FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2015

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**

(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.

(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.

(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.

(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.

(vi) Extra attempt of any question or any part of the attempted question will not be considered.

(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2. (a) How does a vector quantity differ from a scalar quantity? **(06)**

(b) A small airplane leaves an airport on an overcast day and is later sighted 215 km away in a direction making an angle of 22^o east of north. How far east and north is the airplane from the airport when sighted? **(08)**

(c) Explain the conservation of linear momentum and angular momentum. **(06)** **(20)**

Q. No. 3. (a) Describe Michelson-Morley experiment and show how negative results obtained from this experiment were interpreted? **(10)**

(b) What is time dilation in special relativity? Obtain an expression for time dilation regarding time interval between two events measured from two different inertial frames. **(10)** **(20)**

Q. No. 4. (a) What is length contraction in special theory of relativity? **(04)**

(b) What are isothermal and adiabatic changes? Explain with volume pressure diagram. **(08)**

(c) Define the term Coherence. Drive an Expression for the Coherence length of a wave train that has a frequency bandwidth $\Delta\nu$. **(08)** **(20)**

Q. No. 5. (a) Explain the formation of Newton's rings and show that the radii of m^{th} dark ring is proportional to the under root of wavelength. **(10)**

(b) What is diffraction grating? Define grating element. Explain how a plane transmission grating is used to determine the wavelength of light. **(10)** **(20)**

Q. No. 6. (a) What is a LASER? Explain with neat diagram the process of absorption of light, spontaneous emission and stimulated emission of light. **(08)**

(b) Explain with the help of energy level diagram how stimulated emission results from electron impact of He-Ne Gas LASER? **(06)**

(c) Explain how the viscosity of a given liquid is determined using Stokes's method experimentally? **(06)** **(20)**

Q. No. 7. (a) Distinguish between the resolving power and the magnifying power of a Telescope. **(08)**

(b) Discuss the applications of First Law of Thermodynamics. **(06)**

(c) Describe the Galileo's principles of relativity. **(06)** **(20)**

Q. No. 8. Briefly discuss any **FOUR** of the following terms: **(05 each)** **(20)**

(a) Standing waves (b) Doppler's effect

(c) Electromagnetic waves (d) Surface tension

(e) Components of vectors

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2015

Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2. (a) State and prove Gauss's law of electrostatics. Derive its differential form. **(12)**
(b) Use Gauss's law to calculate the electric field due to a line charge. **(05)**
(c) A point charge of $1.8\ \mu C$ is at the centre of a cubical Gaussian surface $55\ cm$ on edge. What is the net electric flux through this surface? Use $\varepsilon_o = 8.854 \times 10^{-12} C^2/N.m^2$. **(03)** **(20)**

Q. No. 3. (a) Analyze the RLC-series circuit using j-operator method and discuss its frequency response. Discuss the importance of this circuit. **(14)**
(b) Find the impedance of a circuit consisting of a $1.5\ k\Omega$ resistor, $5.0\ \mu F$ capacitor and $50\ mH$ inductor in series at a frequency of $10\ kHz$. **(04)**
(c) What are the advantages of A.C. mains supply? **(02)** **(20)**

Q. No. 4. (a) Describe the forward and reverse biased characteristics of a PN junction. **(06)**
(b) Explain the working of a bridge rectifier using a neat and labelled circuit diagram. **(12)**
(c) Why semiconductor devices are preferred over the vacuum tubes? **(02)** **(20)**

Q. No. 5. (a) What is meant by Compton Effect? Derive an expression for Compton shift in wavelength. **(16)**
(b) A beam of X-rays is scattered by a carbon target. At 45^o from the beam direction the scattered X-rays have a wavelength of $2.2\ pm$. What is the wavelength of the X-rays in the direct beam? **(4)**
(Given that $h = 6.626 \times 10^{-34} J.s, m_o = 9.109 \times 10^{-31} kg$ and $c = 2.998 \times 10^8 m/s$) **(20)**

Q. No. 6. (a) Derive expressions for half-life and mean life of a radioactive substance. **(15)**
(b) The activity of a certain radionuclide decreases to 15 percent of the original value in 10 days. Find its half-life. **(03)**
(c) Give any two industrial or medical uses of radioisotopes. **(02)** **(20)**

Q. No. 7. (a) Differentiate between nuclear fission and fusion. **(03)**
(b) Draw a labelled diagram of a nuclear reactor and explain the functions of various parts. **(13)**
(c) Calculate the energy released in the following fission reaction induced by slow neutrons. **(04)**

