



ICATS **SCIENCE**

Contest 2017

**ADOLESCENTS
GRADE 9 & 10 / O-LEVELS**



INTERNATIONAL
CATS CONTESTS

COMPETENCE & APTITUDE TESTING SERVICES

ICATS SCIENCE CONTEST 2017

ADOLESCENTS (GRADE 9 & 10 / O-LEVELS)

TIME ALLOWED : 90 MINUTES

MAXIMUM MARKS : 90

TOTAL QUESTIONS : 30 MCQS

INSTRUCTIONS

1. DON'T START ATTEMPTING THE PAPER UNTIL INSTRUCTED BY THE INVIGILATORS.
2. INSTRUCTIONS FROM THE EXAMINATION INVIGILATORS MUST BE CARRIED OUT PROMPTLY.
3. WRITE YOUR NAME, FATHER NAME, SCHOOL NAME, ADDRESS ETC AT THE BUBBLE SHEET (ANSWERSHEET) ONLY.
4. RECORD ALL ANSWERS ON THE BUBBLE SHEET ONLY. SELECT BEST ANSWER FROM THE FOUR GIVEN OPTIONS AND MARK ONLY ONE OPTION IN EACH QUESTION.
5. USE BLUE / BLACK INK TO FILL UP THE CIRCLES FOR YOUR ANSWERS ON THE BUBBLE SHEET. USE OF LEAD PENCIL IS NOT ALLOWED.
6. USE OF ANY HELPING MATERIAL INCLUDING CELL PHONES AND ELECTRONIC DEVICES IS STRICTLY PROHIBITED.
7. EVERY CORRECT ANSWER EARNS THREE POINTS. THERE WOULD BE NEGATIVE MARKING. ONE POINT WOULD BE DEDUCTED FOR EVERY INCORRECT ANSWER.
8. CANDIDATES MAY NOT LEAVE THE EXAMINATION ROOM UNESCORTED FOR ANY REASON, AND THIS INCLUDES USING THE WASHROOM.
9. NO MATERIALS OR ELECTRONIC DEVICES SHALL BE BROUGHT INTO THE ROOM.
10. THERE ARE FIVE CATEGORIES OF THE CONTEST AS UNDER:
 - A. TODDLERS (GRADE 1 & 2)
 - B. KIDS (GRADE 3 & 4)
 - C. JUNIORS (GRADE 5 & 6)
 - D. JUVENILES (GRADE 7 & 8)
 - E. ADOLESCENTS (GRADE 9 & 10 / O-LEVELS)
11. ONLY REGISTERED STUDENTS CAN PARTICIPATE IN THE CONTEST.
12. NO CANDIDATE SHALL TAKE OUT OF THE HALL ANY ANSWER BOOK(S) OR PART OF AN ANSWER BOOK, WHETHER USED OR UNUSED, OR OTHER SUPPLIED MATERIAL.
13. IF A PARTICIPANT DOES NOT UNDERSTAND A WORD OR PHRASE ON THE EXAM PAPER, NEITHER EXAMINER NOR INVIGILATOR IS PERMITTED TO ANSWER.
14. FOR INFORMATION ABOUT UPCOMING CONTESTS OR PROVIDING VALUABLE FEEDBACK, PLEASE VISIT WWW.CATSCONTESTS.ORG
15. ANY ACADEMIC MISCONDUCT OR MALPRACTICE MUST BE REPORTED TO INTERNATIONAL CATS CONTESTS AT INFO@CATSCONTESTS.ORG

Q1. A student is investigating the effect of plants on indoor air quality and states, "If plants are added to an indoor environment, the air quality will improve". This statement is an example of -

A a theory

B a procedure

C an observation

D a hypothesis

Q2.

Unknown Organism

- Nucleus present
- Mitochondria present
- Multicellular
- Cells grow in columns
- Cell wall made of chitin
- Decomposer

This chart shows observations made of an unknown organism. Based on this information, the organism most likely belongs to the kingdom -

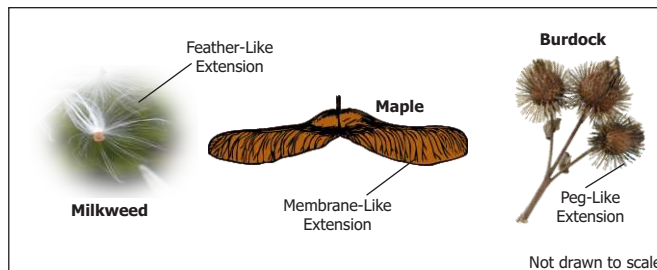
A Fungi

B Plantae

C Eubacteria

D Animalia

Q3. Which statement is an inference based on this information?



