SHAURYA

NDA/NA

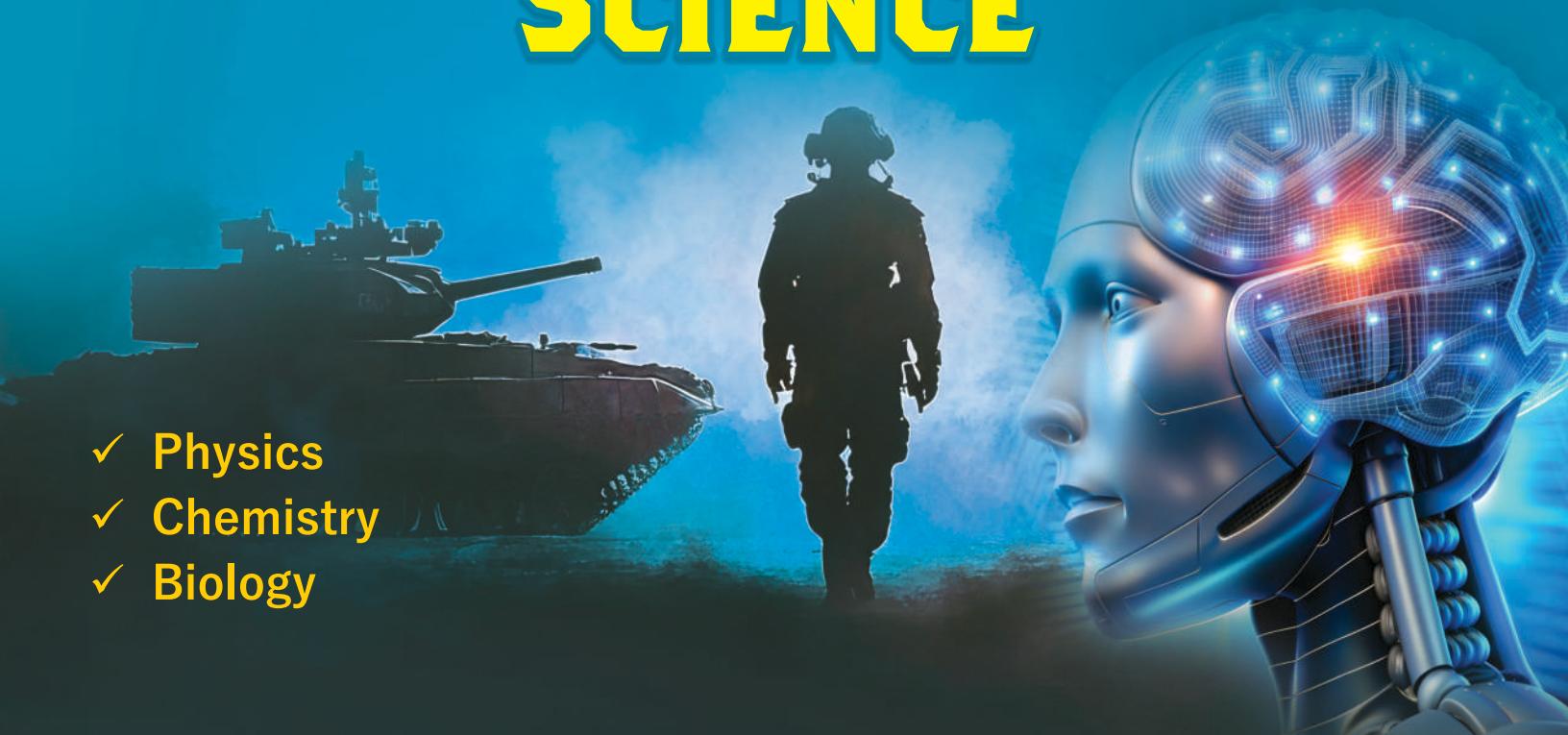## National Defence Academy & Naval Academy

GENERAL ABILITY SCIENCE

PW

- ✓ **Physics**
- ✓ **Chemistry**
- ✓ **Biology**

☑ Precise Chapterwise Theory

☑ Solved Examples

☑ Practice Exercises with Solutions

☑ Handpicked PYQs Covered Till Date

☑ Chapter-Wise Weightage Analysis of **Past 5 Years** Papers

As Per Latest UPSC Exam Pattern

NDA Past 5 Year Paper Analysis

SECTION – A: PHYSICS

		2021-I	2021-II	2022-I	2022-II	2023-I	2023-II	2024-I	2024-II	2025-I	2025-II
PHYSICS		**25**	**26**	**21**	**24**	**23**	**22**	**25**	**24**	**25**	**25**
1.	Properties of Matter	2	3	1	2	2	2	1	2	0	
2.	Mechanics	5	4	7	2	10	4	10	11	9	10
3.	Heat & Thermodynamics	3	3	1	1	0	1	3	2	1	05
4.	Waves	3	2	1	7	2	3	0	0	2	03
5.	Optics	3	4	1	3	4	3	4	4	4	04
6.	Electricity & Magnetism	7	7	6	7	4	8	5	5	8	03
7.	Modern Physics	2	3	3	2	1	1	2	0	1	

SECTION – B: CHEMISTRY

		2021-I	2021-II	2022-I	2022-II	2023-I	2023-II	2024-I	2024-II	2025-I	2025-II
CHEMISTRY		**15**	**15**	**15**	**15**	**15**	**19**	**15**	**15**	**15**	**15**
1.	Basic Concepts of Chemistry, Atomic Structure	7	4	8	4	2	5	1	10	3	06
2.	Carbon and different forms, Carbon dioxide	2	2	2	3	3	3	2	1	1	02
3.	Chemistry of Metals and Non Metals	2	4	0	5	3	5	2	0	0	
4.	Some important Chemical Compounds	3	3	5	1	3	1	5	3	5	05
5.	Acids, Bases and Salts, Oxidation and Reduction	1	2	0	2	4	5	5	1	6	02

SECTION – C: BIOLOGY

		2021-I	2021-II	2022-I	2022-II	2023-I	2023-II	2024-I	2024-II	2025-I	2025-I
BIOLOGY		**10**	**9**	**10**	**9**	**11**	**10**	**10**	**10**	**8**	**08**
1.	Botany	4	4	4	5	11	9	5	4	1	
2.	Zoology	6	5	6	4	0	1	5	6	7	08

CONTENT

SECTION – A: PHYSICS

SECTION–B: CHEMISTRY

SECTION – C: BIOLOGY

PAPERS

Units and Measurements

PHYSICAL QUANTITIES

- ❑ A quantity that we can measure is termed as a **Physical Quantity**.
- ❑ A physical quantity shall have a numeric value or magnitude which can represent the exact amount of the object to be measured.
- ❑ For e.g. length can be measured in metres, mass of an object can be measured in Kgs and so on.