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow [^{236}_{92}U]^* \rightarrow {}^{140}_{54}Xe + {}^{94}_{38}Sr + 2\ {}^{1}_{0}n$$

Express your answer in MeV

[Given that $m(^{235}_{92}U) = 235.043923$ a.m.u. , $m(^{140}_{54}Xe) = 139.921640$ a.m.u.
$m(^{94}_{38}Sr) = 93.915360$ a.m.u. , $m(^{1}_{0}n) = 1.008665$ a.m.u.
and 1 a.m.u. $= 931.5\ MeV/c^2$] **(20)**

Q. No. 8. Write notes on any **TWO** of the following: **(10 each)** **(20)**
(a) Modulation and demodulation (b) Common emitter single stage amplifier
(c) Bainbridge mass spectrometer

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION - 2016
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS)**	**MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II**	**MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2. (a) State and prove Stoke's theorem. **(8)**
(b) Prove that if the vector is the gradient of a scalar function then its line integral around a closed curve is zero. **(4)**
(c) A particle moves along the curve $\mathbf{x = 2t^2}$, $\mathbf{y = t^2 - 4t}$, $\mathbf{z = 3t-5}$ where t is the time. Find the components of its velocity and acceleration at time **t=1** in the direction **2i-3j+2k** **(8)**

Q. No. 3. (a) What is moment of inertia? State and prove parallel axis theorem. **(12)**
(b) Calculate rotational inertia of a hollow cylinder about cylindrical axis. **(8)**

Q. No. 4. (a) State and prove the Kepler's law of areas and Kepler's law of periods of planetary motion. **(8)**
(b) A satellite orbits at a height of 230km above the Earth surface. What is the period of satellite? **(6)**
(c) At what altitude above the earth surface the value of 'g' is three quarters of its value at the surface of the earth. **(6)**

Q. No. 5. (a) What is diffraction grating? Explain how grating diffracts light. Derive relation for resolving power of grating. **(12)**
(b) What is meant by polarization of light? How can we get a plane polarized light by a polarizing sheet? **(8)**

Q. No. 6. (a) Derive equation of Lorentz velocity transformations and show that speed of light is independent of the relative motion between the frames of reference. **(12)**
(b) The siren of a police car emits a source tone at a frequency of 1125 Hz. Find the frequency that would you receive in your car under the following circumstances. **(8)**
(i) Your car at rest, police car moving towards you at 29 m/s.
(ii) Police car at rest , your car moving towards it at 29 m/s.
(iii) Your and police car are moving towards one another at 14.5 m/s.
(iv) Your car moving at 9 m/s, police car chasing behind you at 38 m/s.

Q. No. 7. (a) Define Entropy. State Second law of thermodynamics in terms of Entropy. **(8)**
(b) Discuss applications of First Law of thermodynamics. **(6)**
(c) Discuss briefly the Lissajous patterns. **(6)**

Q. No. 8. Explain any FOUR of the following terms. **(05 each)** **(20)**
(a) Doppler's Effect
(b) Bernoulli's theorem
(c) Newton's rings
(d) He-Ne Gas LASER
(e) Brownian motion

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2016
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS **PART-I(MCQS): MAXIMUM 30 MINUTES**	**PART-I (MCQS)** **PART-II**	**MAXIMUM MARKS = 20** **MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2.
(a) Define electric field intensity $\vec{E}$. State its value for a point charge and give its units. **(8)**
(b) State differential form of Gauss's law and from there develops the poisson's & Laplace's equations. **(8)**
(c) A charge of $10\sqrt{2}$ Coulomb is located at $(3\hat{i} + 4\hat{j} + 5\hat{k})m$. Calculate the electric field intensity at a point having position vector $(5\hat{i} + 4\hat{j} + 3\hat{k})m$. **(4)**

Q. No. 3.
(a) Differentiate between a series and parallel resonant circuits. **(6)**
(b) Explain the construction and operation of a transformer. What are energy losses in a transformer and how are they reduced to a minimum. **(10)**
(c) A series *LCR* circuit contains a coil with L=2.25H, a capacitor having C=16μF and a resistor with R=50Ω. Calculate the impedance and the phase difference between current and voltage. (Take frequency f = 50Hz) **(4)**