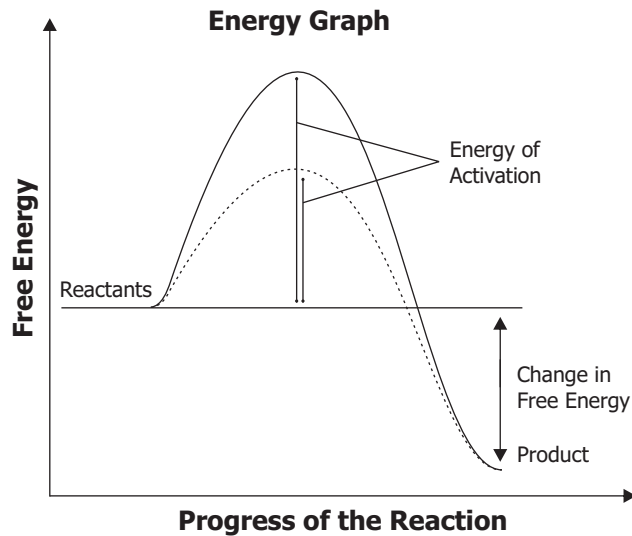
A Plant seeds have different shapes.

B Milkweed seeds are dispersed by wind.

C Maple seeds have a membrane-like extension.

D Burdock seeds have short, peg-like extensions.

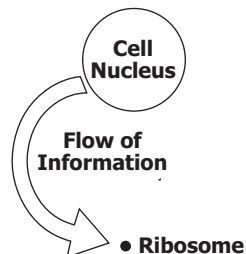
Q4.



What can be concluded from this graph?

- A** The reactants have less energy than the products.
- B** The enzyme is consumed during the course of the reaction.
- C** The enzyme lowers the energy of activation for the reaction.
- D** The amount of free energy produced in the reaction increases with an enzyme.

Q5.



The arrow in the diagram represents the movement of which molecular structure?

- A** DNA molecule
- B** mRNA molecule
- C** Base pair
- D** Protein

Q6.

Comparison of Transpiration Rates Over a 60 Hour Period

Humidity (%)	Plant Species Group (10 plants each)	Type of Soil (200 g)	Average Transpiration Rate ($\text{g}/\text{dm}^2/\text{hr}$)
35	Species 1	Sand	23.5
	Species 1		21.6
46	Species 1	Sand	20.4
	Species 1		23.8
58	Species 1	Sand	18.8
	Species 1		22.9
70	Species 1	Sand	14.4
	Species 1		16.5

A student wanted to compare the transpiration rates of two different plant species at varying levels of humidity. The results are recorded in the table shown. Each plant group was given the same amount of water and light throughout the investigation. Which procedure should have been performed to prevent error in this investigation?

- A** One type of plant should have been tested.
- B** Fewer plants should have been included in each group.
- C** The percentage of humidity should have been kept constant.
- D** Both groups should have been tested in the same soil type at each humidity level.

Q7.

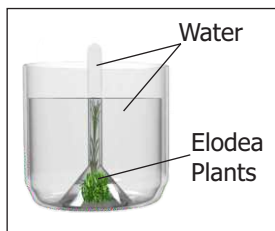
Molly has blonde hair, short legs, and can roll her tongue. She can also play the piano very well.

Which of the following rows identifies examples of discrete variation and continuous variation?

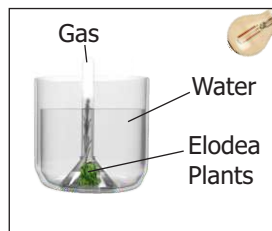
Row	Discrete Variation	Continuous Variation
A.	Leg length	Ability to roll tongue
B.	Ability to roll tongue	Leg length
C.	Ability to play piano	Natural hair colour
D.	Natural hair colour	Ability to play piano

Q8.

