PHYSICS

BOOKS - NAVBODH PHYSICS (HINGLISH)

MODEL QUESTION PAPER

Section A

1. Select and write the corrcet answer :

The escape speed of a body from the surface of

a planet of density ρ and radius R is proportional to

A. $R\sqrt{\rho}$

B. $\rho\sqrt{R}$

C. $\sqrt{R\rho}$

D. $\sqrt{\frac{\rho}{R}}$

Answer: A

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2. Select and write the corrcet answer :

The elastic potential energy per unit volume in a copper wire $\left(Y = 1.2 \times 10^{11} Pa\right)$ stretched by $0.5\,\%$ of its length is

A. $1.5 \times 10^{10} J/m^3$

B. $1.5 \times 10^{8} J/m^3$

C. $1.5 \times 10^{7} J/m^3$

D. $1.5 \times 10^{6} J/m^3$

Answer: A::C::D

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3. Select and write the corrcet answer :

A transistor acts as a ' closed switch' when it is in

A. the cut off region

B. the active region

C. the breakdown region

D. the saturation region.

Answer: D

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4. Select and write the corrcet answer :

When shunted , the current sensitivity of a galvanometer reduces by a factor of 100. The resistance of the shunt is

A. $\frac{22}{33}\Omega$

B. $\frac{1}{3}\Omega$

C. $\frac{2}{3}\Omega$

D. $\frac{3}{2}\Omega$.

Answer: A::B::C

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5. Select and write the corrcet answer :

The capillary rise for a wetting liquid in a capillary tube is

A. $h = \frac{2T}{r\rho g \cos\theta}$

B. $h = \frac{2T\cos\theta}{r\rho g}$

C. $h = \frac{T\cos\theta}{2r\rho g}$

D. $h = \frac{T\cos\theta}{r\rho g}$.

Answer: B

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6. Select and write the corrcet answer :

A simple harmonic progressive wave is represented by $y = 0.01 \sin 4\pi\left(t - \frac{x}{2}\right)$ in SI units. The wavelength of the wave is

A. 4 m

B. 0.5 m

C. 1 m

D. 2 m .

Answer: A::C

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7. Show that all harmonics are present on a stretched string between two rigid supports.

A. a node

B. an antinode

C. either a node or an antinode

D. neither a node nor an antinode.

Answer: A::D

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8. Select and write the corrcet answer :

Which of the following would permit finer detail to be examined using a microscope of given numerical aperture ?

A. Yellow light

B. Green light

C. Violet light

D. Ultraviolet radiation

Answer: D

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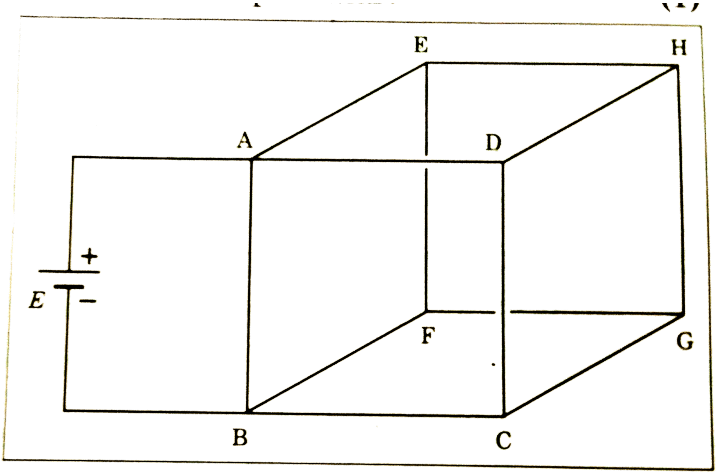
9. Select and write the corrcet answer :

A skeleton cube is made of 12 wires, each of the resistance R. A cell is connected across the edge AB as shown. Which pair(s) of points are

are at the same potential?



A. D and E

B. C and F

C. H and G

D. both (a) and (b) but $V_C \neq V_D$

Answer: A::B::C::D

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10. In the context of Doppler effect in light, the term red shift signifies

A. frequency increase

B. frequency decrease

C. wavelength decrease

D. frequency and wavelength increase.

Answer: B

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11. A message signal $A_1 \sin \omega_1$ t is used to modulate the amplitude of a carrier wave $A_2 \sin \omega_2 t$, where $A_1 < A_2$ and $\omega_2 > > \omega_1$. What is the modulation index of the modulated waye ?

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12. State the dimensions and SI unit of the gyromagnetic ratio of an orbital electron.

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13. The excess pressure inside a thin spherical bubble, of radius R and surface tension T, is $\triangle p$. What is the work by this outward pressure - developed force during an infinitesimal increase dR in the redius ?

