This Question Paper contains 20 printed pages.
(Part - A & Part - B)

Sl.No.

054 (E)

(MARCH / APRIL, 2015)

પ્રશ્ન પેપરનો સેટ નંબર Set No. of Question Paper:
09

Part - A : Time : 1 Hour / Marks : 50
Part - B : Time : 2 Hours / Marks : 50

(Part - A)

Time : 1 Hour] ***[Maximum Marks : 50***

Instructions :

1) **There are 50 objective type (M.C.Q.) questions in Part - A and all questions are compulsory.**
2) **The questions are serially numbered from 1 to 50 and each carries 1 mark.**
3) **Read each question carefully, select proper alternative and answer in the O.M.R. sheet.**
4) **The OMR sheet is given for answering the questions. The answer of each question is represented by (A) O, (B) O, (C) O, (D) O. Darken the circle ● of the correct answer with ball-pen.**
5) **Rough work is to be done in the space provided for this purpose in the Test Booklet only.**
6) **Set No. of Question Paper printed on the upper-most right side of the Question Paper is to be written in the column provided in the OMR sheet.**
7) **Pupil's are use a calculator and log table as necessary.**

Rough Work

1) Find equivalent force constant of series combination of two springs having force constant K_1 and K_2.

(A) $\frac{K_1 K_2}{K_1 + K_2}$

(B) $K_1 + K_2$

(C) $\frac{K_1 + K_2}{K_1 K_2}$

(D) $\frac{K_1}{K_2}$

Rough Work

2) The amplitude of an oscillator performing damped oscillation becomes 1/e times of the initial amplitude in time ———.

(A) 2m/b

(B) m/2b

(C) $e^{-bt/2m}$

(D) $e^{2m/b}$

3) The maximum velocity and maximum acceleration of a particle performing S.H.M. are 1m/s and 3.14 m/s^2 respectively. The Frequency of oscillation for this particle is ———.

(A) 3.14 s^{-1}

(B) 0.5 s^{-1}

(C) 0.25 s^{-1}

(D) 2 s^{-1}

4) The speed of the component waves is 800 m/s. If the distance between consecutive antinode and node is 0.5m then frequency of standing wave will be

(A) 400 Hz (B) 300 Hz

(C) 600 Hz (D) 1200 Hz

5) When the temperature of an ideal gas is increased by 800K, the velocity of sound in the gas becomes $\sqrt{3}$ times the initial velocity in it. The initial temperature of the gas is = ———.

(A) 27°C

(B) –73°C

(C) 127°C

(D) 327°C

Rough Work

6) Mechanical waves carry ———.

(A) matter

(B) energy

(C) both energy and matter

(D) neither energy nor matter

7) An empty vessel is partially filled with water then the frequency of vibration of air column, in the vessel

(A) Increases

(B) Remains same

(C) Decreases

(D) First increases then decreases

8) The speed of the component waves of a stationary wave represented by $y = 10 \sin (100\ t) \cos (0.01\ x)$ is ——— where x and y are in metre and t is in second.

(A) 10^3 ms^{-1}

(B) 10^4 ms^{-1}

(C) 10^2 ms^{-1}

(D) 1 ms^{-1}

9) If a source is moving away from a stationary observer with velocity of sound, what frequency will be observed?

(A) Half

(B) 2 times

(C) 3 times

(D) 4 times

Rough Work

10) A transverse wave is described by the equation $y = A\sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$. For which wavelength of a wave maximum particle velocity is two times the wave velocity?

(A) $\lambda = \frac{\pi A}{2}$ (B) $\lambda = \frac{\pi A}{4}$

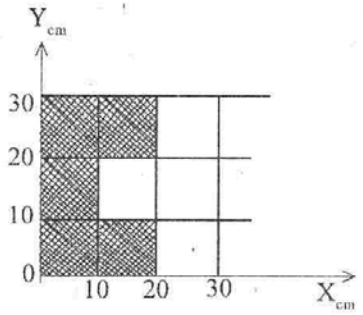
(C) $\lambda = \pi A$ (D) $\lambda = 2\pi A$

11) A bird of 3kg is flying with a constant velocity of $\left(2\hat{i} - 4\hat{j}\right)$m/s and another bird of 2kg with $\left(2\hat{i} + 6\hat{j}\right)$m/s. Then, the velocity of centre of mass of the system of two birds is ——— m/s.

