Questions (INJSO 2009)

Section A: Questions 1 to 60 are multiple choice with every correct answer carrying 1 mark and every wrong answer carrying -0.25 mark.

SECTION A

Q1. Which one of the following expressions has the same units as power?

a) Force x distance
b) Work x time
c) Force x acceleration
d) Force x velocity

Q2. Suppose you are given three resistances of values 2, 4, 6 ohms. Which of the following value is not possible to get by arranging resistances in various combinations?

a) Less than 2
b) Equal to 4.4
c) Equal to 7.33
d) Equal to 6.75

Q3. Green leaf is placed in a dark room is illuminated by red light. The leaf will appear to be

a) Green   b) Red   c) Yellow   d) Black

Q4. The coil of the heater is cut into two equal halves and only one of them is used in the heater. The ratio of the heat produced by the original coil to the halved coil is

a) 2:1   b) 1:2   c) 4:1   d) 1:4

**Q5.** In a very heavy lorry moving on the road with slightly flattened tyres

a) only rolling friction is involved.
b) both rolling and kinetic friction are involved.
c) only kinetic friction is involved.
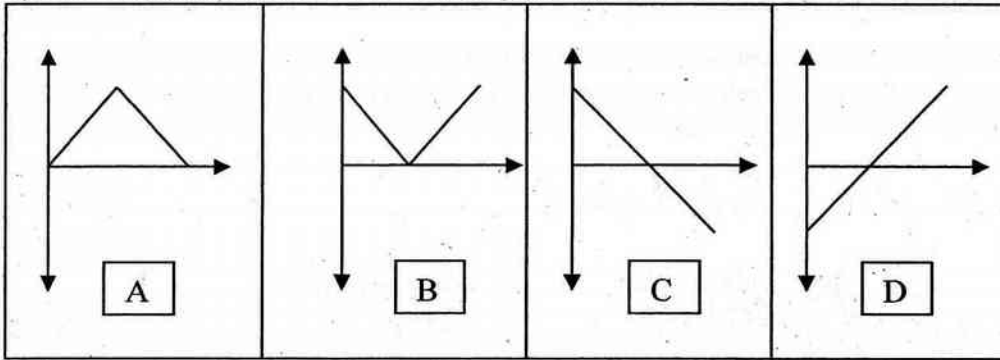d) the type of friction depends on the speed of the lorry.

Q 6. Which of the given velocity: time graphs
(see box in the next page)
matches the given acceleration: time graph which you see at the right?
(Time is plotted along the horizontal axis in all cases.)
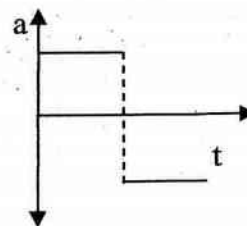
a) A   b) B   c) C   d) D

Q7. A ball is thrown vertically upwards. Ignore air resistance. Take the upward motion as positive. Which one of the following graphs represents the velocity of the ball as a function of time? (Time is plotted along the horizontal axis in all cases.)
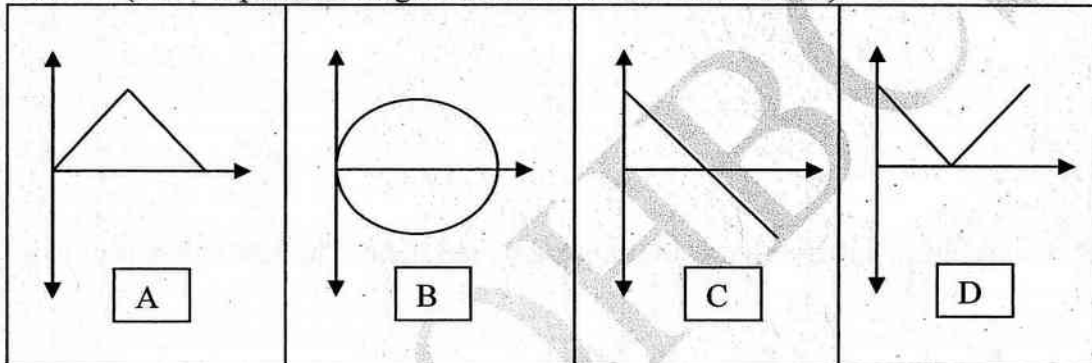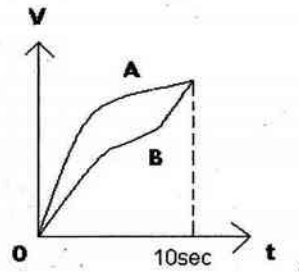

