1) $66\frac{2}{3}$ (2) 100

(3) $105\frac{1}{3}$ (4) 120

2. Look at this series: 7, 10, 8, 11, 9, 12, ... What number should come next?

(1) 7 (2) 10

(3) 12 (4) 13

3. Look at this series: 8, 22, 8, 28, 8, ... What number should come next?

(1) 9 (2) 29

(3) 32 (4) 34

4. Look carefully for the pattern, and then choose which pair of numbers comes next.

5-30; 6-42; 7-56; 8-72,

(1) 9 - 81 (2) 9 - 72

(3) 9 - 90 (4) 9 - 100

5. Look at this series: F2, __, D8, C16, B32, ... What number should fill the blank?

(1) A16 (2) G4

(3) E4 (4) E3

6. Four defensive football players are chasing the opposing wide receiver, who has the ball. Calvin is directly behind the ball carrier. Jenkins and Burton are side by side behind Calvin. Zeller is behind Jenkins and Burton. Calvin tries for the tackle but misses and falls. Burton trips. Which defensive

player tackles the receiver?

(1) Burton (2) Zeller

(3) Jenkins (4) Calvin

7. At the baseball game, Henry was sitting in seat 253. Marla was sitting to the right of Henry in seat 254. In the seat to the left of Henry was George. Inez was sitting to the left of George. Which seat is Inez sitting in?

(1) 251 (2) 254

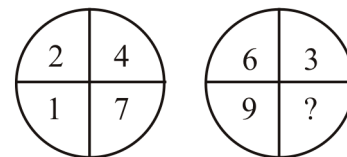
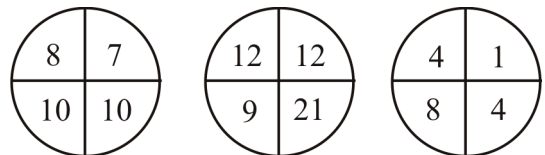
(3) 255 (4) 256

8. Here are some words translated from an artificial language *gorblflur* means *fan belt* *pixngorbl* means *ceiling fan* *arthtusl* means *tile roof*. Which word could mean ceiling tile?

(1) *gorbltusl* (2) *flurgorbl*

(3) *arthflur* (4) *pixnarth*

9. Which number replaces the question mark?



(1) 9 (2) 5

(3) 7 (4) 8

10. A man travels 2 miles, turns left and travels 3 miles, turn left again and travel 6 miles. How far is he from the starting point?

(1) 9 miles (2) 7 miles

(3) 5 miles (4) 9 miles

SECTION B: PHYSICS & CHEMISTRY

11. Dimensional formula of the product of the two physical quantities P and Q is ML^2T^{-2} , the dimensional formula of P/Q is MT^{-2} . P and Q respectively are

- (1) Force, Velocity
- (2) Momentum, displacement
- (3) Force, displacement
- (4) Work, velocity

12. If the displacement y of a particle is $y = A \sin(pt + qx)$, where t is time and x is distance then

- (1) the dimensions of p are M^0L^0T
- (2) the dimensions of q are M^0LT^0
- (3) the dimensions of $\frac{p}{q}$ are M^0LT^{-1}
- (4) the dimensions of pq are M^0LT^{-1}

13. If pressure p, velocity of light c and acceleration due to gravity g are chosen as fundamental units, then dimensional formula of mass is

- (1) $pc^{-1}g^{-4}$
- (2) $pc^{-4}g^3$
- (3) pc^4g^{-3}
- (4) pc^4g^3

14. If $\vec{P} - \vec{Q} = \vec{R}$ and $P = Q = R$, the ratio of angles between \vec{P} & \vec{R} to \vec{P} & \vec{Q} is

- (1) 1 : 2
- (2) 2 : 1
- (3) 1 : 1
- (4) 1 : 3

15. If the sum of two unit vectors is also a vector of unit magnitude, the magnitude of the difference of the two unit vectors is

- (1) 1 unit
- (2) 2 units
- (3) $\sqrt{3}$ units
- (4) Zero

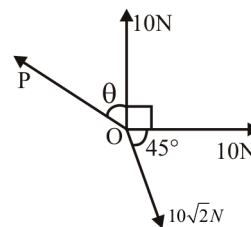
16. A body starts with a velocity $2\hat{i} - 3\hat{j} + 11\hat{k}$ m/s and moves with an acceleration of $10\hat{i} + 10\hat{j} + 10\hat{k}$ ms^{-2} . What is its velocity after 0.25 s?

- (1) $4.5\hat{i} + 0.5\hat{j} - 13.5\hat{k}$
- (2) $4.5\hat{i} - 0.5\hat{j} - 13.5\hat{k}$
- (3) $4.5\hat{i} - 0.5\hat{j} + 13.5\hat{k}$
- (4) $4.5\hat{i} + 0.5\hat{j} + 13.5\hat{k}$

17. The rectangular components of a vector lying in xy plane are (n+1) and 1. If co-ordinate system is turned by 60° , they are n & 3 respectively. The value of 'n' is

- (1) 2
- (2) 3
- (3) 2.5
- (4) 3.5

18. If three vectors acting at a point 'O' as shown in the figure keep the particle in equilibrium then the value of ' θ ' & 'P' are



- (1) $15^\circ, 10\sqrt{2}N$
- (2) $45^\circ, 10N$
- (3) $75^\circ, 10\sqrt{2}N$
- (4) $90^\circ, 20N$

19. If a car covers $\frac{2}{5}$ th of the total distance with v_1 speed and $\frac{3}{5}$ th distance with v_2 then average speed is

- (1) $\frac{1}{2}\sqrt{v_1v_2}$
- (2) $\frac{v_1 + v_2}{2}$
- (3) $\frac{2v_1 + v_2}{v_1 + v_2}$
- (4) $\frac{5v_1v_2}{3v_1 + 2v_2}$

