Model Answers

From your own peers!

B01

B1) Tube A - Expected outcome:- Live R strain cells are ~~co~~ transformed into S strain cells, hence mice will die ✓
Tube B - Expected outcome:- Live R strain cells are transformed into S strain cells, hence mice will die ✓
Tube C - Expected outcome:- No transformation occurs since the DNA is degraded, ~~mice~~ hence mice will survive ✓

(1)

Solution to Q(B1):

Tube A: mouse will ~~live~~ die, since DNA is the genetic material transfered b/w R & S strains, here DNA is still present which will ~~not~~ ~~exchanged~~ transform R to S cells

Tube B: mouse will ~~live~~ die, since DNA is genetic material, it is present, DNA ~~gets~~ ~~is~~ has cells transforms non virulent R to virulent S cells

Tube C: mouse will ~~live~~ (survive), since DNA exchanged now will not take place R will not get converted to virulent strain

(1)

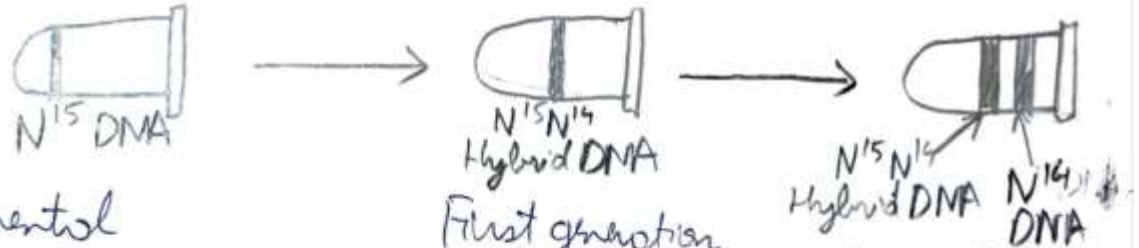
Q B1. Tube A: The mice die

Tube B: The mice die

Tube C: The mice survive, since DNA is the transforming factor and is taken up by the R strain in tubes A and B but not C.

(1)

B2)



Parental generation grown in N^{15} medium → 100% N^{15} DNA

First generation grown in N^{14} medium → 100% $N^{15}N^{14}$ hybrid DNA

Second generation grown in N^{14} medium → 50% $N^{15}N^{14}$ hybrid DNA, 50% N^{14} DNA

(1) The model of DNA replication followed is semiconservative mode of replication

Solution to Q (B2)

* since the results are same as those in E.coli, this model is called semi-conservative model of DNA replication