Q. No. 4.
(a) State and explain the basic postulates of Quantum Physics. **(5)**
(b) Briefly explain with examples what do you mean by Eigen function and Eigen values. **(5)**
(c) Derive the time-dependent Schrodinger Wave Equation for a free particle. **(10)**

Q. No. 5.
(a) Why the resistivity of metals increases with temperature but that of semiconductor decreases? **(6)**
(b) In the process of making semiconductor devices, why silicon is preferred over Germanium? **(4)**
(c) Briefly explain the construction and operation of a Bipolar Junction Transistor (BJT). How it can be used as an Amplifier? **(10)**

Q. No. 6.
(a) What do <111>, [010], (111), and {100} represents for a cubic crystal lattice. **(5)**
(b) What is packing factor? Determine the Atomic Packing factor of FCC lattice. **(5)**
(c) With neat diagram showing X-ray diffraction, derive an expression for Bragg's Law. **(10)**

Q. No. 7.
Define Curie and Becquerel. Establish the relation between them. **(6)**
Calculate the Decay Constant for ^{14}C which has half-life of 5730 years. **(4)**
State and explain Half-life and Mean life of a radioactive element. Show that $< T >$ is greater than $T_{1/2}$. **(10)**

FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION - 2017
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
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(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2.
(a) What is the cross product of two vectors? Why the cross product is called pseudo vector? **(5)**
(b) What is divergence of vector field? What is its physical significance? **(5)**
(c) What is line integral? Under what condition it is used to calculate the work done. **(5)**
(d) Consider three vectors: **(5)** **(20)**

$\vec{A} = -3\hat{i} + 3\hat{j} + 2\hat{k} \quad \vec{B} = -2\hat{i} - 4\hat{j} + 2\hat{k} \quad and \quad \vec{C} = 2\hat{i} + 3\hat{j} + 1\hat{k}$

(i) Find $\vec{A} \cdot (\vec{B} \mathrm{X} \vec{C})$ **(ii)** Find $\vec{A} X (\vec{B} \mathrm{X} \vec{C})$

Q. No. 3.
(a) What do you mean by circular motion? What is centrifugal force? Explain your answer by taking an example from daily life. **(5)**
(b) What is projectile motion? Why a cricket player lowers his hand while catching a ball? **(7)**
(c) What do you mean by work done by the system and work done on the system? Explain by taking an example of each. **(5)**
(d) A batsman hits a cricket ball at an angle with respect to the horizontal. The ball would strike the ground at 60m from the batsman if it is not stopped. But a fielder at a distance 55 m catches the ball at a height of 1.5 m. Calculate the angle of projection and the velocity of projection. **(3)** **(20)**

Q. No. 4.
(a) What do you mean by phase and group velocity? Derive a relation between a group and phase velocity. **(7)**
(b) What is superposition of waves? Show that the standing waves are produced by the superposition of two waves of equal amplitudes moving in opposite direction. **(7)**
(c) A medium is disturbed by an oscillation described by, **(3)**
Y = 3.0cm sin(πx/10cm) cos (50πt)
Determine the amplitude, frequency, wavelength, speed and direction of the component waves whose superposition produces this result.
(d) If light of λ = 660nm has wave train 20λ, what is its coherence length and coherence time? **(3)** **(20)**

Q. No. 5.
(a) What is unique about light from a laser source, and why should you never look directly into a laser beam? Explain briefly. **(5)**
(b) What is plasma? What do you mean by plasma frequency? Briefly discuss. **(5)**
(c) How the blue laser is useful in storing large amount of data on a CD as compared to red laser? **(5)**
(d) For the He-Ne laser at 2m and 4m distances from the laser, the output beam spot diameters are 2 mm and 3 mm. Calculate the angle of divergence. **(5)** **(20)**

PHYSICS, PAPER-I

Q. No. 6.

(a) What is viscosity? Discuss effect of temperature on the viscosity of liquids and gases. **(6)**

(b) Differentiate between streamline and turbulent flow and establish equation of continuity. **(4)**

(c) Explain why the level of mercury is down in capillary when placed in container of mercury, while it is up in the capillary in case of water? **(6)**

(d) A garden hose has an inside diameter of 2 cm and water flows through it is at 3 m/s. **(4)** **(20)**

(i) What nozzle diameter is required for the water to emerge at 10 m/s?

(ii) At what rate does the water leave the nozzle?