a) A   b) B   c) C   d) D

Q8. The distance 'v' of the real image formed by a convex lens is measured for various object distances 'u'. A graph is plotted between $1/v$ and $1/u$. Which of the following graphs is the correct graph?
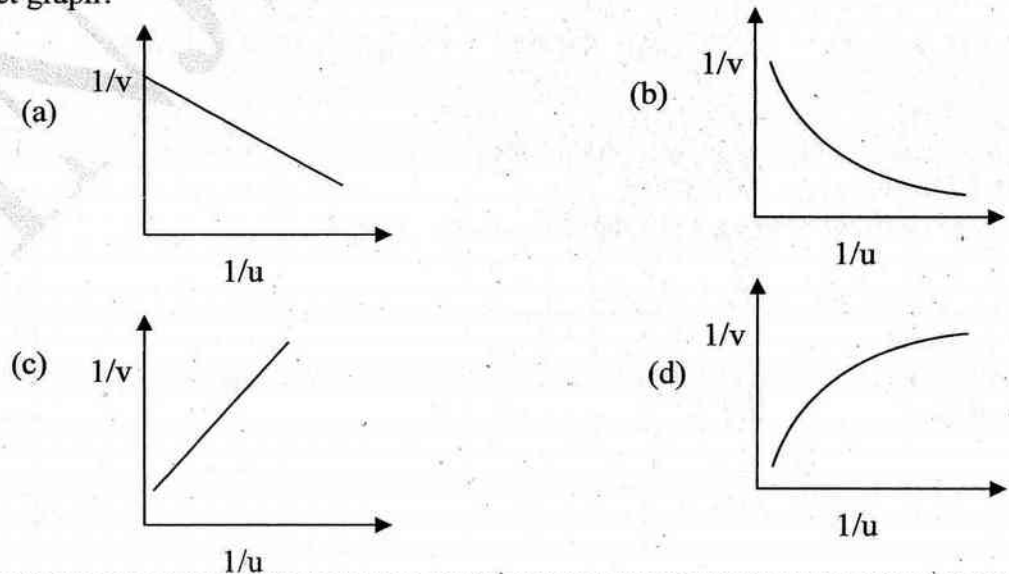
Q9. A graph given, shows the variation of velocity and time of two bodies A and B. Choose an alternative for their average velocities

a) Average velocities of both are same since they have same initial and final velocities

b) Average velocities of both are same since both cover equal distance in equal interval of time

c) Average velocity of A is greater than that of B since it covers more distance than B in 10 sec.

d) Nothing can be said since their accelerations are not given

Q.10. Two identical balls are released simultaneously from on equal heights h. Ball A is thrown horizontally with velocity **v** and the ball B is just released. Choose the alternative that best represents the motion of A and B with respect to an observer who moves with velocity v/2 with respect to the ground as shown in the figure.
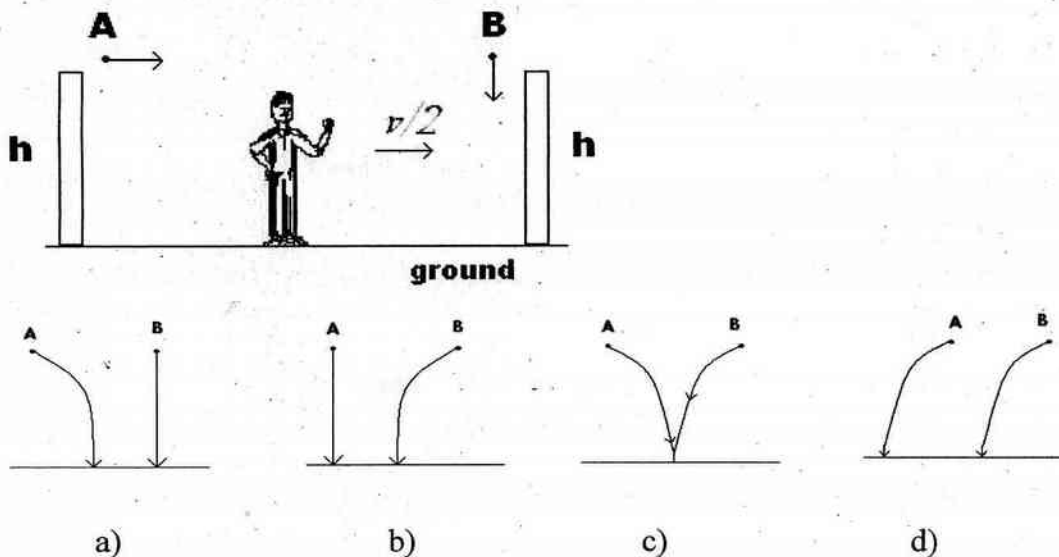
Q11. If M_e is mass of Earth and R_e is the radius of Earth, acceleration due to gravity, g ($\dot= 9.8$ m/s^2) is given by the equation $g = GM_e/R_e^2$. Now, if R is the radius of a star of mass M, which of the following four gives the correct equation for the escape velocity from the star such that it is equal to the speed of light c?