Physical quantities are divided into two types

- ❑ Fundamental Quantities
- ❑ Derived Quantities

PHYSICAL QUANTITIES

Fundamental/ Base Quantities	Derived Quantities
• These quantities are self-sufficient in nature which means they need not depend on other quantities to completely define itself. There are seven Fundamental • e.g. Length, Time, Mass, Electric Current, Temperature, Luminous intensity, Amount of substance.	• These quantities do not have their own identities, they are derived or expressed in terms of the fundamental quantities. • e.g. volume, density, area, velocity, acceleration etc.

UNITS

To estimate the size or to measure a physical quantity we need a reference point or a reference standard. This point of reference is called a Unit of the given physical quantity.

Units are Divided into two types

1. Fundamental units
2. Derived units

Fundamental Units: The unit which gives an idea of the amount or size of the fundamental Quantities are called Fundamental Units.

Derived Units: The units which give an idea of the amount or size of the Derived Quantities are called Derived Units.

e.g., Let us consider the unit of speed.

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\therefore \text{ Unit of Speed} = \frac{\text{unit of distance}}{\text{unit of time}} = \frac{\text{metre}}{\text{second}} = \text{ms}^{-1}$$

Thus, the unit of speed is derived from fundamental units of length and time.

Fundamental Quantity	Unit	Symbol	Derived Quantity	Unit	Symbol
Length	metre	m	Area	metre^2	m^2
Time	second	s	Volume	metre^3	m^3
Mass	kilogram	kg	Density	kilogram/metre^3	kg/m^3
Electric Current	ampere	A	Velocity	metre/second	m/s
Temperature	kelvin	K	Acceleration	metre/second^2	m/s^2
Luminous Intensity	candela	cd	Electric Potential	joule/coulomb or Volt	V
Amount of substance	mole	mol	Resistance	volt/ampere or Ohm	Ω

SYSTEM OF UNITS

A collection of units which can be used to measure all fundamental and derived quantities is called a system of units. Some of the most accepted system of units are given as follows:

CGS System

The Centimetre-Gram-Second (CGS) System is also called the Gaussian System of Units. In this system we use **centimetre (cm)** as unit of length, **gram (g)** as unit of mass, and **second(s)** as unit of time.

Dyne is used as the unit of Force.

FPS System

The Foot-Pound-Second (FPS) System is a British Engineering System of units. In this system we use **foot** (**ft**) as unit of length, **pound** (**lb**) as unit of mass, and **second**(**s**) as unit of time.
Poundal (**pdl**) is used as the unit of Force.

MKS System

In the Metre-Kilogram-Second (MKS) System of units, we use **metre**(**m**) as unit of length, **kilogram**(**kg**) as unit of mass, and **second**(**s**) as unit of time.
Newton is used as the unit of Force.

INTERNATIONAL SYSTEM OF UNITS

The International System of Units generally called **S.I.** units is the latest form of the metric system. The **S.I.** system consists of seven fundamental units and two supplementary units stated below

Fundamental Units

Fundamental Quantity	S.I. Unit	Symbol
Length	metre	m
Time	second	s
Mass	kilogram	kg
Electric Current	ampere	A
Temperature	kelvin	K
Luminous Intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Supplementary Quantity	S.I. Unit	Symbol
Plane Angle	radian	rad
Solid Angle	steradian	sr

UNIT CONVERSIONS (LENGTH)

The length is measured in terms of metre as per the SI system, but it gets complicated to denote very small and very large distances in metre, e.g., the radius of an electron, the distance of the nearby galaxy from earth. All these distances are huge in terms of sheer numbers. So to make it easy, some conversions are followed–

Units to measure small distances	Units to measure large distances
$1 \text{ cm} = 10^{-2} \text{ m}$	$1 \text{ Light Year} = 9.46 \times 10^{15} \text{ m}$
$1 \text{ mm} = 10^{-3} \text{ m}$	
$1 \text{ micron } (\mu) = 10^{-6} \text{ m}$	$1 \text{ Parsec} = 3.08 \times 10^{16} \text{ m}$ $= 3.26 \times 1 \text{ light year}$
$1 \text{ nanometre (nm)} = 10^{-9} \text{ m}$	
$1 \text{ angstrom (Å)} = 10^{-10} \text{ m}$	$1 \text{ Astronomical Unit(AU)}$ $= 1.496 \times 10^{11} \text{ m}$
$1 \text{ fermi} = 10^{-15} \text{ m}$	

DIMENSIONS AND DIMENSIONAL FORMULA

All the physical quantities of interest can be derived from the base quantities. The power (exponent) of base quantity that enters into the expression of a physical quantity, is called the dimension of the quantity in that base. To make it clear, consider the physical quantity force.

$$\textbf{Force} = \text{mass} \times \text{acceleration}$$
$$= \text{mass} \times \frac{\text{velocity}}{\text{time}} = \text{mass} \times \frac{\text{length/time}}{\text{time}}$$
$$= \text{mass} \times \text{length} \times (\text{time})^{-2}$$

So the dimensions of force are 1 in mass, 1 in length and –2 in time.
Such an expression for a physical quantity in terms of base quantities is called dimensional formula.

Dimensional Formula

An expression showing the powers to which the fundamental units are to be raised to obtain one unit of the derived quantity is called Dimensional formula of that quantity.
In general the dimensional formula of a quantity can be written as $[M^x L^y T^z]$. Here x, y, z are dimensions of mass, length and time respectively.

Principle of Homogeneity of Dimension

This principle states that the dimensions of all the terms in a physical expression should be same. For example, in the physical expression $s = ut + \frac{1}{2}at^2$, the dimensions of s, ut and $\frac{1}{2}at^2$ all are same.
Note: The physical quantities separated by the symbols $+, -, =, >, <$ etc., have the same dimensions.

Usage of Dimensional Analysis

(i) To check the correctness of a given formula.
(ii) To establish relation between quantities dimensionally.
(iii) To convert the value of a quantity from one system of units to other system.

