

## Uace biology paper 1

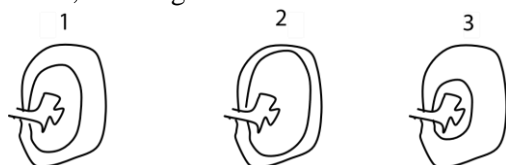
Time 2 hours:45mins

*Instruction: answer all questions*

- Blood plasma contains proteins, but glomerular filtrate does not. Why does this difference in composition occur?
  - Blood osmotic pressure is maintained by the presence of plasma proteins
  - Proteins are actively transported from the kidney tubule back into the blood capillaries
  - Proteins cannot pass through the membrane of the glomerular capillaries
  - There is high hydrostatic pressure in the blood within the glomerular capillaries.

C

- The diagram below shows vertical section of kidneys of three mammals, coypu, brown rat and kangaroo rat, showing the relative sizes of cortex and medulla.



Coypu occur in fresh water and never short of water to drink. Brown rats are able to go some days without drinking. Kangaroo rats are able to live in desert without drinking at all. Which kidney belongs to which animal?

	1	2	3
A	Brown rats	Coypu	Kangaroo rats
B	Kangaroo rats	Coypu	Brown rats
C	Brown rats	Kangaroo rats	Coypu
D	Kangaroo rats	Brown rats	Coypu

A

- Hydrophytes do not have wax-covered leaves because
  - They need much air for respiration
  - They do not need to conserve water
  - The wax would make the leaves heavy and sink
  - Their leaves cannot synthesize wax
- Which one of the following is a method used by marine bony fish to overcome the problem of possessing body fluids that are hypotonic to the surrounding?
  - Increase in glomerular filtrate
  - Extensive reabsorption of salts
  - Retention of urea
  - Elimination of nontoxic nitrogenous wastes
- Which one of the following is a way of **minimising** water loss in a desert animal?
  - Drinking a lot of water
  - Possession of few glomeruli
  - Feeding on succulent vegetation
  - Having a short loop of Henle.

B

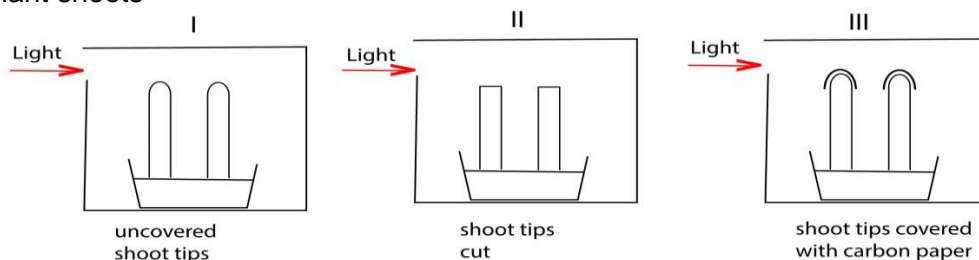
C

B

6. Counter current flow in bony fish achieves a high level of gaseous exchange because it
- A. Increases the concentration gradient
  - B. Decreases the distance across which gases diffuse. D
  - C. Increases the speed of water flow over the gills
  - D. Maintains a high concentration gradient
7. Where in the host is a parasite lacking sense organ and osmoregulatory devices likely to be located?
- A. On the skin
  - B. Under the hair C
  - C. In the alimentary canal
  - D. In the intercellular fluid
8. Which of the following is an advantage of excreting nitrogenous waster in form of uric acid?
- A. is less soluble and less toxic A
  - B. Is excreted in semisolid state
  - C. Cannot be stored in the body for long time
  - D. Requires plenty of tater for its removal
9. Which of the following methods is used by marine fish to overcome the problem of dehydration?
- A. Increase in glomerular filtration rate
  - B. Extensive reabsorption of salts from renal fluid C
  - C. Extrusion of salts by chlorine secretory cells
  - D. Elimination of nitrogenous wastes in form insoluble compounds
10. *Chiloleples*, the desert frog flourishes in the desert because it
- A. It has a water proof skin
  - B. Is nocturnal D
  - C. Has few and small glomeruli
  - D. Reabsorbs metabolic water
11. Which of the following is not a function of progesterone?
- A. Increasing the sensitivity of the uterine muscle C
  - B. Inhibiting release of follicle stimulating hormone
  - C. Inhibiting release of prolactin
  - D. Promoting growth of mammary glands
12. The significance of vascularization of endometrium before implantation in mammals is to
- A. Ensure firm attachment of the foetus on to the uterine wall
  - B. Prevent menstruation D
  - C. Assist in producing hormones which maintain pregnancy
  - D. Facilitate food and oxygen supply to the foetus
13. Which of the following structure is haploid?
- A. Primary oocyte
  - B. Spermatogonium C
  - C. Secondary oocyte
  - D. Germinal epithelium