a) $R^2 = \dfrac{2GM}{c^2}$

b) $R = \sqrt{\dfrac{2GM}{c}}$

c) $\sqrt{R} = \dfrac{2GM}{c^2}$

d) $R = \dfrac{2GM}{c^2}$

Q12. In the circuit shown, the total current supplied by the battery is
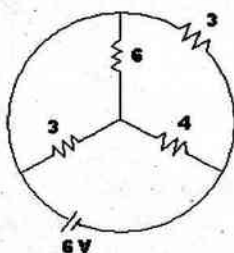
a) 1A   b) 2A   c) 3A   d) 6A

Q13. A satellite orbits the Earth in a circle of radius 8000 km. At that distance from the Earth, $g = 6.2$ m/s^2. The velocity of the satellite is

a) 0.90 km/s   b) 8.9 km/s   c) 7.0 km/s
d) impossible to find without knowing the satellite's mass

Q14. A 230V, 1-kW electric oven is mistakenly connected to 115V power line that also has 15-A fuse. The oven will

a) give off less than 1 kW of heat   b) give off 1kW of heat
c) give of more than 1 kW of heat   d) blow the fuse

Q15. When 20 kJ of heat is removed from 1.2 kg of ice originally at -15° C, its new temperature is

a) -18°C   b) -23°C   c) -26°C   d) -35°C

Q16. A gallon of water and a gallon of antifreeze solution weigh, respectively 8.4 and 9.2 lb. The anti freeze solution has a relative density of

a) 0.095   b) 0.80   c) 0.91   d) 1.1

Q17. A ball whose density is 0.4×10^3 kg/ m^3 falls into water from a height of 9 cm. To what depth does the ball sink? (Hint: Only consider buoyancy and ignore retardation due to viscosity)

a) 9 cm   b) 6 cm   c) 4.5 cm   d) 2.25 cm

Q18. A sealed container at a certain temperature is half full of water. The temperature of the container is increased and maintained till equilibrium is re-established. Which statement is correct when the equilibrium is re-established at the higher temperature?

a) The rate of vaporization is greater than the rate of condensation.
b) The amount of water vapour is greater than the amount of liquid water.
c) The amount of water vapour is greater than what it was at the lower temperature.
d) The rate of condensation is greater than the rate of vaporization.

Q19. The temperature of a substance of mass m (in g) and of specific heat capacity c (in J g^{-1} K^{-1}) increases by t °C . What is the heat change in J ?

a) mct

b) $mc(t + 273)$

c) $\dfrac{mct}{1000}$

d) $\dfrac{mc(t + 273)}{1000}$

Q20. A fixed mass of an ideal gas has a volume of 800 cm^3 under certain conditions. The pressure (in kPa) and temperature (in K) are both doubled. What is the volume of the gas after these changes with other conditions remaining the same?

a) 200 cm^3 b) 800 cm^3 c) 1600 cm^3 d) 3200 cm^3

Q21. What amount of oxygen, O_2, (in moles) contains 1.8×10^{22} molecules?

a) 0.0030   b) 0.030   c) 0.30   d) 3.0

Q22. Which pair of elements reacts most readily?

a) $Li + Br_2$ b) $Li + Cl_2$ c) $K + Br_2$ d) $K + Cl_2$
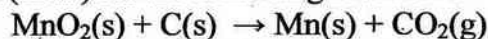
Q23. What is the formula for the compound formed by calcium and nitrogen?

a) CaN b) Ca_2N c) Ca_2N_3 d) Ca_3N_2

Q24. Using the equations below:

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H = -390 \text{ kJ}$$
$$Mn(s) + O_2(g) \rightarrow MnO_2(s) \qquad \Delta H = -520 \text{ kJ}$$
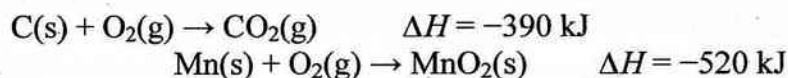
what is ΔH (in kJ) for the following reaction ?
$$MnO_2(s) + C(s) \rightarrow Mn(s) + CO_2(g)$$

a) 910   b) 130   c) −130   d) −910

Q25. The compounds Na_2O, Al_2O_3 and SO_2 respectively are

a) acidic, amphoteric and basic.   b) amphoteric, basic and acidic.
c) basic, acidic and amphoteric.   d) basic, amphoteric and acidic.
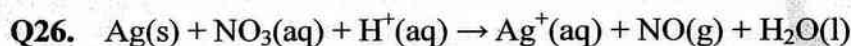
Q26. $Ag(s) + NO_3(aq) + H^+(aq) \rightarrow Ag^+(aq) + NO(g) + H_2O(l)$
When the oxidation-reduction equation above is balanced, what is the coefficient for H^+ (aq)?

