NATIONAL SCIENCE OLYMIAD 2010: LIFE SCIENCES

These questions were compiled from a variety of sources and the detailed answers are mainly from WIKIPEDIA as well as Encyclopedia Britannica and some textbooks.

1. Cirrhosis is a chronic disease of the liver marked by degeneration of cells, inflammation, and fibrous thickening of tissue. It is typically a result of

A hepatitis and alcoholism.
B acute food poisoning.
C sensitivity to antibiotics, especially penicillin.
D blood poisoning.

ANSWER: A
Cirrhosis is a consequence of chronic liver disease characterized by replacement of liver tissue by fibrosis, scar tissue and regenerative nodules (lumps that occur as a result of a process in which damaged tissue is regenerated), leading to progressive loss of liver function. Cirrhosis is most commonly caused by alcohol abuse, hepatitis B and C, and fatty liver disease but has other possible causes. Some cases are idiopathic, i.e., of unknown cause.

2. The substance of bones is formed by specialized cells (osteoblasts) and collagen fibres. Many bones have a central cavity containing marrow. The function of osteoblasts, collagen fibers and bone marrow are, respectively,

A secretion of enzymes; provision of tensile strength; and production of blood cells.
B provision of tensile strength; anchoring; and production of blood cells.
C production of cartilage; provision of tensile strength; and secretion of antibodies.
D secretion of calcium salts which provide hardness and strength in compression; provision of tensile strength; and production of blood cells.

ANSWER: D
Osteoblasts are mononucleate bone-forming cells that descend from osteoprogenitor cells. Osteobasts deposit a matrix of collagen and also release calcium, magnesium, and phosphate ions that ultimately combine chemically within the collagenous matrix into the crystalline mineral hydroxyapatite. It has relatively high compressive strength but poor tensile strength, meaning it resists pushing forces well, but not pulling forces. Osteoblasts also manufacture hormones, such as prostaglandins, to act on the bone itself. They also produce alkaline phosphatase, an enzyme that has a role in the mineralization of bone. While bone is essentially brittle, it does have a significant degree of elasticity (tensile strength), contributed chiefly by collagen. The marrow, located within bones, produces blood cells in a process called hematopoiesis.

3. The pistil of a flower is

A the male organs, producing sperm cells
B the female organs of a flower, comprising the stigma, style, and ovary.
C the part producing hormones (auxins and gibberellins).
D a whorl that encloses the petals and forms a protective layer around a flower in bud.

ANSWER: B
The pistil, also called the *gynoecium* (from Greek *gyne*, meaning *woman*, and *oikos*, meaning *house*) is the female part of a flower. The gynoecium in angiosperms is typically the innermost whorl of structures in a flower and is surrounded (in perfect flowers) by the androecium (stamens) and (in complete flowers) by the perianth (petals and sepals).

4. *Rigor mortis* means

A pronouncement of death of the patient upon arrival at the hospital.
B stiffening of the joints and muscles of a body a few hours after death.

C ossification of joints due to rheumatoid arthritis.
D dilation of the pupils as a result of shock.

ANSWER: B
Rigor mortis is one of the recognizable signs of death (Latin *mortis* meaning "of death") that is caused by a chemical change in the muscles after death, causing the limbs of the corpse to become stiff (Latin *rigor*) and difficult to move or manipulate. In humans it commences after about 3 hours, reaches maximum stiffness after 12 hours, and gradually dissipates until approximately 72 hours (3 days) after death. After death, respiration in organisms ceases to occur, depleting the corpse of oxygen used in the making of (ATP). ATP is no longer provided to operate the sarco/endoplasmic reticulum Ca^{2+} ATPase, (SERCA) pumps in the membrane of the sarcoplasmic reticulum, which pump calcium ions into the terminal cisternae. This causes calcium ions to bind with troponin and allows cross-bridging to occur between myosin and actin proteins. Unlike normal muscle contractions, the body is unable to complete the cycle and release the coupling between the myosin and actin, creating a perpetual state of muscle contraction, until the breakdown of muscle tissue by digestive enzymes during decomposition.

5. Plants of the family *Pinaceae* are mostly evergreen trees and usually dioecious. This means they

A have both the male and female reproductive organs in the same individual tree.
B have the male and female reproductive organs in different individual trees.
C produce seeds enclosed within a carpel.
D none of the above.

ANSWER: B
Dioecious species are whose members can produce only one type of gamete; each individual organism belonging to a dioecious species is distinctly male or female (the word deriving from the Greek for "two households"). The term *dioecious* is typically used only for plant species. In a dioecious species, no individual can produce both male and female gametes; individuals of the species are either androecious (male, producing microspores) or gynoecious (female, producing megaspores). Dioecious species cannot self-fertilize.

6. The frontal lobe of the brain comprises

A the rearmost lobe in each cerebral hemisphere of the brain.
B the part of the brainstem that links the medulla oblongata and the thalamus
C gray matter relaying sensory information and acting as a center for pain perception.
D areas concerned with behavior, learning, personality, and voluntary movement.

ANSWER: D
The frontal lobe is an area in the brain of mammals located at the front of each cerebral hemisphere and positioned anterior to (in front of) the parietal lobes and above and anterior to the temporal lobes. It is separated from the parietal lobe by the primary motor cortex, which controls voluntary movements of specific body parts. The frontal lobe contains most of the dopamine-sensitive neurons in the cerebral cortex. The dopamine system is associated with reward, attention, long-term memory, planning, and drive.

7. Kangaroo rats never drink water yet live normally like all mammals. The reason for this is that

A they are naturally adapted to dry environments and can use metabolic water for all their needs.
B their cell membranes are so thin that drinking water leads to severe internal hemorrhaging.
C they are transgenic knockout mice that have been genetically engineered, obviating the need for water usage
D as close relatives of camels, they store water in their humps during embryogenesis and that lasts them a lifetime.

ANSWER: A
Kangaroo rats, genus *Dipodomys*, are small rodents native to North America. The common name derives from their bipedal form: as they hop in a manner similar to the much larger kangaroo, although they are not related. Like the jerboas of African and Asian deserts and the hopping mice of Australia, kangaroo rats have highly developed hind legs, live in deep burrows that shelter them from the worst of the desert heat, and do not lose water. Instead, they have a highly water-efficient metabolism (their kidneys are at least four times more efficient at retaining water and excreting salt than those of humans) and use metabolic water, a by-product of oxidative phosphorylation, which other mammals such as humans, breathe out as water vapour. These adaptations have prepared them to live in arid conditions.

8. Crocodiles need long recovery times after a burst of activity such as capturing and drowning prey. This is because

A they rely on anaerobic respiration for this and require some time to metabolize the accumulated lactic acid.
B oxygen rich blood rushes to their skeletal muscles, creating temporary and potentially lethal high blood pressure.
C tendons in their killer jaws get over-stretched during killing large prey and require time to relax to original state.
D none of the above.

ANSWER: A
Crocodiles are among the more biologically complex reptiles despite their prehistoric look. Unlike other reptiles, they have a cerebral cortex,; a four-chambered heart; and the functional equivalent of a diaphragm. Their external morphology on the other hand is a sign of their aquatic and predatory lifestyle. A crocodile's physical traits allow it to be a successful predator. They have a streamlined body that enables them to swim swiftly. Crocodiles also tuck their feet to their sides while swimming, which makes them faster by decreasing water resistance. They have webbed feet which, although not used to propel the animal through the water, allow it to make fast turns and sudden moves in the water or initiate swimming. Crocodiles are very fast over short distances, even out of water. Since crocodiles feed by grabbing and holding onto their prey, they have evolved sharp teeth for tearing and holding onto flesh, and powerful muscles that close the jaws and hold them shut. These jaws can bite down with immense force, by far the strongest bite of any animal. Crocodiles are ambush hunters, waiting for fish or land animals to come close then rushing out to attack. They rely on anaerobic respiration for this burst of activity. As cold-blooded predators, they have a very slow metabolism, and thus can survive long periods without food.

9. An ectopic pregnancy literally means

A one in which the embryo/fetus develops in an abnormal place such as either of the Fallopian tubes.
B pregnancy that follows artificial insemination.
C pregnancy that leads to identical twins.
D pregnancy that leads to fraternal twins.

ANSWER: A
An ectopic pregnancy is a complication of pregnancy in which the pregnancy implants outside the uterus. With rare exceptions, ectopic pregnancies are not viable. Furthermore, they are dangerous for the mother, internal bleeding being a common complication. Most ectopic pregnancies occur in the Fallopian tube (so-called tubal pregnancies), but implantation can also occur in the cervix, ovaries and the abdomen. An ectopic pregnancy is a potential medical emergency, and, if not treated properly, can lead to death.

10. As you might have read in the package inserts of some over-the-counter remedies, it is not advisable for young children and teenagers to take aspirin-containing medication for the relief of flu symptoms as this might lead to Reye's syndrome. The latter is

A a life-threatening metabolic disorder involving encephalitis and liver failure.
B blood-clot formation due to coagulation-inducing effects of aspirin.
C lung failure and accompanying heart attack due to the often underestimated asphyxiating effects of aspirin.
D none of the above.

ANSWER: A
Reye's syndrome is a potentially fatal disease that causes numerous detrimental effects to many organs, especially the brain and liver, as well as causing low blood sugar (hypoglycaemia). The exact cause is unknown, and while it has been associated with aspirin consumption by children with viral illness, it also occurs in the absence of aspirin use. The disease causes fatty liver with minimal inflammation and severe encephalopathy (with swelling of the brain). The liver may become slightly enlarged and firm, and there is a change in the appearance of the kidneys. Jaundice is not usually present. The syndrome is named after Dr. Douglas Reye, who, along with two fellow physicians published the first study of the syndrome in 1963. [Reye RD, Morgan G, Baral J (1963). "Encephalopathy and fatty degeneration of the viscera. A Disease entity in childhood". *Lancet* 2 (7311): 749–52.]

11. A healthy, athletic young man from South Africa was recently hospitalized and died upon return from the Central African Republic where he was on a two week travel adventure. Whilst there, the young man unknowingly drank a can of Coca Cola on which rats urinated (and the urine subsequently dried) during storage in a warehouse, before dispatch and sale in the shop. The possible cause of his death was

A Weil's disease, a severe, sometimes fatal form of leptospirosis transmitted by rats.
B bubonic plague caused by the bacterium *Yersinia pestis* which is transmitted by rat fleas.
C cobra venom accumulated in the rats' urine; the rats are resistant to this and excrete it in their urine.
D concentrated aflatoxins in the rats' urine, Central African rats have a particularly peanuts-rich diet.

ANSWER: A
Leptospirosis is a bacterial zoonotic disease caused by spirochaetes of the genus *Leptospira* that affects humans and a wide range of animals, including mammals, birds, amphibians, and reptiles. The disease was first described by Adolf Weil in 1886 when he reported an "acute infectious disease with enlargement of spleen, jaundice and nephritis". Leptospirosis is transmitted by the urine of an infected animal and is contagious as long as it is still moist. Although rats, mice and voles are important primary hosts, a wide range of other mammals including dogs, deer, rabbits, hedgehogs, cows, sheep, raccoons, possums, skunks, and certain marine mammals are able to carry and transmit the disease as secondary hosts. Humans become infected through contact with water, food, or soil containing urine from these infected animals. This may happen by swallowing contaminated food or water, or through skin contact. Complications include meningitis, extreme fatigue, hearing loss, respiratory distress, and often renal and liver failure. The severe form of this disease is known as Weil's disease.

12. Medically speaking, a pig and not a dog, is man's best friend. This is because

A from a pig can be harvested parts for transplantation into humans.
B pigs are a source of proteins (pork).
C dogs can be vicious and harbour diseases like rabies.
D by loving dirt, pigs have taught us a lot about immunity.