Limitations of Dimensional Analysis

(i) It does not predict the numerical value or number associated with a physical quantity in a relation
e.g., $v = \frac{u}{3} + \frac{1}{5} at$ & $v = u + at$
Both are dimensionally valid.
(ii) It does not derive any relations involving trigonometric, logarithmic and exponential functions
e.g., $P = P_0 e^{-bt^2}$ cannot be derived dimensionally.
(iii) It does not give any information about dimensionally constants or nature of a quantity (vector/scalar) associated with a relation.

DIMENSIONS OF FUNDAMENTAL QUANTITIES

Fundamental Quantity	Dimension
Length	[L]
Time	[T]
Mass	[M]

Electric Current	[A]
Thermodynamic temperature	[K]
Luminous Intensity	[cd]
Amount of substance	[mol]

DIMENSIONAL FORMULAE AND SI UNITS OF SOME BASIC PHYSICAL QUANTITIES

Physical Quantity	Formula	Dimensional Formula	S.I. Unit
Velocity	$v = \dfrac{\text{displacement}}{\text{time}}$	$\dfrac{[L]}{[T]} = [M^{\circ}LT^{-1}]$	m/s
Acceleration	$a = \dfrac{\text{velocity}}{\text{time}}$	$\dfrac{[LT^{-1}]}{[T]} = [M^0LT^{-2}]$	m/s^2
Force	F = mass × acceleration	$[M][LT^{-2}] = [MLT^{-2}]$	Newton
Work	W = Fscosθ	$[MLT^{-2}][L] = [ML^2T^{-2}]$	Joule
Kinetic energy	$K.E = \dfrac{1}{2}mv^2$	$[M][LT^{-1}]^2 = [ML^2T^{-2}]$	Joule
Potential energy	P.E = mgh	$[M][LT^{-2}][L] = [ML^2T^{-2}]$	Joule
Torque	τ = Frsinθ	$[MLT^{-2}][L] = [ML^2T^{-2}]$	N-m
Power	$P = \dfrac{\text{Work}}{\text{time}}$	$\dfrac{[ML^2T^{-2}]}{[T]} = [ML^2T^{-3}]$	J/s or Watt
Linear Momentum	p = mass × velocity	$[M][LT^{-1}] = [MLT^{-1}]$	kg-m/s
Impulse	Impulse = Force × time	$[MLT^{-2}][T] = [MLT^{-1}]$	N-s
Angle	$è = \dfrac{\text{arc}}{\text{radius}}$	$\dfrac{[L]}{[L]} = [M^0L^0T^0]$	rad
Strain	$\text{Strain} = \dfrac{\Delta L}{L} \text{ or } \dfrac{\Delta V}{V}$	$\dfrac{[L]}{[L]}$ - dimensionless	No unit
Frequency	$f = \dfrac{1}{\text{time period}}$	$\dfrac{1}{[T]} = [M^0L^0T^{-1}]$	Hz
Angular velocity	$\omega = \dfrac{\text{angle}}{\text{time}}$	$\dfrac{[M^0L^0T^0]}{[T]} = [M^0L^0T^{-1}]$	rad/s
Moment of inertia	I = ∑mr^2	$[M][L]^2 = [ML^2T^0]$	kg-m^2
Angular momentum	L = Iω	$[ML^2][T^{-1}] = [ML^2T^{-1}]$	kg-m^2/s
Surface tension	$\text{Surface tension} = \dfrac{F}{L}$	$\dfrac{[MLT^{-2}]}{[L]} = [ML^0T^{-2}]$	N/m

SOLVED EXAMPLES

1. The value of 2 fermi in terms of metre is equal to
   (a) 2×10^{15} m
   (b) 2×10^{-15} m
   (c) 10^{15} m
   (d) 10^{-15} m

   Ans. (b) Since 1 fermi = 10^{-15} m
   $\therefore$ 2 fermi = 2×10^{-15} m

2. The dimension of frequency is
   (a) $[M^{-1}L^{-1}T^{-1}]$
   (b) $[M^0L^0T^{-1}]$
   (c) $[M^0LT^{-1}]$
   (d) $[ML^0T^{-1}]$

   Ans. (b) Since, $f = \dfrac{1}{\text{time period}} \Rightarrow \dfrac{1}{[T]} = [M^0L^0T^{-1}]$

3. The unit of force in FPS system is
   (a) Poundal
   (b) Newton
   (c) Dyne
   (d) Pascal

   Ans. (a) The unit of force in the FPS system is Poundal.

4. The S.I. unit of acceleration is
   (a) m/s
   (b) cm/s
   (c) m/s²
   (d) cm/s²

   Ans. (c) $\text{Acceleration} = \dfrac{\text{velocity}}{\text{time}} \Rightarrow \dfrac{\text{ms}^{-1}}{\text{s}}$ ms^{-2}

5. The value of 1 Astronomical Unit is
   (a) 1.496×10^{11} m
   (b) 9.46×10^{15} m
   (c) 3.08×10^{16} m
   (d) 3.26×10^{16} m

   Ans. (a) The value of 1 Astronomical Unit is 1.496×10^{11} m.

6. Which of the following is/are not a fundamental quantity
   (a) Mass
   (b) Electric Charge
   (c) (a) and (b)
   (d) None of these

Ans. (b) Electric Charge is not a fundamental quantity.

7. The dimensional formula of Work is equal to that of
   (a) Surface Energy
   (b) Power
   (c) Torque
   (d) Impulse

   Ans. (c) The dimensional formula of Work is $[ML^2T^{-2}]$. The dimensional formula of Torque is $[MLT^{-2}][L] = [ML^2T^{-2}]$.

8. The dimensional formula of spring constant is
   (a) $[ML^0T^{-2}]$
   (b) $[ML^2T^{-2}]$
   (c) $[ML^{-2}T^0]$
   (d) $[M^2L^0T^{-2}]$

   Ans. (a) As spring constant is denoted by $k = \dfrac{F}{x}$, i.e., $\dfrac{\left[MLT^{-2} \right]}{[L]}$

   $= [ML^0T^{-2}]$.