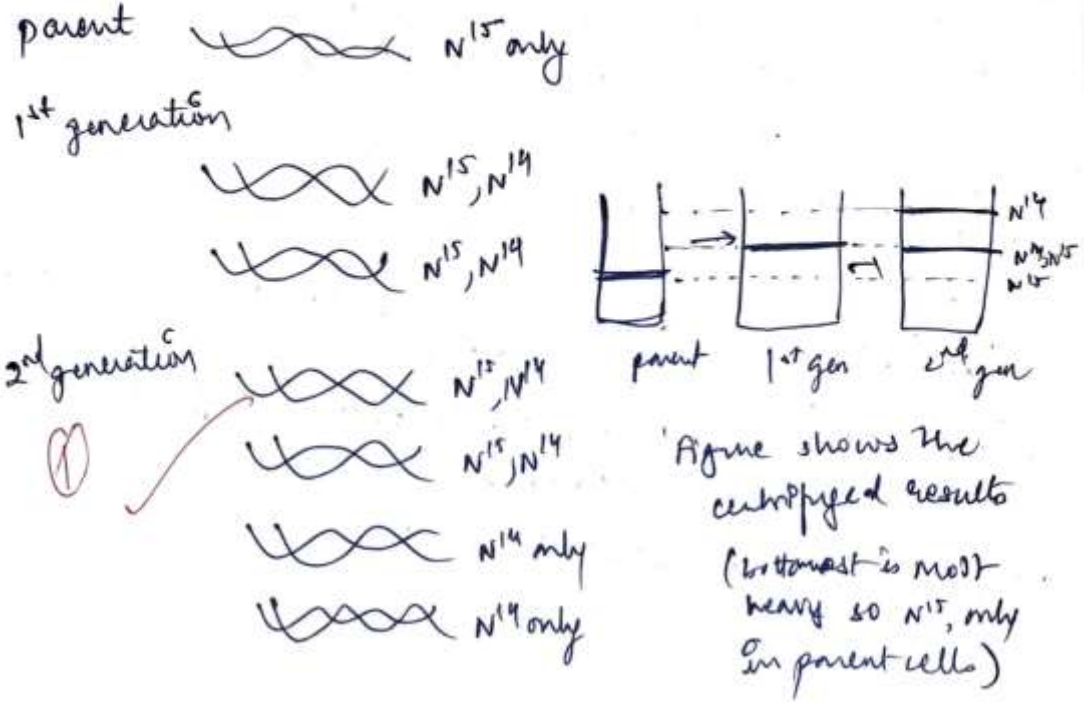


Figure shows the centrifuged results (bottommost is most heavy so N^{15} only in parent cells)

B03

B3) Assumption - The probe DNA should bind to given mRNA

(1) The required SS DNA should be

3' --- GAGTAGTGGCCG --- 5'

B) Rate = 500 bp/min, length of given gene = 3000 bp.

So X = Time for amplification = $\frac{3000}{500}$

= 6 mins

X = 6:00

B04

Solution to Q(B4)

(A) First 10 amino acid

AUG-GCU-UUC-AAG-UGG-UCG-UCC-~~AUG~~ AUC-

0.5 CUC-GCC (corresponding mRNA)

Met-Ala-Phe-Lys-Trp-Ser-Ser-Ile-Leu-Ala

Last 10 Last codon is UAG which is stop so before that

GAU-GAC-GAC-GAC-GAC-GAC-GAC-GAC-GAC-~~UCU~~ UCU

Gly-Gly-Asp-Asp-Asp-Asp-Asp-Asp-Asp-Ser

(B) Forward primer would be from 5'-3' strand i.e.

~~ATG GCT TTC AAG TGG TCG TCC ATC~~ 0.5

5'-ATG GCT TTC AAG TGG TCG-3' (forward primer)

& reverse primer would be complimentary to the last 18 nucleotides ~~of the~~ from the 3' end.

i.e

~~5'-CTA AGA GTC~~

5'-CTA AGA GTC GTC GTC GTC-3' (reverse primer)

B4) A) First ten amino acids of Bisphenoldegradase are:

Met Ala Phe Lys Trp Ser Ser Ile Leu Ala 0.5

Last ten amino acids of Bisphenoldegradase are:

Gly Gly Asp Asp Asp Asp Asp Asp Asp Ser

B) Forward primer for BPAD is:

3'-TACCG AAAG TTCACC AGC-5' ✗

Reverse primer for BPAD is:

5'-GAC GAC GACGAC TCT TAG-3' ✗

B05

B5) A) Each PCR cycle ~~will double~~ is expected to double the ~~DNA~~ number of DNA copies, ie, from x to $2x$

But, efficiency is 60%, ie, from x, $0.6 \times 2x = 1.2x$ DNA copies will be produced

∴ In 25 cycles, from x copies, $(1.2)^{25} x$ copies of x will be produced ✓

B) c) Affinity Chromatography ✓

C) c) Tertiary ✓ (1)

Sol (B5) Initial = x

(A) After 1st cycle → $2 \times x \times \frac{6}{10} = \left(\frac{6}{5}x\right)$.

After 2nd cycle → $\left(\frac{6x}{5}\right) \times 2 \times \frac{6}{10} = \left(\frac{6}{5}\right)^2 x$ - -.

and so on

since x are initially present, and every cycle we have increment by factor of $2 \times 60\% = 6/5$.