20. A freely falling body travels x % of total distance in 5th second where 'x' is

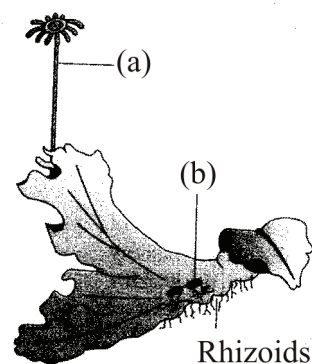
- (1) 8%
- (2) 12%
- (3) 25%
- (4) 36%

21. Photo-electric emission is observed from a surface for frequencies ν_1 and ν_2 of the incident radiation ($\nu_1 > \nu_2$). If the maximum kinetic energies of the photoelectrons in the two case are in the ratio 1 : k then the threshold frequency ν_0 is given by:
- (1) $\frac{\nu_2 - \nu_1}{k - 1}$ (2) $\frac{k\nu_1 - \nu_2}{k - 1}$
 (3) $\frac{k\nu_2 - \nu_1}{k - 1}$ (4) $\frac{\nu_2 - \nu_1}{k}$
22. An excited hydrogen atom emits a photon of wavelength λ in returning to the ground state. If R is the Rydberg constant then the quantum number n of the existed state is:
- (1) $\sqrt{\lambda R}$ (2) $\lambda R - 1$
 (3) $\sqrt{\lambda R - 1}$ (4) $\sqrt{\lambda R(\lambda R - 1)}$
23. Which set of phenomenon shown by the radiation proves the dual nature of radiation?
- (1) Scintillation
 (2) Interference and diffraction
 (3) Interference and photo-electric effect
 (4) None of the above
24. If the nitrogen atom had electronic configuration $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2 2s^2 2p^3$, because the electron would be closer to the nucleus. Yet $1s^7$ is not observed because it violates:
- (1) Heisenberg's uncertainty principle
 (2) Hund's rule
 (3) Pauli's exclusion principle
 (4) Bohr postulate of stationary orbits
25. Alveoli are tiny sacs in the lungs whose average diameter is $5 \times 10^{-10}m$. An oxygen molecule is strapped in a sac. The uncertainty in the velocity of oxygen molecule within a sac is:
- (1) 2.0 m/sec (2) 3.0 m/sec
 (3) 1.0 m/sec (4) 4.0 m/sec
26. The circumference of nth orbit in H-atom can be expressed in terms of de Broglie wavelength λ as:
- (1) $(0.529) n\lambda$ (2) $\sqrt{n\lambda}$
 (3) 13.6λ (4) $n\lambda$
27. When 100 g of ethylene polymerizes to polyethylene according to the equation,
 $n(\text{CH}_2 = \text{CH}_2) \longrightarrow -(\text{CH}_2 - \text{CH}_2)_n-$. The mass of polyethylene produced will be:
- (1) $\frac{n}{2} g$ (2) 100 g
 (3) $\frac{100}{n} g$ (4) 50 g
28. How many g of KCl would have to be dissolved in 60g H_2O to give 20% by mass of solution?
- (1) 15 g (2) 1.5 g
 (3) 11.5 g (4) 31.5 g
29. 0.5 g of fuming H_2SO_4 (Oleum) is diluted with water. This solution is completely neutralized by 26.7 ml of 0.4 N NaOH. The percentage of free SO_3 in the samples:
- (1) 30.6% (2) 40.6%
 (3) 20.6% (4) 50%
30. The equivalent mass of $\text{Na}_2\text{S}_2\text{O}_3$ as reductant in the reaction, $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O} + 4\text{Cl}_2 \rightarrow 2\text{NaHSO}_4 + 8\text{HCl}$:
- (1) (molar mass)/1
 (2) (molar mass)/2
 (3) (molar mass)/6
 (4) (molar mass)/8

SECTION C: BIOLOGY

- 31.** In *Riccia/Marchantia* the rhizoids are
- (1) Branched unicellular
 - (2) Unbranched unicellular
 - (3) Branched multicellular
 - (4) Unbranched multicellular
- 32.** Apophysis in the capsule of *Funaria* is
- | | |
|----------------|------------------|
| (1) Upper part | (2) Middle part |
| (3) Lower part | (4) Fertile part |
- 33.** The structure which help in dispersal of spores in moss capsule is
- (1) Annulus
 - (2) Peristome
 - (3) Operculum
 - (4) Calyptra
- 34.** Bryophytes are amphibians because
- (1) They require a layer of water for carrying out sexual reproduction
 - (2) They occur in damp places
 - (3) They are mostly aquatic
 - (4) All of the above
- 35.** How many of the given pairs are correctly matched
- | | |
|-------------------------|-------------------------|
| a. <i>Marchantia</i> - | Gemma cup |
| b. <i>Selaginella</i> - | Precursor to seed habit |
| c. <i>Cycas</i> - | Mycorrhiza |
| e. <i>Sequoia</i> - | Air pollination |
| f. <i>Salvinia</i> - | Homospory |
| g. <i>Porphyra</i> - | Pear shaped gamete |
- (1) Five
 - (2) Four
 - (3) Three
 - (4) Two

- 36.** Fern gametophyte is
- (1) Unicellular, cordate prothallus
 - (2) Multicellular, green and thalloid prothallus
 - (3) Unicellular, colourless
 - (4) Liver-shaped thallus
- 37.** Identify the functions of (a) and (b) in given diagram



- (1) (a) help in gaseous exchange
(b) help in sexual reproduction
 - (2) (a) help in formation of biflagellated male gamete
(b) help in asexual reproduction
 - (3) (a) help in formation of egg cell
(b) help in asexual reproduction
 - (4) (a) help in asexual reproduction
(b) help in sexual reproduction
- 38.** Write the statements :
- A. Sequoia is tallest gymnosperms
 - B. Sphagnum, a bryophyte is monoecious and *Marchantia* is dioecious
 - C. Bryophyte having generally more economic importance but little ecological importance
 - D. Leaves in gymnosperms are well-adapted to withstand extrem in of temp., humidity and wind.

E. Horsetail belongs to sphenopsida class

How many above the statements are correct ?

