2015

Set: I

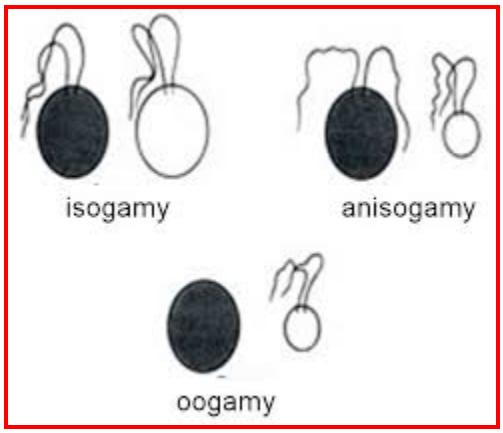
Question: 1 [2 x 5 = 10]

1. Answer the following questions (Alternative are to be noted):

a. Distinguish between isogamy and oogamy.

Answer:

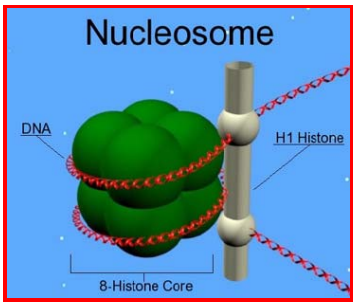
Isogomy	*Oogamy*
Isogamy involves fusion of two morphologically similar and motile gametes.	Oogamy involves fusion of two morphologically dissimilar gametes. The female gamete is larger and non-motile while the male gamete is smaller and motile.
The gametes are physiologically different. The common example of isogamy is seen in case of unicellular algae Chlamydomonas.	The gametes are also physiologically different. The examples are the higher group of algae like Volvox, Oedogonium, etc.



b. What is nucleosome?

Answer:

A nucleosome is a structure in your chromosomes, or bundled DNA. Each nucleosome has a core particle, DNA, and a linker protein. The proteins in the core particle and linker proteins are called histones. The DNA will wrap around the core particle about 1.65 times and is secured by the linker protein.



About 200 bases of DNA are involved with each nucleosome. This includes the portion that is wrapped around the core and a bit of a tail region that connects to the next nucleosome. This arrangement is said to look like beads on a thread. Several nucleosomes together are called chromatin. Chromosomes are bundles of tightly packed chromatin. Humans have 23 pairs of chromosomes.

Or

Mention any two symptoms of Turner's or Klienefelter's syndrome.

Answer:

Klienefelter's syndrome:

1. It is due to trisomy (2n+1) of sex chromosome.
2. Genetic Sex: XXY; generally female because of the presence of two X chromosome.
3. Clinical symptoms: male with slowly degenerating testes, enlarged breasts.

Turner's syndrome:

4. It is due to monosomu (2n-1)
5. Genetic Sex: XO; genetically sexless.
6. Clinical symptoms: Short status , webbed neck , female with poorly developed breasts and degenerated ovaries and rudimentary sexual characters

c. Give scientific names of two exotic carps.

Answer:

silver carp (Hypophthalmichthys molitrix), bighead carp (Aristichthys nobilis).

d. Give two examples of bio-piracy.

Answer:

Example of Biopiracy

• Patenting of Neem (Azadirachta indica)

• Patenting of Basmati

Or

e. Define ecological diversity.

Answer:

Ecological diversity is a type of biodiversity. It is the variation in the ecosystems found in a region or the variation in ecosystems over the whole planet.

What is ex-situ conservation? Give an example.

Answer:

Ex-situ conservation is the preservation of components of biological diversity outside their natural habitats. Example : Botanical garden, Aquarium.

Question: 2 [3x9=27]

Answer the following questions? (Alternatives are to be noted):

a. What is amniocentesis? What is its significance? [1+2]

Answer:

Amniocentesis is a diagnostic procedure performed on pregnant women that looks for genetic and chromosomal abnormalities (birth defects) in the fetus.