∴ After 25 cycles, we have (0.4)

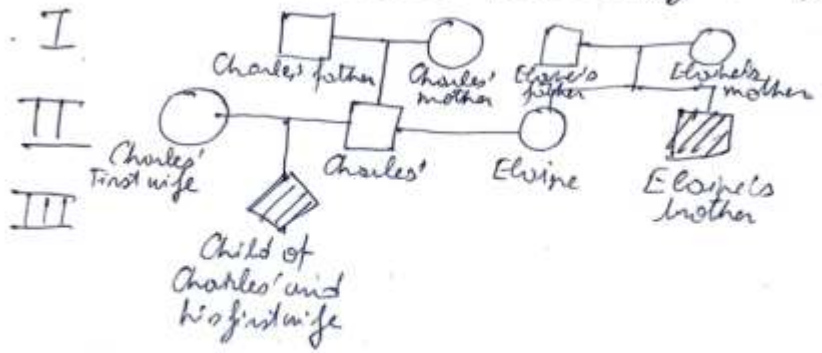
$\left(\frac{6}{5}\right)^{25} \cdot x$ = No. of DNA copies ✓

(B) (c) Affinity chromatography (0.3)

(C) (c) Tertiary (since, only S-S bonds are cleaved, rest H bonds etc. remain intact) so S-S bonds are found only in tertiary structures hence (C)) (0.3)

B06

B6) Assumption - Cystic fibrosis is an autosomal recessive disorder, gives A/a



Since Charles' and his first wife's child had cystic fibrosis, Charles is heterozygous (Aa)

Since Elaine's brother died of cystic fibrosis, ~~both of~~ and her parents don't have cystic fibrosis, both of her parents are heterozygous (Aa).

This means Elaine can be either homozygous dominant (AA), or heterozygous (Aa)

a) If Elaine is homozygous dominant (AA), their child would not have cystic fibrosis (Aa × AA = 50% AA, 50% Aa)

In this case, probability = 0

b) If Elaine is heterozygous (Aa), their child can have cystic fibrosis (Aa × Aa = 25% AA, 50% Aa, 25% aa)

In this case, ~~probability~~ = 0·25

probability = 0·25

Now, Elaine has 1/3 probability of being Homozygous dominant (AA) and 2/3 probability of being heterozygous (Aa)

(Aa × Aa = 25% AA, 50% Aa, 25% aa)

So net probability = $\frac{1}{3} \times 0 + \frac{2}{3} \times 0{\cdot}25$

(1) $= \frac{1}{6}$ (Ans)

B07) a) Parents are AaBbCc, AaBbCc

Required offspring - AaBbCc

Probability of A required offspring = (Probability of Aa offspring) × (Probability of Bb offspring) × (Probability of Cc offspring)

Now Aa × Aa = 25% AA, 50% Aa, 25% aa

Bb × Bb = 25% BB, 50% Bb, 25% bb

Cc × Cc = 25% CC, 50% Cc, 25% cc

∴ Required probability = 0·5 × 0·5 × 0·5 = 0·125 (Ans) ≠ 1/8 (Ans)

b) Parents are aaBbCC and AABbCc

Required offspring - AaBbCc

Probability of required offspring = (Probability of Aa offspring) × (Probability of Bb offspring) × (Probability of Cc offspring) (1)

Now aa × AA = 100% Aa,

Bb × Bb = 25% BB, 50% Bb, 25% bb

CC × CC = 100% Cc

∴ Required probability = 1 × 0·5 × 1 = 0·5 = 1/2 (Ans) ✓

Solution to (a B7) (1)

(a) Aa × Aa → probability to get Aa = 1/2

AA, aa, Aa, Aa

Bb × Bb → similar probability to get Bb = 1/2

and for Cc × Cc probability to get Cc = 1/2

∴ to get AaBbCc = p = 1/2 × 1/2 × 1/2 = 1/8 (all are independent due to independent assortment)