ANSWER: A
Xenotransplantation (*xeno-* from Greek meaning "foreign") is the transplantation of living cells, tissues or organs from one species to another, such as from pigs or baboons to humans. Such cells, tissues or organs are called xenografts or xenotransplants. Human xenotransplantation offers a potential treatment for end-stage organ failure, a significant health problem. It also raises many novel medical, legal and ethical

issues. The main ethical issues associated with xenotransplants are that the animals which would be commonly used for their organs, such as pigs and baboons are killed or sacrificed. Baboons are very similar to humans with human-like hands, faces and a developed social structure. For this reason pigs could be used more as their anatomies are similar to humans and are a lot easier to breed than baboons that only produce one offspring at a time. Pigs are also a lot healthier and carry less disease than primates as well. A continuing concern is that pigs have shorter lifespans than humans: their tissues age at a different rate.

13. Sydney Brenner, the South African born Scientist, shared with H. Robert Horvitz and John E. Sulston the 2002 Nobel Prize in Medicine or Physiology. This was in recognition of

A their discoveries of important principles for drug treatment
B their discoveries of odorant receptors and the organization of the olfactory system
C their discoveries concerning genetic regulation of organ development and programmed cell death.
D their magnificent epic writing which has - in the words of Alfred Nobel - been of very great benefit to humanity.

ANSWER: C
The following is an excerpt from the Presentation Speech by Professor Urban Lendahl of the Nobel Committee at Karolinska Intitutet, December 10, 2002.

"This year's Nobel Prize celebrates the Joy of Worms. Brenner's almost prophetic visions from the early 1960s of the advantages of this model organism have been fulfilled. It has given us new insights into the development of organs and tissues and why specific cells are destined to die. This knowledge has proven valuable, for instance, in understanding how certain viruses and bacteria attack our cells, and how cells die in heart attack and stroke.
Sydney Brenner, Robert Horvitz and John Sulston- Your discoveries concerning the genetic regulation of organ development and programmed cell death have truly opened new avenues for biological and medical research."

Use the following information to answer questions 14, 15 and 16.

The Kruger National Park (KNP) was proclaimed by Paul Kruger, President of the Transvaal Republic, in 1898 to protect the wildlife of the South African Lowveld.

14. Which of the following is NOT TRUE about the KNP?

A It is nearly 2 million hectares large, with a large number of species: 336 trees, 49 fish, 34 amphibians, 114 reptiles, 507 birds and 147 mammals.
B It is part of the Kruger to Canyons Biosphere, an area designated by the UNESCO as an International Man and Biosphere Reserve.
C It has 850 kilometers of tarred roads, besides 1 444 kilometers gravel roads and more than 4 200 kilometers of fire breaks.
D The headquarters of the African branch of America's Centers for Disease Control (CDC) are situated in the park specifically to research bovine tuberculosis in buffaloes.

ANSWER: D
The Centers for Disease Control and Prevention (or CDC, founded in 1942) is a United States federal agency under the Department of Health and Human Services based in Atlanta, Georgia. It works to protect public health and safety by providing information to enhance health decisions, and it promotes health through partnerships with state health departments and other organizations. The CDC focuses national attention on developing and applying disease prevention and control (especially infectious diseases), environmental health, occupational safety and health, and education activities designed to improve the health of the people of the United States. The CDC employs thousands of people; medical professionals, engineers, scientists, statisticians and economists. In addition to the Atlanta headquarters, the CDC has 10 other locations in the United States and Puerto Rico.

15. Which of the following CANNOT BE SEEN in the Kruger Park?

(i) inland taipans and water mocassins
(ii) mocking birds and humming birds
(iii) piranhas and Portuguese men of war

A (i) only
B (i) and (iii)
C (iii) only
D all of the above

ANSWER: D
The inland taipan (*Oxyuranus microlepidotus*), is native to Australia and is the most venomous land snake on Earth. It is a species of taipan belonging to the Elapidae family. Although highly venomous, it is very shy and secretive, preferring to escape from trouble, biting only if threatened.

Water mocassins (Agkistrodon piscivorus) also called “cottonmouths”, are venomous snakes (pit viper), found in the eastern United States. Adults are large and capable of delivering a painful and potentially fatal bite. Water mocassins are semi-aquatic, usually found in or near water, particularly in slow-moving and shallow lakes and streams.

Mockingbirds are a group of New World passerine birds from the Mimidae family. They are best known for the habit of some species mimicking the songs of other birds and the sounds of insects and amphibians often loudly and in rapid succession. There are about 17 species in three genera.

Hummingbirds are birds comprising the family Trochilidae. They are among the smallest of birds, and include the smallest existing bird species, the bee hummingbirds. They can hover in mid-air by rapidly flapping their wings 12–90 times per second (depending on the species). They can also fly backwards, and are the only group of birds able to do so. Their English name derives from the characteristic hum made by their rapid wing beats. Hummingbirds drink nectar, a sweet liquid inside flowers. Since nectar is a poor source of nutrients, hummingbirds meet their needs for proteins, vitamins, minerals and fatty acids by preying on insects. Hummingbirds are found natively in the Americas, from southern Alaska to the Caribbean. The majority of species occur in tropical and subtropical Central and South America.

A piranha is a member of a family of omnivorous fresh water fish (Characidae) which live in South American rivers (the Amazon, the Orinoco, etc). They are known for their sharp teeth and a voracious appetite for meat. Piranhas are normally about 15 to 25 cm long

The Portuguese Man o' War (*Physalia physalis*), also known as the blue bottle, is a jelly-like, marine invertebrate of the family Physaliidae. The Portuguese Man o' War is infamous for having a painful sting, and for swarming in many hundreds. The Portuguese Man o' War lives at the surface of the ocean, with its float above the water, serving as a sail, and the rest of the organism hanging below the surface. It has no means of propulsion, but is moved by a combination of winds, currents, and tides. It is found in open ocean in all of the world's warm water seas but most commonly in the tropical and subtropical regions of the Pacific and Indian oceans.

16. When wild fires caused by natural causes ravage parts of the Kruger Park, they are usually left to run their course and not extinguished by SANParks or the Government. Which one of the following is NOT A REASON why these fires are left alone?

A The Kruger Park is a wildlife sanctuary where nature is left unperturbed.
B Wild fires are a way of nature to get rid of dead organic matter and make room for new growth.
C The Kruger Park is too large and mobilizing resources to quell fires would be too expensive.
D Wild fires in the Park kill mainly elephants which have no natural predators and overpopulate the Park, causing massive damage.

ANSWER: D
Wild fires will kill any animal and although elephant population control in the Park is a

challenge, wild fires are not left to burn with the hope of reducing elephant populations.

17. The reason why rodents continually gnaw at material is because

A their incisor teeth grow non-stop and gnawing is the only way to keep them short.
B rodent teeth have extra sensory cells which they use to identify food.
C they sharpen their teeth that way for self defense.
D they have no sweat glands and the only site for heat loss is their micro-porous teeth.

ANSWER: A
Rodentia is an order of mammals also known as rodents, characterized by two continuously growing incisors in the upper and lower jaws which must be kept short by gnawing. Forty percent of mammal species are rodents, and they are found in vast numbers on all continents other than Antarctica. Common rodents include mice, rats, squirrels, porcupines, beavers and guinea pigs. Rodents have sharp incisors that they use to gnaw wood, break into food, and bite predators. Most eat seeds or plants, though some have more varied diets. Some species have historically been pests, eating seeds stored by people and spreading disease (bubonic plague and Weil's disease).

18. Literature from Germany and Switzerland in the 18th century warned: "Woe is the child who tastes salty when kissed on the forehead, for it is cursed and soon must die." This was recognition of excessive salt loss in certain infants which was later identified as a symptom of a fatal genetic disorder called

A muscular dystrophy
B cystic fibrosis
C Hungtington's disease
D Tay-Sachs disease

ANSWER: D
Cystic fibrosis (CF) is a common hereditary disease which affects the entire body, causing progressive disability and often, early death. The name *cystic fibrosis* refers to the characteristic scarring) and cyst formation within the pancreas. The hallmarks of cystic fibrosis are salty tasting skin, normal appetite but poor growth and poor weight gain, excess mucus production, frequent chest infections and coughing/shortness of breath. Difficulty in breathing results from frequent lung infections that are treated, though not cured, by antibiotics and other medications. CF is caused by a mutation in a gene called the cystic firbrosis transmembrane conductance regulator (CFTR). This gene helps create sweat, digestive juices, and mucus. Although most people without CF have two working copies of the CFTR gene, only one is needed to prevent cystic fibrosis. CF develops when neither gene works normally. Therefore, CF is considered an autosomal recessive disease.

19. Cystic fibrosis is an example of an autosomal recessive genetic disorder. This means that

A two copies of the gene must be mutated for a person to be affected.
B only one mutated copy of the gene will be necessary for a person to be affected.
C males and females are both affected in this disorder, with males typically being more severely affected than females.
D the sons of a man with such a recessive disorder will not be affected, and his daughters will carry one copy of the mutated gene.

ANSWER: A
Refer to the Answer to Question 18 above.

20. Max Theiler was a South African/American virologist. He was awarded the Nobel Prize in Medicine or Physiology in 1951 for developing a vaccine against yellow fever. Yellow fever is

A an acute hemorrhagic disease caused by an RNA virus that is transmitted by the bite of mosquitoes *Aedes aegyti*.
B a disease of the liver caused by a protist and leading to yellowing of the skin and uncontrollable fevers.
C a bacterial disease of the central nervous system caused by

Legionella pneumophila, causing jaundice, fever and an unproductive cough.

D none of the above.

ANSWER: A

Yellow fever is an acute viral hemorrhagic disease. The virus is a 40 to 50 nm enveloped RNA virus of the Flaviviridae family. The yellow fever virus is transmitted by the bite of female mosquitoes *Aedes aegypti*, and other species and is found in tropical and sub-tropical areas in South America and Africa. The only known hosts of the virus are primates and several species of mosquito. Clinically, yellow fever presents in most cases with fever, nausea, and pain and it generally subsides after several days. In some patients, a toxic phase follows, in which liver damage with jaundice (hence the name yellow fever) can occur and lead to death.

21. Green papaya fruit is included as a component in powdered meat tenderizers, and is also marketed in tablet form to remedy digestive problems. This is because

A it is rich in an enzyme called papain, a protease which is able to break down tough meat fibers.

B it is rich in an enzyme called papain, a lipase which is able to break down saturated fats.

C it is rich in an enzyme called trypsin, a protease which is able to break down tough meat fibers

D it is rich in an enzyme called pancreatic lipase, which is able to break down saturated fats.

ANSWER: A

Papain is a cysteine protease (EC3.4.22.2) enzyme present in papaya (*Carica papaya*) and mountain papaya (*Vasconcellea cundinamarcensis*). It consists of 212 amino acids stabilised by 3 disulfide bridges. Its 3D structure consists of 2 distinct structural domains with a cleft between them. This cleft contains the active site, which contains a catalytic triad.Its catalytic triad is made up of 3 amino acids - cysteine-25 (from which it gets its classification), histidine-159, and asparagine-158. Papain's utility is in breaking down tough meat fibers and has been utilized for thousands of years in its native South America. It is sold as a component in powdered meat tenderizer available in most supermarkets.

22. When basking in the sun, hippopotamuses secrete a colourless, viscous sweat that gradually turns red, and then brown. These colour changes are due to

A non-benzenoid aromatic compounds that have antibiotic as well as sunscreen activity.

B mud on the skin of hippos.

C metal salts soaked into the hippos' skin when in water.

D none of the above

ANSWER: A

Chemical analysis and structural elucidation of the constituents of Hippo sweat were conducted by Japanese scientists who published their findings in the journal *Nature* [NATURE 2004, VOL 429, page 363]. They found the constituents to be unstable red and orange non-benzenoid aromatic compounds that are unexpectedly acidic and have antibiotic as well as sunscreen activity.

23. Leavening of bread often involves short incubation with yeast, *Saccharomyces cerevisiae*. The yeast ferments carbohydrates in the flour, including any sugar. The simplified overall equation for this process can be expressed as:

A Sugar → Ethanol + CO_2 + Energy

B Sugar → Methanol + CO_2 + Energy

C Sugar → Ethanol + Lactic acid + CO_2

D Sugar → Methanol + Lactatic acid + CO_2

ANSWER: A

Fermentation is the process of deriving energy from the oxidation of organic compounds, such as carbohydrates, and using an endogenous electron acceptor, which is usually an organic compound, as opposed to respiration where electrons are donated to an exogenous electron acceptor, such as oxygen, via an electron transport chain.