a) 1   b) 2   c) 3   d) 4

Q27. Which solution, of concentration 0.10 mol dm^{-3}, has the highest pH value?

a) HCl(aq)   b) $MgCl_2$(aq)   c) NaCl(aq)   d) $AlCl_3$(aq)

Q28. Which compound dissolves in water to form an aqueous solution that can conduct an electric current?

a) CCl_4 b) C_2H_5OH c) CH_3COOH d) CH_4

Q29. At the same Temperature and Pressure which sample contains the same number of moles of particles as 1 liter of O_2 (g)?

a) 1 L Ne (g)   b) 2L N_2 (g)   c) 0.5 L SO_2 (g)   d) 1LH_2O (g)

Q30. The pH of solution **X** is 1 and that of **Y** is 2. Which statement is correct about the hydrogen ion concentrations in the two solutions?

a) $[H^+]$ in **X** is half that in **Y**.
b) $[H^+]$ in **X** is twice that in **Y**.
c) $[H^+]$ in **X** is one tenth of that in **Y**.
d) $[H^+]$ in **X** is ten times that in **Y**.

Q31. Which compound has the empirical formula with the greatest mass?

a) C_2H_6 b) C_4H_{10} c) C_5H_{10} d) C_6H_6

Q32. Which statements are correct for a reaction at equilibrium?
   I.   The forward and reverse reactions both continue.
   II.   The rates of the forward and reverse reactions are equal.
   III.   The concentrations of reactants and products are equal.

a)   I and II only
b)   I and III only
c)   II and III only
d)   I, II and III

Q33. Which of the following combinations of elements of given atomic numbers can lead to a compound with a chemical formula of XY_3?

a) 2 and 6   b) 5 and 15   c) 3 and 18   d) 13 and 17

Q34. Which list of formulas represents compounds only ?

a) CO_2, H_2O, NH_3 b) H_2, N_2, O_2
c) H_2, Ne, NaCl   d) MgO, NaCl, O_2

Q35. As the elements of Group 17 are considered in order of increasing atomic number, there is an increase in

a) atomic radius   b) electronegativity
c) first ionization energy   d) number of electrons in the first shell

Q36. Which equation represents an oxidation-reduction reaction?

a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
b) $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$
c) $MgCrO_4 + BaCl_2 \rightarrow MgCl_2 + BaCrO_4$
d) $Zn(NO_3)_2 + Na_2CO_3 \rightarrow 2NaNO_3 + ZnCO_3$

Q37. Which conclusion was a direct result of the gold foil experiment?

a) An atom is mostly empty space with a dense, positively charged nucleus.
b) An atom is composed of at least three types of subatomic particles.
c) An electron has a positive charge and is located inside the nucleus.
d) An electron has properties of both waves and particles.

Q38. Which sample at STP has the same number of molecules as 5 liters of $NO_2(g)$ at STP?

a) 5 grams of $H_2(g)$ b) 5 liters of $CH_4(g)$
c) 5 moles of $O_2(g)$ d) 5×10^{23} molecules of $CO_2(g)$


Q39. In the ground state, each atom of an element has two valence electrons. This element has lower first ionization energy than calcium. Where is this element located on the Periodic Table?

a) Group 1, Period 4

b) Group 2, Period 5

c) Group 2, Period 3

d) Group 3, Period 4

Q40. Which substance can not be broken down by a chemical reaction?

