No. Matrik	No. Kad Pengenalan	No. Tempat Duduk

(*Isikan maklumat dengan lengkap*)

KEMENTERIAN PENDIDIKAN MALAYSIA

KOLEJ MATRIKULASI SELANGOR
SELANGOR MATRICULATION COLLEGE

PRA PEPERIKSAAN SEMESTER PROGRAM MATRIKULASI
PRE MATRICULATION PROGRAMME EXAMINATION

CADANGAN SKEMA JAWAPAN
BIOLOGY SB015

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU.

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Untuk Kegunaan Pemeriksa		
No. Soalan	Markah	
	Pemeriksa	KP / KKP
1		
2		
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6		
7		
JUMLAH		

Kertas soalan ini mengandungi **12** halaman bercetak.
This question paper consists of **12** *printed pages.*

3. **FIGURE 1** shows mitosis process in animal cell.

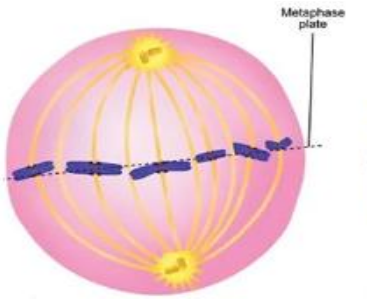
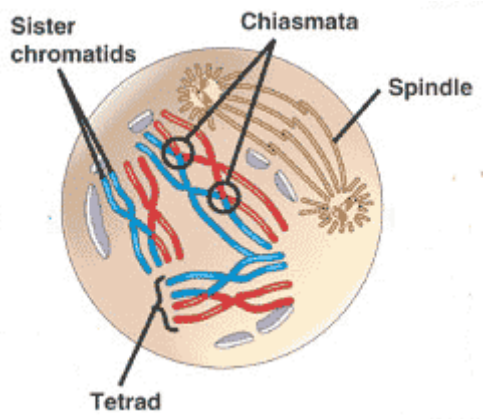


FIGURE 1.

(a) Draw diagram that shows stage Prophase I with same number of chromosome [3 marks]



Correct drawings

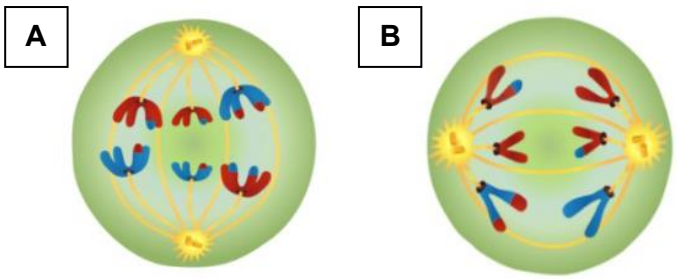
- **cells with correct amount of 6 Chromosome** **1**
- **show 3 homologous chromosome**
- **show crossing over/ synapsis**

Label

- **Homologous chromosomes/ tetrad/ bivalent** **1**
- **Centriole// microtubule/spindle/chiasmata** 1

(b) Differentiate the chromosomal behaviour in a cell at **A** with those in a cell at **B**.

[1 mark]

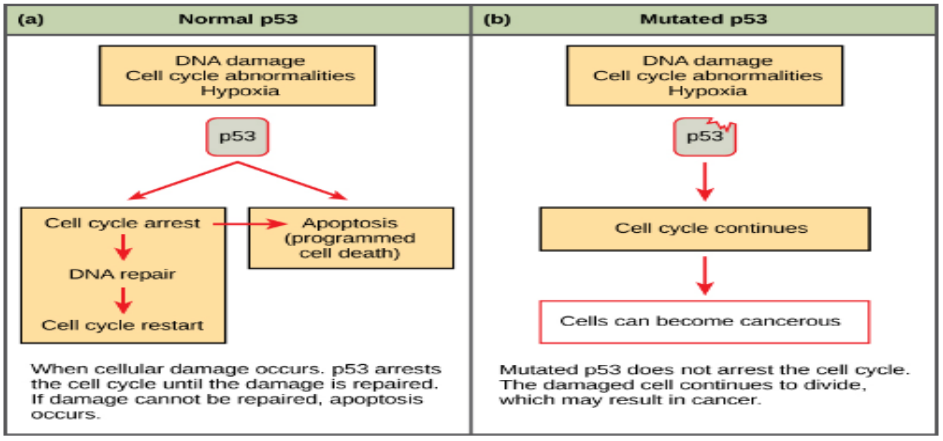


In A/Anaphase I, homologous chromosomes separate and chromosomes move to opposite poles of the cell while in B/ Anaphase II sister chromatids separate and (chromosomes) move to opposite poles of the cell.