Fermentation does not necessarily have to be carried out in an anaerobic environment.

For example, even in the presence of abundant oxygen, yeast cells greatly prefer fermentation to oxidative phosphorylation, as long as sugars are readily available for consumption. Yeast converts sugars to pyruvate through glycolysis then breaks down the pyruvate into ethanol and carbon dioxide. This is important in bread making, brewing and wine production. Usually only one of the products is desired; in bread-making, the alcohol is baked out, and, in alcohol production, the carbon dioxide is released into the atmosphere or used for carbonating the beverage. When the ferment has a high concentration of pectin, minute quantities of methanol can be produced.

24. Biotin (vitamin B7) deficiency can be caused by excessive consumption of raw egg whites over a long period (months to years). This is quite a risk for ill-advised young bodybuilders. The reason for this is that

A raw eggs carry *Salmonella* bacteria which eat up all the biotin once inside a human.
B egg white contains high levels of iron and zinc, all which bind biotin tightly and must be oxidized by boiling or frying.
C all the biotin in the egg is concentrated in the yolk and thus eating only egg white deprives one of this vitamin.
D egg white contains high levels of avidin, a protein that binds biotin strongly and must be denatured by boiling or frying the egg before eating.

ANSWER: D
Avidin is a tetrameric protein produced in the oviducts of birds, reptiles and amphibians and deposited in the whites (albumin) of their eggs. The tetrameric protein contains four identical subunits (homotetramer), each of which can bind to biotin (Vitamin B_7, vitamin H) with a high degree of affinity and specificity.

25. Several metabolic pathways converge on the Krebs cycle. These are

A anabolism, catabolism and oxidative phosphorylation
B glycolysis, oxidative phosphorylation and glucagon synthesis
C glycolysis, protein catabolism and fat catabolism.
D glycogenolysis, glucoronidation and protein synthesis.

ANSWER: C
The citric acid cycle, also known as the tricarboxylic acid cycle (TCA cycle), or the Krebs cycle, is a series of enzyme - catalyzed chemical reactions, which is of central importance in all living cells that use oxygen for cellular respiration. In eukaryotic cells, the citric acid cycle occurs in the matrix of the mitochondrion. The components and reactions of the citric acid cycle were established by seminal work from Albert Szent Gyorgyi and Hans Krebs.

Several catabolic pathways converge on the TCA cycle. Reactions that form intermediates of the TCA cycle in order to replenish them (especially during the scarcity of the intermediates) are called anaplerotic reactions. The citric acid cycle is the third step in carbohydrate catabolism (the breakdown of sugars). Glycolysis breaks glucose (a six-carbon-molecule) down into pyruvate (a three-carbon molecule). In eukaryotes, pyruvate moves into the mitochondria. It is converted into acetyl-CoA by decarboxylation and enters the citric acid cycle.

In protein catabolism, polypeptides are broken down by proteases into their constituent amino acids. The carbon backbone of these amino acids can become a source of energy by being converted to acetyl-CoA and entering into the citric acid cycle.
In fat catabolism, triglycerides are hydrolyzed to break them into fatty acids and glycerol. In the liver the glycerol can be converted into glucose via dihydroxyacetone phosphate and glyceraldehyde-3-phosphate by way of gluconeogenesis. The citric acid cycle is always followed by oxidative phosphorylation. The citric acid cycle is called an amphibolic pathway because it participates in both catabolism and anabolism.

26. Photosynthesis is in actual fact the reverse of aerobic respiration and some metabolites are common in both pathways. Plants are capable of both pathways, how do they keep them separate?

A Photosynthesis occurs in plastids whereas respiration occurs in the cell cytoplasm and mitochondria.
B Photosynthesis occurs in chloroplasts whilst respiration occurs exclusively in mitochondria.
C The enzymes catalyzing photosynthesis and respiration are completely different
D All plant cell organelles have tough cell walls impenetrable by photosynthesis and respiration metabolites.

ANSWER: A
In plants and algae, *photosynthesis* takes place in organelles called chloroplasts (plastids). A typical plant cell contains about 10 to 100 chloroplasts. The chloroplast is enclosed by a composed of a phospholipid inner membrane, a phospholipid outer membrane, and an intermembrane space between them. Within the membrane is an aqueous fluid called the stroma. The stroma contains stacks (grana) of thylakoids, which are the site of photosynthesis. The thylakoids are flattened disks, bounded by a membrane with a lumen or thylakoid space within it. The site of photosynthesis is the thylakoid membrane, which contains integral and peripheral membrane protein complexes, including the pigments (chlorophyll) that absorb light energy, which form the photosystems.

Aerobic respiration requires oxygen in order to generate energy (ATP)). Although carbohydrates, fats and proteins can all be processed and consumed, glucose (a six carbon molecule) is normally the first substrate in energy production and gets broken down enzymatically in the cell cytoplasm to give two pyruvate (3-carbon) molecules. This process is called glycolysis and does not need oxygen to be present! Pyruvate then enters the mitochondrion in order to be oxidized in the Krebs cycle, producing, from each original glucose molecule, 6 NADH, 2 FADH, and 2 ATP.

The NADH thus produced enters the last phase of cellular respiration, called oxidative phosphorylation. This occurs in the mitochondrial cristae. It comprises the electron transport chain that establishes a proton gradient (chemiosmotic potential) across the inner membrane by oxidizing the NADH produced from the Krebs cycle. ATP is synthesized by the ATP synthase enzyme when the chemiosmotic gradient is used to drive the phosphorylation of ADP. The electrons are finally transferred to exogenous oxygen and, with the addition of two protons, water is formed.

27. The Scientist credited with deciphering the mechanisms of photosynthesis in plants is

A Melvin Ellis Calvin (April 8, 1911 - January 8, 1997)
B William Thomson Kelvin (26 June 1824 – 17 December 1907)
C John Calvin (10 July 1509 – 27 May 1564)
D William H. Calvin (30 April 1939 -)

ANSWER: A

The following paragraph is part of the concluding statement of the 1961 Presentation Speech by Professor K. Myrbäck, member of the Nobel Committee for Chemistry of the Royal Swedish Academy of Sciences (www.nobelprize.org):
"Professor Melvin Calvin; your investigations on plant photosynthesis have shed light on a field of biochemistry which was, until recently, veiled in obscurity. You have tracked the various steps of the path of carbon in photosynthesis and created a clear picture of this complicated sequence of reactions, reactions of immense importance for life on our planet."

28. Essential fatty acids are those that cannot be constructed within the human body from other components and therefore must be obtained from the diet. Which of the following is an essential fatty acid?

A α-Linoleic acid (an omega 3-fatty acid).
B cholesterol (a steroid).
C arachidonic acid (an omega-6 fatty acid)
D oleic acid (an omega-9 fatty acid).

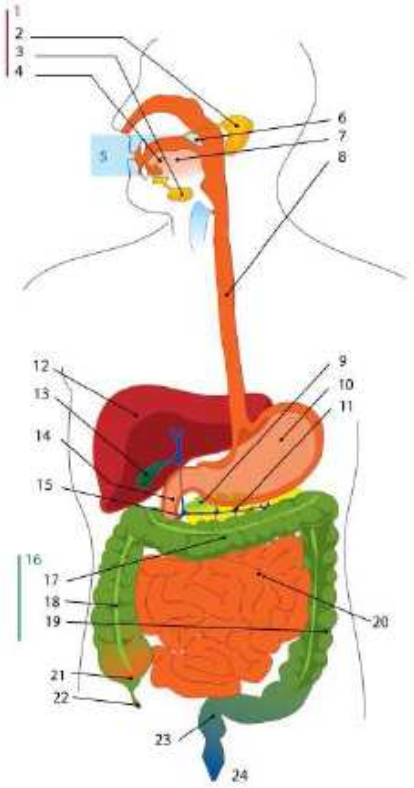
ANSWER: A AND C!
α-Linolenic acid is a carboxylic acid with an 18-carbon chain and three *cis* double bonds. The first double bond is located at the third carbon from the *n* end. Thus, α-linolenic acid is a polyunsaturated omega-3 fatty acid. It is a member of the group of essential fatty acids, so called because they cannot be produced within the body and must be acquired through diet.

Arachidonic acid is an omega-6-fatty acid. It is a carboxylic acid with a 20-carbon chain and four cis-double bonds; the first double bond is located at the sixth carbon from the omega end. Arachidonic acid is a polyunsaturated fatty acid that is present in the phospholipids of membranes of animal cells and is abundant in the brain and muscles. It is an essential fatty acid.

Oleic acid is a mono-unsaturated omega-9 fatty acid found in various animal and vegetable sources. It has the formula $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$. Oleic acid is the most abundant fatty acid in human adipose tissue. It is not essential.

Cholesterol is not a fatty acid but a fat-soluble compound. It is an essential structural component of mammalian cell membranes, where it is required to establish proper membrane permeability and fluidity. In addition, cholesterol is an important component for the production of bile acids, steroid hormones, and several fat-soluble vitamins. Cholesterol is the principal sterol synthesized by animals, mainly in their livers. Thus, most meat and animal products contain cholesterol, with the major dietary sources including cheese, egg yolks, beef, pork and pultry. Cholesterol is not present in plant-based food sources unless it has been added during the food's preparation. However, plant products such as peanuts contain cholesterol-like compounds called phytosterols, which are suggested to help lower serum cholesterol levels.

Use the following diagram to answer questions 29, 30, 31, 32 and 33



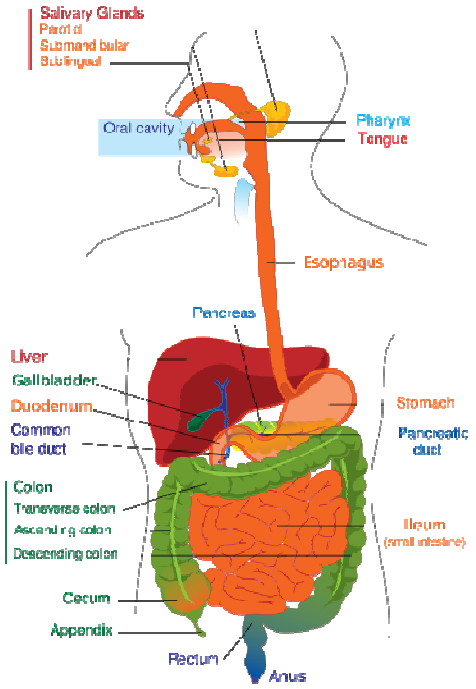
29. Which structure, when attacked by cancer, leads to poor prognosis partly because the cancer usually causes no symptoms early on, leading to locally advanced or metastatic disease at the time of diagnosis?

A 9
B 8
C 12
D 19 and 23

ANSWER: A
The following annotated diagram from WIKIPEDIA is central to answering the questions 29-33.

Structure 9 is the pancreas, a gland organ in critical in the digestive and endocrine systems of vertebrates. It is both an endocrine gland producing several important hormones, including insulin, glucagon and somatostatin as well as an exocrine gland, secreting pancreatic juice which contains digestive enzymes that pass to the small intestine. These enzymes help in the further

breakdown of the carbohydrates, proteins and lipids in the chime. The pancreas is buried rather deep in the body and cancer of the pancreas is sometimes called a "silent killer" because early pancreatic cancer often does not cause symptoms, and the later symptoms are usually non-specific and varied. Therefore, pancreatic cancer is often not diagnosed until it is advanced. Thus, the prognosis is relatively poor with less than 5 percent of those diagnosed still alive five years after diagnosis.



30. The function of 13 is to

A secrete bile, which is essential for the emulsification of fats.
B secrete insulin and glucagon, two critical hormones in glucose homeostasis.
C produce red blood cells
D store excess fats.

ANSWER: A
The gallbladder is a hollow organ that sits in a concavity of the liver known as the gallbladder fossa. It stores bile, which is released when food containing fat enters the digestive tract, stimulating the secretion of cholecystokinin (CCK). The bile, , produced in the liver, emulsifies fats in partly digested food.

