EXERCISE # (S)

1. In system called the star system we have 1 star kilogram = 10^{20} kg. 1 starmetre = 10^8 m, 1 starsecond = 10^3 second then calculate the value of 1 joule in this system.

2. A particle is in a uni-directional potential field where the potential energy (U) of a particle depends on the x-coordinate given by $U_x = k(1 - \cos ax)$ & k and 'a' are constants. Find the physical dimensions of 'a' & k.

3. The equation for the speed of sound in a gas states that $v = \sqrt{\frac{\gamma k_B T}{m}}$. Speed v is measured in m/s, γ is a dimensionless constant, T is temperature in kelvin (K), and m is mass in kg. Find the SI unit for the Boltzmann constant, k_B?

4. If Energy (E), velocity (v) and time (T) are fundamental units. What will be the dimension of surface tension?

5. The time period (T) of a spring mass system depends upon mass (m) & spring constant (k) & length of the spring (ℓ) $\left[k = \frac{Force}{length}\right]$. Find the relation among. (T), (m), (ℓ) & (k) using dimensional method.

6. The distance moved by a particle in time t from centre of a ring under the influence of its gravity is given by $x = a\sin\omega t$, where a &ω are constants. If ω is found to depend on the radius of the ring (r), its mass (m) and universal gravitational constant (G), find using dimensional analysis an expression for ω in terms of r, m and G.

7. A satellite is orbiting around a planet. Its orbital velocity (v_0) is found to depend upon
(a) Radius of orbit (R) (b) Mass of planet (M) (c) Universal gravitation constant (G)
Using dimensional analysis find an expression relating orbital velocity (v_0) to the above physical quantities.

8. Assume that the largest stone of mass 'm' that can be moved by a flowing river depends upon the velocity of flow v, the density d & the acceleration due to gravity g. If 'm' varies as the K^{th} power of the velocity of flow, then find the value of K.

9. Quito, a city in Ecuador and Kampala, a city situated in Uganda both lie on the Equator. The longitude of Quito is 82°30' W and that of Kampala is 37°30' E. What is the distance from Quito to Kampala.
(A) along the shortest surface path
(B) along a direct (through-the-Earth) path? (The radius of the Earth is 6.4×10^6 m)

10. Use the approximation $(1+x)^n \approx 1 + nx$, $|x| << 1$, to find approximate value for (A) $\sqrt{99}$ (B) $\frac{1}{1.01}$

11. Use the small angle approximations to find approximate values for (A) sin 8° and (B) tan 5°

12. Given $\vec{F} = \frac{\vec{a}}{t}$ where symbols have their usual meaning. The dimensions of a is.

13. The position of a particle at time t is given by the relation $x(t) = \left(\frac{v_0}{\alpha}\right)(1 - e^{-\alpha t})$ where v_0 is a constant and $\alpha > 0$. Find the dimensions of v_0 and α.

14. The equation of state for a real gas at high temperature is given by $P = \frac{nRT}{V-b} - \frac{a}{T^{1/2}V(V+b)}$ where n, P, V & T are number of moles, pressure, volume & temperature respectively & R is the universal gas constant. Find the dimensions of constant *a* in the above equation.

HCV Exercises (Chapter No.1 :- 1,5,7,8,10,14,16,17,19)

EXERCISE # (O)

1. The dimensional formula for which of the following pair is not the same
(A) impulse and momentum (B) torque and work
(C) stress and pressure (D) momentum and angular momentum

2. Which of the following can be a set of fundamental quantities
(A) length, velocity, time (B) momentum, mass, velocity
(C) force, mass, velocity (D) momentum, time, frequency

3. Which of the following functions of A and B may be performed if A and B possess different dimensions?
(A) $\frac{A}{B}$ (B) A + B (C) A – B (D) None of these

4. Density of wood is 0.5 g/ cc in the CGS system of units. The corresponding value in MKS units is
(A) 500 (B) 5 (C) 0.5 (D) 5000

5. If area (A), velocity (v), and density (ρ) are base units, then the dimensional formula of force can be represented as
(A) $Av\rho$ (B) $Av^2\rho$ (C) $Av\rho^2$ (D) $A^2v\rho$

6. The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b and c are respectively :
(A) LT^{-2}, L and T (B) L^2, T and LT^2 (C) LT^2, LT and L (D) L, LT and T^2