Q. No. 7.

(a) What do you understand by classical statistical mechanics and quantum statistical mechanics? **(6)**

(b) Differentiate between Fermi-Dirac, Bose-Einstein and Maxwell-Boltzman's statistics. **(6)**

(c) What is equipartition of energy? Explain. **(5)**

(d) A $0.5m^3$ vessal is filled with air at atmospheric pressure. The air is churned by a paddel wheel attached to a shaft 0.1m in diameter, rotating at a speed of 1800 rpm. A force of 5.0N acts on the rim of the shaft. What would be the pressure in the vessel after 10 sec of operation **(3)** **(20)**

Q. No. 8. Write notes on any **FOUR** of the following: **(5 each)** **(20)**

(a) Polarization of light and its application in determining specific rotation of a liquid.

(b) Wave equation on a string.

(c) Normal and anomalous dispersion of light.

(d) Kinetic theory of gases.

(e) Scalar Triple product.

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2017
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
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(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2.	**(a)**	What is dipole moment? Obtain the expression for the potential and field due to an electric dipole.	**(10)**	
	(b)	Calculate the potential at a point on the axis of circular plastic disk of radius R, one surface of which carries a uniform charge density σ.	**(8)**	
	(c)	Why do we use unit "electron volts"?	**(2)**	**(20)**
Q. No. 3.	**(a)**	State and explain the Biot Savart law.	**(4)**	
	(b)	State and prove Ampere's law. Apply it to calculate the magnetic field due to a solenoid.	**(10)**	
	(c)	A long straight wire carries a current of 20 Amperes. An electron at 2.0 cm from the wire is travelling at a speed of 10^7 m/sec. What force acts on the electron if its motion is directed (1) towards the wire, (2) parallel to the wire and (3) at right angles to the direction given in (1) and (2).	**(6)**	**(20)**
Q. No. 4.	**(a)**	Write the Maxwell's equations and explain the significance of each equation.	**(6)**	
	(b)	Deduce the Maxwell equations for free space and also prove that electromagnetic waves are transverse.	**(12)**	
	(c)	What is index of refraction?	**(2)**	**(20)**
Q. No. 5.	**(a)**	Describe the Stern Gerlach experiment that provided experimental evidence of the space quantization of atomic magnetic moments.	**(10)**	
	(b)	What is the physical significance of the three quantum numbers n, 1, and m in the labelling of the hydrogenic wave functions?	**(6)**	
	(c)	What do you understand by strange particles?	**(4)**	**(20)**
Q. No. 6.	**(a)**	What is liquid drop model of nucleus and write down its essential features?	**(8)**	
	(b)	What are magic numbers? How can they be generated on the basis of shell model?	**(8)**	
	(c)	What is nuclear fusion?	**(4)**	**(20)**
Q. No. 7.	**(a)**	Differentiate the Metals, Semiconductors and Insulators on the basis of Energy Band Theory.	**(6)**	
	(b)	What is a rectifier? How we can use diode as a rectifier? Explain half-wave rectification in detail with diagrams.	**(14)**	**(20)**

Q. No. 8. Writer short notes on any TWO of the following: **(10 each)** **(20)**
(a) Schrodinger equation
(b) Linear accelerator
(c) Cyclotron

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION - 2018
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
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(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

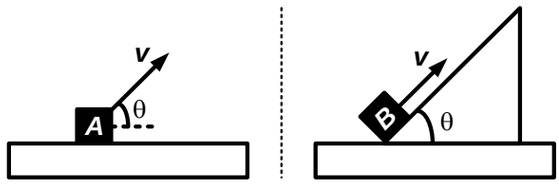
Q. No. 2. **(a)** Show that the work done by a constant force is equal to the difference of initial and final kinetic energies of the body. **(8)**

(b) A 25 kg bear slides, from rest, 12 m down a pine tree, moving with a speed of 5.6 m/s just before hitting the ground. **(8)**

(i) What change occurs in the gravitational potential energy of the bear-Earth system during the slide?

(ii) What is the kinetic energy of the bear just before hitting the ground?

(c) Object *A* is launched as projectile with initial speed *v* at an angle θ above the horizontal. Object *B* has exactly the same initial speed at exactly the same angle as object *A* but object *B* is sliding up a frictionless incline as shown in the figure. Object *A* has mass *M* and object *B* has mass 2*M*. During the subsequent motion, each object will reach a maximum height above the starting location. **(4)**

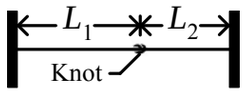


(i) At its maximum height, which object has the larger kinetic energy? Explain.

