## PHYSICS (042)

## General instructions:

1. All questions are compulsory. There are 37 questions in all.
2. This question paper has four sections.
3. Section A contains 20 questions of 1 mark each, Section B contains 7 question of 2 marks each, Section C contains 7 questions of 3 marks each and Section D contains 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices have been provided in 2 questions of 1 mark each, 2 questions of 2 marks, 1 question of 3 marks and 3 questions of 5 marks weightage. You have to attempt only one of the choices in such questions.
5. Use of calculators is not permitted. However you can use log tables if necessary.
6. You may use the following values of physical constants.

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\begin{array}{ll}
\mathrm{G}=6.674 \times 10^{-11} \mathrm{Nm}^{2} / \mathrm{kg}^{2} & \mathrm{M}_{\text {earth }}=6 \times 10^{24} \mathrm{~kg} \\
\mathrm{R}_{\text {earth }}=6.4 \times 10^{3} \mathrm{~km} & \mathrm{M}_{\text {moon }}=7.347 \times 10^{22} \mathrm{~kg} \\
\mathrm{~g}_{\text {earth }}=9.8 \mathrm{~m} / \mathrm{s}^{2} & \mathrm{~g}_{\text {moon }}=1.625 \mathrm{~m} / \mathrm{s}^{2}
\end{array}
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## SECTION -A

1. Conservation of momentum in a collision between particles can be understood from $\qquad$ .
(Conservation of energy, Newton's First Law only, Newton's Second Law only, Both Newton's Second and Third Law)
2. The acceleration due to gravity at a height 1 km above the earth is same as at a depth 'd' below the surface of earth. Then, $\qquad$ .
a) $\mathrm{d}=1 / 2 \mathrm{~km}$
b) $\mathrm{d}=1 \mathrm{~km}$
c) $d=3 / 2 \mathrm{~km}$
d) $\mathrm{d}=2 \mathrm{~km}$
3. If Ve is escape velocity and Vo is orbital velocity of a satellite for orbit close to the earth surface, then they are related by $\qquad$ —.
a) $\mathrm{Vo}=\sqrt{2 \mathrm{Ve}}$
b) $\mathrm{Vo}=\mathrm{Ve}$
c) $\mathrm{Ve}=\sqrt{2 \mathrm{Vo}}$
d) $\mathrm{Ve}=\sqrt{2} \mathrm{Vo}$
4. Bernoulli's theorem is based upon $\qquad$ .
(Conservation of momentum, Conservation of energy, Conservation of mass, None of these)
5. Streamline flow is more likely for liquids with $\qquad$ .
(high density, high viscosity, low viscosity, none of these)
6. An ideal gas undergoes isothermal process from some initial state ' $i$ ' to final state ' $f$ '. Choose the correct alterative.
a) $\mathrm{dU}=0$
b) $d Q=0$
c) $d Q=d U$
d) $d Q=d W$
7. Which type of ideal gas will have largest value for $\mathrm{Cp}-\mathrm{Cv}$ ?
(Mono atomic, Diatomic, Polyatomic, Same for all)
8. At a place where $\mathrm{g}=9.8 \mathrm{~m} / \mathrm{s}^{2}$, the length of seconds pendulum is about $\qquad$ .
( $50 \mathrm{~cm}, 100 \mathrm{~cm}, 2 \mathrm{~cm}, 2 \mathrm{~m}$ )
9. The acceleration of particle executing SHM when it is at mean position is $\qquad$ .
(infinite, varies, maximum, zero)
10. Speed of sound waves in a fluid depends on $\qquad$ .
(directly on density of the medium, square of bulk modulus of the medium, inversely on square root of density and directly on square root of bulk modulus of the medium, none of these)
11. A large force acting for a short time to produce a finite change in momentum is called $\qquad$ .
12. The time period of a spring pendulum is $\qquad$ -.
13. If the angle of friction is $30^{\circ}$, the coefficient of friction is $\qquad$ .
OR
$\qquad$ provide the centripetal force to a car taking a turn on a level road.
14. $\qquad$ is a device that uses work to transfer energy from a reservoir which is at low temperature to a reservoir which is at high temperature.
15. The additional potential energy per unit area of the surface film as compared to the molecules in the interior is called $\qquad$ .
16. State 'Zeroth law of thermodynamics'.
17. Is the maximum height attained by projectile is largest when its horizontal range is maximum?
18. Name two practical applications of Pascal's Law.
19. State Kepler's Third Law of Periods.

OR
Define gravitational potential at a point.
20. What is Doppler Effect?

## SECTION - B

21. Define cross product of two vectors. How is its direction determined?
22. A hammer of mass 1 kg moving with a speed $6 \mathrm{~m} / \mathrm{s}$ strikes a wall and comes to rest in 0.1 second. Calculate.
a) Impulse of force.
b) Retarding force that stops the hammer.
23. Determine the gravitational potential at the height of $36,000 \mathrm{~km}$ of geostationary satellite. (Given mass of earth is $6 \times 10^{24} \mathrm{~kg}, \mathrm{R}=6400 \mathrm{~km}$ ) OR
Discuss the variation of ' $g$ ' with altitude.
24. What is heat engine? Define its efficiency.
25. What is meant by an ideal fluid?

OR
Derive the relationship between surface tension and surface energy.
26. Explain why it is impossible to design heat engine with $100 \%$ efficiency.
27. List any two characteristics of simple harmonic motion.

## SECTION - C

28. Derive an expression for the work done during the isothermal expansion of an ideal gas.
29. Derive the Law of Conservation of linear momentum from Newton's Third Law of Motion.
30. Find the magnitude and direction of resultant of two vectors A and B in terms of their magnitude and angle $\theta$ between them.
31. Derive an expression for the time period of the horizontal oscillations of a mass less loaded spring.
32. A cyclist speeding at $5 \mathrm{~m} / \mathrm{s}$ on a level road takes a sharp circular turn of radius 3 m without reducing the speed. The coefficient of static friction between the tyres and the road is 0.1 . Will the cyclist slip while taking the turn?

OR
Derive an expression for velocity of a car on a banked circular road having coefficient of frictions.
33. A steel wire 0.72 m long has a mass of $5 \times 10^{-3} \mathrm{~kg}$, if the wire is under tension of 60 N . What is the speed of transverse wave on the wire?
34. Differentiate between Geostationary satellites and Polar satellites. Mention their uses.

## SECTION - D

35. A projectile is fired with a velocity $u$ making an angle $\theta$ with the horizontal. Show that its trajectory is a parabola. Derive expressions for
a) Time of flight.
b) Maximum height.
c) Horizontal range.
OR

Define centripetal acceleration. Derive an expression for the centripetal acceleration of a particle moving with uniform speed $v$ along a circular path of radius $r$. Discuss the direction of this acceleration.
36. Describe the operation of Carnot engine. Calculate the efficiency of a Carnot engine.

OR
Describe the working of a refrigerator as a heat pump. Derive an expression for its coefficient of performance.
37. Show that for small oscillations the motion of simple pendulum is simple harmonic. Derive an expression for its time period. Does it depend on mass of the bob?

OR
a) Show that the acceleration of a particle in SHM is proportional to its displacement from its mean position.
b) Draw acceleration-time graph for particle executing SHM.

