Federal Board HSSC-I (2016)

PHYSICS HSSC-I

SECTION-A (Marks 17)

Time allowed: 25 Minutes

NOTE: - Section-A is compulsory and comprises pages 1-2. All parts of this section are to be answered on the question paper itself. It should be completed in the first 25 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q1. Circle the correct option i.e. A / B / C / D. Each part carries one mark.

i. Boltzmann constant $k = \frac{R}{N_A}$, where "R" is the general gas constant and "N_A" is Avogadro's number. What is the SI units of "k"?

A $Jmol^{-1}K^{-1}$ B $JmolK^{-1}$
C JK D JK^{-1}

ii. Which of the following is the dimensions of angular momentum?

A $[ML^2T^{-2}]$ B. $[MLT^{-1}]$
C $[MLT^{-2}]$ D. $[ML^2T^{-1}]$

iii. Which of die following pairs contains one vector and one scalar quantity?

A Torque, Angular momentum
B Work, Power
C Impulse, Torque
D Impulse, Energy

iv. A girl throws a ball vertically upward with a velocity of 20 ms^{-1}. Ignore the air resistance, how long will it take to fall back to her hands? ($g = 10ms^{-2}$)

A. 6 seconds B. 2 seconds
C. 3 seconds D 4 seconds

v. Which of the following quantities is equal to area under velocity - time graph?

A Distance B. Acceleration
C Work done D Power

vi. What is equal to one kilowatt - hour (1kWh)?

A 3.6 MJ B 3.6 μJ
C 3.6 mJ D 3.6 kJ

vii. A projectile is thrown with same initial velocity. For which pair of angles its range is equal?

A. 10°, 80° B. 10°, 40°
C 10°, 50° D 10°, 70°

viii. Two vectors $\vec{A}$ and $\vec{B}$ are enclosing an angle "θ" For which value of θ, $|\vec{A}\times\vec{B}| = |\vec{A}\cdot\vec{B}|$?

A 90° B 0°
C 45° D 60°

ix. A hoop of mass "m" rolls down an inclined plane of height "h", reaches the bottom with linear velocity "v" and angular velocity "ω". If friction is ignored, what is the total energy of the hoop at the bottom of inclined plane?

A mv^2 B $\frac{1}{4}mv^2$
C $\frac{1}{2}mv^2$ D $\frac{3}{4}mv^2$

x. What is the length of simple pendulum whose time period is one second?

A. 0.25 m B. 2.00 m
C. 0.99 m D. 0.50 m

xi. For a mass spring system placed on a smooth horizontal surface oscillating with amplitude "x_0". At what displacement from the mean position energy it's equal to its elastic potential energy?

A. $\frac{x_0}{4}$ B x_0
C $\frac{x_0}{2}$ D. $\frac{x_0}{\sqrt{2}}$

xii. When two notes of frequencies "f_1" and "f_2" are sounded together, beats are produced. If $f_1 > f_2$ what will be the period of beats?

A $\frac{1}{f_1 - f_2}$ B $f_1 + f_2$
C $f_1 - f_2$ D $\frac{1}{f_1 + f_2}$

xiii. Electric current measured by an ammeter is 0.5 A. Which of the following correctly expresses this result?

A 500 MA B 50 mA
C 50 MA D 500 mA

xiv. A stationary sound wave has series of nodes. The wavelength of the sound wave is "λ". What is the distance between first and fifth node.

A 2λ B $\frac{\lambda}{4}$
C $\frac{\lambda}{2}$ D $\frac{3\lambda}{2}$

xv. Which of die following expressions does not have the units equal to joule? Where "P" is the linear momentum and "m" is the mass of the object moving with velocity "v".

A Fd B. $\frac{P^2}{2m}$
C. mv^2 D Fv

xvi. A converging lens of focal length "f" is used as a magnifying glass. What is its angular magnification when final image is formed at infinity? Where "d"

A $\frac{f}{d}$ B $1 + \frac{d}{f}$
C $1 + \frac{f}{d}$ D $\frac{d}{f}$

xvii. When light of wavelength "λ" is incident on a lens of diameter "D" What is the correct expression for its resolving power?

A $\frac{\lambda}{1.22D}$ B $\frac{1.22D}{\lambda}$
C $\frac{1.22\lambda}{D}$ D $\frac{D}{1.22\lambda}$

PHYSICS HSSC-I

Time allowed: 2:35 Hours Total Marks Section B & C: 68

NOTE: - Section-'B' and 'C' comprises pages 1-2 and questions therein are to be answered on the separately provided answer book. Answer all questions from Section 'B' and Section 'C'. Use supplementary answer sheet i.e. Sheet-B if required. Write your answers your neatly and legibly.