(ii) Which object has the larger maximum height? Explain.

Q. No. 3. **(a)** Derive the expression for the total mechanical energy in simple harmonic motion. Draw and discuss the graphs of Energy versus Time and Energy versus Position. **(8)**

(b) In the figure shown below, two strings have been tied together with a knot and then stretched between two rigid supports. The strings have linear densities $\mu_1 = 1.4\times10^{-4}$ kg/m and $\mu_2 = 2.8\times10^{-4}$ kg/m. Their lengths are $L_1 = 3$ m and $L_2 = 2$ m, and string 1 is under a tension of 400 N. Simultaneously, on each string a pulse is sent from the rigid support end, toward the knot. Which pulse reaches the knot first? **(8)**



(c) A mass-spring system is oscillating with amplitude *A*. What will be the displacement at which kinetic energy is equal to the potential energy? **(4)**

Q. No. 4.

(a) What is polarization? Discuss polarization by reflection. **(8)**

(b) Light of wavelength 624 nm is incident perpendicularly on a soap film (n = 1.33) suspended in air. What are the **(8)**

(i) least and

(ii) second least thicknesses of the film for which the reflections from the film undergo fully constructive interference?

(c) A maintenance crew is working on a section of a three lane highway, leaving only one lane open to traffic. The result is much slower traffic flow (a traffic jam). Do cars on a highway behave like **(4)**

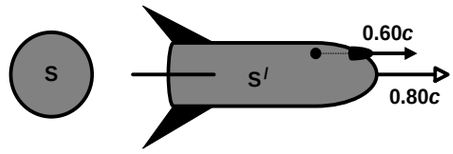
(i) the molecules of an incompressible fluid or

(ii) the molecules of a compressible fluid? Explain.

Q. No. 5.

(a) Show that mass and energy are interconvertible. **(8)**

(b) A spaceship is moving away from the earth at a speed of 0.80c when it fires a missile parallel to the direction of motion of ship. The missile moves at a speed of 0.60c relative to the ship (see figure). What would be the speed of the missile as measured by an observer on the earth? Compare with the prediction of Galilean kinematics. **(8)**



(c) If $\vec{A}$ and $\vec{B}$ are nonzero vectors, is it possible for $\vec{A}.\vec{B}$ and $\vec{A} \times \vec{B}$ to be zero? Explain. **(4)**

Q. No. 6.

(a) Distinguish between Linear and Angular momentum. Derive expression for the angular momentum of a rigid body rotating about a fixed axis. Explain the Law of Conservation of Angular Momentum. **(8)**

(b) A girl of mass M stands on the rim of a frictionless merry-go-round of radius R and rotational inertia I that is not moving. She throws a rock of mass m horizontally in a direction that is tangent to the outer edge of the merry-go-round. The speed of the rock, relative to the ground, is v. Afterward, what are **(8)**

(i) the angular speed of the merry-go-round and

(ii) the linear speed of the girl?

(c) A planet is moving at constant speed in a circular orbit around a star. In one complete orbit, what is the net amount of work done on the planet by the star's gravitational force? What if the planet's orbit is an ellipse, so that the speed is not constant? Explain. **(4)**

Q. No. 7.

(a) Differentiate between Fermi-Dirac, Bose-Einstein and Maxwell-Boltzman statistics. **(6)**

(b) Show that the entropy remains constant in a reversible process but increases in an irreversible one. **(6)**

(c) When 20.9 J was added as heat to a particular ideal gas, the volume of the gas changed from 50 cm^3 to 100 cm^3 while the pressure remained at 1 atm. **(8)**

(i) By how much did the internal energy of the gas change?

(ii) If the quantity of gas present was 2 x 10^{-3}mol, find C_p.

Q. No. 8. Explain the following: **(05 each) (20)**

(a) Scalar triple product **(b)** Surface tension

(c) He-Ne Gas LASER **(d)** Gravitational potential energy

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2018
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE:
(i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2. **(a)** Define and explain Gauss' Law. Deduce Coulomb's Law from Gauss' Law. **(8)**
(b) Find the Electric Field Intensity due to an infinite sheet of charge. **(8)**
(c) The electric field near an infinite sheet of charge is 3.84×10^{5} N/C. What is the surface charge density on the sheet? ($\epsilon_0 = 8.85\times 10^{-12}$ $C^2/N.\ m^2$) **(4)**