Some common conditions that may be detected include Down syndrome (trisomy 21), cystic fibrosis, and neural tube defects (spina bifida). This test is generally performed between weeks 14 and 20 of pregnancy, but may be performed in the third trimester to look for certain conditions,

such as infection and fetal lung maturity. It is highly accurate (98-99%) and is usually recommended by obstetricians if the fetus is at a higher risk for any of the health problems mentioned above. Doctors determine that risk by taking into account some laboratory findings, such as the triple test, family history, and maternal age.

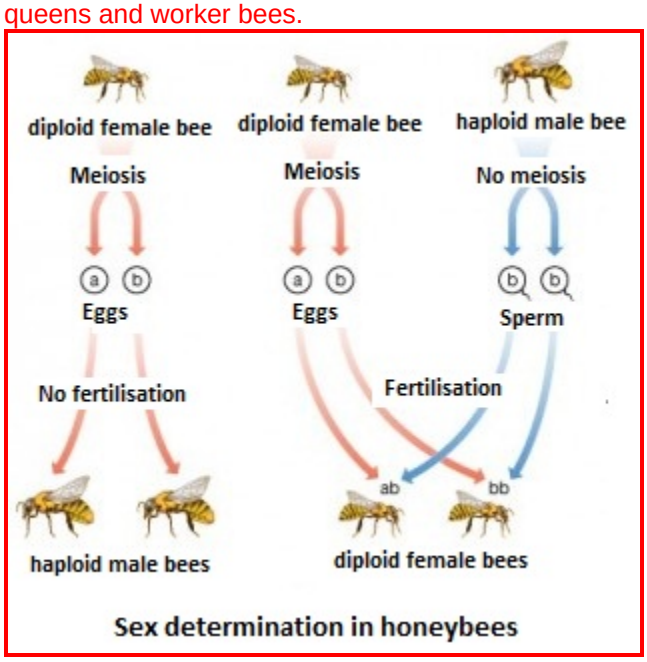
b. What is sex chromosome? Give the method of sex determination in honeybee. [1+2]

Answer:

Sex chromosomes are particular chromosomes that are involved in determining the sex of an organism. In the cells of humans and many other organisms the sex chromosomes consist of a pair of chromosomes called the X and Y chromosomes. The X and Y chromosomes were first discovered in beetles by Nettie Stevens in 1906.

Honeybees show haplodiploid method of sex determination. Haplodiploidy is a sex determination mechanism in which males develop from unfertilised eggs and are haploid, and females develop from fertilised eggs and are diploid. This mode of sex determination was first discovered by Johann Dzierzon, a Catholic priest, in 1845.

In honeybees, sex is normally determined by the fertilisation or non-fertilisation of the eggs, rather than the presence or absence of sex chromosomes. In honeybees, the male progeny normally develops from unfertilised eggs, which are haploid and have just one set of chromosomes. The fertilised honeybee eggs, which are diploid and have two sets of chromosomes, differentiate into queens and worker bees.



Or

Give the significance of principles of Hardy-Weinberg equilibrium. [3]

Answer:

Godfrey Hardy and Wilhelm Weinberg went on to develop a simple equation that can be used to discover the probable genotype frequencies in a population and to track their changes from one generation to another. This has become known as the **Hardy-Weinberg equilibrium equation**. In this equation ($p^2 + 2pq + q^2 = 1$), p is defined as the frequency of the dominant allele and q as the frequency of the recessive allele for a trait controlled by a pair of alleles (A and a). In other words, p equals all of the alleles in individuals who are homozygous dominant (AA) and half of the alleles in people who are heterozygous (Aa) for this trait in a population. In mathematical terms, this is

$$p = AA + \frac{1}{2} Aa$$

Likewise, q equals all of the alleles in individuals who are homozygous recessive (aa) and the other half of the alleles in people who are heterozygous (Aa).

