CBSE Board
Class XI Physics

Time: - 3 **Marks: - 70 Marks**

General Instructions

(a) All questions are compulsory.
(b) There are 29 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 16 carry two marks each, questions 17 to 25 carry three marks each and questions 27 to 29 carry five marks each.
(c) Question 26 is a value based question carrying four marks.
(d) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choices in such questions.
(e) Use of calculator is not permitted.
(f) You may use the following physical constants wherever necessary.

$$e = 1.6\times10^{-19} C$$
$$c = 3\times10^{8} ms^{-1}$$
$$h = 6.6\times10^{-34} JS$$
$$\mu_o = 4\pi\times10^{-7} NA^{-2}$$
$$k_B = 1.38\times10^{23} JK^{-1}$$
$$N_A = 6.023\times10^{23} / mole$$
$$m_n = 1.6\times10^{-27} kg$$

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1. Find the dimension of α in the following equation:

$F = \alpha/x + \nu$

Where, F = force applied, x = distance covered, α and ν are constants. (1)

2. Can a body undergo change in speed or direction due to internal forces? (1)

3. An impulse is applied to a moving object with a force at an angle of 20° w.r.t velocity vector. What is the angle between the impulse vector and change in momentum vector? (1)

4. In a tug of war, one team is slowly giving way to the other. What work is being done and by whom? (1)

5. What are the factors on which the position of centre of mass of a body depends? (1)

6. Will Bernoulli's principle be applicable in case of a parachute falling through atmosphere? (1)

7. What is thermal conductivity of a perfect heat conductor and a perfect heat insulator? (1)

8. Write the differential equation for SHM. (1)

9. The nearest star to our solar system is 4.29 light year away. How much is this distance in terms of parsecs? (2)

10. Define speed. How is it different from velocity? (2)

OR

Distinguish between damped and forced oscillations. What do you mean by resonant oscillations? (2)

11. A bomb is released from a horizontally flying bomber when it is vertically above the target. Will it hit the target? (2)

12. A 120 g mass has a velocity of $\vec{v} = \left(2\hat{i} + 5\hat{j}\right)$ m/s at a certain instant t. What is its K.E.?

(2)

13. A wheel rotates with a constant angular acceleration of 3.6 rad/s^2. If the angular velocity of the wheel rotate is 4.0 rad/s^2 at t_o=0, what angle does the wheel rotate in 1s? What will be its angular velocity at t = 1s? (2)

14. If a planet existed whose mass and radius were both half that of the earth, what would be the value of the acceleration due to gravity on its surface as compared to what it is on the earth's surface? (2)

15. Define efficiency of a heat engine. Also draw the symbolic representation of a heat engine. (2)

16.

(a) In equation, PV = RT, what does V stand for?

(b) In the equation, PV/2 = RT, what does V stand for? (2)

17. State with reasons, whether the following algebraic operations with scalars and vectors are meaningful:

(a) adding any two scalars,

(b) adding a scalar to a vector of same dimension,

(c) multiplying any vector by any scalar,

(d) multiplying any two scalars,

(e) adding any two vectors, and

(f) adding a component of a vector to the same vector. (3)

18. Two masses m_1 and m_2 are connected at the ends of a light inextensible string that passes over frictionless pulley. Find the acceleration, tension in the string and thrust on the pulley when the masses are released. (3)

19. Does the expression K.E = ½ mv^2 hold for a variable force? Prove it. (3)

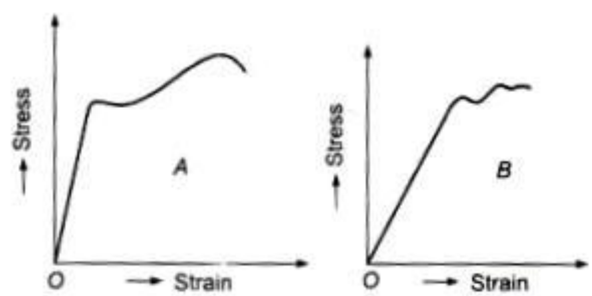
20. Calculate the work done in blowing a soap bubble of radius 10 cm, surface tension being 0.06 Nm^{-1}. What additional work will be done in further blowing it so that its radius is doubled? (3)

21. Assume that the thermal conductivity of copper is four times that of brass. Two rods of copper and brass, of the same length and cross section are joined end to end. The free end of the copper rod is kept it 0^oC and the free end of the brass rod at 100^oC. Calculate the temperature at junction of the two rods at equilibrium. Ignore radiation losses. (3)

OR

Show that for small oscillations the motion of a simple pendulum is simple harmonic. Drive an expression for its time period. Does it depend on the mass of the bob? (3)

22.