Q. No. 3. **(a)** Derive an expression for capacitance of cylindrical and spherical capacitor. **(8)**
(b) Show that the energy consumed in charging a capacitor to charge Q and voltage V can be considered as potential energy stored in the field between the plates. Find expression for energy stored in the field. **(8)**
(c) An isolated conducting sphere whose radius R is 6.85 cm has a charge q=1.25 nC. How much potential energy is stored in the electric field of this charged conductor? ($\epsilon_0 = 8.85\times 10^{-12}$ $C^2/N.\ m^2$) **(4)**

Q. No. 4. **(a)** Derive an expression for time dependent Schrodinger's wave equation. **(8)**
(b) Explain de Broglie's hypothesis of matter wave. **(8)**
(c) Determine the de Broglie's wavelength of an electron that has been accelerated through a potential difference of 100V. ($h = 6.63\times 10^{-34}$J.s) **(4)**

Q. No. 5. **(a)** What is Transistor? Briefly explain three types of Transistor Circuit Configurations. **(8)**
(b) Draw a neat diagram of Transistor Characteristics in Common Emitter Configuration for P-N-P and N-P-N transistor. Also discuss types of characteristic curves for a transistor in Common Emitter Configuration. **(8)**
(c) Write a short note on Load line. **(4)**

Q. No. 6. **(a)** What do you understand by nuclear fission? How was it explained theoretically on the basis of liquid drop model? **(8)**
(b) Briefly describe important uses of radioisotopes. **(8)**
(c) A 5.30 MeV alpha particle happens, by chance, to be headed directly towards the nucleus of an atom of gold, which contains 79 protons. How close does the alpha particle get to the centre of the nucleus before coming momentarily to rest and reversing the relatively massive nucleus? **(4)**

Q. No. 7. **(a)** Explain construction and working of a Geiger Muller Counter. **(8)**
(b) Draw the characteristic of Geiger Muller Counter and also explain it. **(8)**
(c) What are the properties of Gamma Rays? **(4)**

Q. No. 8. Write short notes on any **TWO** of the following: **(10 each)** **(20)**

(a) Poynting Vector

(b) Heisenberg's Uncertainty Principle

(c) Mass Defect and Binding Energy

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2019
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** Explain the Divergence of a Vector field with its physical significance? (10)
(b) A rural mail carrier leaves the post office and drives 22.0 km in a northerly direction. He then drives in a direction 60.0° south of east for 47.0 km. What is his displacement from the post office? (5)
(c) Vectors $\vec{C}$ *and* $\vec{D}$ have magnitudes of 3 units and 4 units, respectively. What is the angle between the directions of $\vec{C}$ *and* $\vec{D}$ if $\vec{C}.\vec{D}$ equals (a) zero, (b) 12 units and (c) -12 units? (5) **(20)**

Q. 3. **(a)** Distinguish between Linear and Angular momentum. Explain the laws of conservation of Angular momentum. (10)
(b) Estimate the net force needed to accelerate (i) a 1000kg car at ½ g; (ii) a 200g apple at the same rate. (5)
(c) A vertical force is applied to a block of mass m that lies on a floor. What happens to the magnitude of the normal force on the block from the floor as magnitude $\boldsymbol{F}$ is increased from zero if force is (a) downward and (b) upward? (5) **(20)**

Q. 4. **(a)** Describe the Michelson - Morley Experiment and show how negative results obtained from this experiment were interpreted? (10)
(b) Derive equation of Lorentz velocity transformations and show that speed of light is independent of the relative motion between the frames of reference. (10) **(20)**

Q. 5. **(a)** What is surface tension? How surface tension is responsible for rising of liquid in capillaries? (10)
(b) Water circulates throughout a house in a hot-water heating system. If the water is pumped at a speed of 0.50 m/s through a 4.0cm diameter pipe in the basement under a pressure of 3.0 atm, what will be the flow speed and pressure in a 2.6cm diameter pipe on the second floor 5.0 m above? Assume the pipes do not divide into branches. (5)
(c) When blood pressure is measured, why must the cuff be held at the level of the heart? (5) **(20)**

Q. 6. **(a)** What is polarization of waves? How plane polarized light can be obtained by a polarization sheet. (10)
(b) Two flat mirrors are perpendicular to each other. An incoming beam of light makes an angle of 15° with the first mirror. What angle will the outgoing beam make with the second mirror? (5)
(c) Since the density of air decreases with an increase in temperature, but the bulk modulus B is nearly independent of temperature. How would you expect the speed of sound waves in air to vary with temperature? (5) **(20)**