$$q = aa + \frac{1}{2} Aa$$

Because there are only two alleles in this case, the frequency of one plus the frequency of the other must equal 100%, which is to say

$$p + q = 1$$

Since this is logically true, then the following must also be correct:

$$p = 1 - q$$

There were only a few short steps from this knowledge for Hardy and Weinberg to realize that the chances of all possible combinations of alleles occurring randomly is

$$(p + q)^2 = 1$$

or more simply

$$p^2 + 2pq + q^2 = 1$$

In this equation, p^2 is the predicted frequency of homozygous dominant (AA) people in a population, 2pq is the predicted frequency of heterozygous (Aa) people, and q^2 is the predicted frequency of homozygous recessive (aa) ones.

c. What is biofertilizer? Write how microbes are used in biofertilizer. [1+2]

Answer:

The fertilizers are used to improve the fertility of the land using biological wastes, hence the term biofertilizers, and biological wastes do not contain any chemicals which are detrimental to the living soil.

Bio-fertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in bio-fertilizers restore the soil's natural nutrient cycle and build soil organic matter. Through the use of bio-fertilizers, healthy plants can be grown, while enhancing the sustainability and the health of the soil. Since they play several roles, a preferred scientific term for such beneficial bacteria is "plant-growth promoting rhizobacteria" (PGPR). Therefore, they are extremely advantageous in enriching soil fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts. Hence, bio-fertilizers do not contain any chemicals which are harmful to the living soil.

Or

What is drug abuse? Give an example each of a stimulus and a tranquilizer drug. [1+(1+1)]

Answer:

Drug addiction is a chronic, often relapsing brain disease that causes compulsive drug seeking and use, despite harmful consequences to the drug addict and those around them.

Stimulants are drugs that speed up the activity of the central nervous system. Stimulants are useful in treating many medical conditions including ADHD, narcolepsy, asthma, obesity, and depression. There are several types of stimulants, including caffeine, nicotine, cocaine, amphetamines, and methamphetamines.

The principal minor tranquilizers are the benzodiazepines, among which are diazepam (Valium), chlordiazepoxide (Librium), and alprazolam (Xanax). These drugs have a calming effect and eliminate both the physical and psychological effects of anxiety or fear.

d. Name one bacterial disease of poultry birds. Mention its main symptom and control. [1+(1+1)]

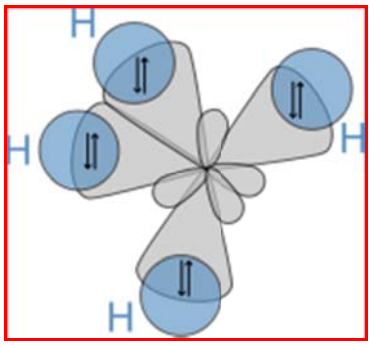
Answer:
Infection in young birds may be indicated by droopiness.

Symptom:
The diagnosis is made by isolating the causative organism. In older birds, blood testing may indicate presence of the disease, but a positive diagnosis depends upon isolation and identification of the organism by laboratory methods.

Control:
Complete eradication is the only sound way to prevent pullorum disease. All hatchery supply flocks should be tested and only pullorum-free flocks used to produce hatching eggs.

e. What is hybridization? Mention the ways by which emasslation is done. [1+2]

Answer:
Hybridisation (or hybridization) is the concept of mixing atomic orbitals into new hybrid orbitals (with different energies, shapes, etc., than the component atomic orbitals) suitable for the pairing of electrons to form chemical bonds in valence bond theory.



f. Define genetic engineering. Name one genetically modified organism. [2+1]

Answer:
Genetic engineering is the deliberate, controlled manipulation of the genes in an organism with the intent of making that organism better in some way. This is usually done independently of the natural reproductive process. The result is a so-called genetically modified organism (GMO). To date, most of the effort in genetic engineering has been focused on agriculture.

