DAY — 05 SEAT NUMBER | | | | | | |

2015	II	26	1100	J - 131	(E)

PHYSICS (54)

(Mechanics, Properties of Matter, Sound and Heat)

Time : 3 Hrs. **(8 Pages)** **Max. Marks : 70**

Note : *(i) All questions are compulsory.*

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of only logarithmic table is allowed.

(v) All symbols have their usual meaning unless otherwise stated.

(vi) Answer to every question must be written on a new page.

(vii) Answers to both sections must be written in the same answerbook.

SECTION – I

Q. 1. Select and write the most appropriate answer from the given alternatives for each sub-question : **[7]**

(i) The period of a conical pendulum in terms of its length (l), semivertical angle (θ) and acceleration due to gravity (g) is :

(a) $\frac{1}{2\pi}\sqrt{\frac{l\cos\theta}{g}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{l\sin\theta}{g}}$

(c) $4\pi\sqrt{\frac{l\cos\theta}{4g}}$ (d) $4\pi\sqrt{\frac{l\tan\theta}{g}}$

(ii) The kinetic energy of a rotating body depends upon

(a) distribution of mass only.

(b) angular speed only.

(c) distribution of mass and angular speed.

(d) angular acceleration only.

(iii) If the metal bob of a simple pendulum is replaced by a wooden bob of the same size, then its time period will

(a) increase

(b) remain same

(c) decrease

(d) first increase and then decrease.

(iv) The graph between applied force and change in the length of wire within elastic limit is a

(a) straight line with positive slope.

(b) straight line with negative slope.

(c) curve with positive slope.

(d) curve with negative slope.

(v) When longitudinal wave is incident at the boundary of denser medium, then

(a) compression reflects as a compression.

(b) compression reflects as a rarefaction.

(c) rarefaction reflects as a compression.

(d) longitudinal wave reflects as transverse wave.

(vi) The dimensions of universal gravitational constant are

(a) $\left[L^1 M^0 T^0\right]$ (b) $\left[L^2 M^1 T^0\right]$

(c) $\left[L^{-1} M^1 T^{-2}\right]$ (d) $\left[L^3 M^{-1} T^{-2}\right]$

(vii) Two copper spheres of radii 6 cm and 12 cm respectively are suspended in an evacuated enclosure. Each of them are at a temperature 15°C above the surroundings. The ratio of their rate of loss of heat is

(a) 2 : 1 (b) 1 : 4

(c) 1 : 8 (d) 8 : 1

Q. 2. Attempt any SIX : **[12]**

(i) In circular motion, assuming $\bar{v} = \bar{w} \times \bar{r}$, obtain an expression for the resultant acceleration of a particle in terms of tangential and radial component.

(ii) Explain why an astronaut in an orbiting satellite has a feeling of weightlessness.

(iii) State theorem of parallel axes and theorem of perpendicular axes about moment of inertia.

(iv) State : (a) Wein's displacement law, and (b) First law of thermodynamics.

(v) A particle in S.H.M. has a period of 2 seconds and amplitude of 10 cm. Calculate the acceleration when it is at 4 cm from its positive extreme position.

(vi) The surface tension of water at 0°C is 75·5 dyne/cm. Calculate surface tension of water at 25°C.
($\propto$ for water = $2 \cdot 7 \times 10^{-3}/°C$)

(vii) The spin dryer of a washing machine rotating at 15 r.p.s. slows down to 5 r. p. s. after making 50 revolutions. Find its angular acceleration.

(viii) Calculate the period of revolution of Jupiter around the Sun. The ratio of the radius of Jupiter's orbit to that of the Earth's orbit is 5.
(Period of revolution of the Earth is 1 year)

Q. 3. Attempt any THREE : **[9]**

(i) Derive an expression for excess pressure inside a drop of liquid.

(ii) Explain what is Doppler effect in sound and state its any 'four' applications.

(iii) Calculate the average molecular kinetic energy :
(a) per kilomole, (b) per kilogram, of oxygen at 27°C.
($R = 8320$ J/k mole K, Avogadro's number $= 6{\cdot}03 \times 10^{26}$ molecules/K mole)

(iv) A uniform steel rod of 5 mm^2 cross section is heated from 0°C to 25°C. Calculate the force which must be exerted to prevent it from expanding. Also calculate strain.
(α for steel $= 12 \times 10^{-6}$/°C and
γ for steel $= 20 \times 10^{10}$ N/m^2)

Q. 4. What are forced vibrations and resonance? Show that only odd harmonics are present in an air column vibrating in a pipe closed at one end. **[7]**

A stretched wire emits a fundamental note of frequency 256 Hz. Keeping the stretching force constant and reducing the length of wire by 10 cm, the frequency becomes 320 Hz. Calculate the original length of wire.

OR

Obtain an expression for potential energy of a particle performing simple harmonic motion. Hence evaluate the potential energy

(a) at mean position and

(b) at extreme position.