Q. 7. **(a)** State and explain Equipartition Theorem. (10)
(b) Define laws of thermodynamics. Explain 3rd law of thermodynamics in detail. (10) **(20)**

Q. 8. Write the short notes on any TWO of the following: (10 each) **(20)**
(a) Gyrocope **(b)** Classical Maxwell-Boltzmann Statistics
(c) Spin and Precession

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2019
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** Derive an expression for the torque and potential energy of an electric dipole in an electric field. (10)
(b) Show that the energy density of a parallel plate capacitor with dielectric medium between them is directly proportional to the square of electric field intensity. (6)
(c) In a microwave oven torque acting on an electric dipole is responsible for the production of heat. Comment. (4) **(20)**

Q. 3. **(a)** Discuss origin of magnetism by considering processes that creates magnetic field in an atom. (8)
(b) What are ferromagnetic domains? How does a typical ferromagnetic material is investigated by Hysteresis loop for technological applications? (8)
(c) How does effect of nuclear magnetism becomes important in nuclear magnetic resonance? (4) **(20)**

Q. 4. **(a)** Derive an expression for the time-independent Schrodinger wave equation in one dimension for a single particle. Define Hamiltonian operator. (10)
(b) Discuss various quantum numbers to describe the complete behavior of an electron in an orbital. (6)
(c) How slowly must an electron be moving for its deBroglie wave-length equal to 1mm? (4) **(20)**

Q. 5. **(a)** Discuss the behavior of particle trapped in infinitely deep well and show that the energy of particle inside the well is quantized. (10)
(b) Explain the terms wave function, probability density and normalization condition associated with quantum mechanics. (6)
(c) Find the expectation value of the momentum. (4) **(20)**

Q. 6. **(a)** What is an oscillator? How an LC oscillator works? Discuss Barkhaausian criteria for oscillations. (10)
(b) What is a feedback transistor? Differentiate negative feedback and positive feedback. (6)
(c) what are RC filters (4) **(20)**

Q. 7. **(a)** Discuss principle, construction and working of Nuclear Reactor. Define Breeder Reactor. (8)
(b) What is nuclear fusion? Describe Proton-Proton cycles for energy release in the Sun and Stars. (8)
(c) What is Q-Value of a nuclear reaction? (4) **(20)**

Q. 8. Write comprehensive notes on any TWO of the following **(10 each)** **(20)**
(a) The Biot and Savart law **(b)** Cyclotron
(c) Electromagnetic waves

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2020
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS)**	**MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II**	**MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** What is the curl of a vector field? Explain its physical significance. (10)

(b) What is vector triple product? Show that (6)

$$\vec{A}\times\left(\vec{B}\times\vec{C}\right)=\left(\vec{A}\cdot\vec{C}\right)\vec{B}-\left(\vec{A}\cdot\vec{B}\right)\vec{C}$$

(c) If $\phi = 2x^3y^2z^4$ then find the div grad Ø. (4) **(20)**

Q. 3. **(a)** State and explain Kelper's law of areas. (8)

(b) A spaceship of mass m = 4.50 × 103 kg is in a circular Earth orbit of radius $r = 8.00\times10^6$ m and period T_o = 118.6 min = 7.119 × 10^3 s when a thruster is fired in the forward direction to decrease the speed to 96.0% of the original speed. What is the period T of the resulting elliptical orbit? (6)

(c) Which has greater magnitude, the angular momentum of the Earth (relative to its center) associated with its rotation on its axis or the angular momentum of the Earth (relative to the center of its orbit) associated with its orbital motion around the Sun? (6) **(20)**

Q. 4. **(a)** Explain the equivalence of mass and energy. (6)

(b) Explain two tests of time dilation i.e microscopic and macroscopic clocks. (8)

(c) The mean lifetime of stationary muons is measured to be 2.2000 ms. The mean lifetime of high-speed muons in a burst of cosmic rays observed from Earth is measured to be 16.000 μs. To five significant figures, what is the speed parameter b of these cosmic-rays muons relative to Earth? (6) **(20)**