14. Prolonged menstrual period may be caused by  
A. High levels of progesterone  
B. A decrease in production of follicle stimulating hormone  
C. Deficiency in oestrogen  
D. High level of luteinising hormone. C
15. The amount of progesterone in blood increases steadily from ovulation to menstruation, then it begins to decline because.  
A. Luteinising hormone inhibits its production  
B. It is washed out with blood during menstruation  
C. Implantation of zygote occurs  
D. Its work of repairing the uterine wall gets complete B
16. Which one of the following hormones helps to guard against miscarriage in pregnancy?  
A. Oestrogen  
B. Progesterone  
C. Oxytocin  
D. Prolactin B
17. In the mammalian menstrual cycle, the decline in the level of progesterone is due to  
A. Successful conception  
B. Formation of corpus luteum  
C. Degeneration of corpus luteum  
D. Maturation of Graafian follicle C
18. All the following are stimulated by the luteinising hormone **except**  
A. Proliferation of the uterine wall  
B. Development of the corpus luteum  
C. Stimulation of the corpus luteum to produce progesterone  
D. Ovulation A
19. Which of the following foetal blood vessel carries the most oxygenated blood?  
A. Pulmonary artery  
B. Dorsal aorta  
C. Posterior vena cava  
D. Umbilical vein D
20. Which one of the following conditions would most likely result in a miscarriage in humans?  
A. High level of progesterone and low level of oestrogen in blood  
B. High level of oestrogen and low level of progesterone in blood  
C. Low levels of progesterone and oestrogen in the blood  
D. High level of progesterone and oestrogen in blood C
21. The importance of phototropism in plants is to enable  
A. Plants to grow towards mineral salts and water  
B. Climbing plants to get grip on their support C

- C. Plants in shade grow faster and get exposed to light  
D. Plant roots gain anchorage
22. The movement of maggots to dark areas when exposed to light is an example of  
E. Phototaxis  
F. Reflex action **A**  
G. Phototropism  
H. Conditioned reflex
23. When the tip of a maize coleoptile is covered with an Aluminium foil and then illuminated on one side, it grows straight because  
A. The foil kills the hormones in the coleoptile  
B. The tip does not receive the light stimulus **B**  
C. Hormones in the coleoptile move to the zone of elongation  
D. The foil activates the hormones in the coleoptile
24. When a seedling is fixed on a rotating clinostat and placed in a horizontal position, the shoot continues to grow in a horizontal position because  
A. Auxins accumulate on the lower side of the shoot  
B. Production auxins stops  
C. Auxins are uniformly distributed in the shoot **C**  
D. Auxins accumulate on the upper side of the shoot
25. The growth of a plant shoot towards light is induced by  
A. Lack of auxins on the dark side  
B. A higher concentration of auxins on the light side  
C. A high concentration of auxins at the tip of the shoot **D**  
D. A higher distribution of auxins on the dark side
26. A radicle of a seedling grows downwards because the concentration of auxins is  
A. higher on the lower side, promoting growth on that side  
B. lower on its lower side, promoting growth on that side  
C. higher on its upper side, promoting growth on that side  
D. lower on its upper side, promoting growth on that side **D**
27. Which one of the following is a nastic response?  
A. Bending of shoot towards light  
B. Folding of plant leaflets when touched **B**  
C. Growing of plant roots towards water  
D. Bending of plant root towards gravity
28. The figure below is a setup of an experiment to show the effect of unilateral lighting on plant shoots



In which experiments would the shoot grow straight?

- A. I and II
- B. I and III
- C. II and III
- D. III only

C

29. Which of the following is directional growth response?

- A. Taxis
- B. Reflex
- C. Tropic
- D. Nastic

C

30. If a long-day plant has a critical night length of 10 hours, which one of the following conditions would allow flowering in the plant?

- A. 8 hours light and 16 hours darkness.
- B. 16 hours light and 8 hours darkness.
- C. 12 hours light and 12 hours darkness.
- D. 10 hours light and 14 hours darkness.