Proponents of genetic engineering claim that it has numerous benefits, including the production of food-bearing plants that are resistant to extreme weather and adverse climates, insect infestations, disease, molds, and fungi. In addition, it may be possible to reduce the amount of plowing necessary in the farming process, thereby saving energy and minimizing soil erosion. A major motivation is the hope of producing abundant food at low cost to reduce world hunger, both directly (by feeding GMOs to human beings) and indirectly (by feeding GMOs to livestock and fish, which can in turn be fed to humans).

A genetically modified mouse (Mus muscles) is a mouse that has had its genome altered through the use of genetic engineering techniques.

g. What is transgenic cell ? Mention two ways in which vector with recombinant DNA is introduced into a cell. [1+2]

Answer:

A transgene cell is a gene or genetic material that has been transferred naturally, or by any of a number of genetic engineering techniques from one organism to another. The introduction of a transgene cell has the potential to change the phenotype of an organism.

- Plasmid vectors,
- Cosmids

Or

Mention three aspects of Bio-safety issues. [3]

Answer:

1. Under Biosafety programed main emphasis has been given to facilitate and implement biosafety procedures and guidelines for ensuring safety from the use of Genetically Modified Organisms (GMOs) and products thereof in research and application to the users as well as to the environment. The institutions and industries involved in recombinant DNA work are carrying out their activities with the approval from Institutional Biosafety Committees (IBSCs), Monitoring-cum-Evaluation Committee (MEC) and Review Committee on Genetic Manipulation (RCGM) and other institutional structures.
2. Apart from considering the applications submitted by various organizations involved in the r-DNA technology, RCGM has taken several policy decisions such as standardization of protocol for conduct of multi-location field trials, data collection parameters, nomenclature of transgenic crop/gene/event, and new monitoring mechanism for Bt. cotton.
3. In the area of recombinant pharma sector, the Department actively participated in finalization of report for the Task Force on "Recombinant Pharma Sector" constituted by the Ministry of Environment & Forests.

h. Mention types of RNA and their functions. [3]

Answer:

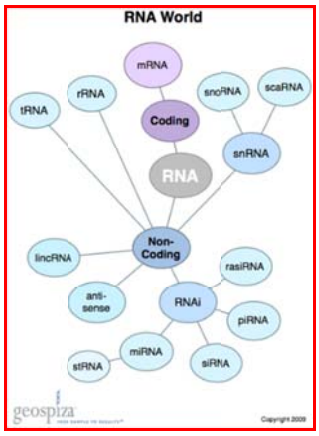
There are actually several types of ribonucleic acid or RNA, but most RNA falls into one of three categories:

- **mRNA or Messenger RNA**
  mRNA transcribes the genetic code from DNA into a form that can be read and used to make proteins. mRNA carries genetic information from the nucleus to the cytoplasm of a cell.

- **rRNA or Ribosomal RNA**
  rRNA is located in the cytoplasm of a cell, where ribosomes are found. rRNA directs the translation of mRNA into proteins.

- **tRNA or Transfer RNA**

  Like rRNA, tRNA is located in the cellular cytoplasm and is involved in protein synthesis. Transfer RNA brings or transfers amino acids to the ribosome that correspond to each three-nucleotide codon of rRNA. The amino acids then can be joined together and processed to make polypeptides and proteins.

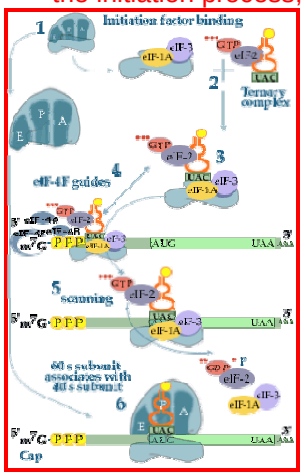


Or

Describe the initiation phase of translation process. [3]

Answer:

1. The initiation process can be divided in several distinct steps. First the ribosome dissociates into its two constituent subunits, called the 40S and 60S subunits. The subunits are prevented from spontaneous reassociation by binding of initiation factor eIF-3 to the small ribosomal subunit.
2. Initiation factor eIF-2 is a GTP-binding protein that specifically recognises initiator tRNA (Met-tRNA^{Met}) forming a ternary complex, eIF2-GTP-Met-tRNA^{Met}.
3. The ternary complex binds to the 40S ribosomal subunit.
4. The cap-structure at the 5´end of the messenger RNA is recognised by initiation factor eIF-4F. This factor has a subunit that specifically interacts with the cap-structure (see splicing: cap-structure). Binding of the initiation factor guides the activated 40S subunit, containing the initiator tRNA, to the 5´end of the mRNA. This type of initiation is known as cap-dependent initiation and is the most common type of initiation. Initiation can also occur through an alternative cap-independent initiation mechanism.
5. The mRNA-bound subunit travels along the 5'-untranslated end of the mRNA until it reaches the first AUG codon that will serve as the start codon for the translation process. This process, known as scanning, requires energy (ATP) and additional initiation factors. 6. When the activated 40S subunit has reached the start codon, the 60S subunit binds to the 40S subunit. This reaction requires an additional initiation factor, eIF-5, which hydrolyses the eIF-2-bound GTP, thereby releasing the initiation factors from the ribosome. As a result of the initiation process, the initiator Met-tRNA^{Met} becomes positioned in the ribosomal P-site.



i. What do you mean by productivity and decomposition? What is microclimate? [2+1]

Answer:

The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis is called productivity. Detritus is the raw materials for decomposition.it includes dead remains of plants (levels, bark and flowers) and of an including faecal matter. It is largely an aerobic process, i.e. requires oxygen for its process.

A microclimate is a change in the climate of an area as small as a few square feet to as large as many square miles. Microclimates can occur naturally. For example, they may occur near a lake or river where the atmosphere is cooled from the water. A greenhouse is an example of a microclimate.

Or

Mention the ways in which water becomes polluted. [3]

Answer:

Acid Rain

Though the acid rain awareness campaign has made this less of an issue than it was in the past, it's still a major pollution problem. A quick refresher on the how: the burning of fossil fuels releases compounds that interact with the H_20 in the air, creating a modified version of the raindrop—one that includes nitric and sulfuric acid, which pollutes the water and ground that's affected by the rain. Too much of those acids inhibits plant growth, and soil damage on a major scale would take eons to repair—which makes soil a "non-renewable resource," according to the U.S. Geological Survey.

Non-point Sources

All water pollution happens in one of two ways: via non-point or point systems. Non-point pollution comes from indirect sources, like agricultural runoff, mining waste, paved roads, and industrial activity. It's impossible to trace the original polluter in these cases, but toxic chemicals and compounds make their way into the water system just the same—through rainwater drainage, melting snow, and running rivers.

The Oil Industry

Everything about the oil industry—drilling, moving, laying pipeline, shipping—opens up the possibility for water pollution. From rigs that are compromised by foul weather (like those on the Gulf Coast) to barges that have accidental spills, the damage is never intentional, but it's still one of the major dangers facing clean water and marine life.

Question: 3 [5x3=15]

Answer the following questions? (Alternatives are to be noted):

a. What is menstrual cycle? Describe briefly the uterine changes during different phases of the menstrual cycle. [1+4]

Answer:

By definition, the menstrual (or uterine) cycle begins with the first day of bleeding, which is counted as day 1. The cycle ends just before the next menstrual period. Menstrual cycles normally range from about 25 to 36 days. The description of the phases of the menstrual cycle below assumes a cycle length of 28 days. However, only 10% to 15% of women have cycles that are exactly 28 days.