Q. 5. **(a)** What is viscosity? Explain in detail. What is the effect of temperature on viscosity? (8)

(b) Caster oil, which has a density of 0.96 × 10^3 kg/m^3 at room temperature, is forced through a pipe of circular cross section by a pump that maintains a gauge pressure of 950 Pa. The pipe has a diameter of 2.6 cm and a length of 65 cm. The castor oil emerging from the free end of the pipe at atmospheric pressure is collected. After 90 s, a total of 1.23 kg has been collected. What is the coefficient of viscosity of the castor oil at this temperature? (5)

(c) A liquid flows through a horizontal pipe whose inner radius is 2.52 cm. The pipe bends upward through a height of 11.5 m where it widens and joins another horizontal pipe of inner radius 6.14 cm. What must the volume flux be if the pressure in the two horizontal pipes is the same? (7) **(20)**

Q. 6. **(a)** What is damped harmonic oscillator? Write its equation of motion and find its solution. (10)

(b) The amplitude of a lightly damped oscillator decreases by 3.0% during each cycle. What percentage of the mechanical energy of the oscillator is lost in each cycle? (4)

(c) An insulating vessel containing 1.8 kg of water is placed on a hot plate, both the water and hot plate being initially at 20°C. The temperature of the hot plate is raised very slowly to 100°C, at which point the water begins to boil. What is the entropy change of the water during this process? (6) **(20)**

PHYSICS, PAPER-I

Q. 7. **(a)** What are travelling waves? Find the rate at which energy is transported by a wave travelling along a string. (5)

(b) A string has linear density μ = 525 g/m and is under tension T = 45 N. We send a sinusoidal wave with frequency f = 120 Hz and amplitude y_m = 8.5 mm along the string. At what average rate does the wave transport energy? (5)

(c) Two sinusoidal waves with the identical wavelengths and amplitudes travel in opposite directions along a string with a speed of 10 cm/s. If the time interval between instants when the string is flat is 0.50 s, what is the wavelength of the waves? (10) **(20)**

Q. 8. **(a)** Explain the volume and pressure corrections in ideal gas law as suggested by van der Waals. (10)

(b) For oxygen the van der Waals coefficients have been measured to be $a = 0.138\ J\ .m^3/mol^2$ and $b = 3.18 \times 10^{-5}\ m^3/mol$. Assume that 1.00 mol of oxygen at T = 50 K is confined to a box of volume 0.0224 m^3. What pressure does the gas exert according to (a) the ideal gas law and (b) the van der Waals equation? (5)

(c) State and explain the zeroth law of thermodynamics. (5) **(20)**

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2020
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** Discuss electric field of point charges, keeping in view the magnitude of force acting on test charge according to Coulomb's Law. (8)
(b) Derive Poisson's equation from Gauss's Law. Also write the expression for Laplace's equation. (8)
(c) Find out the electric field due to charge of 2e at a distance of 26.5 $x10^{-12}$ m. (ε_o =8.85$x10^{-12}$ $C^2/N.m^2$ and e=1.60$x10^{-19}$ C) (4) **(20)**

Q. 3. **(a)** Discuss in details the Energy Transport and the Poynting Vector. (8)
(b) Write the four Maxwell's Equations both in integral and differential forms. (8)
(c) Explain vector potential. (4) **(20)**

Q. 4. **(a)** State and explain Heisenberg's Uncertainty Principle. (8)
(b) Discuss the phenomenon Barrier Tunneling. (8)
(c) Find the momentum of an electron moving with a speed of 1.88 x 10^6 m/s. where mass of electron is 9.11 x 10^{-31} kg. (4) **(20)**

Q. 5. **(a)** What do you understand by the term Dopping? How we can make semiconductors as n-type or p-type with the dopping? (8)
(b) Discuss in details the N-P-N and P-N-P transistors. (8)
(c) Explain MOFET. (4) **(20)**

Q. 6. **(a)** Discuss in detail the process of Natural Radioactivity. (8)
(b) Discuss in detail the radioactive decay. (8)
(c) Find the energy released during the alpha-decay of 238 U. Where the needed atomic masses are ^{238}U 238.050785 *u*, ^{234}Th 234.043539 *u* and ^{4}He 4.002603 *u*. (4) **(20)**

Q. 7. **(a)** Discuss in detail the phenomenon of Fission. (8)
(b) Explain the basic principles of Nuclear Reactors. (8)
(c) Briefly write about the methods of detection of nuclear radiation. (4) **(20)**

Q. 8. Write notes on any **TWO** of the following: **(10 each)** **(20)**
(a) Dielectric medium and Electric Polarization
(b) Ampere's Law
(c) Accelerators

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