(A) $2\hat{i} + 2\hat{j}$ (B) $2\hat{i} + 0\hat{j}$

(C) $2\hat{i} - 2\hat{j}$ (D) $10\hat{i} + 10\hat{j}$

12) As shown in figure, the centre of mass of a thin metal sheet of uniform density is ——— cm.



(A) (11.67,16.67) (B) (9,15)

(C) (8.75,12.50) (D) (7.78,11.11)

13) The centre of mass of a ring of uniform mass distribution lies ———.

Rough Work

(A) outside of ring material

(B) at centre of Ring

(C) at the ring centre but inside the material

(D) at the ring centre, but outside the material

14) A shell following a parabolic path explodes some where in its flight. The centre of mass of Fragments will continue to move in ———.

(A) Any direction

(B) Vertical direction

(C) Horizontal direction

(D) Same parabolic path

15) A bomb of mass 60kg moving uniformly with a velocity of 10m/s explodes spontaneously into two fragments of 40kg and 20kg. If the velocity of the larger fragment is zero, then calculate the velocity of the smaller fragment ———.

(A) 20 m/s (B) 30 m/s

(C) 50 m/s (D) 40 m/s

16) The moment of inertia of a disc of uniform density about an axis co-inciding with its diameter

(A) MR^2 (B) $\frac{1}{2}MR^2$

(C) $\frac{1}{4}MR^2$ (D) $\frac{2}{5}MR^2$

Rough Work

17) A wheel initially at rest acquires an angular velocity of 128 rad s^{-1} in 4s. Hence its constant angular acceleration is = ———.

(A) 128 rad s^{-2} (B) 64 rad s^{-2}

(C) 16 rad s^{-2} (D) 32 rad s^{-2}

18) A circular disc of radius r and mass m rotates about the axis passing through the centre and perpendicular to its plane. The kinetic energy is = ———.

(A) $\frac{1}{2}mrw^2$

(B) $\frac{1}{2}mr^2w^2$

(C) $\frac{1}{4}mr^2w^2$

(D) $\frac{1}{4}mrw^2$

19) A solid sphere rolls (about geometrical axis) without slipping on an inclined plane of angle θ. Find its linear acceleration in the direction parallel to the surface of the inclined plane.

(A) $\frac{7}{5}g\sin\theta$ (B) $\frac{1}{2}g\sin\theta$

(C) $\frac{3}{5}g\sin\theta$ (D) $\frac{5}{7}g\sin\theta$

20) What is moment inertia in terms of angular momentum (L) and kinetic energy (K)?

(A) $\frac{L^2}{2K}$ (B) $\frac{L^2}{K}$

(C) $\frac{L}{2K^2}$ (D) $\frac{L}{2K}$

Rough Work

21) What will be the effect on the length (24 hours) of a day, if snow on the poles of the Earth melts and water comes at the equator?

(A) Day becomes longer

(B) Day becomes shorter

(C) No change in the length of the day

(D) Length of the day and night will become same

22) The angular momentum of a wheel changes from 2L to 5L in 3seconds. What will be the magnitude of torque acting on it?

(A) $L/2$

(B) L

(C) $\frac{L}{3}$

(D) $\frac{L}{5}$

23) If the angular momentum of the body is increased by 50%, its rotational kinetic energy is increased by ———.

(A) 50% (B) 25%

(C) 100% (D) 125%

24) A rigid body is rotating about a fix axis. P and Q are its particles. Which of the following Physical Quantity is same for P and Q?

(A) angular speed

(B) linear velocity

(C) linear momentum

(D) angular momentum

Rough Work

25) Escape velocity on the surface of earth is 11.2 km/s. Escape velocity from a planet whose mass is the same as that of earth and whose radius is $\frac{1}{4}$ that of earth is ——— km/s.

(A) 15.6

(B) 2.8

(C) 22.4

(D) 44.8

26) The radius of Earth at equator is nearly ——— more than the radius at the poles.

(A) 24 km

(B) 21 km

(C) 24 m

(D) 21 m

27) Dimensional formula of gravitational potential is ———.

(A) $M^1L^0T^{-2}$

(B) $M^1L^2T^{-2}$

(C) $M^0L^1T^{-2}$

(D) $M^0L^2T^{-2}$

28) The time period of polar satellite is almost ———.

(A) 100 minute

(B) 100 sec

(C) 100 hour

(D) 100 days

Rough Work

29) Radii of two planets are r_1 and r_2 respectively and their densities are ρ_1 and ρ_2 respectively. The gravitational acceleration on their surface are g_1 and g_2 respectively.