The menstrual and ovarian cycles each have 3 phases: Menstrual cycle

Days 1-5: Menstrual phase

• This phase is from first day of the menses to last day of bleeding (usually lasts from 3–5 days, up to 7 days).
• Bleeding occurs when there is no fertilization.
• Low levels of both progesterone and oestrogen make the blood vessels of the endometrium constrict, cutting off blood flow to the uterine lining.
• The cells of the uterine lining start to die, and the lining sloughs off and causes bleeding.
• Two-thirds of the endometrial lining sheds during menses.
• During this time the ovaries are beginning the follicular stage (see below).

Days 6-14: Proliferative phase
• This phase is from cessation of menses to ovulation.
• Endometrial lining thickens in preparation for implantation of a fertilized ovum. Its thickness doubles to about 4–6 mm.
• Uterine secreting glands increase in size and produce mucus.
• Uterine blood vessels begin to grow.
• Ovulation occurs in the ovaries at the end of this stage, usually around day 14, triggered by a surge in luteinizing hormone (LH) from the anterior pituitary gland.

Days 15-28: Secretory phase
• This phase is from ovulation to the start of the next menses.
• Endometrial glands secrete mucus, which prepares the uterus to receive a fertilized ovum.
• The corpus luteum produces oestrogen, while the cells of the ovaries produce progesterone.
• Endometrium continues to thicken.

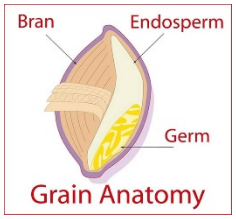
Or

Describe the fertilization process of a flowering plant mentioning the formation of endosperm and embryo.

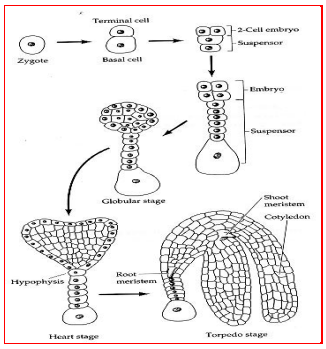
Answer:
The endosperm is developed from triploid primary endosperm nucleus (PEN). It precedes embryo development from zygote. During this process the triploid PEN divides mitotically to produce endosperm tissue filled with food materials. It is used for nourishing developing embryo. There are two types of endosperm development

· Free nuclear endosperm development:
The PEN undergoes successive nuclear division to give rise to free nuclei. This does not involve the cell wall formation. Eg: coconut water.

· Cellular endosperm development:
The PEN undergoes successive nuclear division followed by the cell wall formation. Eg: White kernel of coconut.
During the embryonic development, the embryo may completely consume the endosperm before the seed matures. This results in non endospermic seeds or exalbuminous seeds. Eg: pea, ground nut, bean, etc. The embryo may not utilize the endosperm completely and some amount of endosperm persists in the matured seeds. This results in the formation of endospermic seeds or albuminous seeds. Eg: castor, maize.



The process of development of embryo from zygote is called embryogenesis. The embryo develops from a diploid zygote located at the micropylar region of embryo sac. The zygote development takes place after the formation of certain amount of endosperm from PEN as it requires nourishment. The zygote divides mitotically to form pro embryo and subsequently into the globular, heart shaped and mature embryo. The mature embryo has cotyledon/s and an embryonic axis with plumule and radicle.



b. Give evidences in favour of chromosomal theory of inheritance. What is crossing over? [3+2]

Answer:

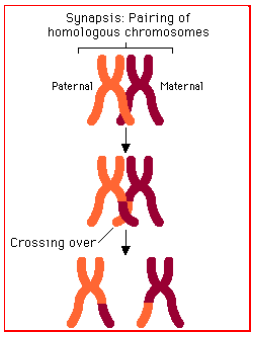
Genes are packaged in bundles called chromosomes. Humans have 23 pairs of chromosomes (for a total of 46). Of those, 1 pair is the sex chromosomes (determines whether you are male or female, plus some other body characteristics), and the other 22 pairs are autosomal chromosomes (determine the rest of the body's makeup).

