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.**
(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

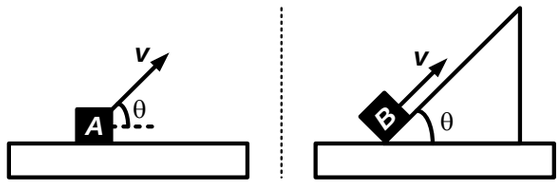
Q. No. 2. **(a)** Show that the work done by a constant force is equal to the difference of initial and final kinetic energies of the body. **(8)**

(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)**

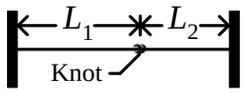


(i) At its maximum height, which object has the larger kinetic energy? Explain.

(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)**

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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?

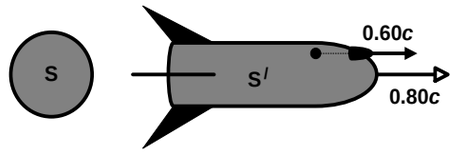
(c) A maintenance crew is working on a section of a three lane highway, leaving only one lane open to traffic. The result is much slower traffic flow (a traffic jam). Do cars on a highway behave like **(4)**

(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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PHYSICS, PAPER-II

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PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

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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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