7. If force, acceleration and time are taken as fundamental quantities, then the dimensions of length will be:
(A) FT^2 (B) $F^{-1}A^2T^{-1}$ (C) FA^2T (D) AT^2

8. In a particular system the units of length, mass and time are chosen to be 10 cm, 10 g and 0.1 s respectively. The unit of force in this system will be equal to
(A) 0.1 N (B) 1 N (C) 10 N (D) 100 N

9. In a certain system of units, 1 unit of time is 5 sec, 1 unit of mass is 20 kg and unit of length is 10 m. In this system, one unit of power will correspond to
(A) 16 watts (B) $\frac{1}{16}$ watts (C) 25 watts (D) None of these

10. If the unit of length be doubled then the numerical value of the universal gravitation constant G will become (with respect to present value)
(A) Double (B) Half (C) 8 times (D) 1/8 times

11. If in a system, the force of attraction between two point masses of 1 kg each situated 1 km apart is taken as a unit of force and is called Newton (Newton written in reverse order) & if $G = 6.67 \times 10^{-11}$N-m^2 kg^{-2} in SI units then which of the following is true?

(A) 1 Newton = 6.67×10^{-11} Newton (B) 1 Newton = 6.67×10^{-17} Newton

(C) 1 Newton = 6.67×10^{-17} Newton (D) 1 Newton = 6.67×10^{-12} Newton

12. The units of three physical quantities x, y and z are gcm^2 s^{-5}, gs^{-1} and cms^{-2} respectively. The relation between x, y and z is

(A) $z = x^2y$ (B) $y^2 = xz$ (C) $x = yz^2$ (D) $x = y^2z$

13. In a book, the answer for a particular question is expressed as $b = \frac{ma}{k}\left[\sqrt{1+\frac{2k\ell}{ma}}\right]$ here m represents mass, a represents acceleration, ℓ represents length. The unit of b should be

(A) m/s (B) m/s^2 (C) meter (D) /sec

14. In two different systems of units an acceleration is represented by the same number, while its velocity is represented by numbers in the ratio 1:3. The ratios of unit of length and time are respectively

(A) $\frac{1}{3}, \frac{1}{9}$ (B) $\frac{1}{9}, \frac{1}{3}$ (C) 1, 1 (D) None of these

15. **Statement 1 :**Method of dimensions cannot tell whether an equation is correct.

and

Statement 2 :A dimensionally incorrect equation may be correct.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

16. **Statement 1 :**Whenever change the unit of measurement of a quantity, its numerical value changes.

and

Statement 2 : Smaller the unit of measurement smaller is its numerical value.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

17. Due to some unknown interaction, force F experienced by a particle is given by the following equation.

$$\vec{F} = -\frac{A}{r^3}\vec{r}$$

Where A is positive constant and r distance of the particle from origin of a coordinate system. Dimensions of constant A are

(A) ML^2T^{-2} (B) ML^3T^{-2} (C) ML^4T^{-2} (D) ML^0T^0

18. The angle subtended by the moon's diameter at a point on the earth is about 0.50°. Use this and the fact that the moon is about 384000 km away to find the approximate diameter of the moon.



(A) 192000 km (B) 3350 km (C) 1600 km (D) 1920 km

19. **Match the following :**

Physical quantity	**Dimension**	**Unit**
(1) Gravitational constant 'G'	(P) $M^1L^1T^{-1}$	(a) N.m
(2) Torque	(Q) $M^{-1}L^3T^{-2}$	(b) N.s
(3) Momentum	(R) $M^1L^{-1}T^{-2}$	(c) Nm^2/kg^2
(4) Pressure	(S) $M^1L^2T^{-2}$	(d) pascal

20. **Match the following :**

Physical quantity	**Dimension**	**Unit**
(i) Stefan's constant 'σ'	(P) $M^1L^1T^{-2}A^{-2}$	(a) W/m^2
(ii) Wien's constant 'b'	(Q) $M^1L^oT^{-3}K^{-4}$	(b) K.m.
(iii) Coefficient of viscosity 'η'	(R) $M^1L^oT^{-3}$	(c) tesla .m/A
(iv) Emissive power of radiation (Intensity emitted)	(S) $M^oL^1T^oK^1$	(d) $W/m^2.K^4$
(v) Mutual inductance 'M'	(T) $M^1L^2T^{-2}A^{-2}$	(e) poise
(vi) Magnetic permeability 'μ_0'	(U) $M^1L^{-1}T^{-1}$	(f) henry

21. In a new system of units known as RMP, length is measured in 'retem', mass is measured in 'marg' and time is measured in 'pal'.