- (1) One (2) Two
(3) Four (4) Three

39. Evolutionary important character of *Selaginella* is

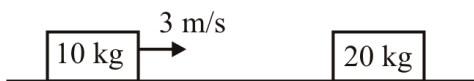
- (1) Strobili
(2) Rhizophore
(3) Heterosporous nature
(4) Ligule

40. Mark the mismatched pair w.r.t bryophyte

- (1) Gemmae - Multicellular, sexual buds
(2) Protonema of moss - Frequently filamentous stage
(3) Leafy stage of moss - Multicellular and branched rhizoids
(4) Capsule - Diploid structure contain spore

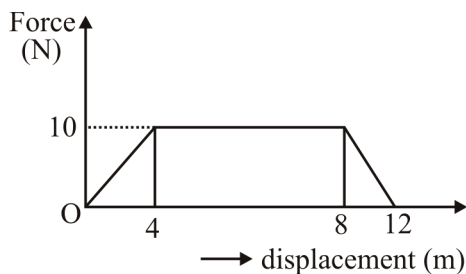
☺☺☺ **ENG OF SECTION C: BIOLOGY** ☺☺☺

41. A 10 kg block is moving towards 20 kg block at rest with a velocity of 3 m/s. The velocity of centre of mass of two block system is



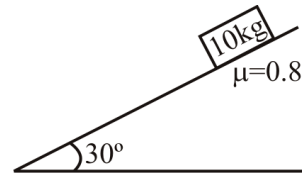
- (1) 1 m/s (2) 2 m/s
(3) 0.5 m/s (4) Zero

42. A particle of mass 0.1 kg is subjected to a force which varies with displacement as shown in fig. It starts its journey from rest at $x = 0$, then its velocity at $x = 12$ m is



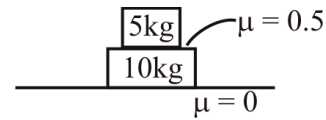
- (1) 0 (2) $20\sqrt{2}$ m/s
(3) $20\sqrt{3}$ m/s (4) 40 m/s

43. Contact force between block and incline is



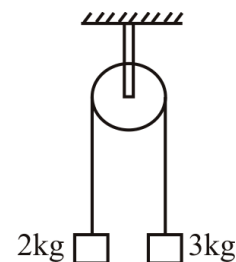
- (1) $50\sqrt{3}$ N (2) 50 N
(3) 100 N (4) Zero

44. The maximum force that can be applied on 5 kg block such that both the blocks should move together



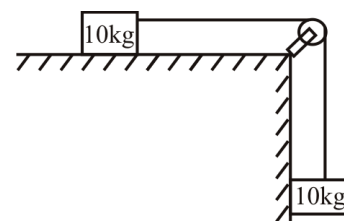
- (1) 37.5 N (2) 50 N
(3) 50.5 N (4) 12.5 N

45. A pulley mass system is shown in figure. Pulley is frictionless and strings are mass less. The acceleration of center of mass is



- (1) 0.4 m/s^2 (2) 5 m/s^2
(3) 2.5 m/s^2 (4) zero

46. Two blocks of 10 kg each are released from rest. Find the distance moved by centre of mass in first second of motion.



(1) $\frac{5}{2}m$

(2) $\frac{5}{4}m$

(3) $\frac{5}{\sqrt{2}}m$

(4) $\frac{5\sqrt{2}}{4}m$

47. A cyclist pedals the cycle for some time and then stops pedalling, then

(1) frictional force on the back wheel is in the direction of motion and front wheel is opposite to the direction of motion

(2) frictional force on the back wheel is opposite to the direction of motion and front wheel is in the direction of motion

(3) frictional force on the both the wheels are opposite to the direction of motion

(4) frictional force on the both the wheels are in the direction of motion

48. The block of mass m is lying on a horizontal surface. The coefficient of friction between block and the surface is μ . The minimum possible force needed to move the block on the surface

(1) $\frac{mg}{\mu}$

(2) μmg

(3) $\frac{mg\mu}{\sqrt{1+\mu^2}}$

(4) $\frac{mg\sqrt{\mu^2+1}}{\mu}$

49. A real gas deviates most from ideal behaviour at

(1) High temperature and Low pressure

(2) High pressure and Low temperature

(3) High pressure and High temperature

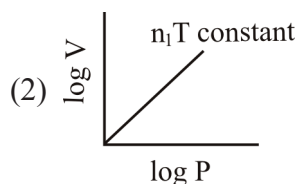
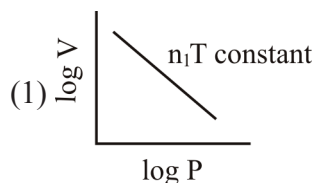
(4) Low pressure and Low temperature

INTERACTIVE SECTION

Student have to solve either left hand side (LHS) questions OR right hand side (RHS) questions. RHS section is for Google Science Fair (GSF) enthusiasts. EHF will be conducting science camp (LEVEL-3) to help students prepare for online GSF participation. The online camp will be conducted by retired IIT-Delhi Professors. Equal preference will be given to students solving either of these sections. More details of online GSF is available on EHF Website www.eduhealfoundation.org

LHS SECTION

50. The Boyle's law can be expressed graphically as



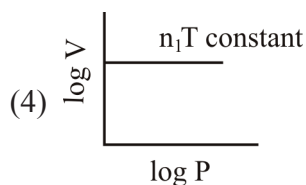
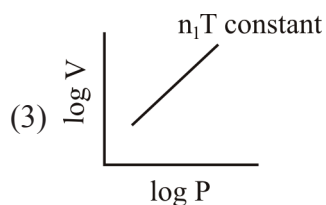
RHS SECTION

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50. The diagram shows the sequence of bases in a strand of DNA that codes for a polypeptide composed of ten amino acids. An additional base sequence coding for the start signal is on the left also codes for methionine.