a) Ammonia   b) Argon   c) Methane   d) Water

Q41. The cells in the following figure were all taken from the same individual (a mammal). Identify the cell division events happening in each cell.
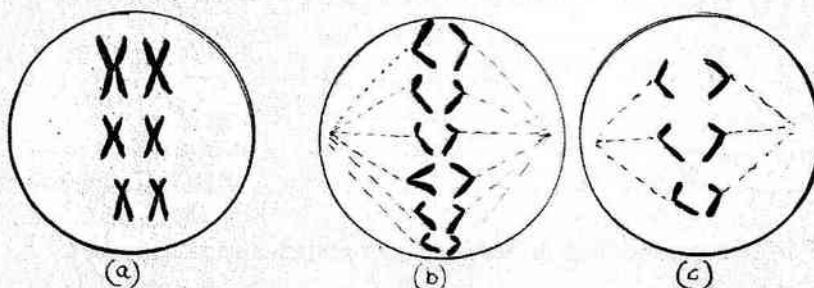
a) (a) Meiotic Metaphase I, (b) Mitotic Anaphase, (c) Meiotic Anaphase II

b) (a) Mitotic Metaphase, (b) Mitotic Anaphase, (c) Meiotic Anaphase II

c) (a) Mitotic Metaphase, (b) Mitotic Anaphase, (c) Meiotic Anaphase I

d) (a) Meiotic Metaphase II, (b) Meiotic Anaphase I, (c) Meiotic Anaphase II

Q42. One form of color blindness in humans is caused by a sex linked recessive mutant gene. A woman with normal color vision and whose father was color blind marries a man of normal vision whose father was also color blind.
Which of the following correctly represents phenotype of ♀ and ♂ offsprings?

a) All daughters have normal color vision, all the sons were color blind

b) Half the daughters and half the sons were color blind

c) All daughters have normal color vision and half the sons were color blind

d) Half the daughters were color blind and all the sons had normal color vision

Q43. The sense of taste is normally caused by the stimulation of chemoreceptors in the taste buds of the tongue. There are four main 'tastes': sweet, salty, bitter and sour. The tongue also has receptors for temperature. It is known that the taste of food can vary according to whether it is cold, warm or hot. Scientists discovered that just warming or cooling parts of the tongue, even when no food was present, also caused a sensation of taste.

Scientists experimented with a group of people. They gradually cooled the tips of their tongues and measured the intensity of the taste felt by each member of the group. The

experiment was repeated, this time warming the tip of the tongue. The graphs show the average values for the group.

Identify which taste was felt most strongly when the tip of the tongue was cooled

a) Bitter   b) Sour

c) Sweet   d) Cannot decide from the data given

Q44. A person wants to eat a particular food item which he loves the most. That particular piece of item is sweet but also has some sourness in it. Then which of the following statements are true, looking at the graph given in question no 43.

     i)   The food item should not be cooled below 25 degrees to enjoy the sweetness

     ii)   The item can be enjoyed the most if taken around 30 degrees temperature.

     iii)   The food item can be cooled to 5 degrees for enjoying its salty taste

a)   Only i   b)   i,ii   c)   i,ii,iii   d)   ii,iii

Q45. What is/are the advantage(s) of using an electron microscope?

     I.   Very high resolution

     II.   Very high magnification

     III.   The possibility of examining living material

a) I only   b) I and II only   c) II and III only   d) I, II and III

Q46. Of the following products, which is produced by both anaerobic respiration and aerobic respiration in humans?

     I.   Pyruvate

     II.   ATP

     III.   Lactate

a)   I only   b)   I and II only

c)   I, II and III   d)   II and III only

Q47. Which organ secretes enzymes that are active at a low pH?

a) Mouth   b) Pancreas
c) Stomach   d) Liver

Q48. The allele for red flower colour (R) in a certain plant is co-dominant with the allele for white flowers (R'). Thus a plant with the genotype RR' has pink flowers. Tall (D) is dominant to dwarf (d). What would be the expected phenotypic ratio from a cross of RR'dd plants with R'R'Dd plants?

a) 9:3:3:1
b) 50 % pink 50 % white, and all tall
c) 1:1:1:1, in which 50 % are tall, 50 % dwarf, 50 % pink and 50 % white
d) 3:1

Q49. Which is not true of active immunity?

a) It can be produced by exposure to a disease causing organism.
b) It can be produced artificially.
c) It can be produced by a virus.
d) It can be transferred via the colostrum.

Q50. Which of the following represents the correct sequence of events when the body is responding to a bacterial infection?
     I.   Antigen presentation by macrophages
     II.   Activation of B-cells
     III.   Activation of helper T-cells

a) I, II, III   b) I, III, II
c) III, II, I   d) II, III, I

Q51. Why do antibiotics kill bacteria but not viruses?

a) Antibiotics stimulate the immune system against bacteria but not viruses
b) Viruses have a way of blocking antibiotics
c) Viruses are too small to be affected by antibiotics
d) Viruses do not have a metabolism

Q52. What is required to form a blood clot?
     I.   Platelets
     II.   Clotting factors
     III.   Antibodies
     IV.   Fibrinogen

a) I and II only   b) I, II and III only   c) I, II and IV only   d) I, II, III and IV