(c) Assume a cell has a diploid chromosome number of 20, how many Tetrads would form during prophase I in the cell? [1 mark]

-10

(d)



If the DNA of the cell is damaged, a protein called p53 at G1 checkpoint stops the cell cycle to allow the damaged DNA to be repaired.
According to the statement above, what will happen to the cell if P53 genes loss its function due to mutation

[2 *marks*]

- **The cell with damage DNA will proceed cell division** **1**
- **Protein that regulates cell cycle checkpoint will not be produced** **1**
- **The mutated DNA will be pass on to daughter cells** **1**
- **Lead to the formation of tumour / cancer cells** **1**

4. (a) In garden pea plant, purple flower (P) and inflated pod shape (F) is dominant over white flower (p) and constricted pod shape (f). A heterozygous parent for both characteristics is crossed with a homozygous recessive genotype

(i) What are the genotypic ratio of the F1 generation?

[1 mark]

1PpFf: 1Ppff: 1ppFf:1ppff

(ii) What are the phenotypes of the F1 generation?

[1 mark]

- **Purple Flower and inflated pod shape, Purple Flower and constricted, White flower and inflated pod shape , White Flower and constricted pod shape**

(iii) Which Mendel's Law explains the combination of alleles in the above cross? [1 mark]

-Law of Independent Assortment

(b) In *Drosophilla* sp. grey (G) body is dominant while black (g) body is recessive for body colour. Meanwhile for type of wing, normal (N) wing is dominant over vestigial (n) wing. F1 test cross was carried out on *Drosophilla* sp. with grey body and normal wing produces the following progenies:

Phenotype	Number of progeny
Grey body, normal wing	877
Black body, vestigial wing	869
Grey body, vestigial wing	111
Black body, normal wing	109

(i) Does the above cross follow Mendelian ratio? Give reason for your answer.

[2 *marks*]

- **No**
- **Test cross ratio is not 1:1:1:1**

(ii) Explain how the situation in (b) (i) occurs [2 *marks*]

- **Genes encoding for the body colour and wing shape are linked // the two genes located on the same chromosomes.**
- **Crossing over occurs**

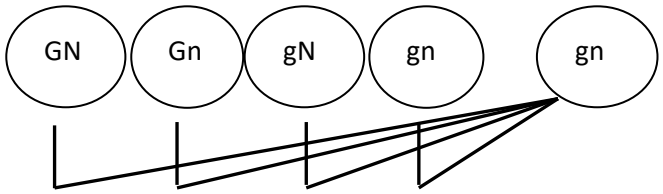
(iii) Construct genetic diagram to show the result obtained above.

[4 *marks*]

F_1 test cross (Phenotype) : Grey body, normal wing Black body, vestigial wing

F_1 test cross (Genotype) : GN/gn X gn/gn 1

Gamete :



1

F_2 generation (genotype) : GN/gn Gn/gn gN/gn gn/gn 1

F_2 generation (phenotype) : Grey body, normal wing, Grey body, vestigial wing, Black body, vestigial wing, Black body, vestigial wing 1

(iv) Calculate the genetic distance between the body colour and wing shape.

[2 *marks*]

Crossing over value (COV) = $\frac{\text{Total number of recombinant}}{\text{Total number of all offspring}}$ X 100

= $\frac{220}{1966}$ X 100 1

= 11.19 %

= 11.19 Centimorgan/ cM/ map unit/ m.u 1

5. Suppose that, out of a sample population of 6500 rabbits, researchers find 400 rabbits that express a recessive allele ***s*** for short ears. Assuming there are only two alleles for ear length in the population and the rabbit's population is in Hardy-Weinberg equilibrium. (Calculation must be in 4 decimal points)

(a) (i) Calculate the recessive and dominant allele frequencies

[2 marks]

Frequency of recessive genotype, q^2 = 400/6500
= 0.0615
Frequency of recessive allele, q = ✓0.0615
= 0.2480 **1**

Since p+q=1
Frequency of dominant allele, p = 1- 0.2480
= 0.7520 **1**

(iii) Calculate the number of heterozygous rabbits.