The Chromosomal Theory of Inheritance was consistent with Mendel's laws and was supported by the following observations:

- During meiosis, homologous chromosome pairs migrate as discrete structures that are independent of other chromosome pairs.
- The sorting of chromosomes from each homologous pair into pre-gametes appears to be random.
- Each parent synthesizes gametes that contain only half of their chromosomal complement.
- Even though male and female gametes (sperm and egg) differ in size and morphology, they have the same number of chromosomes, suggesting equal genetic contributions from each parent.
- The gametic chromosomes combine during fertilization to produce offspring with the same chromosome number as their parents.

Crossing over:

Crossing over is a recombination of genes due to exchange of genetic material. Between two homologous chromosomes. It is the mutual exchange of segments of genetic material between non-sister chromatids of two homologous chromosomes, so as to produce recombination or new combination of genes.
The non-sister chromatids in which exchange of segments have occurred are called recombinants or crossover while the other chromatids in which the crossing over has not taken place are known as known as parental chromatids or non-crossover.



OR

What is central dogma of molecular biology? Describe the main features of transcription processs. [1+4]

Answer:

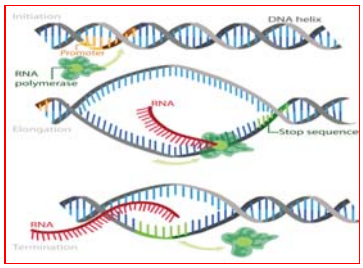
Molecular biology explores cells, their characteristics, parts, and chemical processes, and pays special attention to how molecules control a cell's activities and growth.

The process in which cells make proteins is called protein synthesis. It actually consists of two processes: **transcription** and translation. Transcription takes place in the nucleus. It uses DNA as a template to make an RNA molecule. RNA then leaves the nucleus and goes to a ribosome in the cytoplasm, where translation occurs. Translation reads the genetic code in mRNA and makes a protein.

Steps of Transcription

Transcription takes place in three steps: initiation, elongation, and termination. The steps are illustrated in **Figure** below.

1. **Initiation** is the beginning of transcription. It occurs when the enzyme RNA to a region of a gene called the promoter. This signals the DNA to unwind so the enzyme can ''read'' the bases in one of the DNA strands. The enzyme is now ready to make a strand of mRNA with a complementary sequence of bases.
2. **Elongation** is the addition of nucleotides to the mRNA strand. RNA polymerase reads the unwound DNA strand and builds the mRNA molecule, using complementary base pairs. There is a brief time during this process when the newly formed RNA is bound to the unwound DNA. During this process, an adenine (A) in the DNA binds to an uracil (U) in the RNA.
3. **Termination** is the ending of transcription, and occurs when RNA polymerase crosses a stop (termination) sequence in the gene. The mRNA strand is complete, and it detaches from DNA.



Steps of transcription:

Transcription occurs in the three steps – initiation, elongation and termination- shown here.

c. What do you mean by greenhouse effect? State the significance of global warming. [2+3]

Answer:

The earth receives short wave radiation from the sun, $\frac{1}{3}^{rd}$ of which is reflected while the rest is absorbed by the atmosphere, ocean, Iceland and biota. Short wave radiation can pass easily through the atmosphere, whereas long wave terrestrial radiation emitted by the warm surface of the Earth is partially absorbed by a number of trace gases in the atmosphere. These trace gases are called **G**reen **H**ouse **G**ases (GHG). The natural GHGs are CO_2, CH_4, N_2O, H_2O and O_3 in troposphere and stratosphere.

When there is an increase in CO_2 concentration the thick layer of this gas prevents the heat from being re-radiated out. The thick CO_2 layer thus function like the glass panels of a green house, allowing the sunlight to filter through but preventing the heat from being reradiated in outer space This is called greenhouse effect.