SECTION - B (Marks 42)

Q.2 Attempt any FOURTEEN parts. The answer to each part should not exceed 5 to 6lines each. (14 × 3 = 42)

(i) Speed 'v' of sound waves through air is $v = \sqrt{\frac{E}{\rho}}$, where 'E' is the modulus of elasticity and 'ρ' is the density of air. Show that this equation is dimensionally consistent.

(ii) Under what conditions the work done on an object is negative? Give two examples from your daily life

(iii) An object moves with constant velocity $\vec{v}$ under the action of a constant force $\vec{F}$ Show that power $P = \vec{F}.\vec{v}$

(iv) A car takes 2.50 ± 0.05 s to travel 40.0 ± 0.1m. Calculate the average speed of the car and uncertainty in this value

(v) A picture is suspended from a wall by two equal strings. The tension in the strings will be minimum when angle of strings with the horizontal is 90°. Justify

(vi) Under what conditions the magnitude of cross product of two vectors $\vec{A}_1$ and $\vec{A}_2$ zero?

(vii) Safety helmet prevents the motorcyclist from serious injury. Explain

(viii) Find the angle of projection for which maximum height of a projectile is equal to half of its horizontal range

(ix) Why does a diver change his body positions before and after diving in the pool? Explain

(x) Water flows through a hose whose internal diameter is 1.0 cm with a speed of 2.0 ms^{-1} What should be the diameter of the nozzle, if the water is to emerge at 20 ms^{-1}?

(xi) State Hooke's law. Show that work done on a spring of spring constant 'k' is $\frac{1}{2}kx^2$when it is extended upto a displacement 'x'

(xii) An organ pipe has a length of 50 cm. Find the frequency of its fundamental note. When it is

(a) open at both ends

(b) closed at one end (speed of sound =350 ms^{-1})

(xiii) How is the distance between the interference fringes affected by the separation between the slits of Young's arrangement? Can interference fringes disappear?

(xiv) Why does sound travel faster in solids than the gases? Explain

(xv) Why fog droplets appear to be suspended in air? Explain

(xvi) How can we gain energy from tides? Explain

(xvii) For diatomic gases $\gamma = 1.4$ show that the specific heat at constant pressure 'c_p' and the specific heat at constant volume 'c_v' are $\frac{7}{2}R$ and $\frac{5}{2}R$ respectively where 'R' is the general gas constant

(xviii) In the Young's slit arrangement, one of the slits is covered with blue filter and other with red filter. What would be the pattern of light intensity on the screen? Explain

(xix) What are the main components of spectrometer? Also write their function in brief

SECTION – C (Marks 26)

Note: Attempt any TWO questions. (2×13=26)

Q.3 a. Define conservative field. Show that gravitational field is conservative field (01 + 04)

b. What are the geostationary orbits? Prove $\left|\frac{GMT^2}{4\pi^2}\right|^{\frac{1}{3}}$. Also show that height of geostationary satellites above the equator is 36000 km (01 + 02 + 02)

c. A force (thrust) of 400 N is required to overcome road friction and air resistance in propelling an automobile at 108 kmh^{-1} Find the power of the engine in kilowatt (03)

Q4 a. Define Simple Harmonic Motion (SHM). Show that motion of a simple pendulum is SHM. Also derive an expression for its time period T (02 + 04 + 01)

b. A block weighing 4.0 kg extends a spring by 16 cm from its unstretched position. The block is removed and a 0.5 kg body is hung from the same spring and set vibrating. Find the period of vibration of the body (03)

c. For a mass spring system $v = v_0\sqrt{1 - \frac{x^2}{x_0^2}}$ where 'v_0' is the maximum velocity and 'x_0' is the amplitude of oscillation. From the above equation deduce $x = x_0\sqrt{1 - \frac{v^2}{v_0^2}}$ (03)

Q.5 a. Describe Young's double slit experiment. Derive expressions to find

(i) Position of bright fringes from central maxima

(ii) Position of dark fringes from central maxima

(iii) fringe spacing (width) (03 + 02 + 02 + 01)

b. Sodium light of wavelength 589 nm is incident normally on a grating having 3000 lines per centimeter. How many orders of spectra can be observed on either side of the central maxima on the screen? (03)

c. Under what conditions two or more sources of light behave as coherent? (02)