Student Experiment With Elodea Plants



24-Hour Setup Without Light



24-Hour Setup With Light

After 24 hours, the amount of gas that accumulated at the top of the inverted test tube is measured. The students conclude that the light source is causing the water to evaporate, causing water vapor to fill the top of the tube. The best alternative explanation of the differences between the setups is that the -

- A** gravity increased the downward flow of the trapped water
- B** metabolism of the elodea plants absorbed CO_2 from the water
- C** heat from the light source caused the escape of dissolved gas
- D** light caused the elodea plants to photosynthesize, releasing O_2 gas

Q9.

Physical Adaptations Observed in Four Organisms

I	Durum wheat is high in protein and gluten, which makes it suitable for use in pasta and bread.
II	The beak of a golden eagle is sharp and strong, which makes it useful for ripping and tearing meat.
III	The broad leaves on a maple tree make it efficient at gathering sunlight for photosynthesis.
IV	Wolves have large ridges of bone on the back of their skulls that allow the anchoring of strong jaw muscles.

Which physical adaptation is a result of artificial selection?

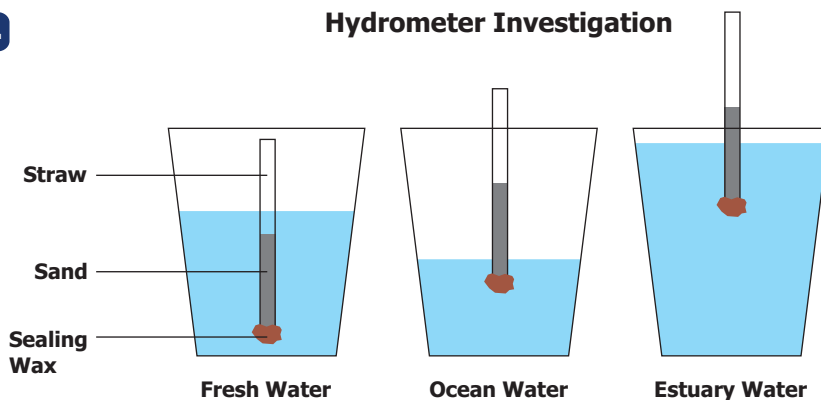
- A** I
- B** II
- C** III
- D** IV

Q10. Which of the following substances is a strong electrolyte when dissolved in water?

- A** NaNO_3
- B** $\text{C}_2\text{H}_5\text{OH}$
- C** S_2Cl_2
- D** $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

Q11.

Hydrometer Investigation



Students made a hydrometer by sealing the end of a straw with wax and adding some sand until the hydrometer barely floated in fresh water. The diagram shows what the students observed when they used the hydrometer to test water from three different sites. Each water sample had the same temperature. Which of these explanations best fits these observations?

- A Estuaries are less salty than fresh water.
- B Oceans support more microbes than fresh water.
- C Salt water is denser than fresh water.
- D Ocean water can freeze at lower temperatures than fresh water.

Q12.



Equilibrium has been reached for the reaction shown. Which conclusion is correct?

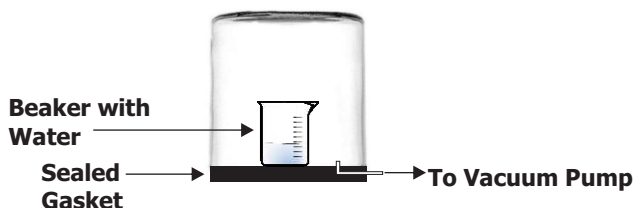
- A The N_2 and F_2 together will form at a faster rate than the NF_3
- B The partial pressures of N_2 , F_2 , and NF_3 will stay constant.
- C The NF_3 will form at a faster rate than the N_2 and F_2 together.
- D The partial pressure of NF_3 will keep changing.

Q13. How many atoms are present in 179.0 g of iridium?

- A 5.606×10^{23} atoms
- B 6.464×10^{23} atoms
- C 1.078×10^{26} atoms
- D 1.157×10^{26} atoms

Q14.

Thick-Walled Vacuum Jar



A beaker of water is placed in a large sealed jar that is attached to a vacuum pump. As air is pumped out of the jar, the water begins to boil because-

- A** the temperature of the water decreases as the surrounding pressure decreases
- B** the lower pressure inside the jar causes the water to contract
- C** the air pressure in the jar has been lowered until it is equal to the vapor pressure of the water
- D** the pressure on the water is insufficient to hold the hydrogen and oxygen atoms together, resulting in a decomposition reaction

Q15.