Q53. Where in the kidney does ultra filtration take place?

a)   Glomerulus   b)   Loop of Henlé
c)   Proximal tubule   d)   Collecting ducts

Q54. If a red blood cell has a diameter of 8μm and a student shows it with a diameter of 40mm in a drawing, what is the magnification of the drawing?

a)   × 0.0002
b)   × 0.2
c)   × 5
d)   × 5000

Q55. What is needed in photosynthesis to convert carbon dioxide into organic molecules?

a)   Light and hydrogen from the splitting of water
b)   Light and oxygen from the splitting of water
c)   ATP and hydrogen from the splitting of water
d)   ATP and oxygen from the splitting of water

Q56. Which is the correct sequence of blood flow in normal human circulation?

a)   pulmonary vein → right atrium → aorta → vena cava
b)   vena cava → pulmonary vein → aorta → right atrium
c)   vena cava → right atrium → pulmonary vein → aorta
d)   pulmonary vein → vena cava → aorta → right atrium

Q57. Which of the following adaptations can help a plant to overcome water stress?

a)   Increase in the surface area.
b)   Opening of the stomata
c)   Increased rate of growth
d)   Decrease in shoot to root ratio.

Q58. A pond comprises of fishes, algae, water beetles and copepods. On the bank of this pond is a tree that is home to many birds. Mark the appropriate food chain in the pond.

a) Tree → beetles → copepods → fishes → birds
b) Tree → copepods → beetles → copepods → birds
c) Algae → birds → copepods → beetles → fishes
d) Algae → copepods → beetles → fishes → birds

**Q 59.** When the number of two species of aquatic organisms was monitored over time, the following graph was obtained. Which of the following statements is most likely to be true?
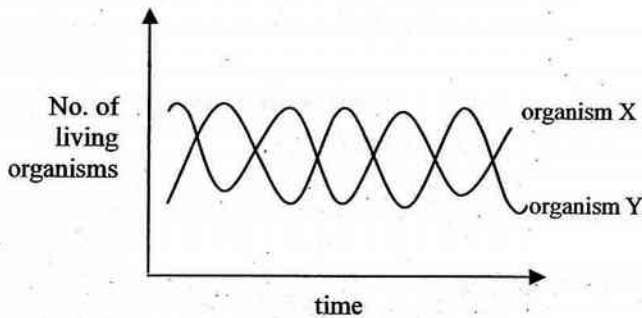
a) One organism is the food of the other.
b) Each organism needs the other type for its survival.
c) Organism X needs Y for multiplication but Y does not need X.
d) One organism is a parasite on the other species.

Q60. A plant cell suspended in a test solution shows the following change in morphology. The test solution possibly could be:
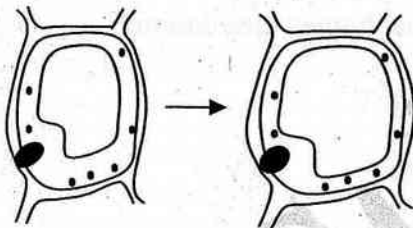
a) Hypertonic containing sodium chloride.
b) Hypotonic containing sucrose.
c) Isotonic containing glucose.
d) Saturated solution of potassium chloride.

Section B: Questions 61 to 68 are 5 marks each. Marks will also be indicated in the questions if there are more than one part to it.

SECTION B (Long questions):

Q61. A) A tortoise is crawling Eastward with velocity $\sqrt{3}$ km/hr and a lazy rabbit is travelling southward with velocity 1 km/hr. With the help of a diagram, find the magnitude and direction of the velocity of the tortoise as observed by the rabbit. Show your working clearly.   (2 marks)

B) A force F varies with time according to F = 4+12t, where F is in Newton and t in seconds. The force acts on a block of mass m = 2.00 kg, which is initially at rest on a frictionless horizontal surface. F makes an angle of 30^0 with the horizontal. When will the force lift the body from the surface? What will the velocity of the body be at that instant?   (3 marks)

Q62. A ball of mass 0.250 kg moves on frictionless horizontal floor and hits a vertical wall with speed 5.0m/sec. The ball rebounds with speed 40m/sec. If the ball was in contact with the wall for 0.150 sec, find the average force that acted on the ball. If the force is assumed to vary with time as shown in the figure, deduce the maximum force that acted on the ball.