[1 mark]

Frequency of heterozygotes, 2pq = 2(0.2480) (0.7520)
= 0.3730
Number of heterozygotes = 0.3730 x 6500
= 2424.5 rabbits
= 2424 rabbits **1**

(iii) Calculate the number of homozygous dominant rabbits

[1 mark].

Number of homozygous dominant = 6500-2424-400
= 3676 rabbits

(b) If the survivorship of the homozygous recessive reduces to zero.
(i) Calculate the new gene pool

[1 mark]

Gene pool = 6500 – 400 = 6100
= 6100 x 2 = 12200 **1**

(ii) Calculate the new dominant allele frequency

[1 mark]

Frequency of dominant allele = $\frac{(3676x2)+2424}{12200}$
= 0.8013 **1**

(iii) Calculate the new recessive allele frequency

[1 mark]

Frequency of recessive allele = $\frac{2424}{12200}$
= 0.1987 **1**

6. (a) **FIGURE 2A** shows the process of the covalent coupling of amino acids to specific 3'-end adapter molecules the tRNA.

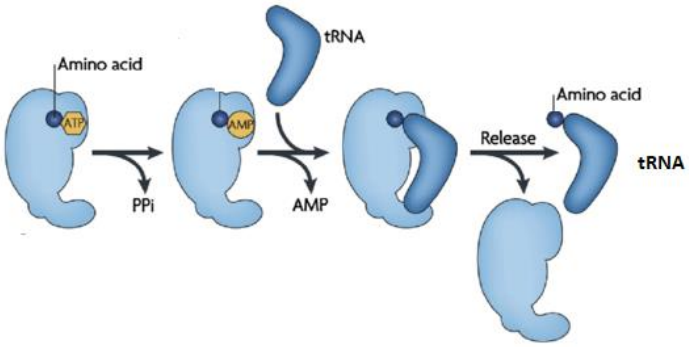


FIGURE 2A

(i) Name the process in **FIGURE 2A.**

[1 mark]

Activation of amino acid

(ii) Name the enzyme involves in this process.

[1 mark]

Aminoacyl-tRNA synthetase

(iii) Name the end product of this process.

[1 mark]

Aminoacyl-tRNA

(b) **FIGURE 2B** shows the formation of translation initiation complex

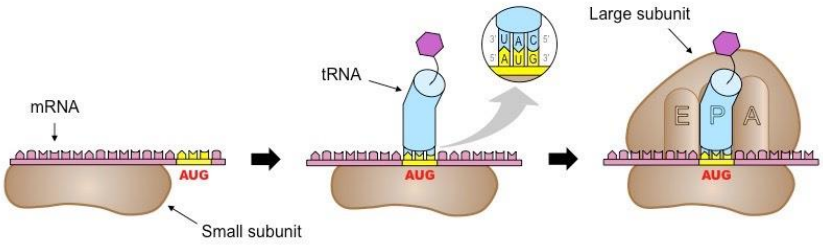


FIGURE 2B

Explain the process shown in **FIGURE 2B**.

[4 marks]

Small ribosomal subunit binds to mRNA **1**
Initiator tRNA/ tRNA (with anticodon 3'-UAC-5') carries amino acid methionine binds to the start codon (AUG) **1**
Large ribosomal subunit bind to the complex to form translation initiation complex **1**
Initiator tRNA occupies the P site **1**
Max 4

(c) **FIGURE 2C** shows a normal mechanism of *lac* operon in the presence of lactose and absence of glucose.

