SECONDARY SCHOOL IMPROVEMENT PROGRAMME (SSIP) 2019

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GRADE 12

SUBJECT: LIFE SCIENCES

TEACHE NOTES & SOLUTIONS

SESSION NO: 2 TOPIC: MEIOSIS

SOLUTIONS FOR SECTION A
Question 1.1

1.1. D✓✓ 1.2. A✓✓ 1.3. A✓✓ 1.4. B✓✓ 1.5. C✓✓
1.6. D✓✓ 1.7. C✓✓ 1.8. B✓✓ 1.9. C✓✓ 1.10. D✓✓ (20)

Question 1.2

1.2.1 Anaphase 1 ✓
1.2.2 Centriole ✓
1.2.3 Homologous ✓
1.2.4 Metaphase 1✓
1.2.5 Prophase ✓
1.2.6 Chiasma ✓
1.2.7 Down Syndrome ✓
1.2.8 Centromere ✓
1.2.9 Miosisis 1 ✓
1.2.10 Spindle fibre ✓ (10x1) (10)

Question 1.3

1.3.1 B only ✓✓
1.3.2 B only✓✓
1.3.3 A ✓✓
1.3.4 B ✓✓
1.3.5 None ✓✓
1.3.6 Both A and B ✓✓ (6x2) (12)

Question 1.4

1.4.1. centriole ✓ (1)

1.4.2 Non-disjunction ✓ ✓ (1)

1.4.3 Anaphase 1✓ (1)

1.4.4 Chromosomes moving to the poles ✓ (1)

1.4.5. 3 ✓ (1)

1.4.6 Two gametes with 2 chromosomes each ✓
Two gamete with 4 chromosomes each ✓ (2)

1.4.7 The zygote will have 7 chromosomes ✓(3+4) instead of 6.
It will cause an abnormality✓ (Trisomy)
There will be an extra chromosome present ✓

OR

The zygote will have 5 chromosomes ✓(2+3) instead of 6.
It will cause an abnormality✓ (Trisomy)
There will be one less chromosome present ✓ (3)

SECTION B

Question 2

2.1. Diagram A✓ (1)

2.2. Crossing over took place✓ there was exchange of genetic material ✓/ there was random assortment of chromosomes ✓ (Any 1) (1)

2.3. 2✓ (1)

2.4. It increases genetic variation✓
Reduces the number of chromosomes by half✓
Results in formation of gametes✓
Ensures that the chromosome number remains constant within species✓
(Mark first TWO only) (2)

Question 3

3.1. X – chiasma ✓
Z - centromere✓ (2)

3.2. The chromosomes are of the same structure ✓/ size/ shape/ length
Crossing-over is taking place✓ any **(Mark first ONE only)** (1)

3.3. It increases genetic variation✓/produces recombinant gametes
(Mark first ONE only) (1)

3.4. Random arrangement of chromosomes✓/independent assortment
(Mark first ONE only) (1)

3.5. 40✓/20 pairs (1)

Question 4

4.1. A - Chromatid✓/chromosome
B – Centromere✓
C – Spindle fibre ✓/spindle thread (3)

4.2. (a) Metaphase 2✓
(b) Prophase I✓ (2)

4.3. Diagram 2, Diagram 3, Diagram 1, Diagram 4✓✓ (2)

4.4.

Meiosis I	Meiosis II
- Crossing over takes place✓	- No crossing over takes place✓
- In metaphase the chromosomes align on the equator in homologous pairs✓	- In metaphase chromosomes align singly✓ on the equator
- Reduction division✓	- No reduction division✓
- During anaphase whole chromosomes✓move towards the poles	- During anaphase chromatids✓ move towards the pole

(Mark first THREE only) any 3 x 2 + 1 table (7)

4.5. Crossing over✓

- Pieces of chromatids/groups of genes are exchanged✓ between
- homologous chromosomes
- Random✓/independent assortment of chromosomes
- Maternal and paternal chromosomes assort themselves randomly/independently on either side of the equator ✓during metaphase (4)