B

31. Onset of depolarization of an axon occurs when the axoplasm temporarily become

- A. more negative
- B. less negative
- C. more positive
- D. less positive

B

32. Wearing a coarse shirt causes a tickling sensation but the sensation disappears. Which of the following is **not** explanation of this observation?

- A. Supply of transmitter substances get exhausted
- B. The discharge of impulses at afferent nerve ceases
- C. The membrane surrounding the generator region becomes less permeable to sodium ions
- D. Generator potential falls below threshold values

A

33. A person who walks unsteadily may have a defect in the

- A. Cerebrum
- B. Cerebellum
- C. Medulla oblongata
- D. Hypothalamus

B

34. Which one of the following describes the sodium-potassium pump?

- A. Active pumping potassium ion out of the axon and sodium ions into it.
- B. Equal concentration of the ions on either side of the axon when at rest
- C. Inability of the axon to absorb the two ions passively
- D. Active pumping sodium ion out of the axon and potassium ions into it.

D

35. Which one of the following is not a transmitter substance?  
A. Acetylcholine  
B. Cholinesterase **B**  
C. Atropine  
D. Noradrenaline
36. The principle function of the autonomic nervous system is to  
A. Innervate the internal organs  
B. Control the contraction of skeletal muscles. **A**  
C. Regulate and control the peripheral nervous system  
D. Transmit impulses from the brain to the central nervous system
37. Which of the following represent the correct order of events that occurs at the synapse during impulse transmission?  
A.  $\text{Ca}^{2+}$  ion influx, release of transmitter substances, depolarization  
B. Depolarization, release of transmitter substance,  $\text{Ca}^{2+}$  ion influx **A**  
C. Release of transmitter substances,  $\text{Ca}^{2+}$  ion influx, depolarization  
D. Release of transmitter substances, depolarization,  $\text{Ca}^{2+}$  ion influx
38. A likely effect of inhibiting the action of acetylcholinesterase at a synapse is  
A. Cessation of impulse transmission  
B. Speeding up of impulse transmission **C**  
C. Continuous impulse transmission  
D. Slowing down of impulse transmission
39. Which one of the following occurs to the axon membrane during an action potential? It is  
A. Polarized with inside negative outside positive  
B. Depolarized with inside negative while outside positive **C**  
C. Depolarized with inside positive while outside negative  
D. Polarized with inside positive while outside negative
40. Myelinated axons of a frog conduct impulses three times less fast as those of the same diameter in rat because the  
A. Myelin sheath in axons of frogs are thinner **A**  
B. Rats are endothermic  
C. Neuron of a frog have more synapses  
D. Frog lives in water which is cold

## Section B (Structured question)

41. When extensive lakes that existed in Bunyoro were reduced to isolated pools many years ago, four species of fish evolved as a result

- (a) Suggest how the drying up of the lake system to isolated pools have resulted in evolution of the four new fish species. (4marks)

*Isolated pools form different geographical micro-environments. This causes geographic isolation of fish in different pools. It prevents interbreeding and thus no gene flow occurs. Since conditions are different in the different pools, different characteristics are selected for in the pools.*

- (b) Describe how environmental factors act as stabilizing forces to natural selection in an isolated pool after the evolution of a new species. (03marks)

*When environmental conditions in each pool change, fish which is better adapted to the condition in each pool survive while fish with unfavorable characteristics are selected against and do not survive. Since the pools have different conditions, different strains of fish evolve.*

- (c) Suggest what would happen to the fish species if water levels rose and the isolated pools once again formed an extensive lake system. (03marks)

*All the different fish species mix up again and:*

*Competition between species may reduce the number of some species of fish. The better adapted will survive while others die and may become extinct.*

*If restricted to different area (niches of the lake, there will be less competition. As a result, most or all species may survive so that a lake with different species of fish is formed. There may restriction of interbreeding so that the different species exist separately in the lake.*

*If interbreeding occurs, more new species of fish evolve in the lake.*

42. (a) What is meant by negative feedback mechanism in the body process? (03marks)

*Negative feedback is a mechanism of homeostasis in which a change in the quantity of a homeostatically controlled parameter from the norm sets up physiological processes that cause a change in the quantity of the parameter in opposite direction to return it to normal.*

- (b) Describe how each of the following affects the metabolism of carbohydrates

- i. Insulin. (03marks)

- *it increases the rate of uptake of glucose by muscle and fat cells through a number of glucose channels in the cell surface membrane.*
- *Insulin increases the utilization of glucose by the cells in the process of respiration.*
- *Insulin increases the rate at which glucose is converted to glycogen in the liver and muscle cells (glycogenesis).*
- *Insulin inhibits the formation of glucose from non-carbohydrates sources in the liver (gluconeogenesis) and also inhibits the process of glycolysis.*

