SET 8 – FULL ANSWER KEY

Section – A Answers (1×16 = 16 Marks)

1. **B** – Two (two polar nuclei participate in triple fusion)
2. **A** – Ovulation
3. **B** – GC rich (3 hydrogen bonds per pair → maximum H-bonds)
4. **B** – Commaless
5. **B** – Gene flow
6. **B** – 0.5
    - 2pq = 2 × 0.5 × 0.5 = 0.5
7. **B** – mRNA degradation
8. **A** – CD4
9. **A** – DNA doubles each cycle
10. **C** – Pond
11. **B** – Collapse of ecosystem
12. **B** – Lepidopterans
13. **A**
14. **A**
15. **A**
16. **A**

Section – B Answers (2×5 = 10 Marks)

17A. Pollen–Pistil Interaction

• Recognition between pollen and stigma
• Compatible pollen germinates
• Self-incompatibility prevents selfing
• Ensures genetic diversity

OR

IVF vs ICSI

IVF	ICSI
Egg and sperm mixed in lab	Single sperm injected into ovum
Used in normal infertility	Used in severe male infertility

18. Meselson & Stahl Experiment

- Grew E. coli in N^{15} medium
- Shifted to N^{14}
- Hybrid DNA observed after one generation
- Concluded DNA replication is semi-conservative

19. Hardy–Weinberg Numerical

Recessive affected = 9%

$q^2 = 0.09$

$q = 0.3$

$p = 1 - 0.3 = 0.7$

Carrier frequency = 2pq
$= 2 \times 0.7 \times 0.3$
$= 0.42$

→ **42% carriers**

20A. Cloning Vector Features

- ori
- Selectable marker
- Multiple cloning site
- Small size
- High copy number

OR

Gel Electrophoresis

Principle: DNA moves toward positive electrode due to negative charge.

Smaller fragments move faster through agarose gel.

21A. Energy Transfer

Producers = 500,000 kcal

Primary = 50,000 kcal
Secondary = 5,000 kcal
Tertiary = 500 kcal

OR

r-strategists → Rapid reproduction (e.g., bacteria)

K-strategists → Stable population, fewer offspring (e.g., elephants)

Section – C Answers (3×7 = 21 Marks)

22. Oogenesis

• Oogonia (2n)
• Primary oocyte (arrested Prophase I)
• Secondary oocyte (arrested Metaphase II)
• Completion after fertilisation

Hormonal regulation by FSH and LH

23. Advanced Probability (AaBb × aaBb)

Gametes:

AaBb → AB, Ab, aB, ab
aaBb → aB, ab

(i) Probability aaBb = 1/4

(ii) Both dominant phenotype = 3/8

(iii) Recessive for both (aabb) = 1/8

24. Convergent vs Divergent Evolution

Convergent → Similar traits in unrelated species
Example: Wings of bat & bird

Divergent → Different traits from common ancestor
Example: Forelimbs of mammals

25. Recombinant DNA Technology

Steps:
- Isolation
- Restriction digestion
- Ligation
- Transformation
- Selection

26. Eutrophication & Biomagnification

Eutrophication → Nutrient enrichment → Algal bloom → Fish death

Biomagnification → Toxin concentration increases at higher trophic levels
Example: DDT

27. Immune Response

Primary → Slow, less antibodies

Secondary → Rapid, high antibodies

Memory cells responsible

28. Population Growth Numerical

$Nt = N_0 e^{(rt)}$

$N_0 = 100$
$r = 0.4$
$t = 3$

$Nt = 100 e^{(1.2)}$

$e^{1.2} \approx 3.32$

$Nt \approx 332$ individuals

Section – D Answers (4×2 = 8 Marks)

29. Sex-Linked Case

Carrier female = X^HX^h
Haemophilic male = X^hY

Possible offspring:
X^HX^h (carrier)
X^hX^h (affected female)
X^HY (normal male)
X^hY (affected male)

Probability haemophilic daughter = 1/4

Males affected more due to single X chromosome

30. Environmental Case

Phenomenon = Eutrophication

BOD = Oxygen required by microbes

High BOD → Oxygen depletion → Fish death

Prevention:
- Industrial effluent treatment
- Reduce fertilizer runoff

Section – E Answers (5×3 = 15 Marks)

31. DNA Replication

- Helicase unwinds
- Primase forms primer
- DNA polymerase synthesizes
- Ligase joins fragments

Lagging strand discontinuous due to opposite orientation of template strands.

32. Agrobacterium & RNAi

Ti plasmid transfers gene

Restriction enzymes create sticky ends

RNAi → dsRNA → mRNA degradation → Pest control

33. Ecology Justification

- Competitive exclusion → Gause
- Resource partitioning → MacArthur warblers
- Keystone species → Pisaster
- 10% law → Lindeman
- Latitudinal gradient → Tropics high diversity due to stable climate