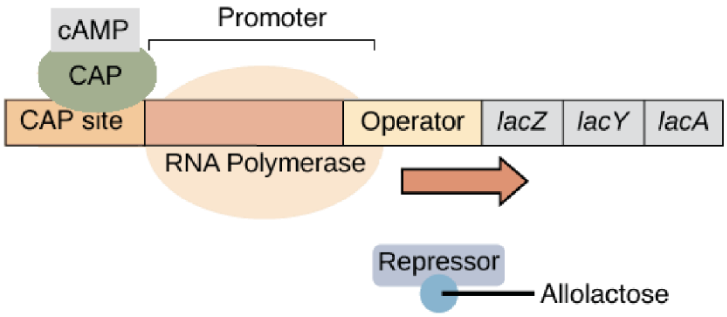


FIGURE 2C

(i) Explain the event or mechanism shown in **FIGURE 2C**.

[4 marks]

The binding of allolactose to the repressor (protein) changes the <u>conformation</u> of the repressor (protein)	**1**
Repressor protein unable to bind to the operator	**1**
RNA polymerase able to bind to the promoter	**1**
***<u>lac</u>* operon is activated/ switched on**	**1**
Transcription (of structural genes) occur	**1**
	Max 4

(ii) Isopropyl thiogalactoside (IPTG) is a molecule that is structurally similar to the inducer of *lac* operon. What do you think happen to the operon if IPTG is present instead of lactose?

[2 marks]

***<u>lac</u>* operon is activated/ switched on**	**1**
Transcription (of structural genes) occur	**1**

5. (a) Aneuploidy is an abnormal condition in which one or more chromosomes are present in extra copies or are deficient in number. State **ONE** example of this condition that results in extra copies of chromosome in autosome and explain how it happens.

[5 *marks*]

- **Down syndrome/ Trisomy <u>21</u>**
- **This is due to nondisjunction of <u>chromosome 21</u> during meiosis I/meiosis II/anaphase I/II**
- **Gamete form has extra one chromosome number 21 (n+1)**
- **Fertilization between normal gamete (n) and abnormal gamete (n+1)**
- **Produce zygote that has 47 chromosomes (2n+1) with three copies chromosome 21.**

(b) **FIGURE 3** shows the process that form an autopolyploid zygote.

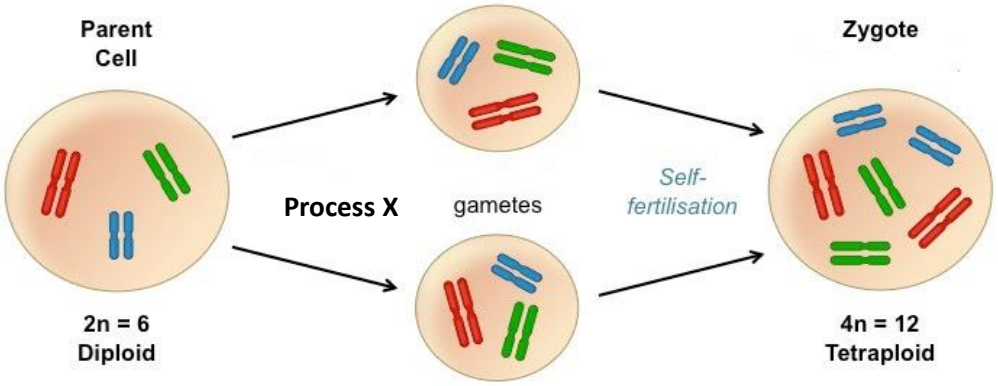


FIGURE 3

i. Identify **process X** that produced unreduced gametes. [1 *mark*]
Non-disjunction / Meiotic error

ii. Is the zygote (4n=12) viable and form fertile organism? Explain your answer. [3 *marks*]

- **Yes. (may be) viable and form fertile organism**
- **Tetraploid has enough set of homologous chromosomes for meiosis to occur**
- **Gametes can be produce**

iii. Give **TWO** advantages of the tetraploid plants. [2 *marks*]

- **Increased size**
- **Enhance yiled**

6. (a) **FIGURE 4.1** shows the stages in gene cloning.