Question 5

5.1 (a) Chromosome✓ (1)

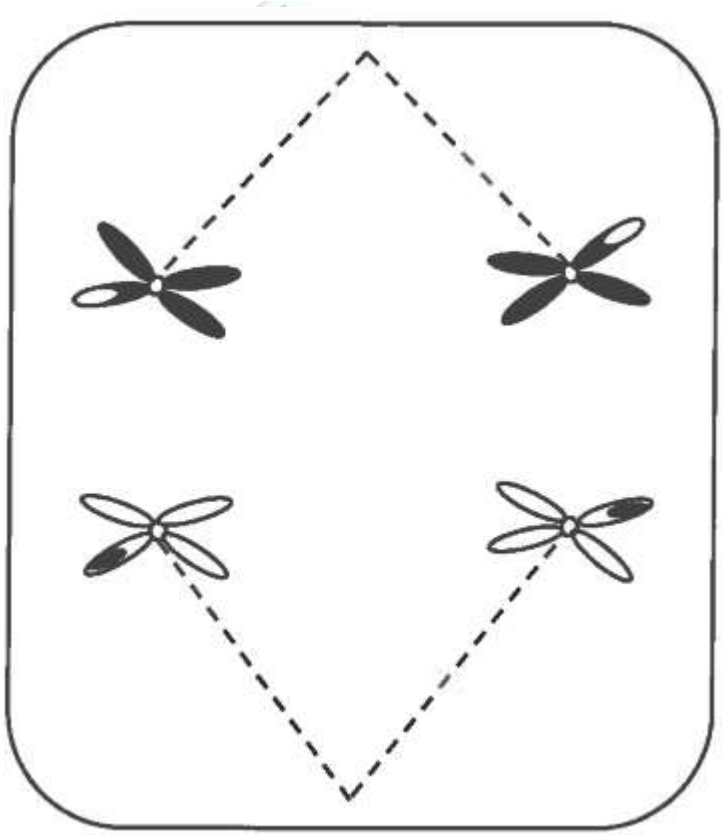
(b) Spindle fibre✓ (1)

(c) Centromere✓ (1)

5.2 Metaphase II✓ (1)

5.3 - Chromosomes lying independently✓/singly
- at the equator✓ (2)

5.4



Mark allocation:

C - Shows **4** chromosomes✓✓ (not chromatids)
S - Shows separation✓ of genetic material
D - Correct variation shown in the chromosomes✓(shading on the chromosomes must be complementary)
(Use the letters for marking process)

(4)

Question 6

6.1 A - Chromatid✓
B - Spindle fibre✓ (2)

6.2 Anaphase II✓ (1)

6.3 Single chromatids are moving to the poles✓ (1)

6.4 2✓ (1)

6.5 4✓ (1)

6.6 Crossing over✓ (1)

6.7 Testis✓ (1)
(8)

Question 7

7.1 D- Chromatid✓
E- Centromere✓ (2)

7.2 23✓ (1)

7.3 (a) E✓ (1)
(b) C✓/B (1)

7.4 (a) Nucleus✓
Mitochondrion✓ (2)
(Mark first TWO only)

(b) Double helix✓ (1)

(c) (DNA) replication✓ (1)
(9)

SECTION C:
Question 8

Possible answer
Crossing – over ✓
- Homologous chromosomes✓/bivalents pair up

- Each chromosome has 2 chromatids✓
- Chromatids overlap/cross over✓
- Points at which crossing-over takes place are referred to as chiasma✓
- Genetic material is exchanged ✓between non-sister chromatids✓
- After the process of crossing-over chromosomes have genes from its homologous partner ✓
- This means that each gamete formed will have a mix of genes from maternal
- and paternal parents✓
- Brings about variation in the gametes✓ formed and also the offspring **Max (7)**