Data Table

Solution	Brightness of Light Bulb	pH
NaHCO_3	Bright	8.4
HClO	Dim	3.7
NaNO_3	Bright	7.0
CH_3NH_2	Dim	8.0

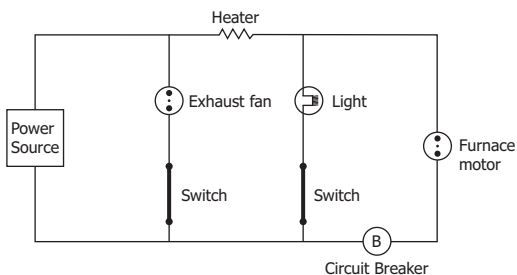
Based on the information provided, which solution is a base and a weak electrolyte?

- A** NaHCO_3
- B** HClO
- C** NaNO_3
- D** CH_3NH_2

Q16.

Use the following information to answer question.

Electrical Circuit of a Garage



The component that is protected by the circuit breaker when both switches are closed is the

- A** furnace motor
- B** exhaust fan
- C** heater
- D** light

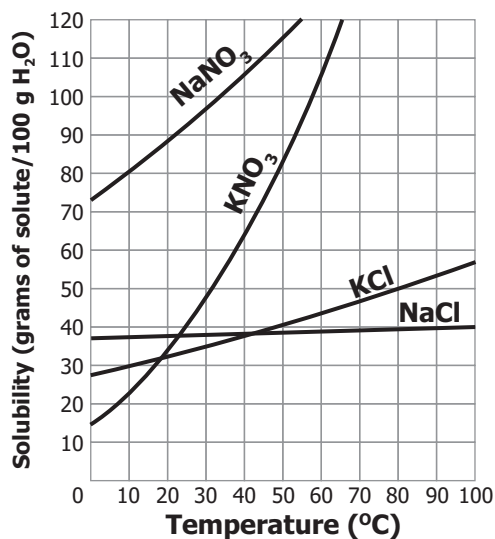
Q17. Solid copper wire, Cu, is placed in a colourless, silver nitrate solution, AgNO_3 . After 15 minutes, the solution has turned blue and silver crystals have formed. A reference text states that when dissolved in water:

- Cu^{+2} ions are blue.
- Ag^+ ions are colourless.
- NO_3^- ions are colourless.

Which of the following is the best conclusion?

- A** The silver atoms have lost electrons forming ions.
B The copper atoms have lost electrons forming ions.
C The silver atoms have gained electrons forming ions.
D The copper atoms have gained electrons forming ions.

Q18. The solubility of an unknown substance was tested during an experiment.



Mass of Unknown Solute That Dissolves in 100 g water

Trial	30°C	40°C	50°C
1	46.0 g	63.2 g	80.2 g
2	45.9 g	61.4 g	81.3 g
3	44.3 g	62.9 g	79.8 g
Average	45.4 g	62.5 g	80.4 g

Based on the solubility curve information and the results of the experiment, what is most likely the identity of this unknown solute?

- A** NaCl **B** KCl **C** KNO_3 **D** NaNO_3

Q19. The following table lists some properties of copper and sulphur.

Property	Copper	Sulphur
Color	Reddish	Pale Yellow
Conductor of Electricity	Yes	No
State of matter at room temperature	Malleable solid	Brittle solid
Metal or nonmetal	Metal	Nonmetallic
Luster	Metallic	Dull
Ductile	Yes	No
Density (g/cm ³)	8.96	2.07

Samples of copper metal and sulfur powder are placed in the same test tube and heated over a Bunsen burner. The resulting substance has the following properties.

- Does not conduct electricity
- Has a density of 5.6 g/cm³
- Has a metallic luster
- Is a black brittle crystalline solid

This black substance is classified as —

- A** a heterogeneous mixture **B** an element
- C** a compound **D** a homogeneous mixture

Q20. The table below shows the standard enthalpy of formation for each of three substances.