## ii. adrenaline

(03marks)

- *It increases the rate of conversion of glycogen to glucose. This increases the blood sugar content.*
- *It increases the rate of production of glucose from non-carbohydrate sources in the liver.*
- *It increases the rate of utilization in the muscle cells in the process of respiration.*

## (c) Describe how hormones from the ovary and pituitary gland interact to control the human menstruation cycle. (06marks)

*Hormones produced by the ovary include progesterone and oestrogen while the pituitary gland produces luteinizing hormones (LH) and follicle stimulating hormone (FSH) which interact as shown below to control events of the menstrual cycle.*

*During the early menstrual phase, levels of oestrogen and progesterone fall. This induces the pituitary gland to secrete FSH and LH.*

*Increased levels of FSH stimulate one or more Graafian follicles to start growing. It also stimulates follicle cells to secrete oestrogen. The levels of oestrogen in blood increase gradually for a few days and reaches the peak on the 12th day of the cycle. High oestrogen concentration inhibits FSH secretion which induces increased production of LH within 12hrs.*

*The high LH causes ovulation with subsequent formation of corpus luteum.*

*During the post ovulatory phase, corpus luteum secretes progesterone. Progesterone acts on the uterine wall to promote cellular proliferation in preparation for implantation and also maintains corpus luteum.*

*High levels of progesterone and oestrogen inhibit the secretion of LH and FSH.*

*If fertilization occurs, the corpus luteum degenerates. Progesterone level reduces markedly and the uterine wall is shed in menstruation. This initiates events of the next cycle (i.e. this is day 1 of the next cycle).*

## 43. Explain the factors that influence the type of nitrogenous waste excreted by animals.

(16marks)

*Here are the 8 factors that influence the type of nitrogenous waste excreted by animals:*

- *Metabolic Rate: Higher metabolic rates result in more nitrogenous waste production.*
- *Diet: Protein-rich diets increase nitrogenous waste production.*
- *Body Size: Smaller animals tend to excrete more ammonia, while larger animals excrete more urea.*
- *Water Availability: Animals in water-scarce environments conserve water by producing less watery waste (e.g., uric acid).*
- *Environmental Salinity: Marine animals often excrete ammonia to avoid salt retention.*
- *Temperature: Temperature affects enzyme activity and waste production.*
- *Phylogenetic History: Different taxonomic groups have distinct nitrogenous waste excretion patterns.*
- *Kidney Function: Efficient kidneys conserve water by producing concentrated waste.*



(b) Describe osmoregulation in terrestrial insects.

(04 marks)

*Osmoregulation in insects that depend on metabolic water is aimed at conserving water.*

- *During excretion, the urine passes from the Malpighian tubules into the ileum and is mixed with faeces with which it is then excreted via the rectum. In the rectum, the rectal glands absorb all the water into the body and uric acid is then excreted in solid form. The water deficit is made up by metabolic water.*
- *The salt fraction is regulated by the Malpighian tubules. In the proximal half, sodium and potassium ions are extracted from the blood, but carefully returned in the distal half with precipitation of uric acid. The uric acid passes in the urine to the ileum for excretion via rectum.*

44. Write an essay on the gametes and their formation.

(20 marks)

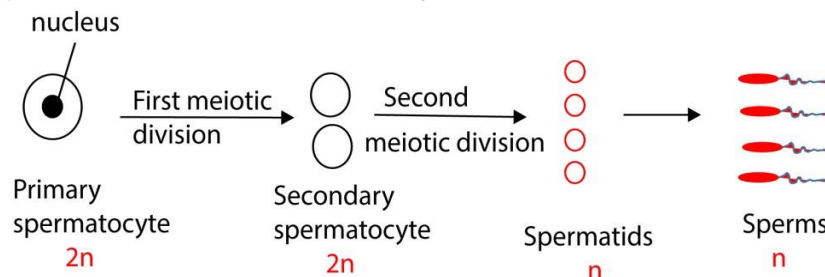
### **Gametogenesis**

*This is the formation of gametes.*

*Sperm (male gamete) formation is called spermatogenesis while egg (female gamete) formation is called oogenesis.*