A horizontal disc is freely rotating about a transverse axis passing through its centre at the rate of 100 revolutions per minute. A 20 gram blob of wax falls on the disc and sticks to the disc at a distance of 5 cm from its axis. Moment of intertia of the disc about its axis passing through its centre of mass is 2×10^{-4} kg m^2. Calculate the new frequency of rotation of the disc.

SECTION – II

Q. 5. Select and write the most appropriate answer from the given alternatives for each sub-question : [7]

(i) Electric field intensity in free space at a distance 'r' outside the charged conducting sphere of radius 'R' in terms of surface charge density 'σ' is

(a) $\frac{\sigma}{\epsilon_0}\left[\frac{R}{r}\right]^2$ (b) $\frac{\epsilon_0}{\sigma}\left[\frac{R}{r}\right]^2$

(c) $\frac{R}{r}\left[\frac{\sigma}{\epsilon_0}\right]^2$ (d) $\frac{R}{\sigma}\left[\frac{r}{\epsilon_0}\right]^2$

(ii) Instrument which can measure terminal potential difference as well as electro motive force (e.m.f.) is

(a) Wheatstone's meter bridge

(b) Voltmeter

(c) Potentiometer

(d) Galvanometer

(iii) If the frequency of incident light falling on a photosensitive material is doubled, then the kinetic energy of the emitted photoelectron will be

(a) same as its initial value

(b) two times its initial value

(c) more than two times its initial value

(d) less than two times its initial value

(iv) Linear momentum of an electron in Bohr orbit of H-atom (principal quantum number n) is proportional to

(a) $\frac{1}{n^2}$ (b) $\frac{1}{n}$ (c) n (d) n^2

(v) In a semiconductor, acceptor impurity is

(a) antimony (b) indium

(c) phosphorous (d) arsenic

(vi) The power radiated by linear antenna of length 'l' is proportional to

(λ = wavelength)

(a) $\frac{\lambda}{l}$ (b) $\left(\frac{\lambda}{l}\right)^2$ (c) $\frac{l}{\lambda}$ (d) $\left(\frac{l}{\lambda}\right)^2$

(vii) The numerical aperture of objective of a microscope is 0·12. The limit of resolution, when light of wavelength 6000Å is used to view an object is

(a) $0{\cdot}25\times10^{-7}$ m (b) $2{\cdot}5\times10^{-7}$ m

(c) 25×10^{-7} m (d) 250×10^{-7} m

Q. 6. Attempt any SIX : **[12]**

(i) What is a polaroid? State its 'two' uses.

(ii) Draw a neat and labelled diagram of suspended coil type moving coil galvanometer.

(iii) Define : (1) Magnetization and (2) Magnetic intensity.

(iv) Draw a block diagram of generalized communication system.

(v) A solenoid 3·142 m long and 5·0 cm in diameter has two layers of windings of 500 turns each and carries a current of 5A. Calculate the magnetic induction at its centre along the axis. https://www.maharashtrastudy.com

(vi) A circular coil of 300 turns and average area $5 \times 10^{-3} m^2$ carries a current of 15A. Calculate the magnitude of magnetic moment associated with the coil.

(vii) The magnetic flux through a loop varies according to the relation $\phi = 8t^2 + 6t + C$, where 'C' is constant, 'ϕ' is in milliweber and 't' is in second. What is the magnitude of induced e.m.f. in the loop at $t = 2$ seconds.

(viii) An electron is orbiting in 5^{th} Bohr orbit. Calculate ionisation energy for this atom, if the ground state energy is –13·6 eV.

Q. 7. Attempt any THREE : **[9]**

(i) Obtain an expression for the radius of Bohr orbit for H-atom.

(ii) What are α and β parameters for a transistor? Obtain a relation between them.

(iii) Two metal spheres having charge densities $5\mu C/m^2$ and $-2\mu C/m^2$ with radii 2 mm and 1 mm respectively are kept in a hypothetical closed surface. Calculate total normal electric induction over the closed surface.

(iv) The threshold wavelength of silver is 3800Å. Calculate the maximum kinetic energy in eV of photoelectrons emitted, when ultraviolet light of wavelength 2600Å falls on it.
(Planck's constant, $h = 6 \cdot 63 \times 10^{-34}$ J.s.,
Velocity of light in air, $c = 3 \times 10^8 m/s$)

Q. 8. Obtain an expression for e.m.f. induced in a coil rotating with uniform angular velocity in a uniform magnetic field. Show graphically the variation of e.m.f. with time (t). **[7]**

Resistance of a potentiometer wire is $0 \cdot 1\Omega/cm$. A cell of e.m.f. 1·5V is balanced at 300 cm on this potentiometer wire. Calculate the current and balancing length for another cell of e.m.f. 1·4 V on the same potentiometer wire.

OR

Describe biprism experiment to calculate the wavelength of a monochormatic light. Draw the necessary ray diagram.

If the critical angle of a medium is $\sin^{-1}\left(\frac{3}{5}\right)$, find the polarising angle.

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