31. Which of the following is not a function of 12?

A Lipogenesis
B Decomposition of erythocytes
C Gluconeogenesis
D Production of erythrocytes

ANSWER: D
The liver has a wide range of functions, including detoxification, protein synthesis, and production of biochemicals necessary for digestion. It is both the largest *internal* organ and the largest gland in the human body. It is necessary for survival; there is currently no way to compensate for the absence of liver function. This organ plays a major role in metabolism and has a number of functions in the body, including glycogen storage, decomposition of red blood cells, plasma protein synthesis, hormone production, and detoxification. The liver is the only internal human organ capable of natural regeneration of lost tissue; as little as 25% of a liver can regenerate into a whole liver.
Except in embryos where the liver serves this function, erythrocytes or red blood cells are produced in the bone marrow through a process named erythropoiesis. They develop from committed stem cells to mature erythrocytes in about 7 days. When matured, these cells live in blood circulation for about 100 to 120 days. At the end of their lifespan, they become senescent, and are removed from circulation.

32. Vitamin synthesis by ectosymbionts as well as water re-absorption occurs in which parts?

A 10 and 12
B 20 only
C 22 and 24
D 17, 18 and 19

ANSWER: D
The large intestine, also called the colon, takes about 32 hours to finish up the remaining processes of the digestive system. Food is no longer broken down at this stage of digestion. The large intestine simply absorbs vitamins that are created by

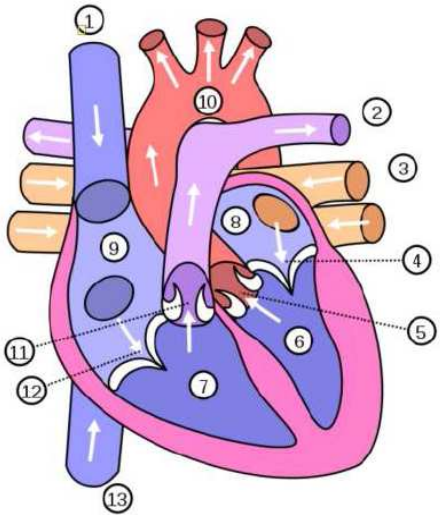
the bacteria inhabiting the colon. It also absorbs water and compacts feces, and stores fecal matter in the rectum until eliminated through the anus.

33. Which part is deemed a vestige that has lost its original function?

A 9
B 24
C 22
D 4

ANSWER: C
The vermiform appendix is a blind-ended tube connected to the caecum, from which it develops during embryogenesis. The caecum is a pouch-like structure of the colon. The appendix is located near the junction of the small and large intestines. Given the appendix's propensity to cause death by infection, and general good health of people who have had their appendix removed the appendix is traditionally thought to have no function in the human body. The most common explanation for the appendix's existence in humans is that it's a vestigial structure which has lost its original function.

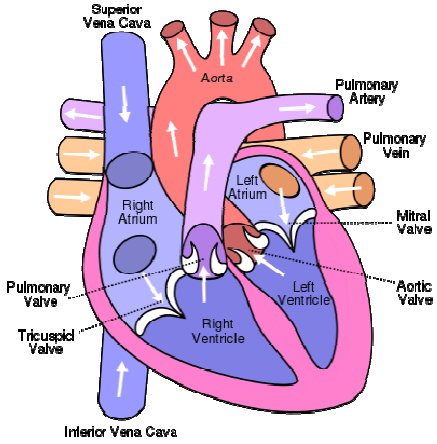
Use the following diagram to answer questions 34, 35, 36, 37 and 38.



34. The part numbered 13 is called the _____ and is responsible for _____

A superior vena cava, carrying deoxygenated blood from the upper half of the body to the right atrium of the heart.
B jugular vein, carrying deoxygenated blood from the head back to the heart via the superior vena cava.
C inferior vena cava, carrying deoxygenated blood from the lower half of the body into the right atrium of the heart.
D azygos vein, carrying deoxygenated blood to the superior vena cava.

ANSWER: C
The following labeled diagram from WIKIPEDIA, is key to answering questions 34-38.



The inferior vena cava is the large vein that carries de-oxygenated blood from the lower half of the body into the right atrium of the heart. It is posterior to the abdominal cavity and runs alongside of the vertebral column on its right side. It enters the right atrium at the lower right, back side of the heart.

35. Which parts can be replaced with similar parts from other animals?

A 1 and 2

B 11 and 12
C 10 and 13
D none of the above

ANSWER: B
Heart valves, from other animals such as pigs (called biological valves). These are first subjected to several chemical procedures in order to make them suitable for implantation in the human heart. The porcine (pig) heart is most similar to the human heart, and thus represents the best anatomical fit for replacement. Implantation of a porcine valve is a type of xenotransplantation, which means a transplant from one species to another. There are some risks associated with a xenograft such as the human immune system's tendency to reject foreign material. Medication can be used to retard this effect, but is not always successful.

36. A heart attack (myocardial infarction) would normally be the result of a blood clot occurring in which structure?

A 1
B 3
C 10
D none of the above.

ANSWER: D
A heart attack, also called myocardial infarction, is the interruption of blood supply to part of the heart, causing some heart cells to die. This is most commonly due to blockage of a coronary artery. Although blood fills the chambers of the heart, the muscle tissue of the heart (the myocardium) is so thick that it requires coronary blood vessels to deliver blood deep into it. The vessels that deliver oxygen-rich blood to the myocardium are known as coronary arteries. The vessels that remove the deoxygenated blood from the heart muscle are known as coronary veins. The coronary arteries that run on the surface of the heart are called epicardial coronary arteries. These arteries, when healthy, are capable of autoregulation to maintain coronary blood flow at levels appropriate to the needs of the heart muscle. These relatively narrow vessels are commonly affected by artherosclerosis and can become blocked, causing angina or a heart attack.

37 In case of a suspected heart attack, which of the following is not a life-saving first aid procedure?

A giving the patient aspirin
B checking for breathing in the patient and making sure his airways are open.
C monitoring pulse and giving cardiopulmonary resuscitation
D letting the patient squat to get his knees to induce heart movements.

ANSWER: D
Heart movements are involuntary and independently controlled and can never be induced or stopped by body posture!
Aspirin, apart from being an analgesic, anti-fever and an anti-inflammatory drug, has an antiplatelet effect by inhibiting the production of thromboxane. Under normal circumstances, thromboxane binds platelet molecules together to create a patch over damage of the walls within blood vessels. Because the platelet patch can become too large and also block blood flow, locally and downstream, aspirin is also used long-term, at low doses, to help prevent heart attacks and strokes by preventing blood clot formation. It has also been established that low doses of aspirin may be given immediately after a heart attack to reduce the risk of another heart attack or of the death of cardiac tissue.

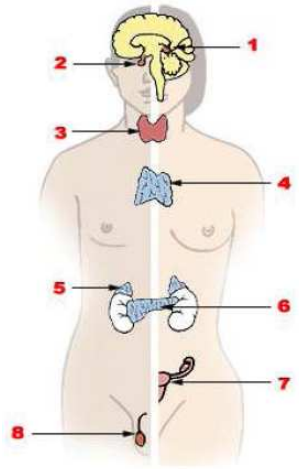
38. The function of the structure numbered 2 is to

A carry deoxygenated blood from the heart to the lungs.
B carry nutrient rich blood from the liver to the rest of the body via the heart
C carry waste laden blood from the body, via the heart, to the kidneys
D none of the above.

ANSWER: A
The pulmonary arteries carry blood from the heart to the lungs. They are the only arteries that carry deoxygenated blood.

Use the following diagram to answer questions 39, 40, 41, 42 and 43. Note that the diagram combines the female and male

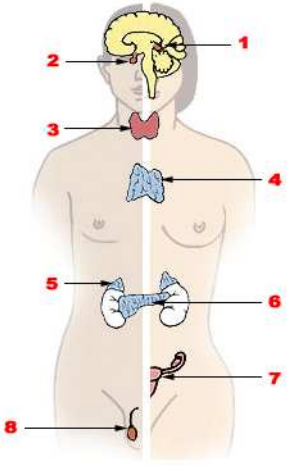
systems, which are normally not found in the same body!



39. Two hormones that are responsible for the break down of glycogen to glucose are _____ and _____, secreted by _____ and _____.

A glucagon and adrenaline, secreted by 6 and 5.
B insulin and glucagon secreted by 6 and 5
C thyroxine and adrenaline secreted by 3 and 5
D testosterone and adrenaline secreted by 8 and 5

ANSWER: A
The following labeled diagram from WIKIPEDIA, is key to answering questions 39-43.



1. *Pineal gland* ***2.*** *Pituitary gland* ***3.*** *Thyroid gland* ***4.*** *Thymus,* ***5.*** *Adrenal gland* ***6.*** *Pancreas* ***7.*** *Ovary* ***8.*** *Testis*

Glucagon is another hormone produced by the pancreas (the other one being insulin), which in many respects serves as a counter-signal to insulin. When the blood sugar begins to fall below normal, glucagon is secreted in increasing amounts and stimulates glycogen breakdown into glucose.
Epinephrine, widely called adrenaline, is a hormone and neurotransmitter secreted by the adrenal glands. It increases heart rate, contracts blood vessels and dilates air passages and participates in the "fight or flight response". The hormone boosts the supply of oxygen and glucose (by stimulating glycogen breakdown) to the brain and muscles, while suppressing other non-emergency bodily processes.

40. Luteinizing hormone is secreted by _____ and its role is to _____.

A 2; trigger ovulation in females and testosterone production in males.
B 7, trigger ovulation in females
C 2, induce overall body growth
D 4, trigger lutein production in males

ANSWER: A
Luteinizing hormone (LH)) is a hormone produced by the anterior pituitary gland. In the *female*, an acute rise of LH triggers ovulation and corpus luteum development. In the *male*, it stimulates Leydig cell production of testosterone.

41. Structure _____ is often referred to as the master gland and produces the hormone _____

A 1, Thyroid Stimulating Hormone
B 2, Growth Hormone
C 1 Growth Hormone
D 3, Thyroxine

ANSWER: B
The pituitary gland secretes hormones regulating homeostasis, including tropic hormones that stimulate other endocrine glands. It is functionally connected to the hypothalamus by the median eminence.

Located at the base of the brain, the pituitary is composed of two lobes: the anterior pituitary (adenohypophysis) and the posterior pituitary (neurohypophysis). The pituitary is functionally linked to the hypothalamus by the pituitary stalk, whereby hypothalamic releasing factors are released and, in turn, stimulate the release of pituitary hormones. Although the pituitary gland is known as the master endocrine gland, both of its lobes are under the control of the hypothalamus. The anterior pituitary synthesizes and secretes important endocrine hormones, such as Adrenocorticotropic hormone (ACTH), Prolactin (PRL), Thyroid-stimulating hormone (TSH), Growth Hormone (GH), Endorphins, Follicle-stimulating hormone (FSH) and Luteinizing hormone (LH). These hormones are released from the anterior pituitary under the influence of the hypothalamus. The posterior pituitary stores and releases Oxytocin and Antidiuretic hormone (ADH, also known as vasopressin).

42. The Follicle Stimulating Hormone is produced by _____ and functions to _____

A 2, stimulates spermatogenesis in males and ovarian follicular growth in females.
B 7, stimulates ovarian follicular growth in females
C 7, regulates the menstrual cycle in females
D none of the above

ANSWER: A
Follicle-stimulating hormone (FSH) is synthesized and secreted by gonadotropes of the anterior pituitary gland. It regulates the development, growth, pubertal maturation, and reproductive processes of the body. FSH and Luteinizing hormone (LH) act synergistically in reproduction. In males, FSH stimulates maturation of seminiferous tubules and spermatogenesis. In *females*, FSH initiates follicular growth.

43. Structure 1 is called the _____ gland and produces _____

A Pituitary, Growth Hormone
B Pineal, Melatonin
C Eustachian, Serotonin
D Circadian, Dopamine

ANSWER: B
The pineal gland is a small endocrine gland in the vertebrate brain. It produces melatonin, a hormone that affects the modulation of wake/sleep patterns and photoperiodic (seasonal) functions.