Random arrangement of chromosomes at the equator ✓
- Each pair of homologous chromosomes ✓may line up either way on the equator of the spindle ✓
- Independently of what the other pairs are doing ✓/ independent assortment
-This means that gametes will have differing number/mix of maternal and paternal chromosomes ✓ **Max (4)**

Down's syndrome
- In meiosis 1 ✓the chromosome pair 21 does not separate ✓ or
- In meiosis II ✓ the chromatids of chromosome 21 do not separate✓/ centromere does not divide
- Referred to as non-disjunction✓
- One gamete will have an extra copy of chromosome number 21✓ / two copies of chromosome number 21
- If this gamete fuses with a normal gamete✓ /gamete with 23 chromosomes
- The resulting zygote will have 3 copies ✓of chromosome number 21 instead of 2 / zygote has 47 chromosomes leading to Down's syndrome

Max (6)
Content (17)
Synthesis (3)

SESSION NO: 3
TOPIC: GENETICS AND INHERITANCE PART 1

Teacher notes:

- *Learners MUST understand the link between meiosis and genetics.*
- *During the crossing over in prophase I of meiosis, chromosomes share information and then during metaphase I, separate randomly.*
- *This determines the combination of chromosomes and genes that you have as an individual. Genetics determines individual variation (to be different) and survival of the fittest.*
- *They MUST have a clear understanding of the genetic terminology in order to study genetics and answer genetic problems.*
- *Mendel's Laws are very important - understand the concepts of dominance and how this plays a role in monohybrid crosses (mono = one = one characteristic or trait).*
- *Be aware of confusing the word 'cross/ crossing' with 'crossing over' in Meiosis. You cross individuals and calculate the chances of a characteristic or*

trait being in the offspring. Learners must be clear of the difference between these two terms.

- *Questions on blood group inheritance and sex determination are often asked. The more examples of genetic crosses that they do, the better they will do.*
- *Pedigree diagrams are a popular way to express family history and are often asked in exams. Make sure they know how to answer them.*

- *There are basically **FOUR types of crosses** e.g.* **HH x hh;**
  Hh x Hh;
  Hh x hh;
  Hh x HH

- In the notation of the genotype the **dominant allele** represented by a **CAPITAL LETTER** must always be written first e.g. Gg and **NOT** gG .

SOLUTIONS FOR SECTION A

Question 1.1

1 D ✓✓
2 C ✓✓
3 B ✓✓
4 B ✓✓
5 C ✓✓
6 A ✓✓
7 C ✓

(7x2) **(14)**

Question 1.2

			[5]S								
[3]H	E	T	E	R	O	Z	Y	G	O	U	S
			X								
			L			[1]G					
			I		[7]P	E	A				
			N			N		[8]S			
			K		[4]D	O	M	I	N	A	N	T
			E			T		C				
			D			Y		K				[11]F
			I			P		L				E
			N		[2]G	E	N	E	S			M
			H					C				A
	[6]G	R	E	G	O	R	M	E	N	D	E	L
			R					L				E
			I			[12]M	A	L	E	S		
			T									
			A			[10]P	K	U				
			N									
[9]C	Y	S	T	I	C	F	I	B	R	O	S	I	S
					E								

(12)

Question 1.3

2.1 A ✓
2.2. C ✓
2.3. A ✓
2.4. B ✓
2.5. D ✓
2.6. D ✓
2.7. C ✓
2.8. D ✓ **(8)**

SECTION B:

Question 2:

P_1
Phenotype: Black x Brown✓
Genotype: Bb x bb✓
Meiosis
Gametes: B, b x b ✓
fertilisation

	b	**b**
B	Bb	Bb
b	bb	bb

F_1 **Genotype**: Bb and bb✓
Phenotype: Black and brown✓

1 mark for stating **P_1 AND F_1**✓ (*must have both*)
1 mark for stating **meiosis AND fertilisation** ✓ (*must have both*) any 6 = **(6)**

Question 3:

3.1 (a) homozygous dominant✓and heterozygous✓ (2)
(b) homozygous recessive✓ (1)