T A C G G T C A A T C T G G T T C T G
G T T C T T C T G A G C A A

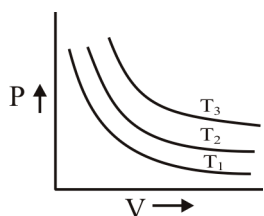
LHS SECTION



51. When the pressure on a gas is decreased to $1/4^{\text{th}}$ and the absolute temperature is increased four-fold, the volume of the gas

- (1) Increases by 16 times
- (2) decreases to $1/16$
- (3) Increases by 8 times
- (4) remains the same

52. From the graph the correct order of temperature for the given mass of gas is



- (1) $T_1 < T_2 < T_3$
- (2) $T_1 = T_2 = T_3$
- (3) $T_1 > T_2 > T_3$
- (4) $T_1 < T_2 > T_3$

53. Match the following

List - 1

(A) Average velocity

(B) Most probable velocity

(C) Kinetic energy of gas

List - 2

(1) $\frac{3}{2}nRT$

(2) $\sqrt{\frac{8RT}{\pi M}}$

(3) $\sqrt{\frac{2RT}{M}}$

RHS SECTION

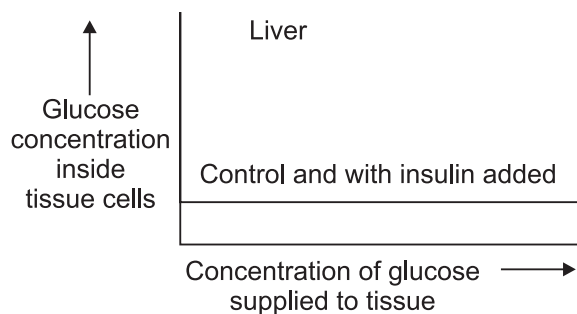
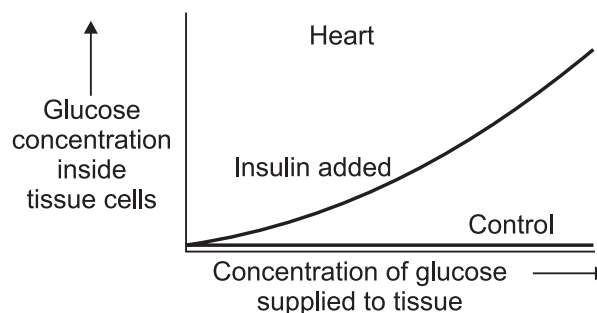
When the polypeptide for which this gene codes was hydrolysed, it yielded the amino acids shown in the table.

Amino acid	Number of amino acid residues per polypeptide
w	1
x	2
y	3
z	4

The correct sequence of amino acids in the polypeptide is:

- (1) y x z y z y z z w x
- (2) y z x y z z y z w x
- (3) z x y z y z y y w z
- (4) x y z x z y z z w y

51. The graphs show the effect of insulin on the glucose concentrations inside the cells of liver and of heart muscle when these two tissues were supplied with increasing concentrations of glucose.



LHS SECTION

(D) RMS velocity (4) $\sqrt{\frac{3RT}{M}}$

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

(2) A - 4; B - 2; C - 1; D - 1

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

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

54. The reaction between gaseous NH_3 and HBr produces a white solid NH_4Br . Suppose that NH_3 and HBr are introduced simultaneously into the opposite ends of 1 metre long glass tube having uniform cross-sectional area under the same condition of temp. and pressure. Where would you expect the white solid to form ?

(N = 14, H = 1, Br = 80)

(1) At a distance of 34.5 cm from NH_3 end

(2) At a distance of 68.5 cm from NH_3 end

(3) At a distance of 44.45 cm from HBr end

(4) At a distance of 45.45 cm from HBr end

55. Which among the following statements about the reaction given below are **CORRECT**?



(I) Manganese oxide is oxidised

(II) Hydrogen Chloride is reduced

(III) Manganese oxide is oxidising agent

(IV) Hydrogen Chloride is reducing agent

(1) I and II

(2) III and IV

(3) II and IV

(4) I, II, III and IV

RHS SECTION

The best interpretation of these data is that:

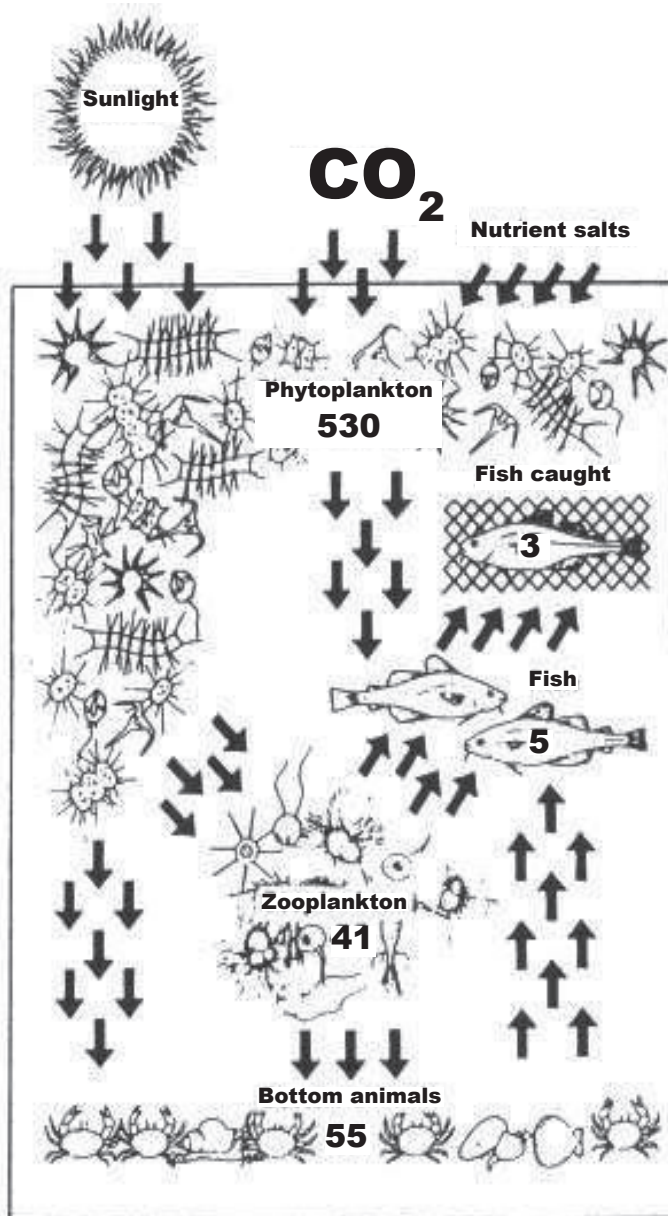
(1) Insulin increases the entry of glucose into the heart tissue but not into liver cells.