44. Reverse osmosis is best known for its use in removing the salt from sea water to get fresh water. It is also the mode of operation of salt glands found in seabirds, among others. The process entails

A removal of salt ions by complexation to proteins (siderophores).
B forcing a solvent from a region of high solute concentration through a membrane to a region of low solute concentration by applying a pressure in excess of the osmotic pressure.
C precipitation of salts and their active transport by enzymes for excretion.
D allowing movement of solvent from an area of low solute concentration, through a membrane, to an area of high solute concentration with no external pressure applied

ANSWER: B
Reverse osmosis is a separation process that uses pressure to force a solvent through a membrane that retains the solute on one side and allows the pure solvent to pass to the other side. More formally, it is the process of forcing a solvent from a region of high solute concentration through a membrane to a region of low solute concentration by applying a pressure in excess of the osmotic pressure. This is the reverse of the normal osmosis process, which is the natural movement of solvent from an area of low solute concentration, through a membrane, to an area of high solute concentration when no external pressure is applied. The membrane here is semi-permeable, meaning it allows the passage of solvent but not of solute. Reverse osmosis is used industrially to purify sea water for drinking purposes. The membranes used for reverse osmosis have a dense barrier layer in the polymer matrix where most separation occurs. In most cases the membrane is designed to allow

only water to pass through this dense layer while preventing the passage of solutes (such as salt ions). This process requires that a high pressure be exerted on the high concentration side of the membrane, usually 2–17 bar for fresh and brackish water, and 40–70 bar (for seawater, which has around 24 bar natural osmotic pressure which must be overcome.

45. Consumption of large doses of vitamin c leads to kidney stones because

A in the body, excess vitamin c is degraded to oxalic acid which combines with calcium in the kidneys to form the insoluble calcium oxalate.
B excess vitamin c is excreted unchanged and crystallizes out in the kidneys.
C vitamin c tightly binds to metal ions and forms crystals in the kidneys.
D also called ascorbic acid, vitamin c corrodes tubes in the kidneys and forms iron salts.

ANSWER: A
Kidney stones, or *Renal calculi*, are crystal aggregations of dissolved dissolved minerals in urine; calculi typically form inside the kidneys or ureters. Renal calculi can vary in size from as small as grains of sand to as large as grapefruit. Kidney stones typically leave the body by passage in the urine stream, and many stones are formed and passed without causing symptoms. If stones grow to sufficient size before passage -- on the order of at least 2-3 millimeters -- they can cause obstruction of the ureter. The resulting distention with urine can cause severe episodic pain, most commonly felt in the flank, lower abdomen and groin (a condition called renal colic). A speculated increased risk of kidney stones may be a side effect of taking vitamin C in larger than normal amounts (more than 1 gram). The potential mechanism of action is through the metabolism of vitamin C to dehydroascorbic acid, which is then metabolized to oxalic acid, a known constituent of kidney stones. As the amount of calcium intake decreases, the amount of oxalate available for absorption into the bloodstream increases; this oxalate is then excreted in greater amounts into the urine by the kidneys. In the urine, oxalate is a very strong promoter of calcium oxalate precipitation, about 15 times stronger than calcium. Other types of kidney stones are composed of struvite (magnesium, ammonium and phosphate); uric acid; calcium phosphate and cystine.

46. Hemoglobin, the oxygen transporting protein found in red-blood cells, shows all four levels of protein structure in one molecule. These are

A α-helices, random coils, β-pleated sheets and spheres.
B primary, secondary, tertiary and quaternary.
C inear, folded, compressed and globular.
D none of the above.

ANSWER: B
There are four levels of protein structure, which are:
(i) Primary structure- the amino acid sequence of the peptide chains as determined by genes.
(ii) Secondary structure- highly regular sub-structures (alpha helices, beta sheets and random coils), which are locally defined, meaning that there can be many different secondary motifs present in one single protein molecule.
(iii) Tertiary structure- three-dimensional structure of a single protein molecule; a spatial arrangement of the secondary structures. It also describes the completely folded and compacted polypeptide chain.
(iv) Quaternary structure- complex of several protein molecules or polypeptide chains, usually called protein subunits in this context, which function as part of the larger assembly or protein complex.
Hemoglobin exhibits all four levels of structures of proteins. Most of the amino acids in hemoglobin form alpha helices, connected by short non-helical segments. Hydrogen bonds stabilize the helical sections inside this protein, causing attractions within the molecule, folding each polypeptide chain into a specific shape. Hemoglobin's quaternary structure comes from its four subunits in roughly a tetrahedral arrangement.

47. Treatment of tuberculosis normally requires a combination of several drugs taken over a period of several months to achieve total cure. The reason for this is that

A the cause of TB, *Mycobacterium tuberculosis,* divides very slowly and can thus survive short-term anti-biotic bombardment.
B *Mycobacterium tuberculosis,* divides very rapidly and many daughter cells survive and multiply again during short-term anti-biotic bombardment.
C all anti-TB drugs have very short half-lives in the human body thus large doses have to be given over very long periods.
D none of the above

ANSWER: A
The primary cause of TB, *Mycobacterium tuberculosis*, is a small aerobic non-motile bacillus. High lipid content of this pathogen accounts for many of its unique clinical characteristics. It divides every 16 to 20 hours, an extremely slow rate compared with other bacteria, which usually divide in less than an hour. MTB can withstand weak disinfectants and survive in a dry state for weeks. In nature, the bacterium can grow only within the cells of a host organism, but *M. tuberculosis* can be cultured in the laboratory.
Treatment for TB uses antibiotics to kill the bacteria. Effective TB treatment is difficult, due to the unusual structure and chemical composition of the mycobacterial cell wall, which makes many antibiotics ineffective and hinders the entry of drugs. The four antibiotics most commonly used are rifampicin, isoniazid, ethambutol and cycloserine. However, instead of the short course of antibiotics typically used to cure other bacterial infections, TB requires much longer periods of treatment (around 6 to 24 months) to entirely eliminate mycobacteria from the body. Latent TB treatment usually uses a single antibiotic, while active TB disease is best treated with combinations of several antibiotics, to reduce the risk of the bacteria developing antibiotic resistance.

48. An essential amino acid is one that cannot be synthesized by humans and therefore must be supplied in the diet. Which of the following is NOT essential?

A Methionine
B Phenylalanine
C Tryptophan
D Aspartic acid

ANSWER: D
Eight amino acids are generally regarded as essential for humans: phenylalanine, valine, threonine, tryptophan, isoleucine, methionine, leucine and lysine. Aspartic acid is non-essential in mammals, being produced from oxaloacetate by transamination.

49. Consumption of healthy polar bear or seal liver can be fatal. The reason for this is that

A these carnivores store excess vitamin A from their diets in their livers.
B the livers of polar bears and seals are laden with toxic heavy metals from sea water.
C their livers store heat generating hormones that keep these animals warm but lead to overheating and death in humans.
D as consumers high up the food chain, these animals concentrate toxins from their diet in their livers.

ANSWER: A
Retinol, the animal form of vitamin A, is a fat-soluble vitamin important in vision and bone growth. Retinol is ingested in a precursor form; animal sources (liver and eggs) contain retinyl esters, whereas plants such as carrots contain pro-vitamin A carotenoids. Too much vitamin A in retinoid form can be harmful or fatal. The body converts the dimerized form, carotene, into vitamin A as it is needed, therefore high levels of carotene are not toxic compared to the ester (animal) forms. The livers of certain animals, especially those adapted to polar environments, often contain amounts of vitamin A that would be toxic to humans. Thus, vitamin A toxicity is typically reported in Arctic explorers and people taking large doses of synthetic vitamin A.

50. In anti-cancer chemotherapy, the molecular targets of the drugs are usually proteins or DNA itself. Which one of the following is NOT a possible mechanism of action of anti-cancer drugs?

A Inhibition of DNA polymerases
B Radical destruction of DNA or intercalation.
C Total inhibition of growth hormone production.
D Inhibition of new blood vessels (angiogenesis).

ANSWER: C
Cancer is a class of diseases in which a group of cells display *uncontrolled growth invasion* (intrusion on and destruction of adjacent tissues), and sometimes metastasis (spread to other locations in the body via lymph or blood). These three malignant properties of cancers differentiate them from benign tumors, which are self-limited, and do not invade or metastasize. Because cancer cells replicate uncontrollably and need constant nutrient supply, anticancer drugs work by destroying DNA and thus inhibit cell replication, inhibiting enzymes critical for normal cell function and division, and also by inhibiting the growth of new blood vessels (angiogenesis).

51. The table below shows how much energy, in kilojoules, is needed by John to do various activities in 1 hour.

Sleeping	**School work**	**Running**
300 kJ	650 kJ	2 400 kJ

How much energy will be needed by John to run for 30 minutes?

A 600
B 1 200
C 800
D 460

Answer: B
One hour (1hr) equals sixty (60) minutes. Thirty (30) minutes is half (½) of 60 minutes. If 2 400 kJ of energy was needed to run for 60 minutes or 1 hr, then, for half an hour John will need

½ X 2 400 kJ = 1 200 kJ

52. Which one of the following is an exception to the risks associated with smoking?

Smoking …

A increases availability of oxygen in the blood.
B leads to narrowing of blood vessels.
C interferes with the smooth operation of the heart.
D interferes with the process of aerobic respiration.

Answer: B
Cigarette smoke contains nicotine, carbon monoxide, tars and the free radicals. Carbon monoxide, when inhaled during smoking, combines with haemoglobin to form carboxyhaemoglobin. Carboxyhaemoglobin has a higher affinity towards carbon monoxide than oxygen. Therefore, cigarette smoking reduces the oxygen-carrying capacity of blood. This decreases availability of oxygen in blood.

53. Which one of the following is associated with ecotourism?

A Attracting visitors to natural ecosystem to raise awareness
B Reducing nature conservation by inter-planting trees and crops.
C Reducing nitrogen held in ecosystems by burning trees
D Replacing deciduous plants with the conifers for commercial purposes

Answer: A
Ecotourism refers to a travel to natural areas to experience rare and beautiful ecosystems. The central attraction here is the quality and uniqueness of the natural environment. In ecotourism both the visitor, local community and the environment benefit.
The following are advantages of ecotourism:
(i) It contributes to the economy of the country. (ii) It promotes public knowledge and awareness of environmental issues.
(iii) Money obtained from ecotourism could be used to build more protected areas to reintroduce species threatened with

extinction, and reduce poaching. (iv) It leads to poverty reduction through job creation.

54. Soil pH is a/an … factor

A Climatic
B Biotic
C Edaphic
D Physiographic

Answer: C
Environmental factors that operate in the soil are called edaphic factors. These include the chemical composition of the soil, the chemical nature of the soil and humus. Soil pH is one of the chemical factors found in the soil. It is a measure of the degree of positively charged hydrogen ions (hydrogen cations). Soil acidity and alkalinity are measured on a pH scale.
Acidic soils range from between a pH of and about 5. A pH of 7 is neutral whereas above 7 it is alkaline. With a decrease in soil pH (increased acidity) various soil chemicals become soluble. Iron and aluminium, which are toxic to plants, are released with increased soil acidity and as organic matter becomes more soluble and vulnerable to leaching, the fertility of the soil begins to fall.
Generally, plants are sensitive to an acid environment and this then predetermines the type of vegetation.

55. Which one of the following is the reason that active transport is affected by changes in oxygen concentration rather than by diffusion?

A Energy
B Concentration gradient
C Anaerobic respiration
D None of the above

Answer: A (Encarta Encyclopedia)
Active transport is an energy-using process in microscopic cells whereby a ell can move dissolved substances through its membrane from less concentrated to more concentrated regions.
Normally, the dissolved substances would move passively across a cell membrane from more concentrated to less concentrated regions. A concentration gradient is required for this to happen. Therefore, active transport reverses this tendency as the life processes of cells sometime require transportation of some substances such as energy-rich nutrients, etc. against the concentration gradient.