$\frac{g_2}{g_1}$ = ———————.

(A) $\frac{r_2\rho_2}{r_1\rho_1}$

(B) $\frac{r_1\rho_1}{r_2\rho_2}$

(C) $\frac{r_1}{r_2} \cdot \frac{\rho_2}{\rho_1}$

(D) $\frac{r_2}{r_1} \cdot \frac{\rho_1}{\rho_2}$

30) ——— are the constituent particles of ionic solids.

(A) Atoms

(B) Molecules

(C) Ion

(D) Electron

31) Young's modulus of a rigid body is ———.

(A) 1

(B) 0

(C) ∞

(D) 0.5

Rough Work

32) When 200N force is applied on an object, its length increases by 1mm. So potential energy stored in it due to this change is _____.

(A) 20 J

(B) 0.1 J

(C) 10 J

(D) 0.2 J

33) Cross-sectional area of a wire of length L is A. Young's modulus of material is Y. If this wire acts as a spring what is the value of force constant?

(A) $\frac{YA}{2L}$

(B) $\frac{YA}{L}$

(C) $\frac{2YA}{L}$

(D) $\frac{YL}{A}$

34) A mass is suspended (tied) at the end of a steel wire. A force acting on the wire due the mass is 162 N. The cross-sectional area of the wire is 6×10^{-6} m^2. Find the produced stress of the wire.

(A) 27×10^{-3} Nm^{-2}

(B) 27×10^{-6} Nm^{-2}

(C) 27×10^{6} Nm^{-2}

(D) 27×10^{3} Nm^{-2}

Rough Work

35) 1 Torr = ——— Pascal.

(A) 133.28

(B) 123.28

(C) 128.23

(D) 128.33

36) A disc of area 10^{-2} m^2 is placed over a layer of oil having thickness 4×10^{-3} m. If the co-efficient of viscosity of the oil is 1.55 Ns m^{-2}, find the horizontal (tangential) force required to move the disc with velocity of 3×10^{-2} ms^{-1}.

(A) 1.32×10^{-1} N

(B) 2.32×10^{-1} N

(C) 2.16×10^{-1} N

(D) 1.16×10^{-1} N

37) A liquid will not wet the surface of solid if its angle of contact is ———.

(A) less than 90°

(B) 0°

(C) more than 90°

(D) 90°

38) Work done to increase the area of the surface of fluid by 1 unit is equal to ———.

(A) mechanical energy

(B) kinetic energy

(C) surface energy

(D) surface tension

Rough Work

39) Particles of liquid P,Q and R are on free surfaces, within the surface and below the surface respectively. If their potential energies are U_P, U_Q and U_R then

(A) $U_P < U_R < U_Q$

(B) $U_P < U_Q < U_R$

(C) $U_R < U_P < U_Q$

(D) $U_R < U_Q < U_P$

40) In equation, $\frac{p^2}{\rho g} + \frac{v^2}{2g} + y$ = constant. Each term has a dimension of ———.

(A) Velocity

(B) Time

(C) Pressure

(D) Length

41) Water is used to cool radiator of engine because ———.

(A) it is easily available

(B) of its lower density

(C) it is cheap

(D) it has high specific heat

42) During same process on an ideal gas dW = 0 and dQ <0 then for this gas ———.

(A) Pressure will remain constant

(B) Temperature will decrease

(C) Volume will increase

(D) Temperature will increase

Rough Work

43) The density of water at 20°C is 998 kg/m^3 and it is 992 kg/m^3 at 40°C. Then co-efficient of volume expansion of water is _____ °C^{-1}

(A) $\frac{998}{992\times 20}$ (B) $\frac{992}{998\times 20}$

(C) $\frac{6}{992\times 20}$ (D) $\frac{6}{998\times 20}$

44) The relation bet^n Temperature and Volume of an ideal gas during Adiabatic process is

(A) T^rV^{r-1} = constant

(B) TV^{r-1} = constant

(C) $T^{r-1}V$ = constant

(D) TV^r = constant

45) A certain amount of Heat Q increases the temperature of 1g of material 'A' by 4°C and 1g of material B by 3°C. Which material has greater specific Heat?

(A) B

(B) A

(C) A and B have same

(D) Nothing can be said

46) A refrigerator has a coefficient of performance equal to 5. Assuming that the refrigerator absorbs 120 J of energy from a cold reservoir in each cycle. Find the work required in each cycle

(A) 24 J (B) 12 J

(C) 36 J (D) 48 J

Rough Work

47) A system can possess ——— but cannot possess ———.