The stress versus strain graphs for two materials A and B are shown in fig. The graphs are to the same scale.

(i) Which material has greater Young's modulus?
(ii) Which material is more ductile?
(iii) Which is more brittle?
(iv) Which of the two is the stronger material? (3)

23. State a few statements for second law of thermodynamics. (3)

24. State:

(i) Avogadro's law
(ii) Graham's law of diffusion
(iii) Dalton's law if partial pressure. (3)

25. The motion of a car along y-axis is given by $v(t) = -12t + 12$ where velocity v is in m/s and time t in seconds. Find the instantaneous position of the car as a function of time if at $t = 0$ it was at 5 m. Also find its acceleration at $t = 2$ second. (3)

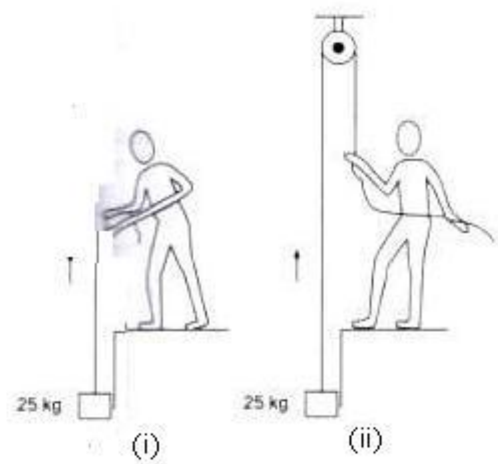
26. Having seen a big stone falling from the top of a tower Ravi pulled his friend Kiran away. The stone hit Ravi slightly and he got hurt. But he was saved from a major accident.

(a) What can you say about values of Ravi?

(b) From the top of a tower 100 m in height, a ball is dropped and at the same time another ball is projected vertically upwards from the ground with a velocity of 25 m/s. Find when and where the two balls meet. Take $g = 9.8\ m/sec^2$. (4)

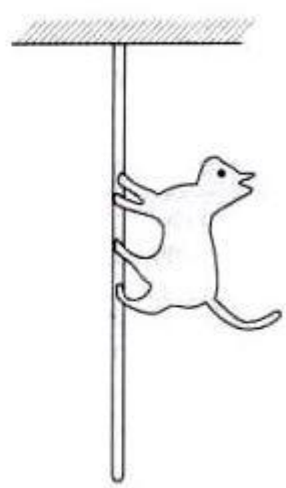
27.

(i)



A block of mass 25 kg is raised by a 50 kg man in two different ways as shown in figure. What is the action on the floor by the man in the two cases? If the floor yields a normal force of 700 N, which mode should the man prefer?

(ii)



An animal of mass 40 kg climbs on a rope which can stand a maximum tension of 600 N. In which of the following cases will the rope break. The animal

(a) climbs up with an acceleration of 6 ms^{-2}
(b) climbs down with an acceleration of 4 ms^{-2}
(c) climbs up with a uniform speed of 5 ms^{-1}
(d) falls down the rope nearly under gravity?
Take g = 10 ms^{-2} and ignore the mass of the rope. (5)

OR

What do you understand by 'laminar flow' and 'streamlined flow'? Water is flowing with a speed of 2 m/s in a horizontal pipe with cross sectional area 2×10^{-2} m^2 at pressure 4×10^4 Pa. What will be the pressure at a smaller cross section where the area decreases to 0.01 m^2? (5)

28. Explain why:
(i) A body with large reflectivity is a power emitter.
(ii) A brass tumbler feels much colder than a wooden tray on a chilly day.
(iii) An optical pyrometer (for measuring high temperatures) calibrated for an ideal black body radiation gives too low a value for the temperature of a red hot piece in the open, but gives a correct value for the temperature when the same piece is in the furnace.
(iv) The earth without its atmosphere would be inhospitably cold.
(v) Heating systems based on circulation of steam are more efficient in warming a building than those based on circulation of hot water. (5)

OR

Two identical springs each of force constant K are connected in (a) series (b) parallel, so that they support a mass m. Find the ratio of the time periods of the mass in the two systems. (5)

29. Obtain an expression for the apparent frequency of a note by an observer when
(a) source alone is in motion towards the observer.
(b) source alone is in motion away from the observer.
(c) observer alone is in motion towards the source.
(d) observer alone is in motion away from the source.
(e) when the source and observer are moving towards each other. (5)

OR

State Hooke's law. Draw a stress-strain curve for a metal and mark the proportional limit, elastic limit and fraction point.
Define each of the terms: proportional limit, elastic limit and fraction point. (5)

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Class XI Physics
Solution

1.
Dimension of α = dim of F × dimension of x
As dimension of LHS = dimension of RHS (each term)

$\alpha = [ML^2T^{-2}]$

2.
No, it is not possible. In order to change the state of motion of a body, some net external force must act on the body.