3.2 Normal is dominant and the dominant condition✓ can show up in either homozygous or heterozygous state✓
OR
To have a normal child ✓the person must have at least one dominant gene✓/phenotype is normal (2)
(5)

Question 4:

4.1 Plant A - YY✓ Plant B - yy✓ (2)

4.2 Yellow: green ✓ = 3 : 1 ✓ (2)

4.3 Phenotype – green peas ✓
Genotype – yy✓ (2)
(6)

Question 5:

5. 1. Mr. Xhosa - I^AI^B ✓
Wife - I^BI^B or I^Bi ✓

F_1 is: I^AI^B or I^BI^B or I^Bi or I^Ai. ✓✓✓✓
Baby 'A' is the only possible blood group ✓ . Baby 'O' is not a possibility (7)

(Remember that in blood groups there are three alleles A, B and O. A and B are co-dominant over O which is recessive. There must be two of the same alleles if a recessive trait is present in the individual)

5.2. Mr. Mbundwini - I^AI^A or I^Ai ✓✓
Wife – Not given, but assume she is recessive ✓
Therefore baby 'O' is the possible blood group ✓ as 'O' cannot be the result of Mr. Xhosa and his wife ✓. (5)
(12)

Question 6:

6. 1.
P_1 (✓ for P_1 and F_1 – if both are present one mark)
Phenotype: normal father x carrier mother ✓ {***mother is heterozygous}
Genotype: X^HY x X^HX^h ✓
Meiosis (✓ for meiosis **and** fertilization – one mark)
Gametes: X^H Y x X^H X^h ✓

fertilization

	X^H	**X^h**
X^H	**X^H X^H**	**X^H X^h**
Y	**X^H** Y	**X^hY**

F_1

Genotype:
1:4 X^H X^H
1:4 X^H X^h
1:4 X^H Y
1:4 X^h Y (all 4 genotypes: ✓)

Phenotype:
50% normal daughters (X^H X^H and X^H X^h)
25% normal son (X^H Y)
25% son with haemophilia (X^h Y) (all phenotypes correct = ✓)
Max (6)

6.2. 25✓%✓ chance /1 ✓out of 4✓/ ¼ ✓✓ (2)

6.3. The male has only one X chromosome✓ Y chromosome does not have the allele for this trait ✓
OR
If he had 'h' he would be a sufferer✓, therefore he must have had 'H'✓.
Max (2)
(10)

Question 7

P_1✓ phenotype Brown x Grey✓
genotype Bb x bb✓

Meiosis✓
Gametes B, b x b, b ✓

Fertilization✓

F_1 genotype Bb ; bb ✓
Phenotype 2 brown, 2 grey✓

OR

Gametes	B	b
b	Bb	bb
b	Bb	bb

1 mark for correct gametes
1 mark for correct genotypes

Allocation of marks
Showing the P_1 (parents), G_1 (gametes) and F_1 (offspring) generation – 1 marks
Showing meiosis – 1 mark
Showing fertilization – 1 mark
Each correct step of problem – 5 mark **(8)**

Question 8:

P1✓ phenotype Red x white✓
genotype RR x rr✓

Meiosis

G R x r✓

Fertilization

F1 ✓ genotype Rr✓
phenotype red✓

OR

gametes	R	R
r	Rr	Rr
r	Rr	Rr

1 mark for correct gametes
1 mark for correct genotypes

max (6)

Question 9:

9.1. X^hY ✓✓ (2)

9.2 P_1: X^hY x X^HX^h ✓

Meiosis
Gametes: X^h Y x X^H X^h
Fertilization
F_1: X^HX^h ✓ X^hX^h ✓ X^HY ✓ X^hY ✓
50 % ✓ probability of having haemophilia (6)
(8)

Question 10:

10.1 Homologous chromosomes ✓/bivalent ✓ (1)

10.2 45 ✓ (1)

10.3 Gonosomes ✓/ Sex chromosomes (1)

10.4 The presence of a Y chromosome ✓/ XY chromosome (1)
(6)

SESSION NO: 4
GENETICS AND INHERITANCE Part 2

Teacher note:
Mutation, natural selection and genetic engineering: tell learners to read about genetic engineering so that they form an opinion of whether this is good or bad, but also so that they understand the basic process and the benefits to human being. See notes on content in session 5.

