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Roll No. | | | | | | |

Answer Sheet No._____

Sig. of Candidate._____

Sig. of Invigilator._____

PHYSICS HSSC–I

SECTION – A (Marks 17)

Time allowed: 25 Minutes

NOTE: Sections–A is compulsory and comprises page 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.

Q. 1 Circle the correct option i.e. A / B / C / D. Each part carries one mark.

(i) When light of wavelength 'λ' is incident on a lens of diameter 'D'. What is the correct expression for its resolving power?

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

(ii) Boltzman 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. JK^{-1} B. $J\,mol^{-1}\,K^{-1}$ C. $J\,mol\,K^{-1}$ D. JK

(iii) Which of the following is the dimensions of angular momentum?

A. $\left[ML^2T^{-1}\right]$ B. $\left[ML^2T^{-2}\right]$

C. $\left[MLT^{-1}\right]$ D. $\left[MLT^{-2}\right]$

(iv) Which of the following pair contains one vector and one scalar quantity?

A. Impulse, Energy B. Torque, Angular momentum

C. Work, Power D. Impulse, Torque

(v) 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. 4 seconds B. 6 seconds C. 2 seconds D. 3 seconds

(vi) Which of the following quantities is equal to area under velocity-time graph?

A. Power B. Distance C. Acceleration D. Work done

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

A. 3.6 kJ B. 3.6 MJ C. 3.6 μJ D. 3.6mJ

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

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

(ix) Two vectors $\vec{A}$ and $\vec{B}$ are enclosing an angle 'θ'. For which value of θ, $\left|\vec{A}\times\vec{B}\right|=\left|\vec{A}.\vec{B}\right|$?

A. $60°$ B. $90°$ C. $0°$ D. $45°$

DO NOT WRITE ANYTHING HERE

(x) 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. $\frac{3}{4}mv^2$ B. mv^2 C. $\frac{1}{4}mv^2$ D. $\frac{1}{2}mv^2$

(xi) What is the length of a simple pendulum whose time period is one second?

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

(xii) For a mass spring system placed on a smooth horizontal surface oscillating with amplitude 'x_o'. At what displacement from the mean position its kinetic energy is equal to its elastic potential energy?

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

(xiii) 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. $\frac{1}{f_1 - f_2}$ C. $f_1 + f_2$ D. $f_1 - f_2$

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

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

(xv) 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. $\frac{3\lambda}{2}$ B. 2λ C. $\frac{\lambda}{4}$ D. $\frac{\lambda}{2}$

(xvi) Which of the 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. Fv B. Fd C. $\frac{P^2}{2m}$ D. mv^2

(xvii) 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' is the distance of near point.

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

For Examiner's use only:

Total Marks:	**17**
Marks Obtained:	

24

PHYSICS HSSC–I

Time allowed: 2:35 Hours **Total Marks Sections B and C: 68**

NOTE: Sections B and C comprise pages 1-2. Answer any fourteen parts from Section 'B' and any two questions from Section 'C' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 42)

Q. 2 Attempt any FOURTEEN parts. The answer to each part should not exceed 3 to 4 lines. (14 x3 = 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 workdone 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 $2.50 \pm 0.05\,s$ to travel $40.0 \pm 0.1m$. 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^{o}. Justify.

(vi) Under what conditions the magnitude of cross product of two vectors $\vec{A}_1$ and $\vec{A}_2$ is 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 = $350ms^{-1}$)

(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. All questions carry equal marks.** **(2 x 13 = 26)**

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

b. What are the geostationary orbits? Prove $r = \left[\frac{GMT^2}{4\pi^2}\right]^{1/3}$. 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)**

Q. 4 **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, $v = v_o\sqrt{1-\frac{x^2}{x_o^2}}$, where '$v_o$' is the maximum velocity and 'x_o' is the amplitude of oscillation. From the above equation deduce $x = x_o\sqrt{1-\frac{v^2}{v_o^2}}$ **(03)**

Q. 5 **a.** Describe Young's double slit experiment. Derive expressions to find: **(03+02+02+01)**

(i) position of bright fringes from central maxima.

(ii) position of dark fringes from central maxima.

(iii) fringe spacing (width)

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)**

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Roll No. | | | | | | |

Answer Sheet No._____

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PHYSICS HSSC–I

SECTION – A (Marks 17)

Time allowed: 25 Minutes

NOTE: Sections–A is compulsory and comprises page 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.

Q. 1 Circle the correct option i.e. A / B / C / D. Each part carries one mark.

(i) For a diatomic gas γ =1.4, specific heat at constant volume 'c_v' is $\frac{5}{2}R$, where 'R' is the gas constant. What is the value of 'c_p' (the specific heat at constant pressure)?