9. The dimensional formula of frequency is equal to that of
   (a) Momentum
   (b) Angular momentum
   (c) Velocity
   (d) Angular velocity

   Ans. (d) Angular velocity $\Rightarrow \dfrac{\text{Radian}}{\text{sec}} \Rightarrow [s^{-1}]$

10. 1 Parsec is equal to
    (a) $326 \times 1 ly$
    (b) $0.326 \times 1 ly$
    (c) $3.26 \times 1 ly$
    (d) $32.6 \times 1 ly$

    Ans. (c) 1 Light Year = 9.46×10^{15} m   ...(i)
    and, 1 Parsec = 3.08×10^{16} m   ...(ii)
    Dividing (i) from (ii), we get
    1 Parsec = 3.26×1 light year.

EXERCISE

1. The SI unit of work function of a metal used in photoelectric effect is
   (a) Joule (J)
   (b) Newton (N)
   (c) Pascal (Pa)
   (d) Hertz (Hz)

2. How many types of units exist in physics?
   (a) 2
   (b) 3
   (c) 4
   (d) 5

3. What is the dimensional formula of strain?
   (a) $M^0L^0T^0$
   (b) $M^1L^{-1}T^{-2}$
   (c) $M^0 L^0 T^{-1}$
   (d) None of the above

4. What is the number of significant figures in 433.00?
   (a) 2
   (b) 3
   (c) 4
   (d) 5

5. Which of the following is not a physical quantity?
   (a) Length
   (b) Time
   (c) Electric current
   (d) Kilogram (kg)

6. The square root of the product of inductance and capacitance has the dimension of
   (a) Length
   (b) Mass
   (c) Time
   (d) No dimension

7. Joule/coulomb is the same as
   (a) 1 Ampere
   (b) 1 kWh
   (c) 1 kW
   (d) 1 Volt

8. The dimensions of power are
   (a) ML^2T^{-2}
   (b) ML^2T^{-3}
   (c) M^2LT^{-3}
   (d) M^2LT^{-2}

9. The standard unit for measuring the frequency of a sound wave is
   (a) metre per second
   (b) newton
   (c) metre
   (d) hertz

36. Which of the following is dimensionless?

(a) $\dfrac{\text{Force}}{\text{acceleration}}$

(b) $\dfrac{\text{Velocity}}{\text{acceleration}}$

(c) $\dfrac{\text{Volume}}{\text{area}}$

(d) $\dfrac{\text{Energy}}{\text{work}}$

37. The dimensions of torque are

(a) $[ML^2T^{-2}]$

(b) $[M^2L^2T^{-2}]$

(c) $[ML^2T^{-1}]$

(d) None of these

38. Statement-I: Absolute error is unitless and dimensionless.

Statement-II: All types of errors are unitless and dimensionless.

(a) Both **Statement-I** and **Statement-II** are correct.

(b) Both **Statement-I** and **Statement-II** are incorrect.

(c) **Statement-I** is correct & **Statement-II** is incorrect.

(d) **Statement-I** is incorrect & **Statement-II** is correct.

39. Statement-I: Two physical quantities having same dimensions, may have different units.

Statement-II: Shake and light year, both measure time.

(a) Both **Statement-I** and **Statement-II** are correct.

(b) Both **Statement-I** and **Statement-II** are incorrect.

(c) **Statement-I** is correct & **Statement-II** is incorrect.

(d) **Statement-I** is incorrect & **Statement-II** is correct.

PAST YEAR QUESTIONS

1. Which one of the following physical quantities has the same unit as that of pressure? **[2017 (I)]**

(a) Angular momentum (b) Stress

(c) Strain (d) Work

2. The symbol of SI unit of inductance is H. It stands for **[2017 (II)]**

(a) Holm (b) Halogen

(c) Henry (d) Hertz

3. Light year is a measure of **[2017 (II)]**

(a) Time

(b) Distance

(c) Total amount of light falling on the Earth in a year

(d) Average intensity of light falling on the Earth in a year

4. 1 dyne (a unit of force in CGS system) equals to **[2019 (I)]**

(a) 10^3 g cm/s^2

(b) 10^{-3} g cm/s^2

(c) 10^5 kg m/s^2

(d) 10^{-5} kg m/s^2

5. The temperature of a place on one sunny day is 113 on the Fahrenheit scale. The Kelvin scale reading of this temperature will be **[2019 (II)]**

(a) 318 K (b) 45 K (c) 62.8 K (d) 335.8 K

6. A student measures certain lengths using a metre scale having least count equal to 1 mm. Which one of the following measurements is more precise? **[2019 (II)]**

(a) 0.50 mm (b) 29.07 cm (c) 0.925 m (d) 910 mm

7. Fundamental laws of physics require **[2021-II]**

(a) conservation of energy and non-conservation of charge

(b) conservation of charge and nonconservation of linear momentum

(c) conservation of charge and non-conservation of energy

(d) conservation of energy, momentum and charge

8. Which of the following pairs of physical phenomena and the discoverer is/are correctly matched? **[2021-I]**

1. James Chadwick : Photoelectric effect

2. Albert Einstein : Neutron

3. Marie Curie : Radium

Select the correct answer using the codes given below.

(a) 1, 2 and 3 (b) 1 and 2

(c) 2 and 3 (d) Only 3

9. Consider the following statements about light year. **[2021-I]**

1. Light year is a unit for measurement of very large distances.

2. Light year is a unit for measurement of very large time intervals.

3. Light year is a unit for measurement of intensity of light.

Which of the statements given above is/are correct?

(a) 1, 2 and 3 (b) 2 and 3 (c) 1 and 2 (d) Only 1

10. The unit of the ratio between thrust and impulse is same as that of **[2021-II]**

(a) frequency (b) speed

(c) wavelength (d) acceleration

11. What is the dimension of gravitational constant? **[2022-I]**

(a) $[ML^3T^{-2}]$ (b) $[M^{-1}L^3T^{-2}]$ (c) $[M^2L^{-2}T^{-2}]$ (d) $[M^2L^{-1}T^{-2}]$

ANSWER KEY

Exercise

1. (a)	2. (a)	3. (a)	4. (d)	5. (d)	6. (c)	7. (d)	8. (b)	9. (d)	10. (c)
11. (c)	12. (d)	13. (d)	14. (c)	15. (c)	16. (c)	17. (d)	18. (c)	19. (c)	20. (d)
21. (a)	22. (b)	23. (b)	24. (a)	25. (c)	26. (a)	27. (d)	28. (b)	29. (a)	30. (c)
31. (a)	32. (c)	33. (d)	34. (a)	35. (a)	36. (d)	37. (a)	38. (b)	39. (c)	

Past Year Questions

1. (b)	2. (c)	3. (b)	4. (d)	5. (a)	6. (c)	7. (d)	8. (d)	9. (d)	10. (a)
11. (b)									

Exercise

1. (a) The work function is a unit of energy measurement. The SI unit for all forms of energy is the joule (J).