### **Spermatogenesis**

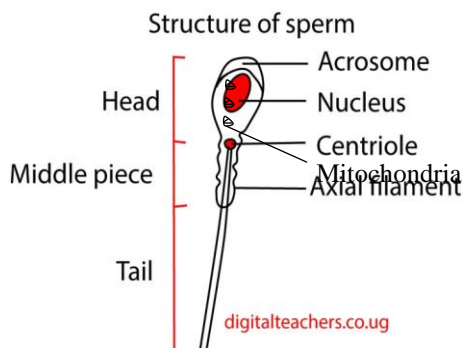
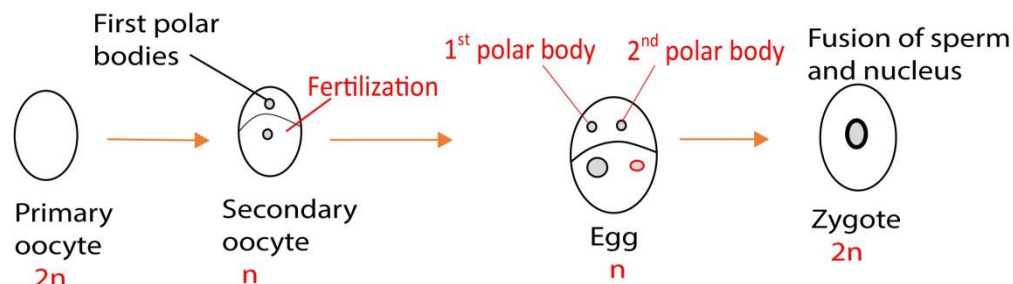
- Spermatogenesis in man occurs in the testis;*
- Primordial germ cells ( $2n$ ) divide mitotically to form spermatogonia that grow into primary spermatocyte (gamete forming cells) with 46 chromosomes*
- Primary spermatocytes undergo first meiotic division to form two secondary spermatocytes ( $n$ ), each with 23 chromosomes.*
- The secondary spermatocyte undergoes a second meiotic division to produce spermatids ( $n$ ), each with 23 chromosomes.*
- Spermatids then differentiate into sperms (spermatozoa).*
- The process of meiosis in male always result in four cells that become sperms.*



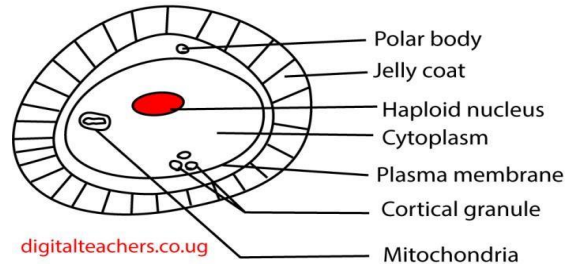
### **Oogenesis**

- Oogenesis occurs in the ovaries of female,*
- Primordial germ cells ( $2n$ ) divide mitotically to form oogonia the grow into primary oocytes ( $2n$ )*
- primary oocytes undergo the first meiotic division to form two haploid cells each having 23 chromosomes. One of these cells termed the secondary oocyte ( $n$ ) receives almost all the cytoplasm. The other is a polar body that may disintegrate or may divide again.*
- The secondary oocyte begins meiosis II and stops at metaphase II.*

- v. Then at ovulation, it leaves the ovary and enters an oviduct where it may be approached by a sperm.
- vi. If a sperm enters the oocyte, it activates to continue meiosis II to completions. The mature egg has 23 chromosomes. Meiosis in female produces only one egg and possibly three polar bodies.
- vii. The polar bodies are used to discard unnecessary chromosomes while retaining much of the cytoplasm in the egg.
- viii. The cytoplasm serves as a source of nutrients to the developing embryo.

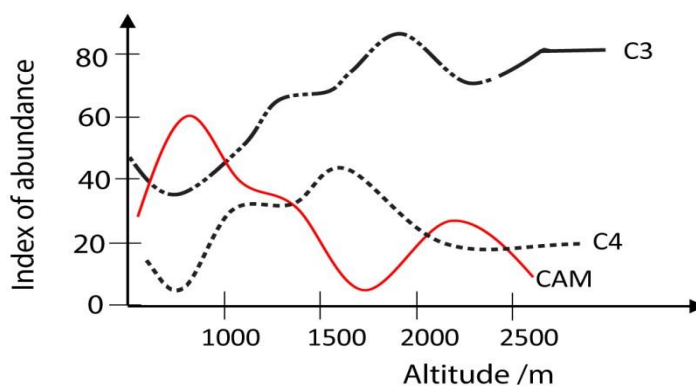


Stucture of an egg



- N
- Acrosome produces enzymes that enable the sperm to penetrate the egg
  - Mitochondria generate energy
  - Axial filament is used for propulsion