100 retem = 1.0 meter
1.0 marg = 10^{-3} kilogram
10 pal = 1.0 second

In the given table some unit conversion factors are given. Suggest suitable match.

Column-I	**Column-II**
(A) One SI unit of force	(P) 10^2 units of RMP
(B) One SI unit of potential energy	(Q) 10^3 units of RMP
(C) One SI unit of power	(R) 10^4 units of RMP
(D) One SI unit of momentum	(S) 10^5 units of RMP
	(T) 10^6 units of RMP

Comprehension # 1

The Vander waal equation for 1 mole of a real gas is

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

where P is the pressure, V is the volume, T is the absolute temperature, R is the molar gas constant and a, b are Vander waal constants.

22. The dimensions of a are the same as those of

(A) PV (B) PV^2 (C) P^2V (D) P/V

23. The dimensions of b are the same as those of

(A) P (B) V (C) PV (D) nRT

24. The dimensional formula for ab is

(A) $ML^2 T^{-2}$ (B) $ML^4 T^{-2}$ (C) $ML^6 T^{-2}$ (D) $ML^8 T^{-2}$

EXERCISE # (JM)

1. Identify the pair whose dimensions are equal **[AIEEE-2002, 4/300]**
(1) Torque and work (2) Stress and energy
(3) Force and stress (4) Force and work

2. The physical quantities not having same dimensions are - **[AIEEE-2003, 4/300]**
(1) stress and Young's modulus (2) speed and $(\mu_0 \in_0)^{-1/2}$
(3) torque and work (4) momentum and Planck's constant

3. Dimensions of $1/(\mu_0 \in_0)$ where symbols have their usual meaning are - **[AIEEE-2003, 4/300]**
(1) L^2T^{-2} (2) L^2T^2 (3) $L^{-1}T$ (4) LT^{-1}

4. The dimensions of the coefficient of viscosity are - **[AIEEE-2004, 4/300]**
(1) $ML^{-1}T^{-1}$ (2) MLT (3) $M^{-1}L^{-1}T^{-1}$ (4) $M^0L^0T^0$

5. Out of the following pairs, which one does not have identical dimensions?
[AIEEE-2005, 4/300]
(1) Angular momentum and Planck's constant
(2) Impulse and momentum
(3) Moment of inertia and moment of a force
(4) Work and torque

6. Which of the following units denotes the dimensions ML^2/Q^2, where Q denotes the electric charge? **[AIEEE-2006, 3/180]**
(1) H/m^2 (2) Weber (Wb) (3) Wb/m^2 (4) Henry (H)

7. The dimension of magnetic field in M, L, T and C (Coulomb) is given as **[AIEEE-2008, 3/105]**
(1) MT^2C^{-2} (2) $MT^{-1}C^{-1}$ (3) $MT^{-2}C^{-1}$ (4) $MLT^{-1}C^{-1}$

8. Let $[\in_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then : **[JEE-MAIN - 2013, 4/120,–1]**
(1) $[\in_0] = [M^{-1} L^{-3} T^2 A]$ (2) $[\in_0] = [M^{-1} L^{-3} T^4 A^2]$
(3) $[\in_0] = [M^{-1} L^2 T^{-1} A^{-2}]$ (4) $[\in_0] = [M^{-1} L^2 T^{-1} A]$

9. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and the cylinder have equal cross sectional area A. When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is P_0. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion withh frequency.
[JEE Mains - 2013]
(1) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$ (2) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$ (3) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$ (4) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$ z

EXERCISE # (JA)

1. A quantity X is given by $\varepsilon_0 L\frac{\Delta V}{\Delta t}$, where ε_0 is the permittivity of free space, L is length, ΔV is potential difference and Δt is time interval. The dimensional formula for X is the same as that of **[JEE (Scr.), 2001' 3/35, –1]**

