DELHI PUBLIC SCHOOL

SAIL TOWNSHIP, RANCHI

ANNUAL EXAMINATION (2017-18)

Class:- XI **Subject:- Physics**
Time- 3 Hrs. **F. M:- 70**

General Instructions:-

(i) All questions are compulsory. There is no overall choice. However there is one choice in each of Section B and Section C. Section E has choices in all the three questions.
(ii) Section A has 5 questions ,each of 1 mark.
(iii) Section B has 5 questions, each of 2 marks.
(iv) Section C has 12 questions, each of 3 marks.
(iv) Section D has one value-based question of 4 marks.
(v) Section E has three questions , each of 5 marks.

Section- A

Q.1 **Write down the equation of the First law of thermodynamics when it is applied to an isochoric process.** **[1]**

Q.2 **State Hooke's Law.** **[1]**

Q.3 **If the speed of a motor car is doubled, how much more distance will it cover before stopping, under the same retarding force?** **[1]**

Q.4 **Draw the stress-strain graph pertaining to a brittle body.** **[1]**

Q.5 **If the coefficient of friction of a rough inclined plane is $\sqrt{3}$, what is the angle of repose?** **[1]**

Section- B

Q.6 **A body of mass 1 kg , at rest, explodes into three fragments of masses in the ratio 1:1:3. The two pieces of equal masses fly in mutually perpendicular directions with a speed of 30 m/s each. What is the velocity of the heavier fragment?** **[2]**

Q.7 **Two particles of masses 2 kg and 1 kg are moving along the same straight line with speeds 2m/s and 5m/s respectively. What is the speed of the centre of mass of the system if both the particles are moving (i) in the same direction and (ii) in opposite direction?** **[2]**

Q.8 **Derive an expression to show how the acceleration due to gravity (g) varies with the altitude (h) of place. Represent the result graphically.** **[2]**

Q.9 **Draw a labelled block diagram of a heat engine. Write the expression for it's efficiency.** **[2]**

OR

Using P = $\frac{1}{3}\rho\ \overline{v}^{\ 2}$ [where the notations carry their usual meaning], prove (i) Boyle's law (ii) kinetic interpretation of temperature.

Q.10 **Prove that the motion of a simple pendulum, for small oscillations, is simple harmonic in nature.** **[2]**

Section- C

Q.11 **The energy of a system as a function of time t is given as $E(t) = A^2\ e^{-\alpha t}$ where $\alpha = 0.2\ s^{-1}$.**

The measurement of A has an error of 1.25 % and the error in the measurement of time is 1.5 %. Find the percentage error in the value of E(t) at t=5 sec. **[3]**

Q.12 **With reference to projectiles , derive expressions for (i) time of flight (T) (ii) maximum height attained (H_{max}) and (iii) horizontal range (R) .** **[3]**

Q.13 **What are beats? Derive an expression for the beat frequency.** **[3]**

Q.14 **Using the method of dimensions, derive Stoke's formula.** **[3]**

Q.15 **A body of mass 0.5 kg travels in a straight line with velocity v=$ax^{3/2}$ where a = 5$m^{-1/2}$ s^{-1}. What is the work done by the net force during it's displacement from x=0 to x= 2 m?** **[3]**

OR

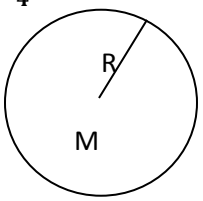
Derive an expression for the P.E. stored in a spring of spring constant k when it is stretched by a length 'A'. Show graphically the variation of this P.E. with the distance from it's mean position on either side.

Q.16 **State and prove Bernoulli's theorem.** **[3]**

Q.17 **Derive an expression for the work done in an isothermal expansion of a gas.** **[3]**

Q.18 **What do you mean by escape velocity? Derive an expression for escape velocity.** **[3]**

Q.19 **From a uniform circular disc of mass M and radius R, a circular disc of radius (r=$\frac{R}{4}$) is removed as shown. Find the position of the centre of mass of the remaining portion of the disc.** **[3]**



Q.20. **State the triangle law of vector addition. Deduce an expression for the magnitude and direction of the resultant of two vectors, using this law.** **[3]**

Q21. **With reference to satellites; derive expressions for their (a) orbital velocity (b) time period (c) height above the ground.** **[3]**

Q.22 **Find the component of a vector $\vec{A}$ = 3 î + 2 ĵ along the direction of (î+ĵ) and (î − ĵ) .** **[3]**

Section- D

Q.23 **Ravi went to the market along with his grandfather and purchased a weighing machine. They came back to their society complex and entered the lift. Ravi placed the weighing machine on the floor of the lift and asked his grandfather to stand on it. The reading was 50 kg. When the lift started moving up, the reading increased to 75 kg and when the lift stopped at the 10th floor, the reading dropped to 50 kg. His grandfather got annoyed, scolded him and insisted that the machine was faulty. Ravi calmly explained why the machine was not faulty.**

(i) What are the values exhibited by Ravi?

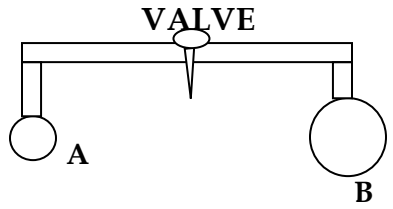
(ii) Give a mathematical formula which supports Ravi's explanation. **[4]**

Section- E

Q.24 **Define terminal velocity. Deduce an expression for terminal velocity of a spherical body falling through a viscous medium. What will happen if the density of the surrounding medium is greater than the density of the body?** **[5]**

OR

Derive an expression for the excess pressure in an air bubble in water. Consider two bubbles of different sizes formed at the two ends of a tube as shown in the figure. When the valve is opened , which of the two bubbles will grow at the cost of the other? Why?



Q.25 **What is an elastic collision? Discuss elastic collision between two bodies in one dimension. Find the final velocities of the two bodies after collision.** **[5]**

OR

State work-energy theorem. Using calculus, prove the theorem. The kinetic energy of a body decreases by 19% . What is the percentage decrease in it's linear momentum?

Q26. **What are stationary waves? Discuss analytically how stationary waves are formed in stretched strings. Deduce expressions for the frequencies in the various modes of vibrations.** **[5]**

OR

The sirens of two fire engines have a frequency of 600 Hz each. A man hears the sirens from the two engines, one approaching him with a speed of 36 km/hr and the other going away from him at 54 km/hr. What is the difference in frequencies of the two sirens heard by the man? Take the speed of sound to be 340 ms^{-1}.

Differentiate between progressive and stationary waves. (2 points)

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