(b) AA × aa ↓ Bb × Bb ↓ CC × cc ↓

	A	A
a	Aa	Aa
a	Aa	Aa

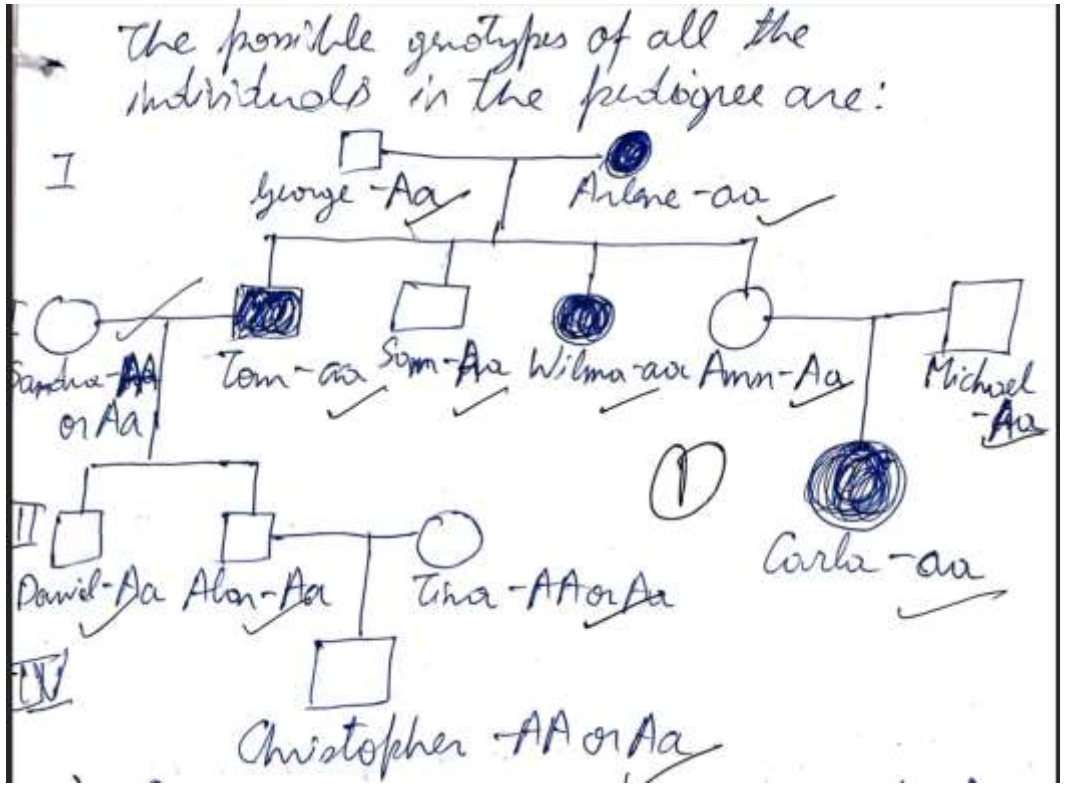
	B	b
B	BB	Bb
b	Bb	bb

	C	C
C	Cc	Cc
C	Cc	Cc

p(AaBbCc) = p(Aa) × p(Bb) × p(Cc) = 1 × 1/2 × 1 = 1/2.

B08

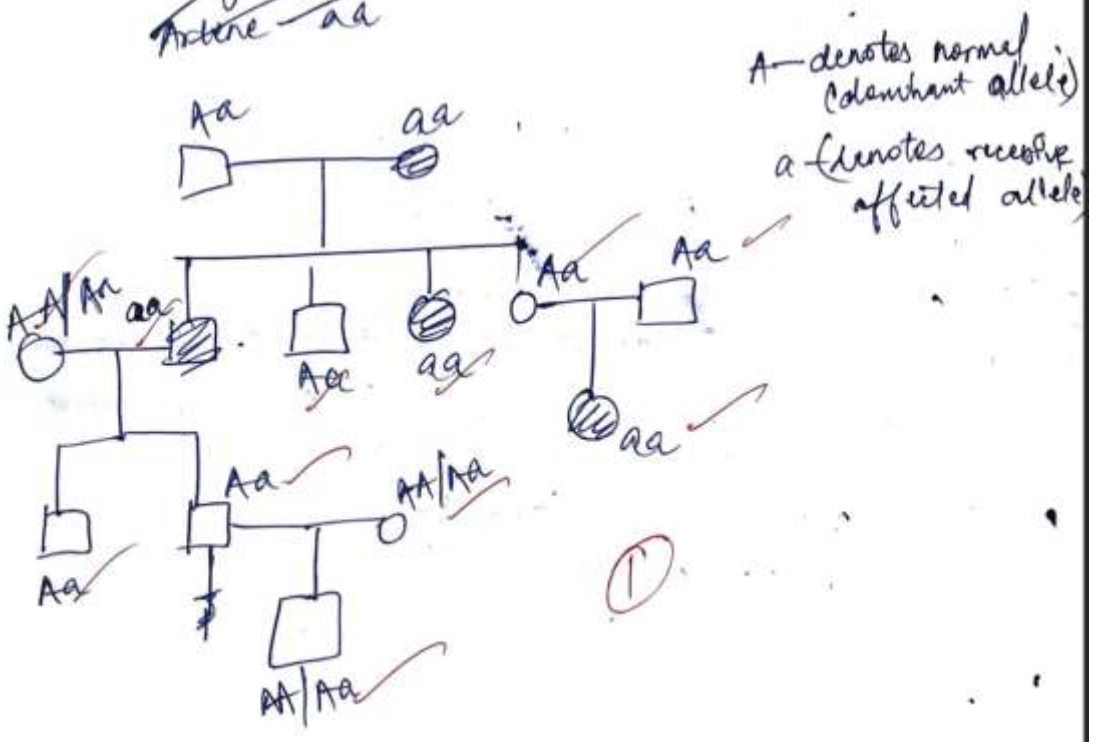
B8) Since Ann and Michael, themselves do not have alkaptonuria, but their child Carla, has, the disease is an autosomal recessive disorder.
Say genes for alkaptonuria are A and a