(2) Insulin increases the entry of glucose into heart and liver cells.

(3) Liver cells are impermeable to glucose.

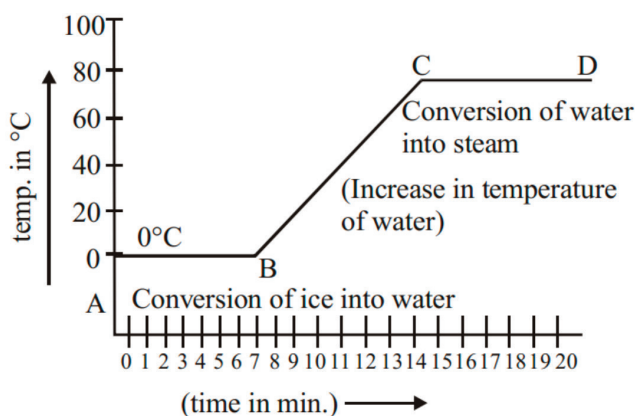
(4) Insulin is metabolised rapidly by liver cells.

52. The percentage of energy transferred from one trophic level is called the ecological efficiency.

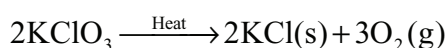


LHS SECTION

56. The inference drawn by the temperature versus time graph are:



- (1) During the melting, temperature of substance does not change
 - (2) Temperature rises after all amount of ice melts.
 - (3) At a specific temperature, water starts boiling and temperature remains the same during the conversion of water into steam.
 - (4) All of these
57. Four students were asked to study the reaction between barium chloride and sodium sulphate. They reported their experiment as follows. Which one is a correct report ?
- (1) On mixing the powder of barium chloride and sodium sulphate, the colour of the mixture changes to brown.
 - (2) On adding powdered sodium sulphate to barium chloride solution; solution becomes white.
 - (3) On adding the powder of barium chloride and sodium sulphate solution; solution turns white.
 - (4) On mixing solution of barium chloride and sodium sulphate, white solid substance is formed
58. The following reaction is used for the preparation of oxygen gas in the laboratory.



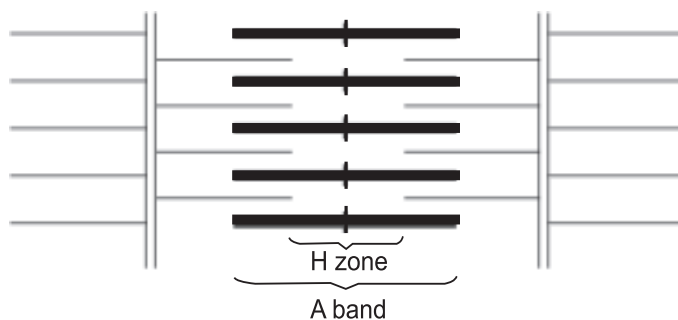
RHS SECTION

The figure summarises the annual production (in million tonnes) in the North Sea. The arrows show the direction of the energy flow.

Calculate the ecological efficiency of the true primary consumers that are feeding solely on phytoplankton.

- (1) 18.1%
- (2) 19.1%
- (3) 10.4%
- (4) 7.5%

53. The diagram shows protein filaments in a muscle myofibril.



Which one of the following, 1 to 4, correctly describes what would happen to the A band and the H zone when the muscle contracts?

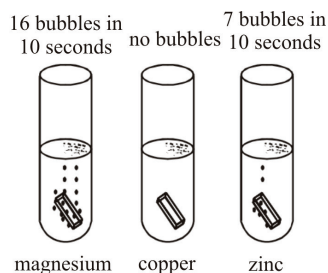
- | A band | H zone |
|-------------|---------|
| (1) shorter | shorter |
| (2) same | same |
| (3) same | shorter |
| (4) shorter | same |
54. The graph show egg production at different population densities of the barnacle (*Semibalanus balanoides*) at three rates of water flow. Which of the following inferences is supported by these data?

LHS SECTION

Which of the following statement about the reaction is correct ?

- (1) It is a decomposition reaction and endothermic in nature.
- (2) It is a combination reaction.
- (3) It is a decomposition and accompanied by release of heat.
- (4) It is a photochemical decomposition reaction and exothermic in nature

59. Different metals react with hydrochloric acid at different rates as shown in the diagrams below. The order from least to most reactive metal is



- (1) zinc, magnesium copper
- (2) copper, zinc, magnesium
- (3) magnesium, zinc, copper
- (4) copper, magnesium, zinc

60. Complete the following table

	A	Z	n
${}^{235}_{92}\text{U}$			
${}^{238}_{92}\text{U}$			

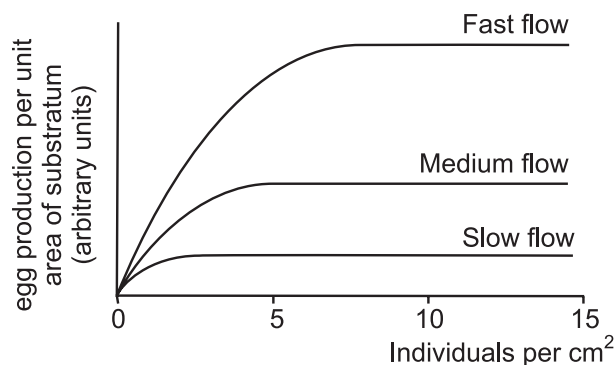
Where A = mass number, Z = atomic number, n = number of neutron. In two different forms of Uranium