Question 1:

1.1 - Combating heart diseases✓ - Improving intelligence✓ (2)
(Mark first TWO only)

1.2 10 ✓ x 100 ✓ 1 800
= 0,55 ✓% (3)

1.3 The gene responsible for producing omega-3 fatty acids is located ✓
in the DNA of salmon✓/fresh mackerel/tuna
This gene is cut ✓ from the donor organism, inserted into a plasmid of a bacterium ✓
Bacteria replicates to form many copies of the gene ✓
These genes are then inserted into the cells of the zygote ✓/embryo any (4)

1.4 (a) Support - Healthier for humans to eat ✓/combating heart disease
- Mass production of healthy fat ✓
- Improves intelligence✓any (2)
(Mark first TWO only)

(b) Against - Cultural objection to eat meat from pigs✓
- The success rate is very low ✓ - Expensive procedure ✓
- No value for vegetarians ✓
- Objection to eating any genetically modified food ✓ any (2)
(Mark first TWO only)

Question 2:

2.1 (a) 13 ✓ (1)
(b) 26 ✓ (1)

2.2 Has a full set ✓of chromosomes ✓ /Diploid number of chromosomes/ complete set of chromosomes (2)

2.3 They have same/identical chromosomes ✓/genetic material / DNA from the nucleus of the somatic/body cell collected from the same frog/X ✓ (2)

2.4 Cloning ✓ (1)

2.5 (**a) In favour:**
- Producing individuals with desired traits✓✓
- Better yield ✓✓
- Resistant to diseases ✓✓
- Organisms produced in a shorter time ✓✓
- Saving endangered species ✓✓
- Producing body parts ✓✓
- Produce offspring for organisms that cannot have offspring ✓✓ (1 x 2) (2)

(***Mark FIRST answer only in learner's script)***

(b)Against:
- Objection to interfering with God's ✓✓/Supreme Being's creation/nature
- Reducing the gene pool by reducing variation✓✓/ Reduces genetic diversity
- Cloned organisms may have developmental/morphological problems✓✓
- Costly process ✓✓
- May generate more experimental waste ✓✓
- May lead to killing of clones to obtain spare body parts ✓✓
- Cruelty to animals ✓✓ (1 x 2) (2)

(***Mark FIRST answer only in learner's script)***

Question 3:

P_1 (✓ for P_1 and F_1 – if both are present then half mark each)

Phenotype: black + brown eyes ✓ x white +blue eyes✓
Genotype: BB GG ✓ crossed with bb gg✓

Meiosis(✓ for meiosis and fertilization – half mark each)
Gametes: B G x b g ✓
fertilization

	BG	**BG**	**BG**	**BG**
bg	BbGg	BbGg	BbGg	BbGg
bg	BbGg	BbGg	BbGg	BbGg
bg	BbGg	BbGg	BbGg	BbGg
bg	BbGg	BbGg	BbGg	BbGg

F_1 **Genotype:** 16:16 ✓ BbGg heterozygous offspring ✓

Phenotype: 100% ✓ black with brown eyes✓ Max (8)

Question 4:

4.1 (a) Female without SCID✓ (1)
(b) Male with SCID✓ (1)
(c) X^DX^d✓✓ (2)

4.2 – He inherited the recessive allele (X^d) ✓
– from the mother✓ (2)
(6)

Question 5:

5.1 (a) It allows for the production of organisms with desired characteristics✓ (1)
(Mark first ONE only)

(b) – It reduces genetic variation✓ in offspring
– It is expensive✓ (1)
Any 1
(Mark first ONE only)