Solution to (Q B8)

We can conclude that this happens due to a recessive allele, this can be deduced as Ann & Michael both are normal individuals, yet it appears in Carla, hence due to generation skipping it is recessive

~~George - Aa~~
~~Arlene - aa~~



B09

B9) Since the man had haemophilia (X^hY), his daughter will be a carrier for the disease (XX^h). Now, her husband is normal (XY)

Parents - ♂ XY (Normal) × XX^h ♀ (Carrier)

Gametes: X, Y × X, X^h

Offspring:

♀ \ ♂	X	Y
X	XX	XY
X^h	XX^h	X^hY

Normal female = 1/4
Normal male = 1/4
Carrier female = 1/4
Affected male = 1/4

From the Punnet square,

a) Probability of their daughter having is haemophilia (X^hX^h) = 0 (Ans)

b) Probability of each son to be born of haemophilia (X^hY) = 1/2 = 1/4 / 1/4 + 1/4 = 1/2

∴ ~~Probability~~ (1)

∴ Probability of all four sons to have haemophilia = 1/2 × 1/2 × 1/2 × 1/2

= 1/16 (Ans)

B7) A/A

Solution to Q (B9) :

Since man has haemophilia his genotype is X^hY, which means his daughter receives X^h allele from her father; (as she has normal phenotype, her other allele is dominant normal)

∴ Daughter = X^hX genotype

her husband = XY genotype (normal) (1)

	X	Y
X^h	XX^h	X^hY
X	XX	XY

(a) There is zero probability daughter has haemophilia

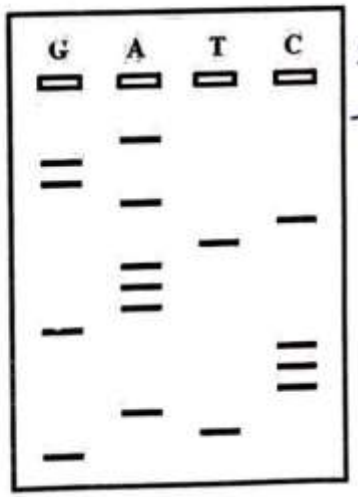
(b) Son has 1/2 probability of having haemophilia

(c) For all 4 sons $p = 1/2 \times 1/2 \times 1/2 \times 1/2 = 1/16$ to have haemophilia

B10

A. A student is working on 5'-labelled DNA for sequencing. He performed agarose gel electrophoresis and found following result (see image). Write the sequence in 5' to 3' direction. **(0.5 marks)**