(A) Heat energy, Heat

(B) Heat, Heat energy

(C) Heat, mechanical energy

(D) Work, Heat energy

48) The displacement of a simple Harmonic oscillator is given by $y = 0.40 \sin (440\ t+0.61)$. For this what is the value of time period ———.

(A) 0.0443 sec

(B) 0.0643 sec

(C) 0.0343 sec

(D) 0.0143 sec

49) 0.2m compressed spring produces a restitution force of 10N in it. The force constant of the spring is _____ Nm^{-1}.

(A) 100 (B) 50

(C) 150 (D) 200

50) For a particle executing S.H.M. when the potential energy of the oscillator becomes $\frac{1}{8}$ the maximum potential energy, the displacement of the oscillator in terms of amplitude A will be ———.

(A) $\frac{A}{2\sqrt{2}}$ (B) $\frac{A}{\sqrt{2}}$

(C) $\frac{A}{2}$ (D) $\frac{A}{3\sqrt{2}}$

054 (E)

(MARCH / APRIL, 2015)

(Part - B)

Time : 2 Hours] *[Maximum Marks : 50*

Instructions :

1) **Write in a clear legible handwriting.**
2) **There are three sections in Part - B of the question paper and total 1 to 18 questions are there.**
3) **All the questions are compulsory. Internal options are given.**
4) **The numbers at right side represent the marks of the question.**
5) **Start new section on new page.**
6) **Maintain sequence.**
7) **Pupil's are use a calculator and log table as necessary.**

SECTION - A

■ **Question numbers 1 to 8 are short answer. Each carries 2 marks.**

1) Write down the expression for the centre of mass of a system of n-particles in three dimensions and obtain the expression $M\vec{V}_{cm} = \vec{P}$. [2]

2) With help of geometrical Representation explain the law of conservation of Angular momentum. [2]

3) Prove that the ratio of the rate of change of g at a height equal to the Earth's radius from the surface of the Earth to the value of g at the surface of the Earth is equal to $-\frac{1}{4R_e}$. [2]

OR

Prove that "the square of the orbital time period of the satellite is directly proportional to the cube of the orbital radius".

4) Depending on the types of the constituent particles, write the names of four types of crystalline solids and explain covalent solids. [2]

OR

With the help of example of rectangular cross-section rod, explain the buckling.

5) Derive an equation of continuity for steady incompressible fluid. [2]

6) Average temperature of the Earth was 300 K when the Earth came into existence. At present its average temperature is 3000K. What would be the radius of the Earth at the time of its birth? For the material of the Earth $\gamma = 3\times10^{-5}\ K^{-1}$. At present, radius of the Earth = 6400 km. [2]

7) With help of the Force law, derive the Formula of time period of the Simple Harmonic Motion.

$$T = 2\pi\sqrt{\frac{m}{K}}.$$ [2]

8) Show that the velocity of sound in a gas at temperature t is given by,

$$V_t = V_0\left(1+\frac{t}{546}\right)$$

Where, V_0 is speed of sound in air at 0°C (t<<273). [2]

SECTION - B

Answer the following question as asked. Question numbers 9 to 14 carries 3 marks each.

9) The particles of mass m_1 = 1kg, m_2 = 2kg and m_3 = 3kg are placed on the vertices of an equilateral triangle of sides "a = 1m". Find the centre of mass of this system with respect to the position of particle of mass m_1. [3]

SECTION - C

■ **Answer the question as asked. Question numbers 15 to 18. Each carries 4 marks.**

15) Find the moment of inertia of a uniform circular disc about an axis passing through its geometrical centre and perpendicular to its plane and also find its radius of gyration. **[4]**

16) What is capillary action? Derive the formula for rise of liquid in a capillary tube immersed vertically in liquid. **[4]**

17) Explain the **[4]**

a) Specific Heat at Constant Volume (C_V)

b) Specific Heat at Constant Pressure (C_P).

Derive relation $C_P - C_V = R$.

OR

What will be the mass and temperature of water obtained by giving 210 kJ heat to ice of 1kg lying at -10°C ($C_{ice} = 2220\ Jkg^{-1}\ K^{-1}$)

18) The speed of sound in dry air at STP is 332 ms^{-1}. Assume air as composed of 4 part of nitrogen and one part of oxygen. Calculate speed of sound in oxygen under similar condition when the density of nitrogen and oxygen at STP are in the ratio of 14:16. **[4]**

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