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14. At a constant temperature what should be the percentage increase in pressure for a $10\,\%$

decrease in the volume of gas ? .

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15. What is the stopping potential when a metal, of photoelectric work function 4.13 eV , is irradiated with UV photons of energy 6.2 eV?

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16. A straight conductor of length L and carrying a current I is kept in a uniform

magnetic field of induction $\overrightarrow{B}$. Write the expressions for the force on the conductor and the magnitude of the maximum force.

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17. State Gauss's Theorem in electrostatics and deduce coulomb's law from Gauss's theorem.

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18. What is the total change in energy when a positive charge is taken round a closed loop in an electrical network ?

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Section B

1. Banking of roads at curve is necessary so as to avoid

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2. The equation of a plane progressive wave is $y = 5 \sin 2\pi(8t - 5x)$. Where y and x are in an and t in seconds. Calculate the amplitude, frequency, wavelength and velocity of the wave.

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3. Draw a neat, labelled energy level diagram for H atom showing the transitions.

Explain the series of spectral lines for H atom. Whose fixed inner orbit numbers are 3 and 4

respectively.

The work function for potassium and caesiumare 2.25 eV and 2.14 eV respectively. Is the photoelectric effect possible for either of them if incident wavelength is 5180 Å ?

[Given : Planck's constant $= 6.63 \times 10^{-34} J.s.$, Velocity of light $= 3 \times 10^{8} m/s, 1eV = 1.6 \times 10^{-19} J$]

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4. What are the drawbacks or limitations of amplitude modulation ?

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5. CHARACTERISTICS OF STATIONARY WAVES

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6. The spectrum from a black body radiation is a

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7. Explain how a moving - coil galvanometer is converted into a voltmeter . Derive the necessary formula.

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8. An LCR series circuit has a resistance of 25 Ω and a reactance of 93.25Ω. If the reactance is capacitive, what is the phase angle between the current and applied emf ? Does the applied emf lag behind or lead the current ?

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9. A solid sphere of mass 1 kg rolls on a table with linear speed 2 m/s. Find its total kinetic energy.

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10. A potentiometer wire , 4 m long and having a resistance of 10 Ω, is connected in series with an external resistance of 38Ω and a cell , of emf

2 V and internal resistance 2Ω. Calculate the potential gradient along the wire.

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11. The total energy of a body of mass 100 g performing SHM is 0.2 J. Find its maximum speed .

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12. When a thin flake of mica $(n_m = 1.58)$ covers one slit of a double - slit interfernce setup, the fringe pattern shifts by seven fringe widths. If the wavelength of the light used is 5500Å, what is the thichness of the mica flake ?

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Section C

1. Given that $T^2 = kR^3$, express the constant k of the above relation in days and kilometres.

Given, $k = 10^{-13} s^2 m^{-3}$. The Moon is at a distance of $3.84 \times 10^5 km$ from the earth. Obtain its time period of revolution in days.

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2. Define phase of S.H.M. Show variation of displacement, velocity and acceleration with phase for a particle perfoming linear S.H.M. graphically, when it starts from extreme position.

A body starts rotating from rest. Due to a couple of $20Nm$ it completes 60 revolutions in

one minute. Find the moment of inertia of the body.

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3. The photoelectric work function of a metal is 5.5eV . Calculate the maximum speed of the fastest photoelectrons emitted when radiation of photon energy 5.8 eV is incident on the metal surface.

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4. Draw the I - V characteristics of Ge and Si pn-junction diodes and explain the same .

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5. Poisson's ratio.

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6. The barometric height at a certain place is 0.75 m of mercury. What will be the barometric height ifa liquid of density $3.4 \times 10^3 k \frac{g}{m^3}$ is

used to llll the barometric tube?

$[P_{\text{mercury}} = 13.6 \times 10^3 kg/m^3]$

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7. Explain paramagnetism on the basis of electron theory.

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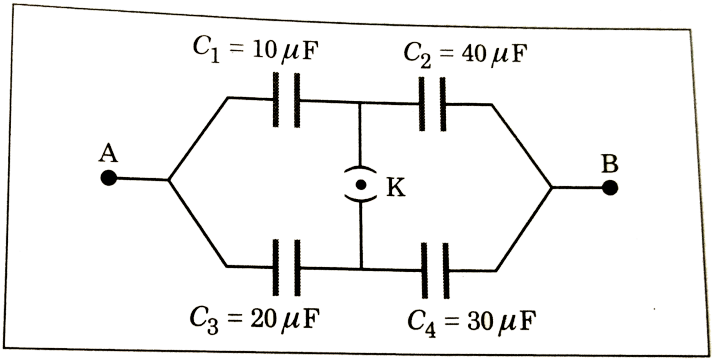
8. In the figure,

$C_1 = 10\mu F, C_2 = 40\mu F, C_3 = 20\mu F, C_4 = 30\mu F$

. Find the capacitance between the points A and B when (i) the key K is closed (ii) the Key K is open .