     A second harder ball of identical mass to the first also bounces of the wall with same initial and final speed, but stays in contact with the wall for only 0.125 sec. What is the maximum force exerted by the wall on this ball?
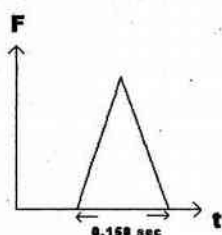
     (5marks)

Q63. A 100.0 g sample of NaCl(s) has an initial temperature of 0^0C. A chemist measures the temperature of the sample as it is heated. Heat is not added at a constant rate. The heating curve for the sample is shown below:

Part I. Determine the temperature range over which the entire sample is a liquid.

(1 mark)

a) 0^0C to 801^0C

b) 801^0C to 1465^0C

c) 0^0C to 1465^0C

d) 1465^0C to 0^0C

Part II. Identify one line segment on the curve where the average K.E of the particles of the NaCl sample is changing.   (2 marks)

a) AB and CD

b) BC and DE

c) AB and BC

d) CD and DE

Part III. Identify one line segment on the curve where the NaCl sample is in a single phase and capable of conducting electricity.   (2 marks)

a) AB   b) BC   c) CD   d) DE

Q 64. Combustion reaction of glucose ($C_6H_{12}O_6$) produces carbon dioxide gas. The occurring reaction is:

$$C_6H_{12}O_6(aq) + 6\ O_2\ (g) \longrightarrow 6CO_2\ (g) + 6\ H_2O\ (l)$$

Data on enthalpy formation:

ΔH_f° of glucose (s) $= -1273.3$ kJ mol^{-1}

ΔH_f° $CO_2(g)$ $= -393.5$ kJ mol^{-1}

ΔH_f° $H_2O(g)$ $= -241.8$ kJ mol^{-1}

ΔH_f° $H_2O(l)$ $= -285.8$ kJ mol^{-1}

ΔH_f° $O_2(g)$ $= 0$ kJ mol^{-1}

Universal gas constant, R = 0.0821 liter.atm.mol^{-1} K^{-1}

Volume of 1 mole gas at 25 $^{\circ}$ C, 1 atm = 22.4 liters

(Important: Show all your calculation steps clearly)

1. Calculate the energy produced when 1 mole of glucose is oxidized.

[ΔH° reaction $= \Delta H^{\circ}$ products - ΔH° reactants]   (1 mark)

2. Calculate the volume of air (25 $^{\circ}$ C, 1 atm) needed to oxidize 10.0 g of glucose (Oxygen content in air is 20.0 % volume).   (2 marks)

3. Calculate the volume of dry carbon dioxide gas produced in the combustion of 10.0 g glucose at temperature 37 $^{\circ}$ C and pressure at 1 atm. (PV = nRT)   (2 marks)

Q65. Figure 1 Shows a graph of O_2 uptake during and immediately after a period of vigorous exercise. To satisfy the energy demands of the exercise aerobically 3 dm^3 of oxygen per minute must be supplied.

After exercise the body continues to breathe in and use extra oxygen. The amount of this

oxygen reserves in the lungs, tissue fluids, haemoglobin and myoglobin. In the initial few minutes of exercise muscle fiber use two other sources for ATP production (other than aerobic respiration). They are:

a) Creatine phosphate system. Muscle cells have 2-4 times as much creatine phosphate as ATP. This is the main source of energy during short bursts of activity.

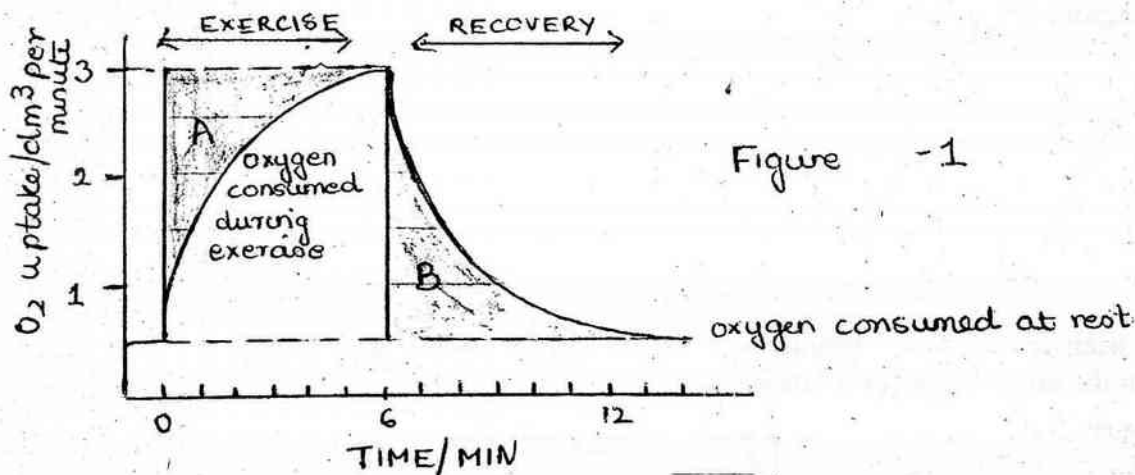b) Anaerobic respiration which operates faster than aerobic respiration and provides energy for about 40- 90 s.