- (1) Z is same and n is different.
- (2) Both Z and n are same.
- (3) A is same and n is different.
- (4) Z is different, A is same and n is different

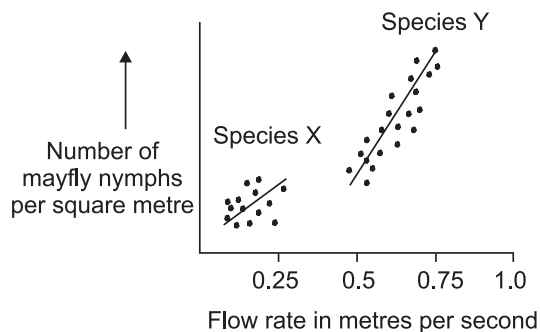


END OF THE EXAM

RHS SECTION



- (1) The greater the population density, the more fertile the organisms become.
 - (2) Beyond a certain population density, overcrowding reduces the rate of egg production by individuals.
 - (3) An inverse relationship exists between the rate of water flow and egg production.
 - (4) A linear relationship exists between population density and egg production at all population densities.
55. The scatter graphs show the relation between the number of mayfly nymphs of two species, X and Y, and the flow rate of the water in which they live. The correlation coefficients for species X is 0.34 and for species Y is 0.87.

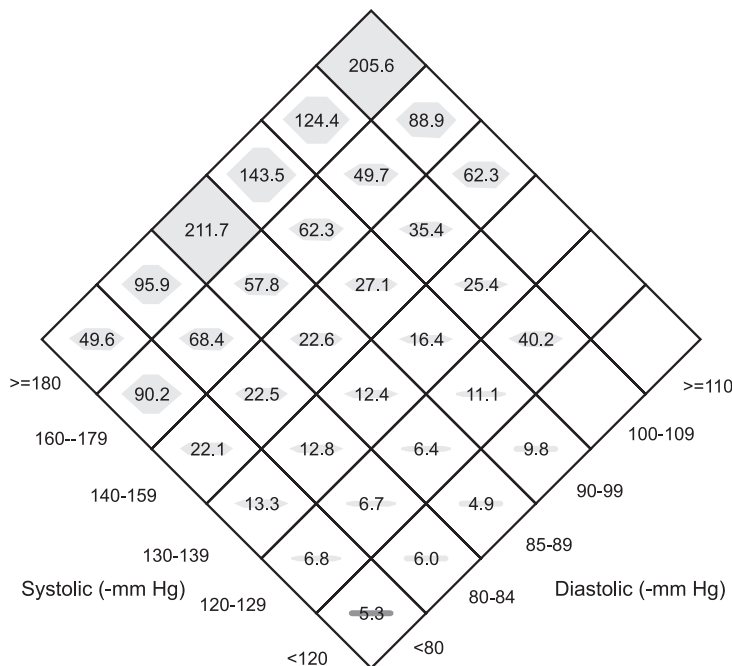


The correlation coefficient for species X is lower than that for species Y because

- (A) The scattering of the points is greater.

- (B) The mean flow rate is less.
 - (C) There are fewer points in its scatter graph.
 - (D) The slope of the line is less.
 - (E) The number of mayfly nymphs per square metre is less.
- (1) B & C (2) A only (3) D & E (4) None of these

56. A new diamond graph method has been developed that can represent 3 variables equally on a 2-D graph. The diamond graph is essentially a 3-D bar graph viewed from above rather than from the side. Instead of using rising parallel bars, the diamond graph uses expanding polygons within a diamond-shaped grid to represent values. This diamond graph depicts the age-adjusted incidence rates of end-stage renal disease due to any cause per 100,000 person-years according to six categories of both systolic and diastolic blood pressure.



(Li, -Buechner, arwaer, and Munoz, 2003)

What is the incidence per 100,000 person-years of end-stage renal disease expected in individuals with a blood pressure of 170/100 (mm Hg)

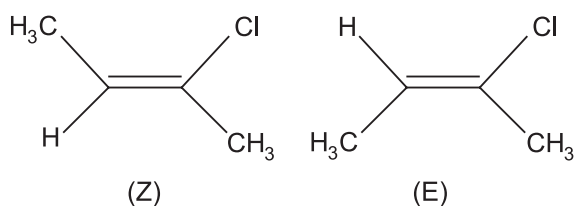
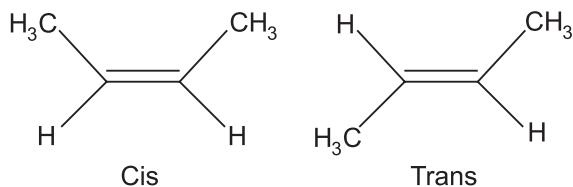
(A) 143.5 (B) 124.4 (C) 62.3 (D) 49.7

(E) None of the above.

- (1) A only (2) Either B or C (3) Either C or D (4) D only

57. Geometric isomers are molecules which have the same molecular formula with the same connectivity between atoms but which have a different orientation across a double bond. The diagram below shows the different types of geometric isomers.

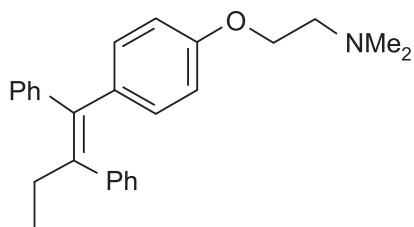
Geometric isomers



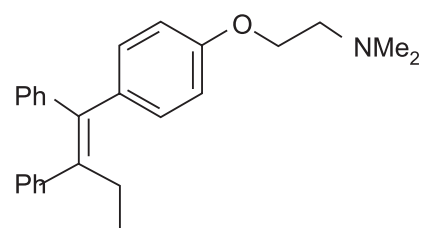
When both sides of the double bond contains the same 2 groups, then cis and trans is used. Cis = same side, Trans = opposite sides.