(A) resistance (B) charge (C) voltage (D) current

2. In the relation ; $P = \frac{\alpha}{\beta}e^{-\frac{\alpha Z}{k\theta}}$ **[JEE - 2004(Scr.) 3/84, –1]**

P is pressure, Z is distance, k is Boltzman constant and θ is the temperature. The dimensions of β will be:

(A) $[M^0 L^2 T^0]$ (B) $[ML^2 T]$ (C) $[ML^0 T^{-1}]$ (D) $[M^0 L^2 T^{-1}]$

3. Which of the following set have different dimensions? **[JEE-2005(Scr.); 3/84, –1]**

(A) Pressure, Young's modulus, Stress
(B) Emf, Potential difference, Electric potential
(C) Heat, Work done, Energy
(D) Dipole moment, Electric flux, Electric field

4. Some physical quantities are given in **Column I** and some possible SI units in which these quantities may be expressed are given in **Column II**. Match the physical quantities in **Column I** with the units in **Column II.** **[IIT-JEE-2007; 6/184]**

	Column I	**Column II**
(A)	GM_eM_s G - universal gravitational constant, M_e - mass of the earth, Ms - mass of the Sun	(p) (volt) (coulomb) (metre)
(B)	$\frac{3RT}{M}$ R - universal gas constant, T - absolute temperature, M - molar mass	(q) (kilogram) $(metre)^3$ $(second)^{-2}$
(C)	$\frac{F^2}{q^2B^2}$ F - force, q - charge, B - magnetic field	(r) $(metre)^2$ $(second)^{-2}$
(D)	$\frac{GM_e}{R_e}$ G - universal gravitational constant, M_e - mass of the earth R_e - radius of the earth	(s) (farad) $(volt)^2$ $(kg)^{-1}$

5. Match List Iwith List IIand select the correct answer using the codes given below the lists :

[JEE (Advanced) 2013; 3/60]

	List I		**List II**
P.	Boltzmann constant	1.	$[ML^2T^{-1}]$
Q.	Coefficient of viscosity	2.	$[ML^{-1}T^{-1}]$
R.	Planck constant	3.	$[MLT^{-3}K^{-1}]$
S.	Thermal conductivity	4.	$[ML^2T^{-2}K^{-1}]$

Codes :

	P	Q	R	S
(A)	3	1	2	4
(B)	3	2	1	4
(C)	4	2	1	3
(D)	4	1	2	3

6. To find the distance d over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass density ρ of the fog, intensity (power/area) S of the light from the signal and its frequency f. The engineer find that d is proportional to $S^{1/n}$. The value of n is: **[JEE Advanced-2014; P-1, 3/60]**

RESULTS OF BEST MENTORSHIP BY THE NUCLEUS TEAM



AIR-1
CHITRAANG MURDIA
Gen. Category - 2014



AIR-3
GOVIND LAHOTI
Gen. Category - 2014

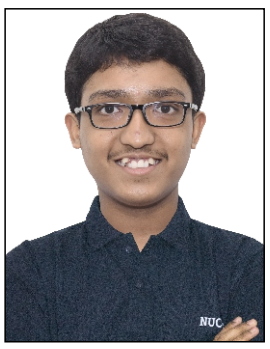


AIR-6
NISHIT AGARWAL
Gen. Category - 2012

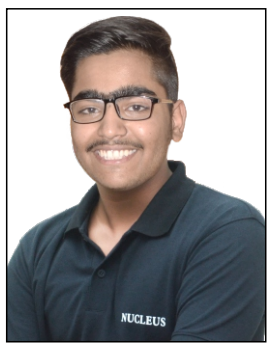


AIR-8
AMEY GUPTA
Gen. Category - 2014

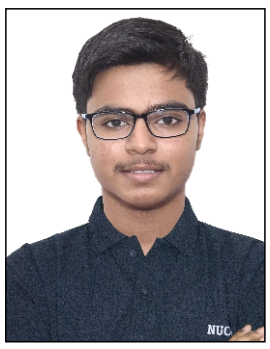
JEE MAIN RESULTS 2020 (January Attempt) OF NUCLEUS EDUCATION



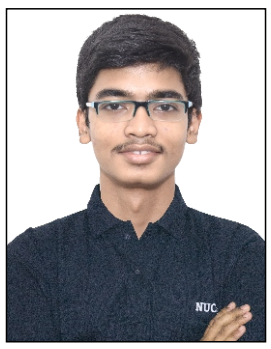
100 Percentile
(Physics)
DAKSH KHANDELWAL
2020