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9. Derive an expression for a one - dimensional simple harmonic progressive wave travelling in

the direction of the positive x - axis. Express it in terms of A, λ, v , t and x .

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10. A ray of light is incident on a glass slab at the polarising angle of 58° . Calculate the percentage change in the speed of light in glass.

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11. Assuming the expression for the pressure exerted by the gas on the walls of the container, it can be shown that pressure is

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12. For constructive interference, the phase difference between the two interfering waves is

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Section D

1. Derive the relation between the linear velocity and the angular velocity of a particle in circular motion.

A conical pendulum has length 1 m and the angle made by the string with the vertical is 10° . The mass of the bob is 100 g . Find the tension in hte string.

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2. Derive an expression for the kinetic energy of a body rotating with constant angular velocity. State how it depends on the moment of inertia, and frequency and period of rotation.

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3. A sonometer wire stretched by a load of density ρ has a fundamental frequency n_1. When the load is completely immersed in water (density ρ_w), its fundametnal frequency is n_2.

Show that $\frac{n_2}{n_1} = \sqrt{\frac{\rho - \rho_w}{\rho}}$.

Two organ pipes , open at both ends, are sounded together and 5 beats are heard per second. The length of the shorter pipe is 0.25 m . Find the length of the longer pipe. [Speed of sound in air = 350 m/s, end correction at one end = 0.015 m for both pipes .]

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4. A sinusoidally alternating emf is applied to an LCR series circuit . (i) Define the impedance

of the circuit . (ii) Obtain the expressions for the impedance and the phase difference between the emf and current from the phasor diagram. (iii) Discuss the behaviour of the circuit for different relative values of the two reactances in the circuit.

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5. Draw a neat labelled diagram of the setup in the Davisson and Germer experiment for diffraction of electron waves.

Calculate the mass defect of $^{59}_{27}Co$ which has a nucleus of mass 58.933 u.

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Section A

1. Two cars, A and B, take the same time to go round around two concentric circular tracks of radii r_1 and r_2, respectively. If $r_2 = 4r_1$, the ratio of the angular speed of car A to that of car B is

A. 4

B. $\frac{1}{4}$

C. 2

D. 1

Answer: D

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2. A single drop is formed by coalescing 1000 small droplets. The surface energy decreases in the ratio

A. $1:1$

B. $10:1$

C. $100:1$

D. $1000:1$

Answer: B

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3. A thin toroidal winding of mean circumference of 150 cm has 7500 turns and

carries a current of 5 A. The magnetic intensity within the toroid at its mean radius is

A. $10A/m$

B. $250A/m$

C. $10^3A/m$

D. $25 \times 10^3A/m$

Answer: D

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4. If L is the angular momentum and I is the moment of inertia of a rotating body, then $\frac{L^2}{2I}$ represents its

A. linear momentum

B. total energy

C. translational kinetic energy.

D.

Answer: B

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5. The stored energy per unit volume of a stretched wire is

A. $\sqrt{\frac{Y}{2u}}$

B. $\sqrt{\frac{2u}{Y}}$

C. $\sqrt{2uY}$

D. $\sqrt{\frac{2Y}{u}}$

Answer: C

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6. The angle between particle velocity and wave velocity in transverse wave is

A. zero

B. $\pi/4$ rad

C. $\pi/2$ rad

D. π rad.

Answer: C

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7. The polariser and analyser are inclined to each other at 60°. The intensity of polarised light emerging from polariser is I. The intensity of the unpolarised light incident on the polariser is

A. I_0

B. $\frac{3}{4}I_0$

C. $\frac{1}{2}I_0$

D. $\frac{1}{4}I_0$

Answer: D

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8. The energy spent by the cell in circulating unit charge once through the complete circuit is

A. the potential gradient

B. the Joule heat

C. the emf of the cell

D. the terminal p.d. Of the cell

Answer: D

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9. A Photo sensitive material would emit electrons if excited by photons beyond a threshold. To overcome the threshold, one would increases -

A. the intensity of light

B. the frequency of light

C. the wavelength of light

D. the collector potential.

Answer: B

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10. In AM wave total power of side bands is given by :

A. the entire AM band

B. the modulated carrier wave

C. the side bands

D. the pulse amplitude.

Answer: C

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11. Van de Graaff generator is

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12. What is the nature of molecular forces?

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13. What was Hertz's observation of photoelectric effect.