When different groups are attached to either side, Z and E is used. Z is when the higher priority groups (ranked according to the Cahn-Ingold-Prelog rules) are orientated on the same side across the double bond. Zusammen is the German word for together. E is when the higher priority groups are orientated on different sides across the double bond. Entgegen is the German word for opposed.

The isomerization of a molecule may have significant effects on its biological function. Tamoxifen is an antiestrogenic drug used to treat and prevent a form of breast cancer without the negative side effects of traditional chemotherapy. It exists as (Z)-Tamoxifen and its structure is shown below (1). It also exists less commonly as another isomer (2) that has estrogenic activity and therefore promotes the growth of breast cancer.



(Z)-Tamoxifen (1)
Antiestrogenic activity

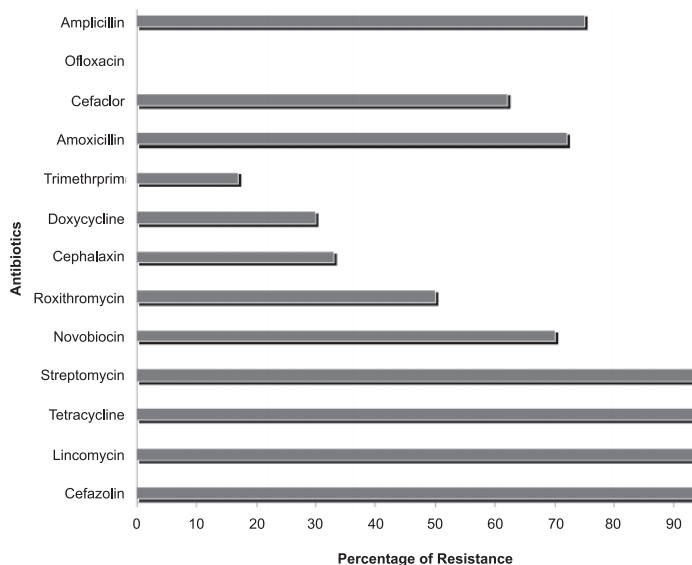


(E)-Tamoxifen (2)
Estrogenic activity

Isomer 2 is best described as:

- (1) Cis-Tamoxifen
- (2) Trans-Tamoxifen
- (3) Cis(Z)-Tamoxifen
- (4) E-Tamoxifen

58. Bacterial contamination of meat was studied in Karachi, Pakistan in 2010. Of the 342 bacterial pathogens isolated from meat samples, 120 (35%) were identified as *Escherichia coli* and 51 (15%) of these *E. coli* isolates were characterized as serotype 0157:H7, which is known to cause hemorrhagic colitis. Other potentially pathogenic isolates were *Listeria* species 14 (4%), *Klebsiella* 27 (8%), *Enterobacter* species 51 (15%), and *Staphylococcus aureus* 24 (7%). Antibiotic susceptibility was tested on the total microbial population and the results are shown below.



Ali, et al. 2010. Microbial contamination of raw meat and its environment in retail shops in Karachi, Pakistan. *J Infect Dev Ctries*; 4(6):382-388.

What is the probability that a pathogenic bacterium chosen at random would be *E. coli* 0157:H7 that is resistant to Novobiocin?

- (A) 0% (B) 10.50%
 (C) 12.60% (D) 70.15%
 (E) 24.5%
- (1) B only (2) Either C or D
 (3) A only (4) None of these

Direction for Q. 59

Conservation of the critically endangered Maui's dolphin requires a good understanding of the trends in abundance and effective population sizes so that conservation actions can be planned and evaluated. Department of Conservation (2012) reported on the genetic monitoring of the Maui's dolphin using DNA profiles to estimate the current abundance and effective population size, as well as to document movements of individuals. The study collected of 37 dart-biopsy samples in

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summer 2010 and a further 36 in summer 2011. DNA profiles were completed for each sample and the sex was identified. These profiles were used to identify individual Maui's dolphins and Hector's dolphin migrants, to describe individual movements, and to estimate the abundance, population trend and effective population size of Maui's dolphins for 2010–11, including comparison with data from a previous set of samples collected in 2001–07.

Based on the microsatellite genotyping, 26 individuals were identified from the 37 samples collected in 2010 (16 females, 10 males) and 27 individuals from 36 samples collected in 2011 (16 females, 11 males). Twelve individuals were sampled in both 2010 and 2011, and with the addition of one unique male washed up on a beach in 2010, this provided a minimum census of 42 individuals (25 females, 17 males) alive at some point during the two years of the survey. Of this total, two females were identified as West Coast South Island Hector's dolphin (*C. h. hectori*) migrants based on distinct mtDNA haplotypes and genotype-based population assignment procedures.

Population size can be estimated by the Lincoln-Petersen estimator:

$$N = [(n_1+1)(n_2+1)/(m_2+1)] - 1$$

Where N = abundance

n_1 = number of individuals sampled in occasion 1

n_2 = number of individuals sampled in occasion 2

m_2 = number of individuals sampled in both occasions 1 and 2

An Expert Panel of New Zealand and international scientists, convened by the New Zealand government in 2012, estimated that five Maui's dolphins were killed in fishing gear each year – one in trawl fisheries and four in gillnet fisheries. The number of gillnet mortalities per year is estimated to have decreased from four to at best two per year as a result of the 350 sq. km set net restriction extension. The Ministry of Primary Industries (MPI) and the Department of Conservation (DOC) reviewed the Maui's dolphin portion of the Threat Management Plan (TMP) in 2013. During the TMP review process it was highlighted that non-fishing-related threats such as seismic surveying, oil and gas exploration, vessel strikes, and disease also pose a serious risk to the long-term viability of Maui's dolphins. These threats represented 4.5% of the estimated dolphin mortalities. The importance of both the fishing and nonfishing risks needs to be assessed relative to the Potential Biological Removal (PBR) level which is defined as the number of human-caused deaths the stock can withstand annually. The PBR for Maui's dolphins is one dolphin in 10 – 23 years or 0.044 – 0.1 per year.