5.2 LMJC 865 had a high average milk-production yield✓/78 litres per day (1)

5.3 – A diploid cell/ a cell with all the genetic information is needed✓
– An ovum is a haploid cell/ only contains half of the genetic information✓ (2)

54 – The nucleus of the donor cell was removed✓
– and implanted into an empty ovum✓
– The resulting zygote was stimulated to divide✓
– The embryo was then placed into the uterus of an adult female✓ (4)
(9)

Question 6:

6.1 Purple✓ (1)

6.2 – When purple and white flowering plants are crossed ✓
– all offspring have purple flowers✓ /no white flowers (2)

6.3 – Since alleles for a characteristic are on homologous chromosomes ✓/homologous dominant is crossed with

homologous recessive
– and homologous chromosomes separate during meiosis ✓
– each gamete will contain only one allele for each characteristic✓

(3)

6.4

P_1	Phenotype	Purple	x	Purple✓
	Genotype	Dd	x	Dd✓

Meiosis

	G/gametes	D, d	x	D, d✓

Fertilisation

F_1	Genotype	DD; Dd; Dd	dd✓
	Phenotype	3 Purple : 1 White✓*	

P_1 and F_1✓
Meiosis and fertilisation✓

*Compulsory 1 + Any 5

OR

P_1	Phenotype	Purple	x	Purple✓
	Genotype	Dd	x	Dd✓

Meiosis

Fertilisation

Gametes	D	d
D	DD	Dd
d	Dd	dd

1 mark for correct gametes
1 mark for correct genotypes

F_1 Phenotype 3 Purple : 1 White✓*

P_1 and F_1✓

Meiosis and fertilisation✓

*Compulsory 1 + Any 5 (6)

(12)

SESSION NO: 5 Reproduction Part 1
Diversity of reproductive strategies in some animals

Question 1.1

1.1 D ✓✓
1.2 D ✓✓
1.3 C ✓✓
1.4 B ✓✓ (4X2) = **(8)**

Question 1.2

1.2.1 External fertilisation ✓
1.2.2 Altricial ✓
1.2.3 Vivipary ✓
1.2.4 Altricial ✓
1.2.5 Vivipary ✓
1.2.6 Ovipary ✓ **(6)**

Question 1.3

1,3.1 A only ✓✓
1.3.2 A only ✓✓ (2x2)=**(4)**

SESSION NO: 6 Reproduction Part 2

QUESTION 1

1.1 (a) Nucleus✓ (1)

(b) Tail✓ (1)

1.2
- C/ middle piece contains mitochondria✓ that provides energy for movement✓
- Has a tail✓ for swimming✓
- Torpedo shape✓ reducing friction✓

Any (1 x 2) (2)

(Mark first ONE only)

1.3
- No acrosome✓ will be present in the sperm cell

- therefore no enzymes present✓
- Sperm cell will be unable to penetrate the ovum✓
- *therefore no fertilisation will occur✓

(3)

*__compulsory mark__ + any other 2

(7)

QUESTION 2

2.1 (a) Time✓ (1)

(b) Average age of first menstruation✓ (1)

2.2
- Decide on sample size✓
- Decide on proportion from racial groups✓
- Decide on the age range of participants✓
- Decide on proportions from socio-economic status of sample✓
- Decide on the recording tool✓/ instrument /method
- Ask permission ✓from participants

(3)

Any

(Mark first THREE only)

2.3
- The hypothesis will be rejected✓/not accepted
- and therefore needs to be reformulated✓

(2)

2.4
- Breast development✓
- Widening of hips✓
- Development of pubic hair✓/(body hair)

Any (2)

(Mark first TWO only) **(9)**

QUESTION 3
- High levels of progesterone✓
- Inhibits secretion of FSH✓
- There is no development of a follicle✓
- Therefore no ovum released/ovulation✓
- Thus there will be no fertilisation✓

(4)

Any

QUESTION 4

4.1 (a) A✓ - penis✓ (2)

(b) E ✓ - testes✓ (2)