Compound	ΔH_f° (kJ/mol)
CaCO ₃ (s)	- 1206.9
CaO(s)	- 635.1
CO ₂ (g)	- 393.5

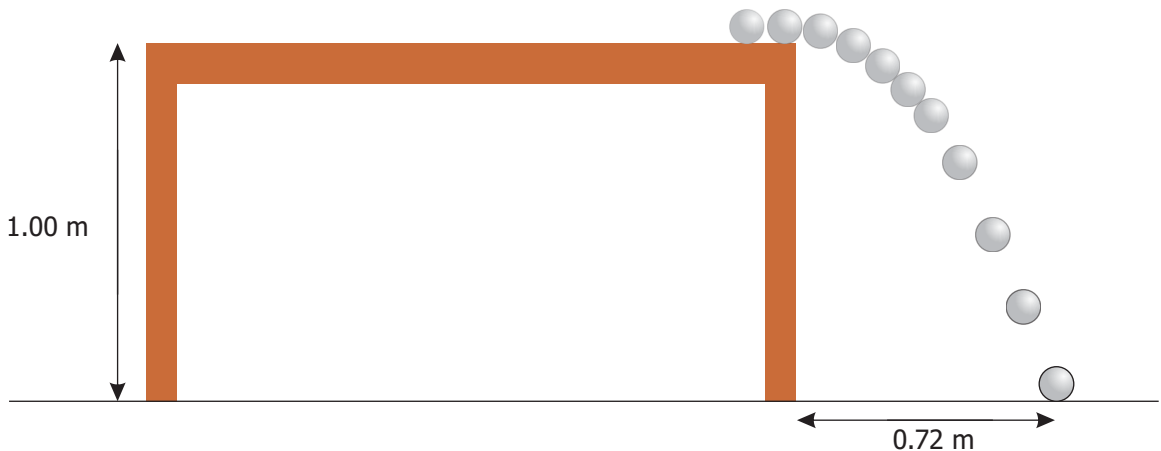
CaCO₃ decomposes according to the equation $\text{CaCO}_3(\text{s}) \xrightarrow{\Delta} \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$. What is the enthalpy of reaction?

- A** 178.3 kJ **B** 571.8 kJ **C** -1029 kJ **D** -2236 kJ

Q21. Which situation is a good example of the transfer of energy through radiation?

- A** A fan cools the CPU in a computer.
- B** Energy passes from one person's hand to another person when they shake hands.
- C** Warm air that is less dense rises to the ceiling of a room.
- D** A snake's body temperature increases when the snake lies in the sun.

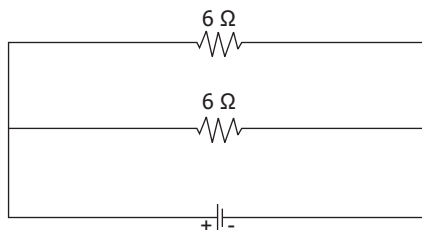
Q22. A tennis ball rolled off the edge of a table that has a height of 1.00 m.



The ball took 0.45 s to hit the ground 0.72 m from the table. What was the horizontal velocity of the ball as it rolled off the table?

- A** 0 m/s
- B** 0.63 m/s
- C** 1.6 m/s
- D** 2.2 m/s

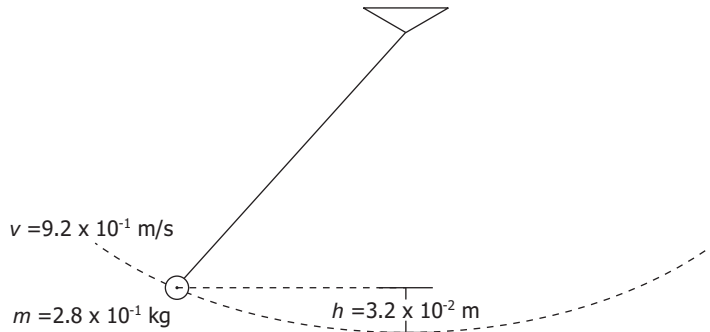
Q23. A schematic diagram of a circuit consisting of two resistors is shown below.



What is the total resistance of the circuit?