A. $\frac{7}{3}R$ B. $\frac{7}{2}R$ C. $\frac{7}{5}R$ D. $\frac{5}{3}R$

(ii) Amount of heat absorbed by Carnot engine is 'Q_1' when temperature is T_1 (K) and amount of heat rejected to the sink is 'Q_2' at temperature T_2 (K). Which of the following relations is correct for its efficiency?

A. $\frac{T_2-T_1}{T_1}$ B. $\frac{Q_1-Q_2}{Q_1}$ C. $\frac{Q_2}{Q_1}$ D. $\frac{Q_2-Q_1}{Q_1}$

(iii) Which of the following quantities has the dimensions as $\left[ML^2T^{-3}\right]$?

A. Pressure B. Angular momentum

C. Work D. Power

(iv) Which of the following pair contains both the vector quantities?

A. Torque, Angular momentum B. Velocity, Power

C. Work, Acceleration D. Energy, Impulse

(v) Which is equal to area under force-displacement graph?

A. Work done B. Power C. Acceleration D. Impulse

(vi) Kinetic Energy (KE) of an object of mass 'm' moving with velocity 'v' is $\frac{1}{2}mv^2$. What will be its KE, when its velocity is doubled and mass is halved?

A. $\frac{1}{2}KE$ B. $2KE$ C. $\frac{1}{8}KE$ D. $\frac{1}{4}KE$

(vii) For which value of θ, $\left|\vec{A}+\vec{B}\right|=\left|\vec{A}-\vec{B}\right|$? Where 'θ' is the angle between $\vec{A}$ and $\vec{B}$.

A. 45° B. 90° C. 0° D. 30°

(viii) A disc of mass 'm' rolls down an inclined plane of height 'h', reaches the bottom with linear velocity 'v' and angular velocity 'ω'. What is its rotational kinetic energy, if friction is ignored?

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

DO NOT WRITE ANYTHING HERE

(ix) If 'M' is the mass and 'R' is the radius of the earth. What will be the correct expression for escape velocity 'v' on the surface of earth?

A. $v = gR$ B. $v = 2gR$ C. $v = \sqrt{gR}$ D. $v = \sqrt{2gR}$

(x) A simple pendulum having time period 2.0 seconds is called second's pendulum. What is its frequency?

A. $2.0Hz$ B. $4.0Hz$ C. $0.5Hz$ D. $1.0Hz$

(xi) A mass spring system placed on a smooth horizontal surface is oscillating with amplitude 'x_o'. At what displacement from the mean position, its kinetic energy is twice to that of its elastic potential energy?

A. $\sqrt{2}\ x_o$ B. $\sqrt{3}\ x_o$ C. $\frac{x_o}{\sqrt{2}}$ D. $\frac{x_o}{\sqrt{3}}$

(xii) How many maximum number of beats per second can be recognized by a normal ear?

A. 8 B. 10 C. 2 D. 4

(xiii) Focal lengths of objective and eyepiece of a telescope are 'f_o' and 'f_e' respectively. What will be its length, when it is in the normal adjustment?

A. $\frac{f_e}{f_o}$ B. $f_o + f_e$ C. $f_o - f_e$ D. $\frac{f_o}{f_e}$

(xiv) A stationary sound wave has series of nodes. The distance between the first and sixth node is 30 cm. What is the wavelength of the sound wave?

A. 10 cm B. 12 cm C. 5.0 cm D. 6.0 cm

(xv) A 1000 kg sports car accelerates from rest to $20ms^{-1}$ in 10 seconds. What is the average power delivered by the automobile engine?

A. 200 kW B. 2000 kW C. 2 kW D. 20 kW

(xvi) In the white light spectrum obtained with a diffraction grating, the third order image of a wavelength 'λ_1' coincides with the fourth order image of a second wavelength 'λ_2'. What is the ratio of two wavelengths $\lambda_1 : \lambda_2$?

A. 3 : 4 B. 4 : 3 C. 2 : 1 D. 1 : 2

(xvii) Which of the following is correct for final image formed by a compound microscope?

A. It is virtual, erect and enlarged B. It is virtual, inverted and enlarged

C. It is real, inverted and enlarged D. It is real, erect and enlarged

For Examiner's use only:

Total Marks:	17
Marks Obtained:	

2-6

PHYSICS HSSC–I

Time allowed: 2:35 Hours **Total Marks Sections B and C: 68**

NOTE: Sections B and C comprise pages 1-2. Answer any fourteen parts from Section 'B' and any two questions from Section 'C' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 42)

Q. 2 Attempt any FOURTEEN parts. The answer to each part should not exceed 3 to 4 lines. (14 x3 = 42)

(i) Velocity of waves along a string is $v=\sqrt{\frac{T}{m}}$, where 'T' is the tension in the string and 'm' is mass per unit length of the string. Show that this equation is dimensionally correct.