2. (a) There are two main types of Units are present. Fundamental units and Derived units.

3. (a) There is no dimension to it. Its dimension can be expressed as $[M^0L^0T^0]$.

4. (d) The number of digits up to which we are confident in their accuracy is referred to as significant figures. Trailing zeros or the zeros placed to the right of the number is significant. Therefore, 433.00 has five significant figures.

5. (d) The kilogram is a unit of physical quantity, not a physical quantity itself.

6. (c) $\sqrt{LC}$ is $\Rightarrow \sqrt{LC} = \left[M^0L^0T^1\right]$

   The dimension of time is the square root of the product of inductance and capacitance.

7. (d) Electric potential $(V) = \dfrac{\text{Work done } (W)}{\text{Charge } (q)}$

   $1V = \dfrac{J}{C}$ i.e Joule/coulomb is the same as $1V$.

8. (b) The dimensions of power $= \dfrac{(\text{Dimension of work})}{\text{Time}}$

   $= \dfrac{(ML^2T^{-2})}{T} = ML^2T^{-3}$

9. (d) The Sl unit of frequency is Hertz (Hz).

10. (c) $\dfrac{C}{L}$ has not the dimension of frequency dimension of C/L is $M^{-2} L^{-4} T^6 A^4$.

11. (c) $Q = \dfrac{x^3 y^2}{z}$

   $\dfrac{\Delta Q}{Q} \times 100 = 3\dfrac{\Delta x}{x} \times 100 + 2\dfrac{\Delta y}{y} \times 100 + \dfrac{\Delta z}{z} \times 100$

   $\dfrac{\Delta Q}{Q} = 3\dfrac{\Delta x}{x} + \dfrac{2\Delta y}{y} + \dfrac{\Delta z}{z} = 3 \times 1 + 2 \times 2 + 4 = 11$

   $= \dfrac{\Delta Q}{Q} \times 100 = 11\%$

12. (d) 1 Pound is a unit of weight equals to 16 ounces.

13. (d) Candela is a unit of luminous intensity.

14. (c) The relationship between the degree Celsius and the Kelvin scale is as follows: $K - 273 = C$

15. (c) The electromotive force and the potential difference have the same unit.

16. (c) Surface tension $= \dfrac{\text{Force}}{\text{length}} = \dfrac{\left[MLT^{-2}\right]}{[L]} = \left[MT^{-2}\right]$

17. (d) $\Rightarrow \text{meter} = (\beta \times \text{time}) + \text{meter}$

   $\Rightarrow \beta = \dfrac{\text{meter}}{\text{time}} \Rightarrow ms^{-1}$

18. (c) Time is the physics quantity that has the same unit in both the C.G.S and the M.K.S systems.

19. (c) ∴ Dimensional formula of density is $\left[ML^{-3}\ T^0\right]$.

20. (d) There are 5 significant figures for 42306- here. Between significant digits, a zero is considered significant 0.0007
   There is only one significant figure. 6.5×10^{-3}
   There are only 2 significant figures.

21. (a) Solid angles are measured in steradians.

22. (b) The fundamental units in the MKS system are the same as in the SI system.

23. (b) The kilogram is the standard unit of mass measurement.

24. (a) The kilogramme is one of the available options for measuring mass. As a result, the kilogramme can be used to quantify matter.

25. (c) Three basic parameters – mass, length, and time – are used in a simple dimensional equation.

26. (a) Dimensional analysis has two primary applications. First, to ensure that an equation is dimensionally correct. Second, to convert a physical quantity between two different units systems.

27. (d) The value of a dimensionless constant cannot be calculated, which is a limitation in dimensional analysis. It is a disadvantage rather than a benefit.

28. (b) $\vec{F} = q\vec{B}|\vec{v}\sin\theta|$

   $[B] = \dfrac{[F]}{[q][v]} = \dfrac{\left[MLT^{-2}\right]}{[AT]\left[LT^{-1}\right]} = \left[ML^0T^{-2}A^{-1}\right]$

   $= \left[MT^{-2}A^{-1}\right]$

29. (a) On equating,

   $\left[L^{-1}\right] = qx$

   $\Rightarrow \left[LT^{-1}\right] = q[L] \Rightarrow q = \left[T^{-1}\right]$

   $\left[LT^{-1}\right] = rt^2$

   $\Rightarrow \left[L\ T^{-1}\right] = r\left[T^2\right] \Rightarrow r = \left[L^{-3}\right]$

   Ratio $= \dfrac{r}{q} = \dfrac{\left[LT^{-3}\right]}{\left[T^{-1}\right]} = \left[LT^{-2}\right] \Rightarrow ms^{-2}$

30. (c) Given equation is $A = xt + bt^2$

   $[xt] = \left[bt^2\right] \Rightarrow [b] = \left[xt/t^2\right]$

   $[b] = [x/t]$

   'x' has dimension of length and 't' has the dimension of time. So unit of b will be ms^{-1}.

31. (a) $(1 - e^{-at})$ is a constant value and will have no dimensions.

   $\Rightarrow [x] = \left[\dfrac{v}{A}\right]$

1. What is the nickname of the National Men's Hockey Team of Australia ?
   - (a) The Kangaroos
   - (b) The Boomers
   - (c) The Dolphins
   - (d) The Kookaburras

2. Which one of the following organisations has completed 150 years of service to the nation in the the year 2025 ?
   - (a) Botanical Survey of India
   - (b) Survey of India
   - (c) India Meteorological Department
   - (d) Press Trust of India

3. Which of the following statements about 'Jalvahak' is/are correct?
   1. It is a newly commissioned navel ship inducted into Indian Navy
   2. It is a major policy for cargo Promotion unveiled by the Government of India

   Select the answer using the code given below:
   - (a) 1 only
   - (b) 2 only
   - (c) Both 1 and 2
   - (d) Neither 1 nor 2

4. How many rural districts does Mahatma Gandhi National Rural Employment Guarantee Act cover as on 2024-25?
   - (a) 600
   - (b) 740
   - (c) 700
   - (d) 680