56. Which one of the following is an element of the scientific approach?

(i) Observation
(ii) Evaluating
(iii) Testing
(iv) Interpreting

A (i); (ii); (iv)
B (i); (ii); (iii)
C (ii); (iii); (iv)
D (i); (ii); (iii); (iv)

Answer: D (Understanding Life Sciences)
The scientific approach is the general approach taken by scientists to explain phenomena. Scientists get to know things either by ''Inquiry'' which is carried out either through ''discovery'' or ''explanation''.
In the ''discovery'' inquiry, observations are made, data collected, recorded and carefully analyzed with the purpose of making generalizations about the phenomena. This is inductive reasoning. During the ''explanatory'' inquiry, scientists will look for explanations for the generalizations of (observed) phenomena. For example, for an explanation that light intensity influences the rate of photosynthesis (hypothesis) will require (testing) and (interpretation). This is deductive reasoning. Therefore, in the scientific approach, one or more of the following key elements are included:

- Observation
- Questioning
- Hypothesizing
- Predicting
- Testing
- Interpretation

57. The following is formed in the stratosphere when the ultra-violet (UV) rays of the sun react with oxygen.

A The greenhouse effect
B Water vapour
C The ozone layer

D Acid rain

Answer: C
Ozone layer is the layer of the chemical, ozone (O_3) that is present in the atmosphere and protects the earth from the ultraviolet radiation of the sun. Ozone is formed when the ultraviolet radiation of the sun splits one oxygen molecule into two atoms of oxygen. The atomic oxygen then combines with an oxygen molecule O_2 to form ozone, O_3. Most ozone found in the earth's atmosphere occurs in the stratosphere.

58. Although dust particles pollute the air, they are nevertheless important for life on earth as they also …

A cause rain to fall
B allow light from the sun to penetrate the earth and the heat is radiated back to the atmosphere
C prevent light from the sun to penetrate the earth and also absorb heat in the atmosphere resulting in cooling
D allow light from the sun to penetrate the earth and the heat in the atmosphere is absorbed

Answer: C (Encarta Encyclopedia)
Dust particles are fine particles of organic and inorganic substances found suspended in the atmosphere. Dust includes animal and vegetable fibre, pollen, bacteria, etc. In cities, dust in the atmosphere contains smoke and tarry soot particles. Atmospheric dust has two important physical properties, viz.:

- They can scatter light of the short wavelengths, thereby preventing some rays of the sun from entering the earth – hence reducing the level of heating
- They serve as nuclei for the condensation of water vapour. Thus, mist, fog, smog and clouds depend on dust to form

59. A name given to the reaction where one atom donates and the other receives an electron.

A Oxidation
B Redox
C Reduction
D Ionisation

Answer: B

Redox reactions are chemical reactions in which both oxidation and reduction take place. During oxidation, oxygen is gained while hydrogen is lost or electrons are lost. Reduction, on the other hand, involves the loss of oxygen while hydrogen is gained, i.e. electrons are gained. For example, coenzyme NADH is oxidized when it loses H during the terminal oxidative phosphorylation of respiration. At the same time, oxygen, which finally receives H becomes reduced.

60. TWO of the following animal organisms have a bilaterally symmetrical body structure.

(i) Frog
(ii) Earthworm
(iii) Locust
(iv) Hydra

A (i); (ii)
B (i); (iii)
C (ii); (iii)
D (iii); (iv)

Answer: B
Bilateral Symmetry is a body structure which can be divided into two equal halves along one plane. Only the frog and the locust possess that body structure.

61. Progress of HIV during testing is done by determining the levels of which one of the following?

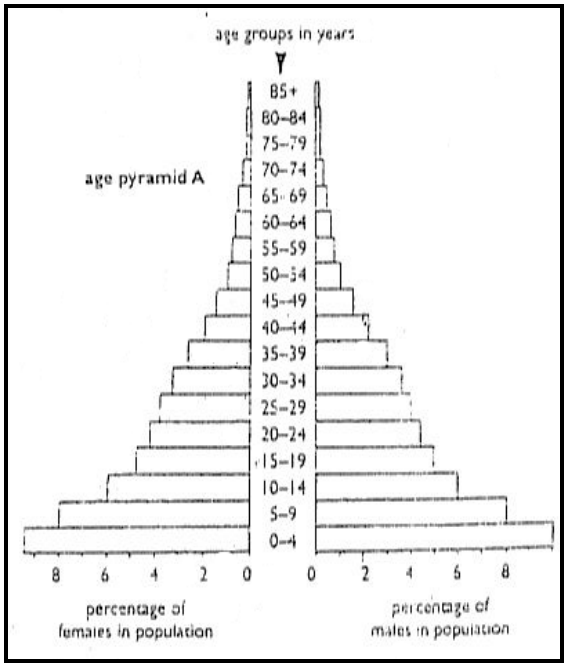
A White blood cells
B Red blood cells
C Haemoglobin
D Blood platelets

Answer: A (Encarta Encyclopedia)
The progression of the point of HIV infection to the occurrence of one of the chemical diseases that define AIDS takes a long time. The progression to disease in HIV-infected individuals is monitored by using surrogate markers (laboratory data that correlate with disease progression or clinical end-points;

i.e. illness that occurs after a specific degree of immuno-suppression has been reached).

Surrogate markers include the progressive loss of CD4 + T – lymphocytes, the major white blood cells lost through HIV infection. The lower the patient's CD4 + T cell content, the more advanced the degree of immuno-suppression is.

The following graph represents a population distribution for a developing country.



62. Which one of the following is true for the population distribution in a developing country?

A Birth rate is directly proportional to death rate
B There are more deaths than births
C There are very few people
D There are more births and more deaths.

Answer: D (Encarta Encyclopedia & Kent, M. Advanced Biology)
The total number of human inhabitants of a specified area such a s city, country or continent is known as population. The study of populations is called demography. Demography is primarily concerned with the study of populations in respect of size, structure and development. Formal demography is concerned with the manipulation of data relating purely to demographic variables such as births, deaths, etc.

Most population growths in recent years have taken place in developing countries. It is believed that these countries will go through the same stages of population growth as the industrially developed countries. Before the industrial revolution in Britain, for instance, the population was low and stable with high birth rates and high death rates.

With industrialization, improved agriculture, better nutrition and medical knowledge brought about a turn around in the population structure. The birth rates rose while death rates were lowered, resulting in rapid population growth. This is similar to the present situation in developing countries.

63. Which age group makes exactly 6% of the male population?

A 20 – 24 years
B 10 – 14 years
C 35 – 39 years
D 80 – 84 years

Answer: B
This age pyramid consists of two bar graphs, one for females to the left and the male bar graph to the right. From both graphs, the x-axis represents the percentage of a population while the y-axis represents the age group with the population. Therefore, from the male population graph, 6% of males are aged between 10 – 14 years.

<u>Questions 64 and 65 refer:</u>
A learner in grade 11 wanted to know how different light intensities affected the rate of photosynthesis. He put up an experiment and recorded the observed results.

64. Which one of the following was an independent variable for that experiment?

A Oxygen
B Light
C Carbon dioxide
D Water

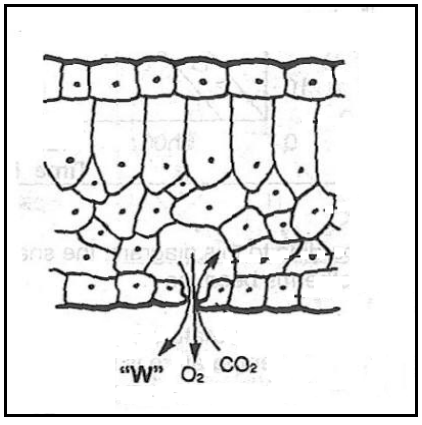
Answer: B (Encarta Encyclopedia)
Variables in the context of a scientific experiment can be distinguished as dependent and independent. The dependent variable in this case would be the rate of photosynthesis, and the independent variable would be light. This is so because the rate of photosynthesis depends on the intensity of light. For instance, when drawing a graph to illustrate the result of such an experiment, it is normal to represent the light intensity, as an independent variable would be represented on the horizontal or *x*-axis, and the rate of photosynthesis, as a dependent variable as the vertical or y-axis.

65. Which one of the following would have been the correct statement of the aim for the experiment?

A To determine the influence of light intensity on the process of photosynthesis
B To determine whether light is necessary for photosynthesis
C To determine whether chlorophyll is necessary for photosynthesis
D To show that plants release heat during photosynthesis

Answer: A
The answer was in fact given in the background statement to the question!

66. Arrow "w" in the diagram below is a molecule which also diffuses out during the day.



Which one of the following is correct?

A Water
B Hydrogen
C Nitrogen
D Carbon monoxide

Answer: A
Stomata are microscopic pores in the epidermis of the leaves of plants. By controlling the aperture of the stomata, plants are able to compromise between maximizing gaseous exchange and minimizing water losses. When the stomata are open, the sub-stomatal air spaces are connected with the atmosphere. In this way, gases are exchanged between the plants and the atmosphere. Carbon dioxide from the atmosphere enters the leaf for photosynthesis and oxygen, a product of photosynthesis, leaves the plant into the atmosphere where animals will capture it for respiration. The evaporated water on the surface of the mesophyll, as a result of the effect of the sun diffuses from the surface of the mesophyll cells as water vapour into the sub-stomatal air spaces of the leaf. From here water diffuses into the atmosphere

67. Only an embryo cell can divide into an embryo and an egg cell cannot because …

A embryo cells are specialized cells
B embryo cells have a diploid number of chromosomes
C egg cells are not differentiated
D egg cells have a haploid number of chromosomes

Answer: B
An egg (or ovum) is a female reproductive cell, or gamete. It has the ability to develop into a new organism after fertilization by a sperm, which is the male gamete. Both female and male gametes are the final products of 2^{nd} meiotic cell division during gametogenesis (oogenesis and spermatogenesis). The gametes are haploid, i.e. they contain half the number of chromosomes (n) or only one gene set and therefore can not further divide. During fertilization, the female and male gametes fuse to form a zygote. The zygote contains a diploid number (2n) of chromosomes or two complete sets of genes, one from each parent. By repeated mitosis, the zygote

divides into many cells with the same number of chromosomes as the parents. NB: Each species has a fixed number of chromosomes

Question 68 and 69 refer:
A 1-year carp (type of fish) has an average mass of 30 g. A nearby lake was stocked with hundreds of these young fish.

68. What was the total average mass of the carp population when it was first put in the lake?

A 3 000 g
B 30 000 g
C 25 000 g
D 45 000 g

Answer: B
The total average mass of 1-carp fish = 30 g
The total average mass of 100-carp fish = **x**
Therefore, 1-carp fish.
x = 100-carp fish x 30 g = 30 000 g

69. The total average mass of hundred fish was 45 000 g after a 50% increase of the initial average.

Which one of the following will be the total average mass of fish remaining in the lake after 60% of the carp were caught by the fishermen?

A 15 000 g
B 27 000 g
C 9 000 g
D 18 000 g

Answer: D
60% of 45 000 g = 60/100 X 45 000 g
= 27 000 g of carp caught by fishermen. Therefore, 45 000 g – 27 000 g = 18 000 g of fish are remaining in the lake.

70. Under which of the following conditions may drug resistance in micro-organisms occur?

When …

A micro-organisms respond perfectly to drug treatment
B patients continue to take prescribed medication without stop
C a combination of drugs is used during treatment
D the drugs themselves have a potential to cause mutations

Answer: D (Encarta Encyclopedia)
The ability of certain disease-causing micro-organisms to overcome the effects of drugs that are meant to destroy them is called drug resistance (Isaac et al.). Antibiotics refer to any chemical compound used to kill or inhibit the growth of infectious organisms, particularly bacteria and fungi. All antibiotics share the property of selective toxicity, i.e. they are more toxic to an invading organism than they are to an animal or human host.