Figure 1

Table 1

a)   Glucose $\xrightarrow{Glycolysis}$ 2 Lactate + 2 ATP
                          (lactic acid)
b)   Glucose $\xrightarrow{Glycolysis}$ 2 ethanol +2 CO_2 +2 ATP
c) $C_6H_{12}O_6 + 6CO_2 \longrightarrow 6CO_2 + 6 H_2O$ +38 ATP
d)   Creatine phosphate + ADP $\longrightarrow$ ATP + Creatine
e)   Creatine + ATP $\longrightarrow$ Creatine phosphate + ADP

Table 2

a)   3 min   b)   6 min   c)   12 min

Table 3

a)   oxygen debt   b)   oxygen deficit   c)   oxygen uptake

Answer the questions below, giving the letter of the appropriate statements from the respective tables given above.

a) What does region A represent? (Table 3)   (0.5 marks)

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b). What does region B represent? (Table 3) (0.5 marks)

c) If you make a dash of 100 m to catch a bus, which reaction from Table 1 would predominantly supply energy to your leg muscles? (1 mark)

d) You missed the bus, so now you run another 200 m to the next bus stop which reaction from Table 1 would predominantly supply energy to your leg muscles? (1 mark)

e) How many minutes after the onset of exercise, does the body meet the energy demands of the exercise aerobically? (Figure 1 and Table 2) (1mark)

f) Which reaction from Table 1 describes supply of energy by aerobic respiration? (1mark)

Q66. A.)

Diagram 1   Diagram 2   Diagram 3-------------------Diagram n
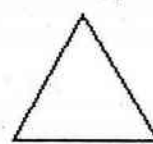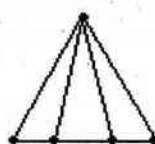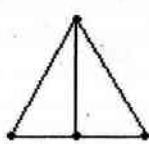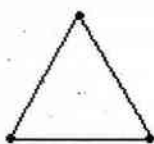
3 dots, 1 triangle   4 dots, 3 triangles   5 dots, 6 triangles -----------
Complete the table below for n^{th} diagram

Diagram	1	2	3	--------------	n
Number of dots	3	4	5	--------------	
Number of triangles	1	3	6	--------------	

(3 marks)

B. If 'S' is the surface area of cuboid of dimensions x, y, z and V is the volume, then 1/S is equal to (2 marks)

a) $\dfrac{V}{2}(x+y+z)$

b) $\dfrac{1}{2V(\frac{1}{x}+\frac{1}{y}+\frac{1}{z})}$

c) $\dfrac{\frac{V}{x+y+z}}{}$

d) $\dfrac{x+y+z}{V}$

Q 67. ABO blood group is controlled by gene I which has three alleles I^A, I^B, I^O. I^A and I^B are completely dominant over I^O. But when I^A and I^B are present together they both express themselves because of co-dominance. I^A produces A antigen, I^B produces B antigen, I^O results in the absence of both antigens.

Now answer the following questions. Each question can have more than one option as correct answer. Select the corresponding letter of the correct answer.

i) From the options below what are the possible genotypes of a woman with blood type A and a man with blood type B? (1 mark)

A. $I^O I^O$
B. $I^A I^O$
C. $I^B I^O$
D. $I^A I^B$
E. $I^A I^A$
F. $I^B I^B$

ii) If the blood group of both the parents is B then what are the possible blood groups of the children? (Choose from the options below). (1 mark)

A. A blood group   B. B blood group
C. AB blood group   D. O blood group

iii) If the man and woman from Question (i) above get married and have children of blood types A, B, AB and O, then what is the only possible genotype of each parent? (Use the options of Question i)? (1 mark)

Mother:
Father:

iv) A woman sued a famous actor for the support of her child, claiming that he was its father. (Child: Blood type B, Mother: Blood type A, Accused actor: Blood type O)
What is the genotype of the mother? Use the options of Question (i) above. (1 mark)

v) In Question (iv) above what is the probability (chance) that the accused actor is the father of the child? (1 mark)

A. 0%   B. 25%   C. 50%   D. 100%

Q68. For the circuit given below find the effective resistance between point A and B. The number of resistances, r, connected in the given arrangement is very large (5marks)