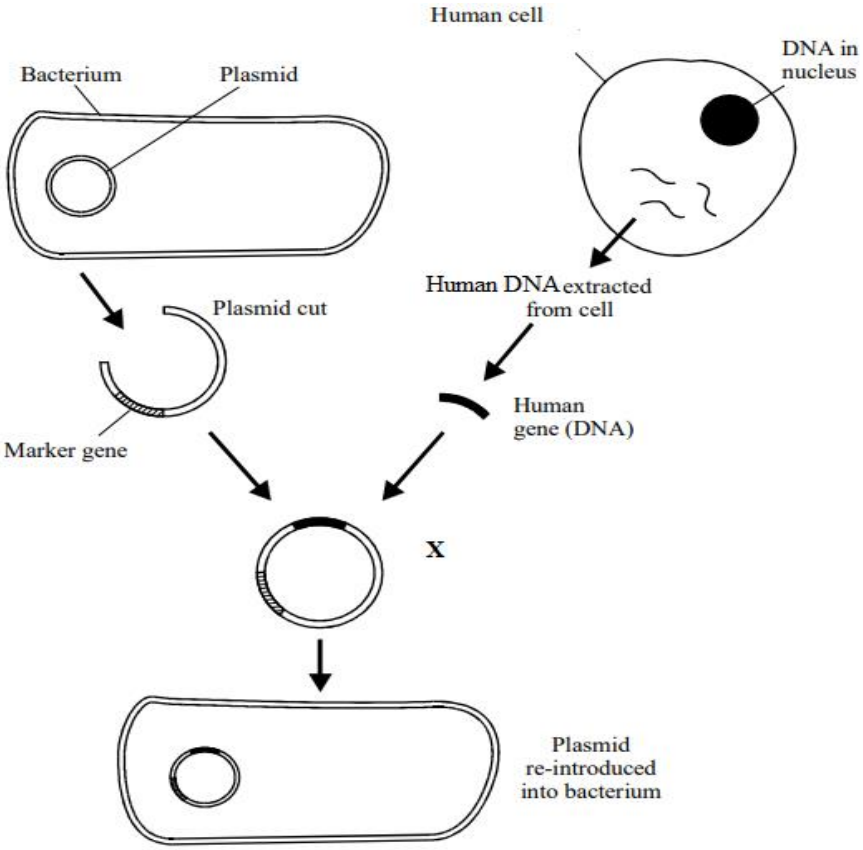


FIGURE 4.1

i. Name structure **X** [1 *mark*]

Recombinant DNA/plasmid

ii. Explain how structure **X** are made by genetic engineering.

[3 *marks*]

- **Isolate human DNA <u>from human cell</u> and plasmid <u>from bacteria</u>**
- **Cut/cleave both plasmid and human DNA with <u>same</u> restriction enzyme to <u>produce complementary ends for both DNA</u>**
- **Insert DNA fragment with plasmid by <u>adding the DNA ligase</u> and forming structure X**

iii. Explain how the use of the marker gene in **FIGURE 4.1** enable bacteria containing structure **X** to be detected.

[3 *marks*]

- **Example of marker gene in FIGURE 8.1 is ampicillin resistant gene (*<u>amp</u>*^{R})**
- **The bacteria are cultured in medium containing ampicillin (where the marker gene will expressed)**
- **Transformed bacteria containing plasmid have ampicillin resistant gene will survive// Bacteria without plasmid (did not have ampicillin resistant) will die.**

- **Transformed bacteria expressing the marker gene (*amp*^{R}) have structure X (recombinant plasmid) or non-recombinant plasmid.**

(Any 3)

(b) **FIGURE 4.2** below shows schematic representation of a cycle of amplification of a DNA segment carried *in vitro.*

