

KHYBER PAKHTUNKHWA PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR THE POSTS OF PMS-2022

PAPER PHYSICS-I

Time allowed: 03 hours

Maximum marks: 100

NOTE: Attempt any FIVE questions

- Q. No. 1 (a) Show that for any three vectors A , B & C : 10
 $A \times B \times C = B(A \cdot C) - C(A \cdot B)$ & $A \cdot B \times C = -B \cdot A \times C$
- (b) Show that the vectors: $A=2i-j+k$, $B=i-3j-5k$, $C=3i-4j-4k$, form the sides of a 06
right triangle.
- (c) Explain in what sense a vector equation contains more information than a 04
scalar equation.
- Q. No. 2 (a) Consider a system of n -particles, each having its own mass, velocity and linear 10
momentum. Find its linear momentum and show that it is conserved.
- (b) A cannon whose mass $M=1300$ kg fires a ball whose mass $m=72$ kg in a 06
horizontal direction with a velocity $v = 55$ m/s relative to cannon, which
recoils (freely) with a velocity V relative to earth. Find V .
- (c) A football is thrown across the field. What can you say about conservation of 04
its vertical and horizontal linear momentum.
- Q. No. 3 (a) State and explain the Keplers law of orbits, -areas and -periods. Do they hold 10
for satellites orbiting earth or any massive central body.
- (b) A playful astronaut puts a bowling ball whose mass m is 7.20 kg into a circular 06
orbit about the earth at an altitude h of 350 km. Find the kinetic and potential
energy of the ball and its mechanical energy on the launching pad.
- (c) If the gravitational force acts on all bodies in proportion to their masses, why 04
doesn't a heavy body fall correspondingly faster than a light body?
- Q. No.4 (a) Consider a wave moving along a stretched string. Find the average rate at 10
which kinetic energy and power is transmitted by the wave.
- (b) A sinusoidal wave travelling along a string is described by: 06
 $y(x,t) = 0.00327 \sin(72.1x-2.72t)$ in which the numerical constants are in SI
units (0.0032 m, 72.1 rad/m and 2.72 rad/s). Find the amplitude, wavelength,
period and wave number of this wave.
- (c) What is the basic difference between a mechanical wave and an 04
electromagnetic wave? Give examples of each type of waves.
- Q. No. 5 (a) Explain diffraction of light from a single slit by using phasors and hence 10
determine the intensity of light.

- (b) A converging lens, 32 mm in diameter and with a focal length of 24 cm, is used to form images of objects. What angular separation must two distant objects have to satisfy Rayleigh's criterion? How far apart are the centers of diffraction patterns due to point objects in the focal plane of the lens? 06
- (c) Why is the diffraction of sound waves more evident in daily life than that of light waves? 04
- Q. No. 6 (a) Explain how diffraction occurs from a diffraction grating. Determine the diffraction equation, dispersion and resolving power of a grating. 10
- (b) How many rulings must a 4.0 cm wide diffraction grating have to resolve the wavelengths 415.496 nm and 415.487 nm in the second order? At what angle are maxima found? 06
- (c) Why do radio waves diffract around buildings, although light waves do not? 04
- Q. No. 7 (a) Use first law of thermodynamics to explain adiabatic-, constant volume- and cyclic-processes. 10
- (b) How much heat is needed to take ice of mass $m = 720$ g at -10°C to a liquid at 15°C ? 06
- (c) Why must heat be supplied to melt ice when, after all the temperature does not change? 04
- Q. No. 8 (a) State Maxwell's distribution law for distribution of speed of gas molecules. Use it to explain the speed distribution of water molecules in the case of rain. 10
- (b) A container is filled with oxygen gas maintained at 300 K. What fraction of molecules have speed in the range 599-601 m/s? The molar mass of oxygen is 0.0320 kg/mol. 06
- (c) List effective ways of increasing the number of molecular collisions per unit time in a gas. 04