(ii) Under what conditions the work done on an object is zero, when a constant force is acting on the object? Explain with examples.

(iii) Two identical balls move towards each other on a smooth horizontal track at speeds $60cms^{-1}$ and $40cms^{-1}$. They stick together on impact. Calculate the speed of the balls after impact.

(iv) Given that $\vec{A}=2\hat{i}-\hat{j}+2\hat{k}$ and $\vec{B}=4\hat{i}-2\hat{j}+4\hat{k}$. Find the projection of $\vec{A}$ on $\vec{B}$.

(v) Show that time rate of change of momentum of a body is equal to the applied force.

(vi) A cup is dropped from certain height in the presence of air, which breaks into pieces on impact with the ground. What energy changes are involved? Explain.

(vii) A particle P is revolving along a circular path of radius 'r' with linear velocity 'v' and angular velocity ω. Prove that $v=r\omega$.

(viii) When mud flies off the tyre of a moving bicycle, in what direction does it fly? Explain.

(ix) Show that product of cross-sectional area 'A' of the pipe and the fluid speed 'v' at any point along the pipe is constant for an incompressible fluid when its flow is steady.

(x) The frequency of the note emitted by stretched string is 300Hz. What will be the frequency of the note when length of the wave is reduced by one third without changing the tension? Show calculation steps.

(xi) Fringes of separation Δy are observed on a screen 1.00 m from a Young's slit arrangement that is illuminated by yellow light of wavelength 600nm. Calculate the distance from the slits to observe the fringes of same separation Δy ,when using blue light of wavelength 400 nm.

(xii) An astronomical telescope having magnifying power 5, consists of two thin convex lenses which are 36 cm apart. Find the focal lengths of the lenses, when telescope is in the normal adjustment.

(xiii) Give drawbacks to use the period of a simple pendulum as a time standard.

(xiv) Define kilowatt-hour (kWh). Show that 1kWh = 3.6 MJ.

(xv) An object of mass 'm' is tied to a string and whirled in a vertical circle of radius 'r'. At what point on the circle the string is likely to break? Explain.

(xvi) Show that orbital angular momentum of a satellite of mass 'm' revolving with linear velocity 'v' in a circular orbit of radius 'r' is equal to mvr.

(xvii) Two vectors $\vec{A}$ and $\vec{B}$ are enclosing an angle θ. Show that the magnitude $\vec{A}\times\vec{B}$ is equal to the area of the parallelogram formed with $\vec{A}$ and $\vec{B}$ as its two adjacent sides.

(xviii) How would you distinguish between unpolarized and plane polarized lights? Explain.

(xix) Why is specific heat of gas at constant pressure greater than specific heat at constant volume?

SECTION – C (Marks 26)

Note: **Attempt any TWO questions. All questions carry equal marks.** **(2 x 13 = 26)**

Q. 3 **a.** Define and explain scalar product of two vectors, also write its properties **(01+02+04)**

b. Find the angle between two vectors $\vec{A}$ and $\vec{B}$, such that $\vec{A} = 5\hat{i} + \hat{j}$ and $\vec{B} = 2\hat{i} + 4\hat{j}$. **(03)**

c. Derive a relationship for the time period 'T' of a simple pendulum using dimensional analysis. Where 'T' depends on length of the pendulum 'ℓ', mass of the bob 'm', acceleration due to gravity 'g' and angle 'θ' which the thread makes with the vertical. **(03)**

Q. 4 **a.** Define elastic and inelastic collisions. For elastic collision in one dimension between two smooth, non-rotating balls, show that the magnitude of relative velocity of approach is equal to the magnitude of relative velocity of separation. **(01+01+04)**

b. What is projectile motion. Derive an expression for horizontal range of a projectile, when projected with initial velocity 'vi' at an angle 'θ' with the horizontal. **(01+03)**

c. A football is thrown upward at an angle of 30° with the horizontal. To throw a 40 m pass, what must be the initial speed of the ball? **(03)**

Q. 5 **a.** What is a Carnot engine? Discuss different steps of Carnot cycle. Also derive an expression for its efficiency. **(01+03+03)**

b. A heat engine performs 100 J of work and at the same time rejects 400 J of heat energy to the cold reservoir. Find the efficiency of the engine. **(03)**

c. Show that ratio of the root mean square speeds of molecules of two different gases at certain temperature is equal to the square root of the inverse ratio of their masses. **(03)**

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