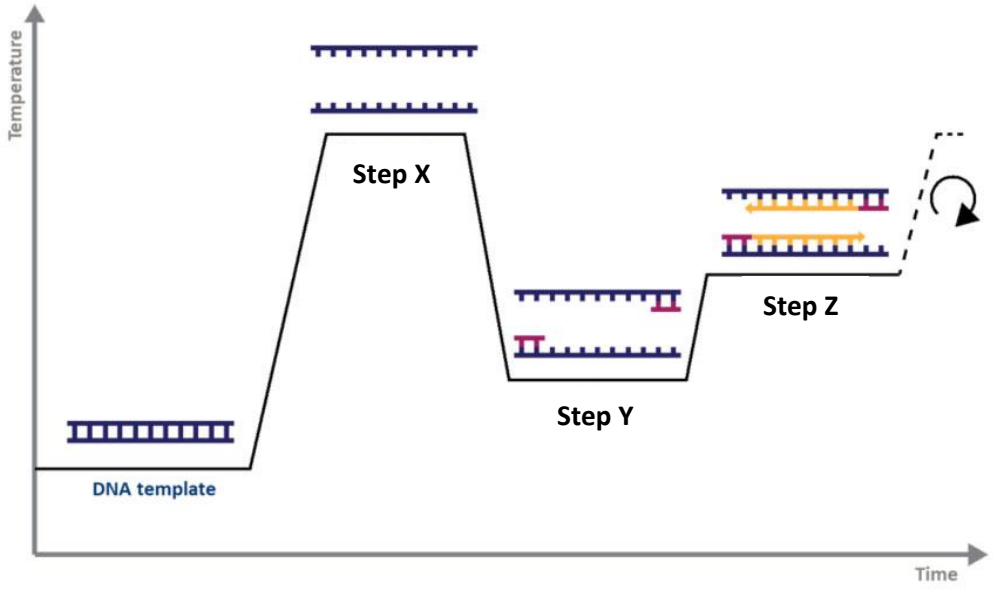


FIGURE 4.2

i. Name **Step Y**. [1 *mark*]

Annealing (of primer)

ii. Briefly explain **Step Z.** [2 *marks*]

- **In Extension, DNA is warmed to ~72^{o}C**
- ***Taq* polymerase begins adding nucleotides to build DNA (from 5' to 3' end)**

iii. If the template used for the amplification of the gene is extracted from mRNA, briefly explain the step required to prepare the DNA template. [3 *marks*]

- **Addition of reverse transcriptase enzyme to catalyzes the synthesis of the first DNA strand using mRNA as template**
- **Addition of mRNA degrading enzyme to breaks down mRNA, leaving a single strand cDNA**
- **Addition of DNA polymerase catalyzes the synthesis of the second DNA strand complementary to the first producing double stranded cDNA.**

7.(a) The **FIGURE 5.1** shows changes in hormones concentrations during female reproductive cycle. A, B and C are the phases in uterine cycle.

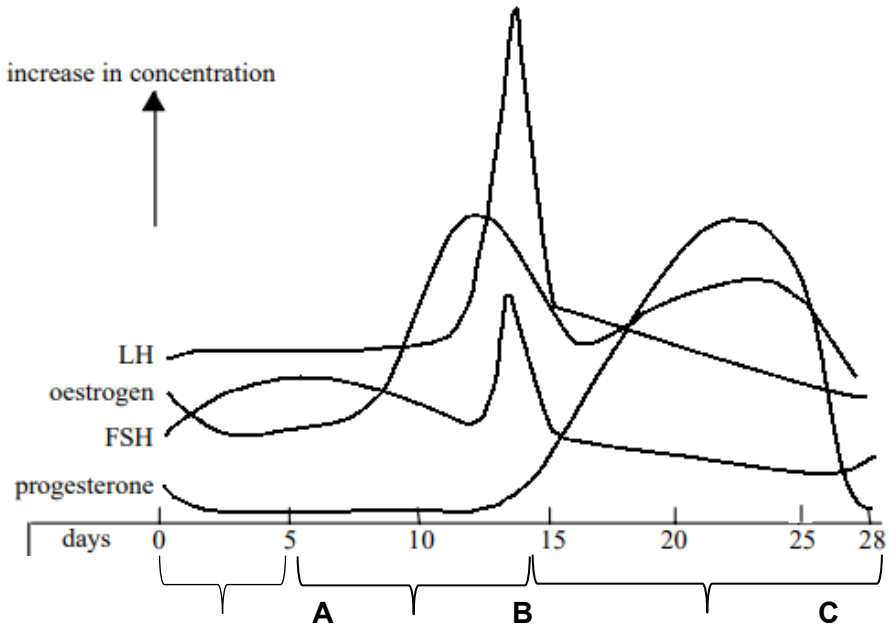


FIGURE 5.1

i. Name phase **B** and state the structure that secrete estrogen during that phase**.**

[2 *marks*]

- **Proliferative phase**
- **Developing follicle /growing follicle**

ii. With reference to the hormone patterns shown in graph, describe the hormonal control of FSH and LH from day 1-14 during female productive cycle.