44. Figure below shows the distribution of C<sub>3</sub>, C<sub>4</sub> and CAM plants at altitudes



- (a) Suggest reasons for the trends in the distribution of each of the plants  
(i) C<sub>3</sub> plants. (02 marks)

*Are more abundant at high altitude.*

**Reason(s)**

*At high altitude, the partial pressure of oxygen is lower. This reduces competition between carbon dioxide and oxygen for RUBP carboxylase enzyme and enhance carbon dioxide fixation. Thus, C<sub>3</sub> plants are more abundant at high altitude where they can photosynthesis more efficiently at low temperature.*

- (ii) C<sub>4</sub> plants. (02 marks)

*Are more abundant at mid-altitude levels.*

**Reason (s)**

*Since PEP carboxylase is not affected by oxygen concentration, temperature is the major limiting factor for photosynthesis in C<sub>4</sub> plants.*

*At low altitudes, temperatures are very high than at high altitude. Only moderate temperature of mid- altitude levels favour efficient photosynthesis in C<sub>4</sub> plant, making them more abundant there.*

- (iii) CAM plants. (02 marks)

*Are more abundant at low attitudes*

**Reason (S)**

*CAM plants adapted to photosynthesizing more efficiently at higher temperatures.*

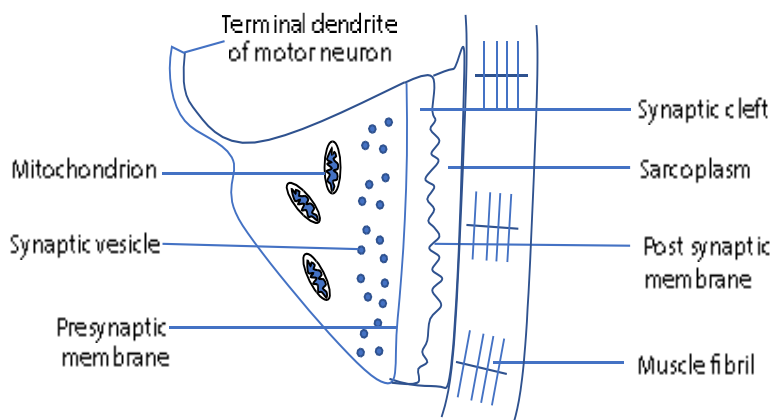
*Such temperature can only be experienced at low altitudes, explaining their more abundance there.*

- (b) State **four** physiologic differences between C<sub>3</sub> and C<sub>4</sub> plants. (04 marks)

<b>C<sub>3</sub> plants</b>	<b>C<sub>4</sub> plants</b>
<i>Carbon dioxide acceptor is RUBP</i>	<i>Carbon dioxide acceptor is PEP</i>
<i>First stable product is PGA</i>	<i>First stable product is Oxaloacetic acid (OAA).</i>
<i>Photorespiration occurs</i>	<i>Photorespiration does not occur.</i>
<i>Requires 18 ATP for the synthesis of one glucose molecule</i>	<i>Require 30 ATP for the synthesis of one glucose molecule.</i>

45. (a) Draw a fully labelled diagram of a neurotransmitter junction. (08 marks)

#### Neuromuscular junction



- (b) Explain how the impulse are transmitted across the junction in (a) above. (07 marks)

- *Arrival of impulse causes the calcium voltage gates to open leading to influx of calcium ions from the synaptic cleft.*
- *The  $\text{Ca}^{2+}$  ion causes the synaptic vesicles to move towards the pre-synaptic membrane.*
- *The vesicles fuse with the pre- synaptic membrane and release a transmitter substance into the synaptic cleft by exocytosis.*
- *The transmitter substance diffuses across the synaptic cleft and attaches to specific receptor sites on the post synaptic membrane.*
- *This causes an influx of  $\text{Na}^+$  ion into post- synaptic membrane, resulting in local depolarization of the membrane. If the  $\text{Na}^+$  ion surge is large enough, an action potential (impulse) is generated in the post –synaptic neuron.*

- (c) How is the transmission across the synapse controlled? (04 marks)

- *the availability and rate-of-synthesis of the neurotransmitter,*
- *the release of that neurotransmitter,*
- *the baseline activity of the postsynaptic cell,*
- *the number of available postsynaptic receptors for the neurotransmitter to bind to.*
- *deactivation of the neurotransmitter by enzymes or presynaptic reuptake.*