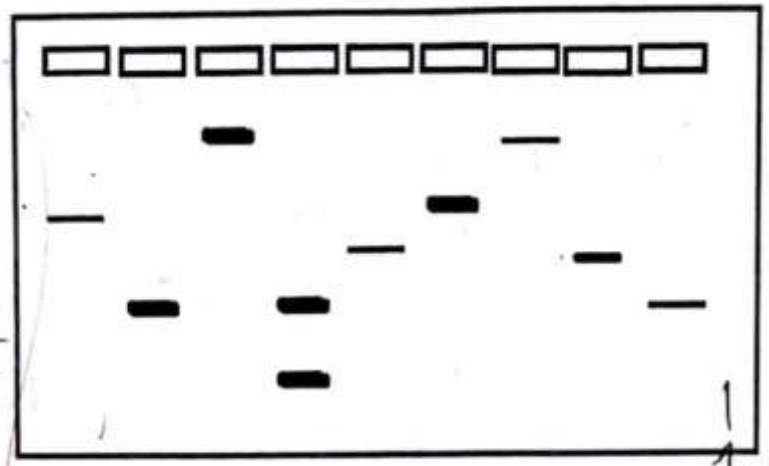
16



3'

5'

-GTACCCGAAATCAGGA-



B, C, D, and F are esporessed more &

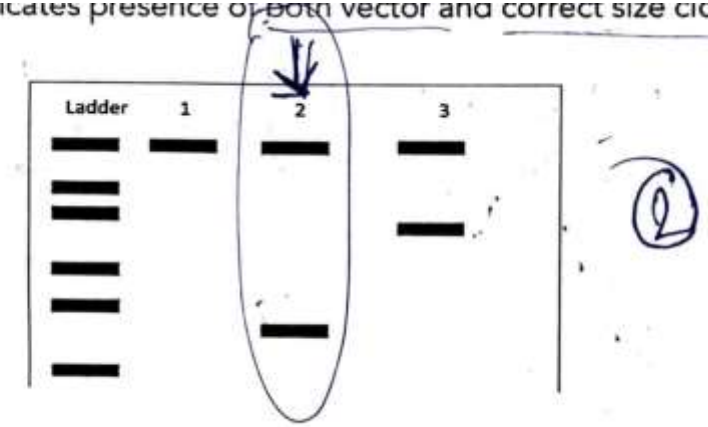
A, E, G, H & I are esporessed less.

B11

Solution to Q(B11)

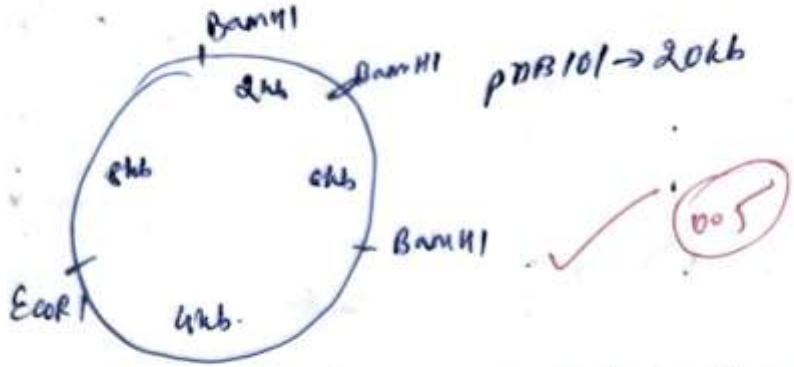
(A) Lane 3 represents the presence of vector & the correct size clone, as the ROI (Gene of Interest) will be shorter as compared to the vector, the vector band has to lie closer to the correct sized clone, Hence lane 3. ✗

Which lane indicates presence of both vector and correct size clone, (0.5 marks)



(2)

Soln (B) (Not to scale)



(05)

Fig:- Plasmid map with Spots of enzymes (2 of BamHI & 1 of EcoRI)

B12

B12) A) a is the ladder consisting of gene fragment of known sizes
b is the linearised vector
C is the gene of interest

B) Size of vector is 900 bp,
Size of gene of interest is 500 bp

C) The restriction enzymes used to create the recombinant (rDNA) are x and y

D) From the figure A, it is clear that a total of 5 bands will be formed if all 5 restriction enzymes (v, w, x, y, z) are used

solution to Q(B12)

(A) Since lowermost band is 100 bp. a will be a marker corresponding to 400 bp (a is like the standard measure of bp). (0.3)
b represents the vector and c represents the marker of gene of interest.

(B) size of vector = 900 bp
size of insert = 500 bp (0.3)

(C) enzymes X & Y are used (0.2)

(D) we would observe 5 bands corresponding to XY, YZ, ZV, VW and WX segments (0.2)