5. Under which one of the following initiatives does the NITI Aayog support interested States to establish a State Institution for Transformation (SIT)?
   - (a) NITI for States Platform
   - (b) Bharat Ke Badhte Kadam
   - (c) State Support Mission
   - (d) Aspirational Block Programme

6. Which one of the following Indian States account for the maximum deposits of Bauxite and Chromite?
   - (a) Andhra Pradesh
   - (b) Madhya Pradesh
   - (c) Jharkhand
   - (d) Odisha

7. Consider the following statements with regard to National Technology Day:
   1. It commemorates the momentous events of 11th May 1998, when India conducted successful nuclear tests under Operation Shakti
   2. The official theme for National Technology Day 2025 is 'School to Star'

   Which of the statements given above is/are correct?
   - (a) 1 only
   - (b) 2 only
   - (c) Both 1 and 2
   - (d) Neither 1 nor 2

8. Which of the following were added in India as Ramsar Site in the year 2025?
   1. Sakkarakottai Bird Sanctuary
   2. Udhwa Lake
   3. Rudrasagar Lake
   4. Bakhira Wildlife Sanctuary

   Select the answer using the code given below:
   - (a) 1 and 4
   - (b) 2 and 3 only
   - (c) 1 and 2 only
   - (d) 1, 2 and 3

9. Consider the following statements about Cricket player Virat Kohli :
   1. He is the only captain to have scored seven double centuries in Test Cricket
   2. He is the only Indian cricketer with most centuries as a captain
   3. He is the first Indian captain to achieve twin centuries on captaincy debut
   4. He holds the record for the most double centuries by an Indian in Test Cricket

   Which of the statements given above are correct?
   - (a) 1 and 2 only
   - (b) 2 and 3 only
   - (c) 1, 3 and 4 only
   - (d) 1, 2, 3 and 4

10. Ethereum, Tether, Solana and Cardano are all forms of
    - (a) Crypto currency
    - (b) Artificial Intelligence (AI) Startups
    - (c) Humanoid Robots
    - (d) Medical apps

11. The book 'The Origin of Species by Means of Natural Selection' was authored by
    - (a) Charles Darwin
    - (b) Carolus Linnaeus
    - (c) Barbara McClintock
    - (d) Copernicus

12. The headquarters of World Meteorological Organization (WMO) is located at
    - (a) Switzerland
    - (b) Scotland
    - (c) South Africa
    - (d) Italy

13. The optimum pH at which the enzymes pepsin and trypsin of the human alimentary canal works are
    (a) pH 2.0 and 7.9, respectively
    (b) pH 4.5 and 3.5, respectively
    (c) pH 9.5 and 4.5, respectively
    (d) pH 7.0 and 8.0, respectively

14. The amount of air breathed in and out during a normal respiration by human lungs is referred to as
    (a) Vital capacity   (b) Tidal volume
    (c) Inspiratory volume   (d) Total lung capacity

15. Which one among the following statements about arteries and veins in humans is NOT correct?
    (a) Arteries carry blood away from heart while veins bring blood towards the heart
    (b) Pulmonary arteries always carry oxygenated blood while Pulmonary veins always carry deoxygenated blood
    (c) Arteries have thicker and more elastic walls compared to veins in general
    (d) Arteries do not have valves but veins do have valves

16. Identify the functions that are controlled by the hind brain of human being
    (a) Involuntary actions such as blood pressure, salivation vomiting etc.
    (b) Controlling the regions receiving sensory impulses from receptors
    (c) Controlling the movement of voluntary muscles
    (d) Sensation of hunger or being full

17. Iodized salt is a vital part of our diet as it is essential for the synthesis of
    (a) Estrogen   (b) Thyroxin   (c) Insulin   (d) Adrenalin

18. The menstrual cycle in females is controlled by hormones that are secreted by
    (a) Ovary and lacrimal gland (b) Ovary and sebaceous gland
    (c) Ovary and pituitary gland (d) Prostate and pituitary gland

19. Which one of the following blood cells type secrete large number of antibodies during an immune response of the body?
    (a) Neutrophils   (b) Eosinophils
    (c) Lymphocytes   (d) Monocytes

20. Which of the following organelles have their own DNA and ribosomes?
    (a) Endoplasmic reticulum and Golgi bodies
    (b) Mitochondria and Chloroplast
    (c) Endoplasmic reticulum and cyto-skeleton
    (d) Cell wall and nucleolus

21. Arrange the following zones in ascending order in terms of their latitudinal extent on the Earth surface:
    1. Equatorial zone   2. Midlatitude zone
    3. Subarctic zone   4. Tropical zone
    Select the answer using the code given below:
    (a) 1-3-2-4   (b) 1-3-4-2
    (c) 1-4-2-3   (d) 3-1-2-4

22. Consider the following statements with reference to Feldspar mineral:
    1. Half of the earth's crust is composed of feldspar
    2. It has light cream to salmon pink colour
    3. Magnesium is a common element in all types of feldspar

Which of the statements given above is/are correct?
    (a) 1 only   (b) 1 and 2 only
    (c) 2 and 3 only   (d) 1, 2 and 3

23. Consider the following pairs with reference to sedimentary rocks and the process of their formation:

Sedimentary Rock	Process of Formation
1. Chert	– Chemically formed
2. Geyserite	– Organically formed
3. Shale	– Mechanically formed

    Which of the pairs given above is/are correctly matched ?
    (a) 1 only   (b) 1 and 2 only
    (c) 2 and 3 only   (d) 1, 2 and 3

24. Which of the following statements is/are correct?
    1. Oceanic trenches are very signi-ficant in the study of plate move-ments
    2. Oceanic trenches are associated with active volcanoes and strong earthquakes
    Select the answer using the code given below:
    (a) only   (b) 2 only
    (c) Both 1 and 2   (d) Neither 1 nor 2

25. Which of the following statements with reference to shadow zones in an event of an earthquake is/are correct?
    1. Zone between 105° and 145° from epicentre was identified as the shadow zone for both P-waves and S-waves
    2. The shadow zone of P-waves is much larger than that of the S-waves
    Select the answer using the code given below:
    (a) 1 only   (b) 2 only
    (c) Both 1 and 2   (d) Neither 1 nor 2

26. Which one among the following volcanic island chains is NOT asso-ciated with mid-oceanic ridge?
    (a) Azores Islands   (b) Ascension Islands
    (c) Hawaiian Islands   (d) Tristan da Cunha