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14. In a transistor, the collector current changes by 0.99 mA with a 1 mA change in the emitter current. What is the common-base current gain of the transistor?

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15. A body of mass 1 kg oscillates on a spring of force constant 16 N/m. Calculate the angular frequency.

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16. By measuring the period of revolution and orbital radius of a satellite around a planet, which of the two can we determine : the mass of the satellite or that of the planet?

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17. State Lenz's law of electromagnetic induction.

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18. Magnetic susceptibility of a diamagnetic substances

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Section B

1. Resolving power of a microscope depends upon

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2. Using the method of dimensions , derive an expressions for the energy of a body executing SHM , assuming this energy depends upon its mass m , frequency v and amplitude of vibration r .

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3. The change in the angular momentum of the electron when it jumps from the fourth orbit ot the first orbit in a H-atom is

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4. What is the changed in amplitude modulation?

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5. A body cools from $70^{\circ}C$ to $60^{\circ}C$ in 5 minutes and to $45^{\circ}C$ in the next 10 minutes. Calculate the temperature of the surroundings.

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6. Distinguish between harmonics and overtones.

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7. Two pipes closed at one end, 53 cm and 54 cm long, produce 3 beats per second when they are sounded together in their fundamental modes. Ignoring end correction, calculate the speed of sound in air.

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8. PARAMAGNETIC SUBSTANCES

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9. Keeping the angle of banking, if the radius of curvature is made four times, the percentage increase in the maximum speed with which a vehicle can travel on a circular road is

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10. State the modificrt Ampere's circuital law. Explain each term involved in it.

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11. The photoelectric work function for aluminium is 4.2 eV. What is the stopping potential for radiation of wavelength 2500 Å ?

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12. A thin uniform rod- of length L, area of cross section A and density ρ - is rotated about an axis passing through a point at a distance $\frac{L}{6}$ from one end and perpendicular to its length. Derive its moment of inertia about this axis in terms of L, A and ρ.

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Section C

1. Obtain an expression for the linear acceleration of a particle in UCM.

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2. An $n-p-n$ transistor power amplifier in $C-E$ configuration gives.

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3. Define critical speed of a satellite. Derive an expression for it.

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4. Huygen's wave theory of light could not explain

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5. The amplitude of an alternating voltage is 240 V. What is its rms value?

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6. A torque of $160N \cdot m$ is applid to a flywheel initially at rest. If the flywheel acquires kinetic energy of 8 kJ in 5 s, its angular momentum at the end of 5 s is

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7. A steel wire of length 7 m and cross section 1 mm^2 I suspended from a rigid support, with a steel weight of volume $10^3 cm^3$ hanging from its other end. Find the decrease in the length of the wire when the steel weight is completely immersed in water.

$Y_{\text{steel}} = 2 \times 10^{11} N/m^2$ density of water $= 10^3 kg/m^3$]

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8. Derive Laplace's law for a spherical membrane.

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9. A cube of amber, 1 cm on the side, is kept in an electric field of intensity 200 V//m. Determine the electrostatic energy contained in the cube of amber. [Dielectric constant of amber = 2.8]

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10. A battery of emf 3 V and internal resistance 1Ω is connected in parallel with a cell of emf 1.5 V and internal resistance 0.5Ω with their like poles together. The combination is used to pass a current through a resistor of resistance of 5Ω. Using Kirchhoffs circuital laws, find the current through the 5Ω resistor.

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Section D

1. Assuming the expression for the pressure exerted by an ideal gas, show that the rms speed of a gas molecule is directly proportional to the square root of its absolute temperature. Calculate the kinetic energy of 10 grams of argon molecules at $127^{\circ} C$. [Atomic weight of argon= 40]

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2. Assuming the expression for the path difference between two interfering light waves for bright and dark fringes, obtain an

expression for the fringe width.

The central fringe of a double-slit interference pattern produced by light of wavelength 6000Å shifts to the position of the 5th bright fringe on introducing a thin glass plate of refractive index 1.5 in front of one of the slits. Calculate the thickness of the plate.

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3. Derive an expression for the current sensitivity of a moving-coil galvanometer.

A solenoid, 1.5 m long and 4 cm in diameter, has

10 turns/cm and carries a current of 5 A. Calculate the magnetic induction at its centre.

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4. Define linear simple harmonic motion. Assuming the expression for displacement of a particle starting from extreme position, explain graphically the varition of velocity and acceleration w.r.t. time.

A clock reagulated by seconds pendulum, keeps correct time. During summer, length of pendulum increases to 1.005 m. How much will

the clock gain or loose in one day $\left(g = 9.8m/s^2 \text{ and } \pi = 3.142\right)$.

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5. Explain the phenomenon of nuclear fusion with at least two examples.

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