- A** 12 Ω
- B** 3 Ω
- C** 2 Ω
- D** 0.33 Ω

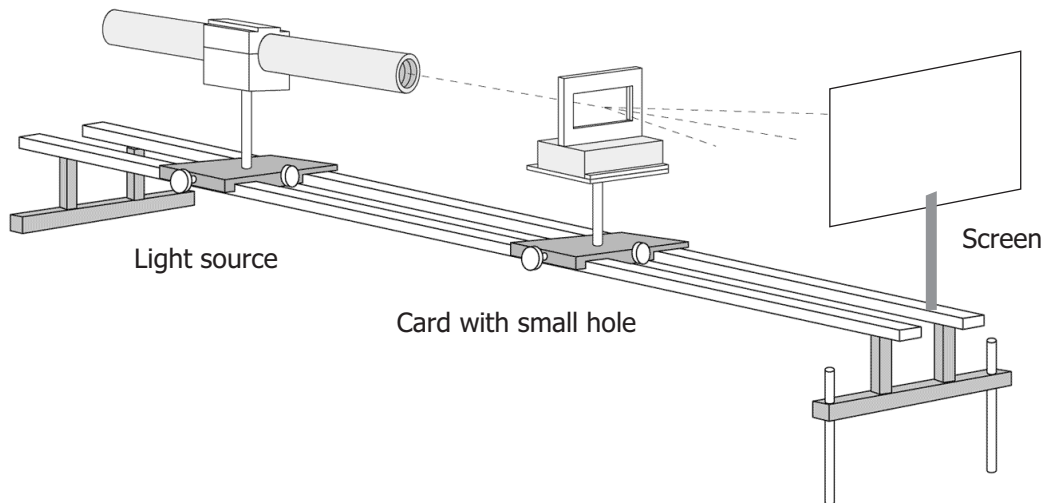
- Q24.** A pendulum swings back and forth along the dashed path shown in the diagram. Its instantaneous velocity for the location shown is given in the diagram.



What is the pendulum's total mechanical energy at the given location with respect to the bottom of the swing?

- A** $3.2 \times 10^{-2} \text{ J}$ **B** $8.8 \times 10^{-2} \text{ J}$ **C** $1.2 \times 10^{-1} \text{ J}$ **D** $2.1 \times 10^{-1} \text{ J}$

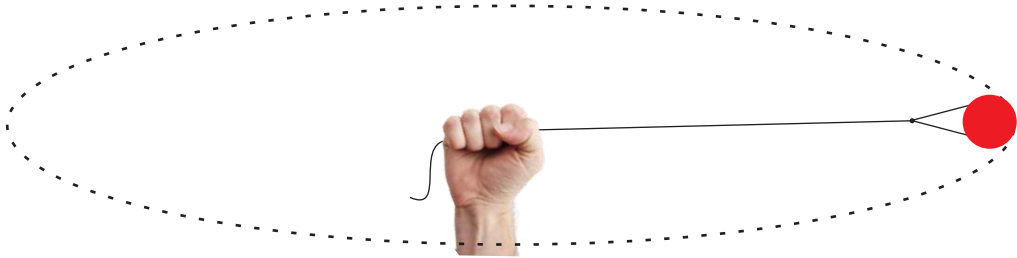
- Q25.** Students use the setup shown below for a lab activity.



The setup is most useful for demonstrating —

- A** absorption **B** diffraction **C** resonance **D** refraction

Q26. A 0.040 kg ball tied to a string moves in a circle that has a radius of 0.700 m



If the ball is accelerating at 43.2 m/s^2 , what is the tangential velocity of the ball?

A 5.50 m/s

B 30.2 m/s

C 1.73 m/s

D 61.7 m/s

Q27. A student releases a ball from a height of 1.5 m above the floor.



Which of the following statements best describes the energy of the ball as it falls?

A Its potential energy is changed to kinetic energy.

B The total amount of its mechanical energy increases.

C Its kinetic energy is changed to potential energy.

D The total amount of its mechanical energy decreases.

Q28. A train passes a stationary observer. Which of the following best describes how the amplitude and the apparent frequency of the sound waves heard by the observer change as the train moves away?

- A** Both the amplitude and the apparent frequency increase.
- B** Both the amplitude and the apparent frequency decrease.
- C** The amplitude of the sound waves increases, and the apparent frequency decreases.
- D** The amplitude of the sound waves decreases, and the apparent frequency increases.

Q29. Which statement best explains the difference between light waves traveling through a vacuum and light waves traveling through a medium?

- A** Light waves traveling through a vacuum are transverse, but light waves traveling through a medium are longitudinal.
- B** Light waves traveling through a vacuum travel faster than light waves traveling through a medium.
- C** Light waves traveling through a vacuum have no mass, but light waves traveling through a medium have a mass greater than zero.
- D** Light waves traveling through a vacuum have a shorter wavelength than light waves traveling through a medium

Q30. The resistance of a wire can be reduced by ___ i ___ the diameter of the wire or by ___ ii ___ the length of the wire.

The statement above is completed by the information in row

Row	i	ii
A.	decreasing	decreasing
B.	increasing	decreasing
C.	decreasing	increasing
D.	increasing	increasing