For Maui's dolphin the impact of seismic surveying was combined within all mining and oil activities. This was estimated to contribute to the equivalent of 0.10 deaths per year (95% confidence interval 0.01-0.46), with a 61.3% likelihood of exceeding the PBR. In terms of seismic surveying, the greatest concern is noise in the marine environment. Noise leading to trauma was

scored at 0.01 deaths per year (95% CI: <0.01-0.13) and a likelihood of exceeding the PBR of 8.8%, while non-trauma noise effects was scored at 0.03 deaths per year (95% CI: <0.01-0.23) and a likelihood of exceeding the PBR of 28.6%.

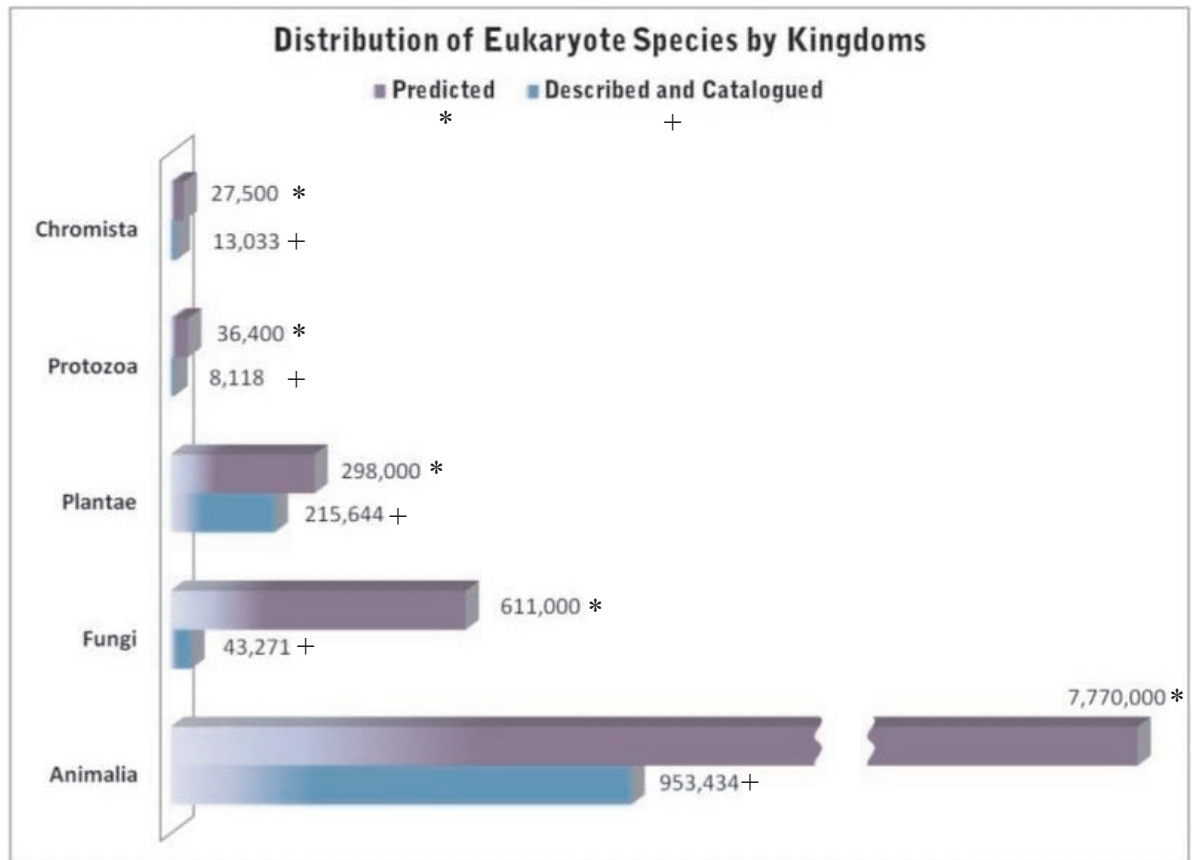
The Minister of Conservation has proposed the following measures:

- Making the Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations a mandatory standard by reference under section 28 of the Marine Mammal Protection Act.
- Developing a voluntary code of conduct with the inshore boat racing community to minimise the potential for vessel strike, and
- Ensuring that disease investigations are a priority in the Maui's dolphin Research Advisory Group.

There has been no recommendation to prevent set net and trawl fishing throughout the range of Maui's dolphins as to do so would need to extend fishing restrictions as far south as Whanganui, out to the 100 m depth contour, and include all harbours.

59. Considering all the scientific evidence you have available about the Maui's dolphin, what would you recommend that the government does to protect this critically endangered dolphin?
- (A) The extension to the set netting restricted areas together with the new codes of conduct for acoustic surveying and boat racing is sufficient.
- (B) Ban set netting and mining and oil activities within the West Coast North Island Marine Mammal Sanctuary.
- (C) Ban set netting throughout the range of Maui's dolphins including south to Whanganui, out to the 100m depth contour and within all harbours.
- (D) Prevent all mining and oil activities within the West Coast North Island Marine Mammal Sanctuary.
- (E) Ban trawl fishing, set netting, and mining and oil activities throughout the range of Maui's dolphins including south to Whanganui, out to the 100m depth contour and within all harbours.
- (1) A, B & C
- (2) E only
- (3) C, D & E
- (4) B, C & D
60. Eukaryotes are organisms with their DNA organised in chromosomes, found in a distinct nucleus. Eukaryotes include algae, fungi, plants, and animals. Prokaryotes are single-celled organisms that have neither a nucleus nor other organelles. Prokaryotes include bacteria and cyanobacteria. There are approximately 8.7 million species of eukaryotes on earth – the relative size of each eukaryote group is listed below.

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From the information provided, the best conclusion is?

- (1) Fungi are not well described as a taxonomic group.
- (2) Animals have gone through the most evolution.
- (3) Eukaryotes are better described than prokaryotes.
- (4) There are not many prokaryotes on Earth.



END OF THE EXAM