[4 *marks*]

- **FSH stimulates the development of follicle in ovary**
- **Developing follicle secrete estrogen**
- **At low level of estrogen, it inhibit anterior pituitary from secreting of FSH and LH to keep both hormones level low**
- **At high level of estrogen,it stimulates hypothalamus to secrete more GnRH thus anterior pituitary gland to secrete more FSH and LH (by positive feedback)**
- **Day 14, LH surge stimulates ovulation/release of secondary oocyte into fallopian tube and formation of corpus luteum**

(Any 4)

iii. Briefly describe negative feedback mechanism during phase **C**

[2 *marks*]

- **High concentration of estrogen <u>and</u> progesterone will inhibits hypothalamus to secrete GnRH & anterior pituitary to secrete FSH and LH**
- **To prevent development of new/other follicles**

(b) **FIGURE 5.2** shows stages in formation of a human fetus.

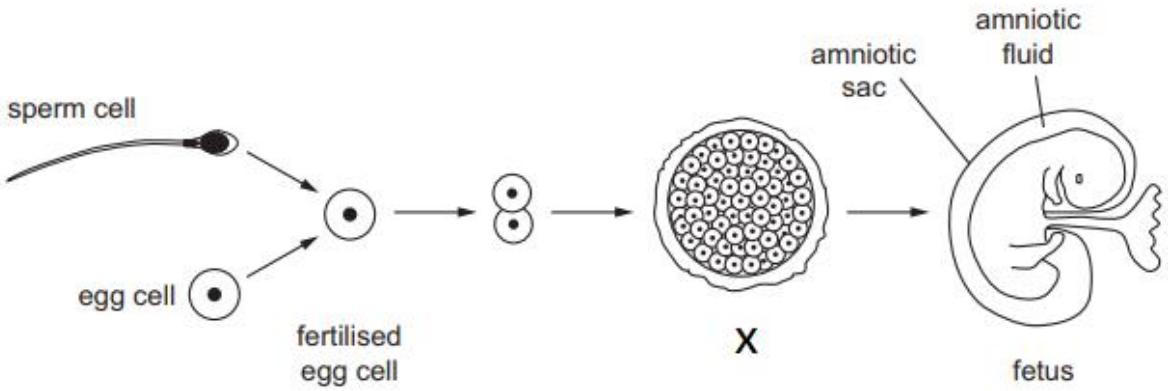


FIGURE 5.2

i. Name **X** [1 *mark*]

Morula

ii. Name the process that result in the formation of **X** [1 *mark*]
Cleavage

iii. Where does the process takes place? [1 *mark*]
Fallopian tube/Oviduct

iv. At the **end** of 3rd trimesters of pregnancy, mother will feel contraction during parturation. Explain the role of hormones during birth process.

[5 *marks*]

Explanation	Mark
During the last week of pregnancy, <u>estrogen</u> level increases	**<u>1</u>**
To triggers oxytocin receptors on the uterus	**1**
<u>Progesterone</u> level drops off	***1***
Removes inhibition of uterine contraction/stimulate the beginning of contraction that will lead to birth	***1***
<u>Oxytocin</u> is secreted by fetal and maternal posterior pituitary glands	**<u>1</u>**
Oxytocin stimulates the contraction of uterus/endometrium	**1**
And stimulates the placenta to secrete prostaglandins	**1**
<u>Prostaglandins</u>	**<u>1</u>**
enhances the contraction of uterus/endometrium	**1**
Max	**5**

OR

Explanation	Mark
Estrogen	**1**
Its level increase to triggers oxytocin receptors on the uterus	**1**
Progesterone	***1***
Its level decrease to removes inhibition of uterine contraction/stimulate the beginning of contraction that will lead to birth	***1***
Oxytocin	**1**
stimulates the contraction of uterus/endometrium	**1**
And stimulates the placenta to secrete prostaglandins	**1**
Prostaglandins	**1**
enhances the contraction of uterus/endometrium	**1**
Max	**5**