Penicillin is the most well-known antibiotic and has been used to fight many infectious diseases, including syphilis, gonorrhea, tetanus, and scarlet fever. Another antibiotic, streptomycin, is used to combat tuberculosis (TB). Originally the term antibiotic referred only to organic compounds, produced by bacteria or moulds that are toxic to other micro-organisms. The term now includes synthetic and semi-synthetic as well as organic compounds. Antibiotic refers primarily to antibacterials but also includes anti-malarials and anti-protozoals. There are also a number of antivirals, but most viral infections cannot and should not be treated with an antibiotic.
The use of antibiotics is limited is to prescription only medicine because bacteria have evolved resistance against certain antibiotics.
Resistance therefore, occurs in any one of the following:
(i) inactivation of the antibiotic, i.e., resistance to penicillins and chloramphenicol, among others.
(ii) a mutation that changes the bacterial enzyme affected by the drug in such a way that the antibiotic can no longer inhibit it.
The problem of resistance is exacerbated by the use of antibiotics as prophylactics—intended to prevent infection before it occurs. (i) Indiscriminate and inappropriate use of antibiotics for the treatment of the common cold and other common viral infections, against which they have no effect, removes antibiotic-sensitive bacteria

and allows the development of antibiotic-resistant bacteria. (ii) Similarly, the use of antibiotics in poultry and livestock feed has promoted the spread of drug resistance and has led to the widespread contamination of meat and poultry by drug-resistant bacteria such as *Salmonella*.

71. HIV is a retrovirus because …

A it affects the white blood cells only
B its DNA is not replicated when that of the host cell does
C it incorporates its genetic material into that of the host cell
D it spreads very rapidly

Answer: C
Retroviruses are viruses that are able to make DNA from RNA. They are characterized by a unique mode of replication within the cells of their hosts. Like some other viral groups, retroviruses contain a core of the nucleic acid RNA instead of the usual DNA. Unlike other RNA viruses, retroviruses replicate as DNA rather than RNA genomes inside their hosts by means of an enzyme they carry, called reverse transcriptase. The retroviruses cause various infections in birds and mammals, including humans. Some genera also cause cancers in animals, such as feline leukaemia. The Human Immunodeficiency Virus (HIV) that causes AIDS is also a retrovirus.

Questions 72 and 73 refer:
The Table herewith gives the results from a plant competition experiment where five pea plants of differing numbers were grown in areas of similar fertile soil measuring ¼ square metre.

Number of plants per ¼ square metre	Average number of pods	Average number of seeds per pod
20	8.3	6.0
40	6.8	5.9
60	3.9	6.2
80	2.7	5.9
100	2.1	3.0

72. Which one of the following is the correct number of seeds produced by 60 plants?

A 600
B 372
C 120
D 236

Answer: B
The average number of seeds for 60 plants is 6.2. Therefore, the correct number of seeds produced by 60 plants will be

60 X 6.2 = 372

73. Since seed mass appears not to be affected by competition, according to the results found in the Table, what number would be the better number of seeds to grow per ¼ square metre?

A 20
B 60
C 80
D 120

Answer: A
The average number of seeds produced by 100 plants is 3.0 and that for 20 plants if 6.0. On the other hand, 60 plants produce 6.2 while that of 80 plants is 5.9. Therefore, it would be better to grow fewer plants (20) instead of many in a ¼ square metre
In a genetic cross, where "**G**" represents a dominant gene for green colour and "**g**" is the gene for albinism (absence of colour), two parent plants, one heterozygous green and the other homozygous green, produced offspring in the F1 generation

74. In a genetic cross, where "**G**" represents a dominant gene for green colour and "**g**" is the gene for albinism (absence of colour), two parent plants, one heterozygous green and the other homozygous green, produced offspring in the F1 generation

Which one of the following would be true about the offspring?

A They will all have the same phenotype
B They all have the same genotype
C Three are green and one is albino
D Three are albino and tone is green

Answer: A

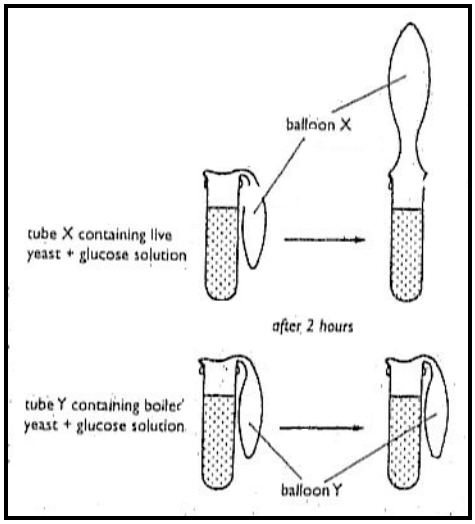
Gg X GG
G g G G
GG GG gG gG
F1 generation: All offspring have the same phenotype

75. Which one of the following is true about a seed?

A A structure containing an embryo and food store formed from an ovule following fertilization
B A structure that protects unopened floral bud
C The structure in the flower's ovary that contains female gametes
D The swollen region of the flower's female sex organ containing ovules

Answer: A
Soon after fertilization, an ovule develops into a seed. A seed contains a multicellular embryo, a new small plant, surrounded by a protective coat to shield it from adverse environmental conditions and biological attack. A seed is adapted to remain dormant until conditions are favorable again for germination and the emergence of a new plant. When conditions are favorable, the food store and the tissues of the embryo enable the plant to grow.

76. The experiment in the accompanying diagram was set up to investigate the effect of the yeast on glucose solution. It was left in an incubator at 30ºC for 2 hours.



Which of the following is the reason balloon X was inflated while balloon Y failed to do so?

A Air in balloon Y was made more thin by temperature
B Gas was produced by the activity of yeast in X than in Y
C Test sizes of both the balloons and the test tubes are important
D The experiment should start at the same time in all the test tubes

Answer: B
Pyruvic acid is formed when glucose is broken down during the process of glycolysis. The process can take place without oxygen. Alcoholic fermentation, on the other hand, is the process following glycolysis whereby plants and fungi convert pyruvic acid or pyruvate to carbon dioxide and alcohol with the release of some energy. In the experiment above, alcoholic fermentation took place in test tube X and nothing occurred in test tube B. Therefore, an inflated balloon in test tube X is the result of carbon dioxide that was produced.

77. The following reasons are proposed for the conservation of nature.

(i) to make profit from tourists
(ii) to manufacture medicines from plants and animals
(iii) to retrench workers
(iv) to decrease threats for human survival

A (i); (ii) and (iii)
B (i); (ii) and (iv)
C (ii); (iii) and (iv)
D (i); (iii) and (iv)

Answer: B
Nature conservation refers to the sustainable use of natural resources, such as soils, water, plants, animals, and minerals. The conservation of nature can be viewed from the following dimensions:
(i) Economically, the natural resources of any area constitute its basic capital, and wasteful use of those resources would, therefore, constitute an economic loss. (ii) From the aesthetic and moral viewpoint, it includes also the maintenance of national

parks, wilderness areas, historic sites, and wildlife resulting in the creation of job opportunities (iii) In certain cases, conservation may imply the protection of a natural environment from any human economic activity.

There are two main types of natural resources, namely: renewable and non-renewable. Renewable resources include wildlife and natural vegetation of all kinds. Non-renewable resources, on the other hand, are those that cannot be replaced or that can be replaced only over extremely long periods of time.

78. Which one of the following is a disadvantage of selective breeding?

A Inbreeding may lead to loss of resistance to disease
B Productivity is always compromised
C It increases the gene pool of the species
D It tampers with God's creation

Answer: A
Selective breeding refers to a situation where particular individuals are selected and allowed to breed while others are prevented from doing so. This means that only alleles that give characteristics that are favored by humans are retained, while those that give undesirable characteristics are eliminated. Inbreeding usually increases the risk of harmful recessive alleles as a result of increased homozygosity

79. Which one of the following explains why nails and hair are alike?

A Both are not stiffened by keratin
B Nails and hair are a modified form of skin
C They both have a resting state
D Both grow at the same rate

Answer: B
Skin, is the protective organ covering the external surface of the body and merging, without break, at the various body openings, with the mucous membranes of the alimentary and other canals. The skin forms a protective barrier against the action of physical, chemical, and bacterial agents on the deeper tissues and contains the special end organs for the various sensations commonly grouped as the sense of touch, temperature, and pain.
The skin consists of an outer, protective layer (epidermis) and an inner, living layer (dermis). The top layer of the epidermis is composed of dead cells containing keratin, the horny scleroprotein that also makes up hair and nails.
In certain places the outer layers of the skin are modified to produce the hair and nails. The skin varies in thickness from 0.5 mm (0.02 in) on the eyelids to 4 mm (0.17 in) or more on the palms and soles.

80. Which one of the following always accounts for a slightly higher CO_2 levels in spring than later in summer?

A An decreased rate of animal respiration
B An increased rate of photosynthesis
C A decreased rate of photosynthesis
D An increased rate of animal respiration

Answer: C
Carbon dioxide is an atmospheric gas resulting from animal respiration, industrial emissions, burning of fossils, etc.Normally much of thus gas is remove from the atmosphere as it constantly gets absorbed by plants during photosynthesis.Deciduous plants are plants that shed leaves annually at the approach of a season of cold not favourable to growth – autumn and winter. Spring is that season shortly after winter. Many deciduous plants at this time are starting to bud and develop foliage. Therefore, less photosynthesis takes place in this season than it would in summer. Consequently, the level of carbon dioxide is likely to be higher in spring than in summer.

81. Which one of the following is the result of deforestation?

A Increased rainfall
B Increased CO_2 levels
C The preservation of the species
D Increased absorption of water by plants

Answer: B
Deforestation refers to a large-scale removal of the forest prior to its replacement by other

land uses. Deforestation has an adverse effect on the livelihoods of millions of people who depend on the forest for food, shelter and fuel. As the forest plays a role in carbon storage through the process of photosynthesis, its removal will lead to elevated carbon dioxide levels in the atmosphere.

82. When may sneezing and/or coughing not necessarily be a sign of any illness?

A When entry of pathogens through the skin is prevented
B When mucus containing pathogens is expelled from the body
C When sneezing slowly spreads disease
D When coughing is able to destroy the bacteria

Answer: B
A sudden expulsion of air through the mouth and/or nose is called coughing or sneezing. Sneezing, more than coughing is an involuntary process and may be a response to an irritating situation. To some extent also, coughing may be involuntary. Therefore, because of the nature of coughing and sneezing, foreign and harmful substances, including pathogens will be expelled from the body.

83. There is a growing trend of farmers in South Africa to grow hedgerows surrounding their farms.

Which one may be the reason for this?

A Hedges prevent soil erosion
B Hedges provide shelter for crops from wind
C Hedges prevent wild animals from invading the farm
D Hedges always improve the view of farms

Answer: B
A hedgerow is a closely planted line of trees or shrubs. The initial purpose of hedgerows was to separate stock from crops. The need for intensive farming could have led to removal of hedgerows on the grounds that huge farming space was required also to accommodate large machinery.

However, environmentalists advocate for the planting of hedgerows for the following reasons:

- Hedgerows make the country aesthetically pleasing
- Hedgerows diversify life by providing food and nesting
- Hedgerows act as refuges for predators which limit growth of pests
- Hedgerows act as wind breakers that reduce wind erosion

84. The concept “pandemic” refers to

A an occasional and unconnected outbreak of disease
B a disease outbreak that is always present in a particular area
C a disease outbreak that affects many people in an certain area
D a disease outbreak that spreads across several countries

Answer: D
Pandemic refers to a very quick outbreak of disease over a whole country or across several countries

85. Chemical digestion assists which one of the following processes?

A Respiration
B Mastication
C Absorption
D Excretion

Answer: C
The digestion of food in the alimentary canal is both mechanical and chemical processes. During mechanical digestion food is broken down to smaller parts through chewing or mastication in the mouth and churning by the walls of the stomach and the intestines. Chemical digestion, on the other hand, is a catalytic reaction that involves the action of enzymes. Food if further broken down by this process into its most basic constituents that are soluble in water, such as glucose, which can be absorbed into the blood stream.

86. People with greenhouses should paint the glass white to …

A reflect most of the sun’s rays

B absorb heat and store it
C prevent the greenhouse effect
D attract more insects for pollination

Answer: A (Encarta Encyclopedia)
A greenhouse is a building with a glass or plastic roof or walls used for the cultivation of and protection of tender plants and of plants that are grown out of season.
Greenhouses (sometime called glasshouses) are designed to create an environment in which temperature, moisture and light can be controlled and balanced in order to produce favourable conditions for the growth of plants such as tomatoes
Natural sunlight is sufficient to meet the requirements favourable for plant growth. However,

- in autumn and winter, sunlight is supplemented by artificial light
- in summer, light is reduced by whitewashing the panes leading also to the reduction of heat

87. In a fatal accident involving a lorry and a minibus taxi, one passenger who apart from losing both legs, bled profusely and lost a lot of blood as a result. The passenger, whose blood type was **A** had to receive blood donated by the public.