100 Percentile
(Maths & Physics)
VAIBHAV SAHA
2020



100 Percentile
(Physics)
ANISH MOHAN
2020



100 Percentile
(Maths)
ARCHIT PATNAIK
2020

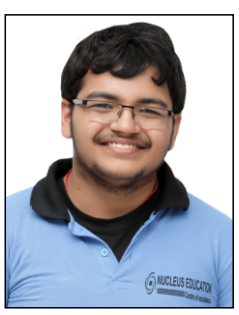


100 Percentile
(Maths)
SWAPNIL YASASVI
2020



100 Percentile
(Maths)
PARSHANT ARORA
2020

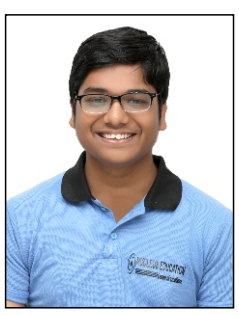
JEE ADVANCED RESULTS OF NUCLEUS EDUCATION



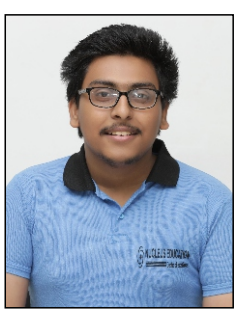
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LAKSHAY SHARMA
Gen. Category - 2017



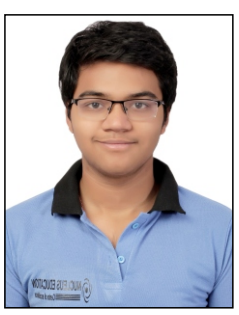
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YATEESH AGRAWAL
Gen. Category - 2017



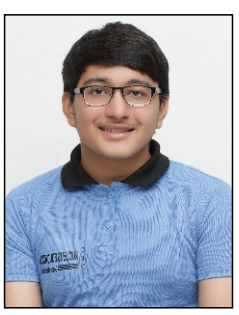
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ABHEY GOYAL
Gen. Category - 2017



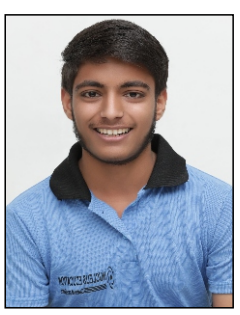
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TUSHAR GAUTAM
Gen. Category - 2017



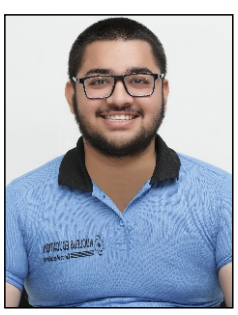
AIR-37
PIYUSH TIBAREWAL
Gen. Category - 2017