27. Consider the following statements with reference to sea waves:
    1. The height of waves is determined by wind speed, wind duration, and fetch
    2. The energy of a wave is proportional to the square of its height
    3. Waves retain most of their energy as they travel across the deep ocean
    Which of the statements given above is/are correct?
    (a) 1 only   (b) 1 and 2 only
    (c) 2 and 3 only   (d) 1, 2 and 3

28. Which of the following statements with reference to soil forming processes is/are correct?
    1. Translocation, enrichment, removal and transformation are different classes of soil forming processes
    2. In translocation, fine particles are transported downward by eluviation and accumulate in lower horizons by illuviation
    Select the answer using the code given below:
    (a) 1 only   (b) 2 only
    (c) Both 1 and 2   (d) Neither 1 nor 2

ANSWER KEY

1. (*d*)	**2.** (*c*)	**3.** (*b*)	**4.** (*b*)	**5.** (*c*)	**6.** (*d*)	**7.** (*a*)	**8.** (*c*)	**9.** (*d*)	**10.** (*a*)
11. (*a*)	**12.** (*a*)	**13.** (*a*)	**14.** (*b*)	**15.** (*b*)	**16.** (*a*)	**17.** (*b*)	**18.** (*c*)	**19.** (*c*)	**20.** (*b*)
21. (*c*)	**22.** (*b*)	**23.** (*a*)	**24.** (*c*)	**25.** (*d*)	**26.** (*c*)	**27.** (*d*)	**28.** (*c*)	**29.** (*d*)	**30.** (*d*)
31. (*c*)	**32.** (*d*)	**33.** (*b*)	**34.** (*b*)	**35.** (*c*)	**36.** (*d*)	**37.** (*c*)	**38.** (*c*)	**39.** (*d*)	**40.** (*a*)
41. (*b*)	**42.** (*b*)	**43.** (*d*)	**44.** (*c*)	**45.** (*c*)	**46.** (*c*)	**47.** (*a*)	**48.** (*a*)	**49.** (*b*)	**50.** (*d*)
51. (*c*)	**52.** (*c*)	**53.** (*d*)	**54.** (*d*)	**55.** (*c*)	**56.** (*a*)	**57.** (*c*)	**58.** (*b*)	**59.** (*d*)	**60.** (*d*)
61. (*c*)	**62.** (*c*)	**63.** (*c*)	**64.** (*d*)	**65.** (*b*)	**66.** (*b*)	**67.** (*b*)	**68.** (*d*)	**69.** (*b*)	**70.** (*b*)
71. (*b*)	**72.** (*d*)	**73.** (*c*)	**74.** (*c*)	**75.** (*d*)	**76.** (*d*)	**77.** (*b*)	**78.** (*c*)	**79.** (*d*)	**80.** (*b*)
81. (*c*)	**82.** (*d*)	**83.** (*a*)	**84.** (*a*)	**85.** (*b*)	**86.** (*c*)	**87.** (*a*)	**88.** (*d*)	**89.** (*b*)	**90.** (*b*)
91. (*b*)	**92.** (*b*)	**93.** (*a*)	**94.** (*b*)	**95.** (*c*)	**96.** (*c*)	**97.** (*a*)	**98.** (*c*)	**99.** (*a*)	**100.** (*a*)

EXPLANATION

1. (*d*) The National Men's Hockey Team of Australia is nicknamed **"The Kookaburras."** Named after the native Australian bird, the kookaburra, known for its loud, distinctive call.

Symbolizes resilience, agility, and teamwork, reflecting the team's playing style.

The Kookaburras are consistently ranked among the top teams globally by the International Hockey Federation (FIH).

They won their first **Olympic medal** in 1968 (silver) and their first **Olympic gold** in Tokyo 2020. Multiple FIH Hockey World Cup and Commonwealth Games titles highlight their dominance. The nickname strengthens national identity and complements the women's team, the Hockeyroos.

2. (*c*) The India Meteorological Department (IMD) was established in 1875.

It completed 150 years of service to the nation on 15 January 2025.

The India Meteorological Department (IMD) is the principal government agency in India responsible for weather forecasting, meteorological observations, and seismology.

It is an agency of the Ministry of Earth Sciences and is headquartered in New Delhi.

The Botanical Survey of India was founded in 1890, so it completes 135 years in 2025.

Survey of India was founded in 1767, so far more than 150 years.

Press Trust of India was established in 1947, so much younger than 150 years.

3. (*b*) The Union Minister for Ports, Shipping & Waterways has introduced the 'Jalvahak' scheme to boost inland waterway transport and cargo movement.

The initiative seeks to unlock the trade potential of inland waterways, lower logistics costs, and ease the burden on road and rail networks.

It offers incentives for long-distance cargo transport along National Waterways (NW) 1 – Ganga, NW 2 – Brahmaputra, and NW 16 – Barak.

Under the scheme, operators can receive reimbursements of up to 35% of operating expenses for cargo movement on these routes via the Indo-Bangladesh Protocol Route.

Additionally, it encourages the hiring of vessels from private operators, fostering competition and operational efficiency.

4. (*b*) Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) covered 740 rural districts in the financial year 2024–25; this figure is used in official reviews and scheme-statistics for FY 2024–25.

The scheme now extends to nearly all districts except those with 100% urban population, so district counts change only with administrative re-organisation.

FY 2024–25 performance reports reference targets and monitoring (e.g., ombudsperson placement) across these 740 districts, confirming the operational coverage.

5. (*c*) The State Support Mission (SSM) of NITI Aayog explicitly aims to assist interested States/UTs to establish State Institutions for Transformation (SITs) or reimagine existing state planning bodies.

SITs are conceived as multidisciplinary, state-level resource units — staffed by officials and domain experts — to drive strategy, monitoring, capacity building and evidence-based policymaking.

SSM launched with a central outlay and governance structures (Mission Steering & Implementation Committees) to institutionalise NITI–State engagement up to 2047.

6. (*d*) Odisha is recognized as the leading Indian state for deposits and production of both Bauxite and Chromite.

Odisha accounts for the largest bauxite resources in India (about 41–52% of national resources in various IBM reports), with major belts in Kalahandi–Koraput and the east coast.

Odisha also holds the vast majority of chromite reserves (around 90–96%), concentrated in the Sukinda valley (Jajpur, Keonjhar), making it the principal chromite producer.