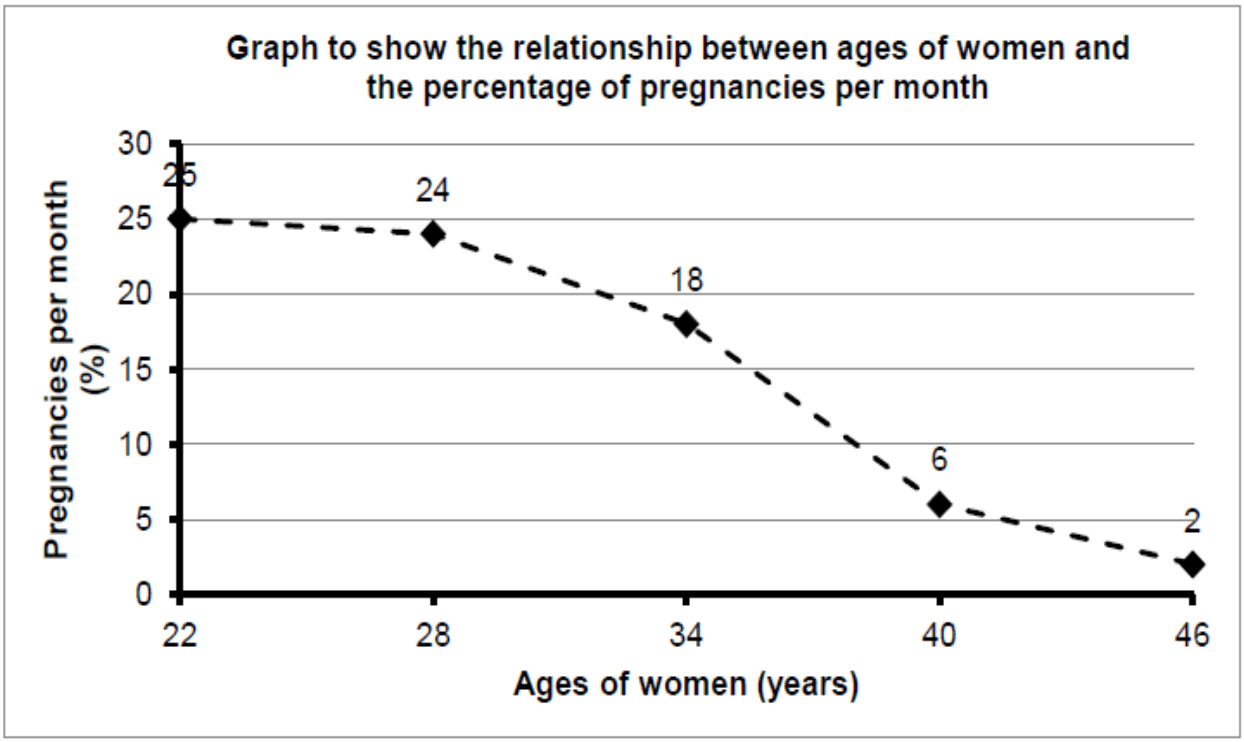
4.2 (a) D✓ and E✓ (2)

(b) B✓ and C✓ (2)

(8)

QUESTION 5

5.1



Mark allocation of the graph

Criteria	Mark Allocation
Correct type of graph drawn for the pregnancies per month only	1
Title of graph including the two variables (Age of women and pregnancies per month)	1
Correct label and unit for X-axis and Y-axis	1
Correct scale for X-axis and Y-axis	1
Drawing of the graph	0: No points plotted correctly 1: 1 to 4 points plotted correctly 2: All 5 points plotted correctly

NOTE:

If axes are transposed: marks will be lost only for labelling of X-axis and Y-axis. (6)

5.2 The older the women, the higher the chances of having miscarriage ✓✓

OR

The younger the women, the lower the chances of having miscarriages ✓✓ (2)

5.3 50% x 12✓ = 6✓

OR

$\frac{50}{100}$ x 12✓ = 6✓

(2)

(8)