AIR-42
SATVIK
Gen. Category - 2017



AIR-66
MAYANK DUBEY
Gen. Category - 2017



AIR-98
HRITHIK
Gen. Category - 2017



AIR-20
SHASHANK AGRAWAL
Gen. Category - 2018



AIR-27
RAAGHAV RAAJ
Gen. Category - 2018



AIR-32
SHREYA PATHAK
Gen. Category - 2018



AIR-61
SIDDHANT CHOUDAHRY
Gen. Category - 2018



AIR-67
ANISWAR S KRISHNAN
Gen. Category - 2018
DLP



AIR-78
AAYUSH KADAM
Gen. Category - 2018



AIR-61
SARTHAK BEHERA
Gen. Category - 2018
*SDCCP



AIR-91
ANDREWS G. VARGHESE
Gen. Category - 2018
*SDCCP



AIR-2
HIMANSHU GAURAV SINGH
Gen. Category - 2019
*SDCCP



AIR-19
VIBHAV AGGARWAL
Gen. Category - 2019



AIR-33
S. PRAJEETH
Gen. Category - 2019
*SDCCP



AIR-48
SOHAM MISTRI
Gen. Category - 2019
DLP



AIR-51
SAYANTAN DHAR
Gen. Category - 2019
DLP



AIR-53
GAURAV KRISHAN GUPTA
Gen. Category - 2019
DLP



AIR-86
SATVIK JAIN
Gen. Category - 2019

Result JEE Main

Result Highlights 2019



100 Percentile
HIMANSHU GAURAV SINGH
2019 (*SDCCP)



99.99 Percentile
GAURAV KRISHAN GUPTA
2020 (DLP)



99.98 Percentile
SARTHAK ROUT
2020 (CCP)



99.98 Percentile
VIBHAV AGGARWAL
2019 (CCP)



99.97 Percentile
RITVIK GUPTA
2020 (DLP)



99.97 Percentile
BHAVYA JAIN
2020 (CCP)



99.96 Percentile
AYUSH PATTNAIK
2019 (CCP)



99.96 Percentile
SAYANTAN DHAR
2020 (DLP)

Result Highlights 2018

AIR 29



Sarthak Behera

AIR 36



Shashank Agrawal

AIR 46



Shreya Pathak

AIR 48



Raaghav Raaj

AIR 2 SC



Aayush Kadam

AIR 18 OBC



Gunjan

Result Highlights 2017

AIR 12



Abhay Goyal

AIR 14



Piyush Tibarwal

AIR 20



Abhinav Kumar

AIR 38



Tushar Gautam

AIR 49



Saurav Sahoo

AIR 60



Pratyush

Mentored by Team

AIR 4



Kushal Babel
2014

AIR 15



Gourika Bang
2015

AIR 21



Amit Malav
2013

AIR 24



Suraj Sanjay Jog
2012

AIR 38



Chitraang Murdia
2014

AIR 58



Pulkit Tandon
2012

AIR 68



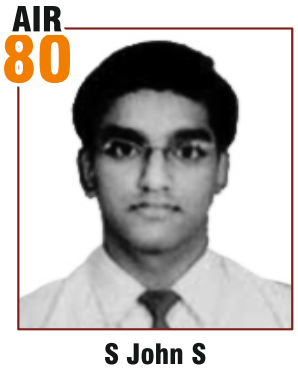
Kapil Shobhnani
2016

AIR 70



Utkarsh Sinha
2015

AIR 80



S John S
2015

ANSWER KEY

EXERCISE # (S)

1. 10^{-30} star joule
2. L^{-1}, ML^2T^{-2}
3. $kg.m^2.s^{-2}.K^{-1}$
4. $[S] = Ev^{-2}T^{-2}$
5. $T = a\sqrt{\frac{m}{k}}$
6. $\omega = K\sqrt{\frac{GM}{r^3}}$
7. $v_0 = k\sqrt{\frac{GM}{R}}$
8. K = 6
9. (A) $\frac{2\pi}{3}\times 6.4\times 10^6\,m$; (B) $\sqrt{3}\times 6.4\times 10^6\,m$
10. (A) 9.95, (B) 0.99
11. $2\pi/45$, $\pi/36$
12. $[MLT^{-1}]$
13. $[v_0] = [M^0L^1T^{-1}]$, $[\alpha] = [M^0L^0T^{-1}]$
14. $ML^5T^{-2}K^{1/2}$

EXERCISE # (O)

1.	D	**2.**	C	**3.**	A	**4.**	A	**5.**	B	**6.**	A	**7.**	D
8.	A	**9.**	A	**10.**	D	**11.**	C	**12.**	C	**13.**	C	**14.**	B
15.	C	**16.**	C	**17.**	B	**18.**	B						

19. (1) → (Q) → (c) , (2) → (S) → (a) , (3) → (P) → (b) , (4) → (R) → (d)
20. (i) → (Q) → (d)
(ii) → (S) → (b)
(iii) → (U) → (e)
(iv) → (R) → (a)
(v) → (T) → (f)
(vi) → (P) → (c)
21. **(A) → (Q); (B) → (S); (C) → (R); (D) → (R)**
22. B **23.** B **24.** D

EXERCISE # (JM)

1.	(1)	**2.**	(4)	**3.**	(1)	**4.**	(1)	**5.**	(3)	**6.**	(4)	**7.**	(2)
8.	(2)	**9.**	(3)										

EXERCISE # (JA)

1. (D) **2.** (A) **3.** (D)
4. (A) → (p),(q); (B) → (r), (s); (C) → (r), (s); (D) → (r), (s)
5. (C) **6.** 3