7. (*a*) Statement 1 is correct: National Technology Day, observed annually on May 11, commemorates India's successful nuclear tests carried out under Operation Shakti on May 11 and 13, 1998, in Pokhran, Rajasthan.

Statement 2 is incorrect: the official theme for National Technology Day 2025 is "YANTRA – Yugantar for Advancing New Technology, Research & Acceleration".

The theme "School to Startups – Igniting Young Minds to Innovate" was used for National Technology Day 2023.

8. (*c*) Sakkarakottai Bird Sanctuary is located in Ramanathapuram district of Tamil Nadu. In 2025, it was designated as a Ramsar Site, highlighting its ecological significance in conserving avian diversity.

Udhwa Lake is situated in Sahibganj district, Jharkhand; it is the only bird sanctuary of the state. It comprises two connected lakes – Pataura and Berhale. Added as a Ramsar Site in 2025, strengthening wetland protection in eastern India.

Rudrasagar Lake is located near Melaghar town in Tripura. A man-made lake, formed by impounding a small river. It was recognized as a Ramsar Site in 2005.

Bakhira Wildlife Sanctuary is situated in Sant Kabir Nagar district, Uttar Pradesh. It is the largest natural floodplain wetland in the state. It was declared a Ramsar Site in 2021.

9. (*d*) Virat Kohli holds the record for 7 Test double centuries as captain, the most by any captain in cricket history.

Kohli has scored 41 international centuries as captain, the highest by an Indian skipper, surpassing MS Dhoni and Sourav Ganguly.

In 2014, during his first Test as captain vs Australia in Adelaide, he scored 115 & 141, becoming the first Indian captain with twin tons on debut.

Kohli's 7 double centuries is the highest by any Indian player in Test history.

10. (*a*) Ethereum, Tether, Solana, and Cardano are all forms of crypto currencies, which are digital or virtual currencies secured by cryptography.

Ethereum (ETH) is a blockchain platform with smart contract functionality, widely used for decentralized applications (dApps).

Tether (USDT) is a stablecoin pegged to the US dollar, designed to minimize volatility in crypto transactions.

Solana (SOL) is a high-speed blockchain network known for scalability and low transaction fees, supporting decentralized finance (DeFi) and NFTs.

Cardano (ADA) is a blockchain platform focusing on sustainability, scalability, and academic research-driven development.

11. (*a*) The book "On the Origin of Species by Means of Natural Selection" was authored by Charles Darwin in 1859.

It introduced the revolutionary concept of evolution through natural selection, explaining how species adapt and change over generations.

Darwin argued that organisms best suited to their environment survive and reproduce, a process now known as "survival of the fittest."

This work laid the foundation for modern evolutionary biology.

Carolus Linnaeus: Known for taxonomy (binomial nomenclature).

Barbara McClintock: Discovered "jumping genes."

Copernicus: Proposed heliocentric theory.

12. (*a*) The World Meteorological Organization (WMO) is a specialized agency of the United Nations (UN). It was established in 1950, replacing the International Meteorological Organization (IMO).

The headquarters of WMO is located in Geneva, Switzerland.

WMO coordinates international cooperation in weather forecasting, climate monitoring, water resources, and atmospheric sciences.

It plays a crucial role in global efforts to address climate change, disaster risk reduction, and sustainable development.

13. (*a*) Pepsin works best in the highly acidic environment of the stomach, with an optimal pH of approximately 2.0.

This low pH is maintained by hydrochloric acid. Pepsin is a protease that begins the digestion of proteins.

Trypsin functions in the slightly alkaline environment of the small intestine. Its optimal pH is approximately 7.9.

It continues the digestion of proteins that was started by pepsin.

14. (*b*) Tidal Volume (TV) is the amount of air inhaled or exhaled during normal, quiet breathing.

In an average adult, it is approximately 500 ml per breath. Tidal volume ensures continuous gas exchange in the lungs even during rest.

Vital Capacity (VC): Maximum air exhaled after maximum inhalation.

Inspiratory Reserve Volume (IRV): Extra air inhaled beyond normal inspiration.

Total Lung Capacity (TLC): Maximum air lungs can hold after deep inhalation.

15. (*b*) In humans, the pulmonary artery carries deoxygenated blood from the right ventricle to the lungs, and the pulmonary veins carry oxygenated blood back to the left atrium.

Arteries carry blood away from the heart, veins bring it towards the heart.

Arteries have thicker, more elastic walls to withstand high pressure, while veins have thinner walls.

Arteries generally lack valves, while veins have valves to prevent backflow due to low blood pressure.

16. (*a*) The hindbrain of a human being primarily controls several vital involuntary actions and plays a role in motor control and balance.

The medulla oblongata, a part of the hindbrain, regulates essential involuntary functions like blood pressure, heart rate, breathing, swallowing, salivation, coughing, and vomiting.

The cerebellum, another hindbrain structure, is responsible for coordinating voluntary movements, posture, balance, and fine motor skills.

The pons, part of the brainstem within the hindbrain, acts as a bridge, relaying signals between the forebrain and the cerebellum, and is also involved in sleep and breathing regulation.

17. (*b*) Iodine is a crucial component for the synthesis of thyroid hormones, particularly thyroxin (T4) and triiodothyronine (T3), produced by the thyroid gland.

Thyroxin plays a vital role in regulating the body's metabolism, controlling how efficiently cells use energy.

Iodized salt ensures a sufficient intake of iodine, preventing iodine deficiency disorders such as goiter and cretinism.

18. (*c*) The menstrual cycle in females is a recurring process involving ovulation, preparation of the uterus, and menstruation.

It is regulated by hormones secreted by:

Ovary: Produces estrogen and progesterone, which control the development of the uterine lining and ovulation.

Pituitary gland: Secretes follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which stimulate the growth of ovarian follicles and trigger ovulation.

19. (*c*) Lymphocytes are the primary white blood cells involved in the adaptive immune response.

B-lymphocytes (B-cells): Upon encountering an antigen, they differentiate into plasma cells.

Plasma cells are responsible for secreting large numbers of antibodies, which help neutralize pathogens and facilitate their removal.

20. (*b*) Mitochondria and chloroplasts are unique eukaryotic organelles because they contain their own genetic material (DNA) and ribosomes.

This means they can synthesize some of their own proteins, making them semi-autonomous within the cell.

The presence of their own DNA and ribosomes, along with other structural similarities, strongly supports the endosymbiotic theory.