Which blood group would be the most convenient to donate to the patient?

A group B
B group O
C group AB
D group AB and A

Answer: B
Blood transfusion is the procedure of introducing the blood of the donor into the blood stream of the recipient. Successful blood transfusion depends largely on compatibility. In the past, the procedure was accomplished with whole blood. But components of blood are used today.
Blood transfusion is done with concentrated blood cells that have been separated from blood plasma. The classification of red blood cells according to the presence of specific substances on their surfaces is called blood typing. This is a prerequisite for successful transfusion.
The four known blood types are A, B, AB and O.

88. One of the following reactions is a homeostatic process that takes place in the liver of humans?

A Urea →Amino acids
B Starch → Maltose
C Glycogen → Glucose
D Bile → Haemoglobin

Answer: C
Homeostasis is the process by which an organism maintains the constant internal conditions for life. It is based on coordination that is brought about by both the endocrine and nervous systems.
Homeostasis operates on the principle of feedback. This may be positive or negative. Negative feedback, particularly applied in the instance of this question, states that an accumulation of a product leads to the reversal of its production as guided by circumstances and vice versa.
Homeostasis is regulated by hormones. Once there is an abundance of glycogen while blood glucose is depleted, glucagon will convert glycogen back to glucose until stability is reached

89. The absence of which one of the following products will prevent the dark phase in the process of photosynthesis from being finalized?

A Hydrogen
B Oxygen
C CO_2
D Water vapour

Answer: A
The following are the products of the process of photosynthesis during the light phase:

- Hydrogen derived from photolysis
- ATP derived from photophosphorylation
- Oxygen derived from photolysis

Therefore, it is only hydrogen from the light phase which will combine with carbon dioxide from the atmosphere in the dark phase to form carbohydrates.

90. Males are more vulnerable to sex-linked disorders such as haemophilia, than are females.

Which one the following is correct?

A Women are not carriers of the disease
B Males always inherit a female chromosome, X, which carries the gene for the disorder
C The Y chromosome inherited by a female carries a gene for this disease
D Males are weaker than females

Answer: B (Encarta Encyclopedia)
Sex-linked inheritance refers to a pattern of sexual differences in the inheritance of traits. Sex is usually determined by the action of a single pair of chromosomes. Abnormalities of the endocrine system or other disturbances may alter the expression of secondary sexual characteristics, but they almost never completely reverse the sex. A human female, for example, has 23 pairs of chromosomes, and the members of each pair are much alike. A human male, however, has 22 similar pairs and one pair consisting of two chromosomes that are dissimilar in size and structure. The 22 pairs of chromosomes that are alike in both males and females are called autosomes.

The remaining chromosomes, in both sexes, are called the sex chromosomes. The two identical sex chromosomes in the female are called X chromosomes. One of the sex chromosomes in the male is also an X chromosome, but the other, shorter one is called the Y chromosome. When gametes are formed, each egg produced by the female contains one X chromosome, but the sperm produced by the male can contain either an X or a Y chromosome. The union of an egg, which always bears an X chromosome, with a sperm also bearing an X chromosome produces a zygote with two Xs: a female offspring. The union of an egg with a sperm that bears a Y chromosome produces a male offspring. Modifications of this mechanism occur in various plants and animals.

The human Y chromosome, apart from its role in determining maleness, appears to be genetically inactive. Thus, most genes on the X have no counterpart on the Y. These genes, said to be sex-linked, have a characteristic pattern of inheritance. The disease called haemophilia, for example, is usually caused by a sex-linked recessive gene (h). A female with HH or Hh is normal; a female with hh has haemophilia. A male is never heterozygous for the gene because he inherits only the gene that is on the X chromosome. A male with H is normal; with h he has haemophilia. When a normal man (H) and a woman who is heterozygous (Hh) have offspring, the female children are normal, but half of them carry the h gene—that is, none of them is hh, but half of them bear the genotype Hh. The male children inherit only the H or the h; therefore, half the male children have haemophilia. Thus, in normal circumstances a female carrier passes on the disease to half her sons, and she also passes on the recessive h gene to half her daughters, who in turn become carriers of haemophilia. Many other conditions—including red-green colour blindness, hereditary nearsightedness, night blindness, and ichthyosis (a skin disease)—have been identified as sex-linked traits in humans.

91. Which of the following is the role of gaseous exchange in animals?

A To break food into smaller particles
B To make oxygen available for cellular respiration
C To transport nutrients in the body
D None of the above

Answer: B (Encarta Encyclopedia)
Respiration, term with dual meaning in biology: first, the physical process by which living things (organisms) take in oxygen from the surrounding medium and emit waste carbon dioxide—in this sense it is variously known as physical respiration, breathing, ventilation or gas exchange; second, the chemical process by which fuel molecules such as sugars (see Sugar Metabolism) and fats are broken down with the help of oxygen within a cell to liberate energy for cellular life processes—in this sense it is

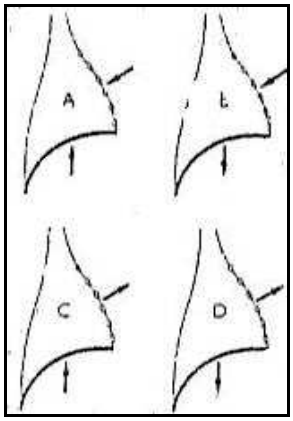
also known as chemical, biochemical, or cellular respiration.

92. The following is the disadvantage of taking in air through the mouth and through the nose.

A Air is always moist
B Air is warm
C Air is not filtered
D Air is warmed and filtered

Answer: C (Encarta Encyclopedia)
A nose is an organ of smell, and also part of the apparatus of respiration and voice. Considered anatomically, the margins of the nostrils are usually lined with a number of stiff hairs (vibrissae) that project across the openings and serve to arrest or filter the passage of foreign substances, such as dust and small insects, which might otherwise be drawn up with the current of air intended for respiration.
Mouth, on the other hand refers to an opening into the body of most animals, through which food is ingested, and usually the outlet of sound or voice communication.
Since there is no hair in the mouth, breathing through it will result in taking in foreign bodies together with air because there is no filtering.

93. In which diagram do the arrows correctly indicate the movements of the diaphragm and rib cage during expiration?



Answer: B
Expiration or exhalation is one of the two stages of breathing during external respiration. It is a physical process in which air from the lungs is expelled to the atmosphere.

Breathing involves the movement of muscles, ribs and the diaphragm in such a way that the volume of the thoracic cavity is either increased or decreased resulting in pressure increase or decrease. These have implications for the exchange of gases to take place.
The following happens during expiration, for example:

- The intercostals muscles relax
- The diaphragm relaxes also and moves downward
- The ribs move downward
- The volume in thoracic cavity decreases
- Resulting in the pressure becoming greater than that of the atmosphere

Air is forced out and exhaled.

94. A plant tissue through which manufactured food is transported is the .....?

A Phloem
B Xylem
C Cambium
D Cortex

Answer: A
The transport of food in solution manufactured during photosynthesis from the leaves and all other photosynthesizing organs to the different parts of the plant is called translocation.
The phloem, in higher plants, is a vascular tissue that conducts sugars and other synthesized food materials from the regions of manufacture to the region of consumption and storage. The phloem is found in the vascular bundles, the longitudinal strands of conductive tissue, together with the water-conducting tissue, or xylem.

95. Which one of the following combinations of concepts is true about malaria and swine flu?

A	Endemic	Epidemic
B	Pandemic	Sporadic
C	Sporadic	Endemic
D	Pandemic	Endemic

Answer: D

The study of the pattern and transmission of disease through the population and the various factors that affect their spread is called epidemiology. Diseases such as swine flu caused by the N1H1 virus that occur throughout the world population at extremely high rates are called pandemics.
Diseases such as malaria or yellow fever, on the other hand, are said to be endemic because they are always present in particular areas at a time.

96. Some features, such as finger print patterns and the shape of the hand are permanent while others like the lines on the hands change daily.

Which TWO of the following form the basis for such changes?

A Diet and Exercise
B Diet and gaseous exchange
C Ill-health and exercise
D Exercise and gaseous exchange

Answer: A (City Press, 17 May 2009)
A finger print is an impression made by the papillary ridges on the ends of the fingers and thumbs. Finger prints afford an infallible means of personal identification because the ridges on every finger are unique and different from each other. According to chirologist, Kevin Leak, the finger print patterns and shape of the hand are permanent while others, like the lines on the hand change daily. The changes are brought about by stress, diet and exercise.
It is believed that the permanent features reflect more of the individual's lasting characteristics while the changing features provide the individual's current experiences.

97. A tree that has a damaged bark will have problems associated with which one of the following?

A Organic food
B Oxygen
C Water
D Mineral salts

Answer: A

The two types of stems are woody stems and non-woody or herbaceous stems. The herbaceous stems are covered by a layer of epidermal cells. Stomata penetrate the epidermis for gaseous exchange. In woody stems on the other hand, the epidermis is replaced by the bark which consists of many layers of dead cells. The bark has openings called lenticels for gaseous exchange.

The stems of woody trees are supported by a woody tissue that makes up the bulk of these stems. The woody stems consist of the xylem and fibres formed by the process of secondary growth or thickening brought about by the dividing cells of the cambium.
Both the xylem and phloem constitute the vascular bundle of the stem. The xylem is located more to the inside of the stem while the phloem is more towards the outside and the bark. Thus, in the case of the bark getting damaged, the phloem is likely to be damaged, as well. In this way, a plant will have a problem of translocation of food manufactured during photosynthesis to different body parts

98. An allergic response characterized by a whistling movement of air caused by excessive mucous and spasms of smooth muscles in the bronchioles.

A Tuberculosis
B Bronchial asthma
C Emphysema
D Pneumonia

Answer: B (Kent, M: Advanced Biology)
Asthma is a Greek word meaning to pant or panting. It may be brought on by exercise or infection, but the most common form results from an allergic reaction in which mast cells in the lower part of the airway release their chemicals.

These chemicals cause the bronchioles to constrict and the alveoli to become full of fluid and mucus. The situation leads to coughing, wheezing and difficulty in breathing. This is bronchial asthma. The common allergens would include pollen, fur, feather and house dust

99. It is advisable for a football team from Durban to arrive a week in advance to play their Kenyan counterparts because

A players form Durban require less oxygen on high altitudes.
B the team must get used to the surface of the pitch for the whole week.
C air pressure in Durban equals that in Kenya.
D the concentration of oxygen decreases with increased altitudes.

Answer: D (Kent, M: Advanced Biology)
High altitude environments are potentially dangerous. As altitude increases, air temperature, humidity and air pressure decrease. When the partial pressure of the atmospheric gases decreases, the penetration of solar radiation, especially ultraviolet light increases. These changes bring with them many diseases such as skin cancer, etc.
Exposure to high altitudes causes hyperventilation and an increase in sub-maximal heart rate which increases the cardiac output aimed at increasing oxygen supply to the respiring tissue. The process whereby a person allows the body to make reversible physiological adjustments in order to cope better with new conditions is called acclimatization.
Altitude acclamatisation includes the following:

- Increase haemoglobin content and the volume of red blood cells
- Increase in the number of red blood cells
- Increase in the number of capillaries supplying the muscles
- Increase in myoglobin

100. Which one of the following combinations of conditions best explains the situation where plants lose water in the form of water droplets?

A	Low humidity	High root pressure
B	High humidity	High root pressure
C	Low root pressure	Low humidity
D	High humidity	Low root humidity

Answer: B

Guttation is the loss of water droplets by plants through the openings on the edges of the leaves called hydathodes. Root pressure is linked to this process. Guttation occurs mostly at night but can also take place in very humid conditions. Therefore, high root pressure and high humidity are the two major factors that affect guttation

Transpiration, on the other hand, involves the loss of water in the form of water vapour through the stomata of the leaves. It is influenced by the suction force of the leaves as a result of the dry atmosphere of the day.