3.
Impulse and change in momentum are along the same direction. Therefore, angle between these two vectors is zero degree.

4.
Work is done by the winning team. It is equal to the product of the resultant force applied by the two teams and the displacement that the losing team suffers.

5.
It depends upon the shape and size of the body and the distribution of its mass.

6.
Since in case of a parachute fall, appreciable work is done against the non-conservative force of friction, Bernoulli's equation as such cannot be applied.

7.
K is infinity for perfect heat conductor and K is Zero for perfect heat insulator.

8.

$$\frac{d^2y}{dt^2} + \omega^2 y = 0$$

9.

$$1 \text{ light year} = 9.46 \times 10^{15}\ \text{m}$$

$$1 \text{ par sec} = 3.08 \times 10^{16}\ \text{m}$$

$$\therefore 1 \text{ light year} = \frac{9.46 \times 10^{15}}{3.08 \times 10^{16}}$$

$$= 0.307 \text{ par sec}$$

Distance of Alpha centauri

$$= 4.29 \times 0.307 \text{ par sec}$$

$$= 1.32 \text{ par sec}$$

10.

Speed of a moving body is defined as the rate of change of position of the body with respect to time. It is measured by the distance travelled by the body in a unit time.

$$\text{speed} = \frac{\text{Distance travelled by the body}}{\text{Time taken}}$$

Velocity of a moving body is defined as the rate of change of position of the body along a particular direction with respect to time.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

OR

Damped oscillations are oscillations in which dissipative forces act as additional restoring forces to continuously decrease the amplitude of oscillation.

Forced oscillations are oscillations whose amplitude is maintained by an external periodic force which compensates for the energy loss in damped oscillations.

Resonant oscillations are those forced oscillations in which the frequency of driver force matches with the natural frequency of the system resulting in large increase in amplitude.

11.

No, the bomb will not hit the target. At the time the bomb is released, it has horizontal velocity same as that of the bomber. Due to this velocity (say u) it will fall a distance $u = \sqrt{2h/g}$ ahead of the target, where h is the height of the bomber when the bomb is dropped.

12.

$$K.E = \frac{1}{2}mv^2$$

$$= \frac{1}{2}m\,(\vec{v}.\vec{v})$$

$$= \frac{1}{2}m\,(2\hat{i}+5\hat{j}).(2\hat{i}+5\hat{j})$$

$$= \frac{1}{2}\times\frac{120}{1000}(4+25)J$$

$$= 1.74J$$

13.

$\alpha = 3.6\,rad/s^2$

$\omega_o = 4.0\,rad/s,$

$\theta = ?\ t = 1s$

Using $\theta = \omega_o t + \frac{1}{2}\alpha t^2$

$$= 4\times1+\frac{1}{2}\times.36\times1$$

$$= 4+1.8 = 5.8\,rad$$

Again $\omega = \omega_o + \alpha t = 4+3.6\times1$

$$= 7.6\,rad/s$$

14.

We know, $g = \frac{GM}{R^2}$ ....(i)

$g' = \frac{GM'}{(R')^2}$ ....(ii)

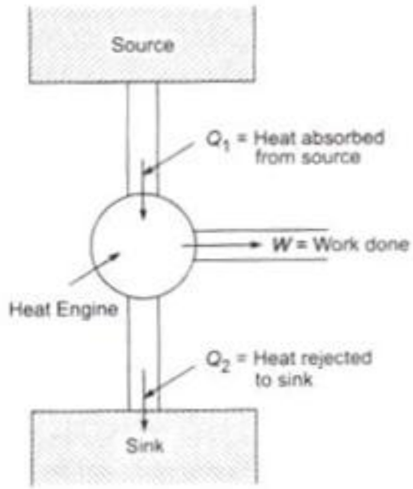
From (i) and (ii) we have,

$$g'/g = \left(\frac{M'}{M}\right)\left(\frac{R}{R'}\right)^2$$

$$= \frac{1}{2}\times2^2 = 2$$

$g' = 2g$

15.



Consider the above figure. The thermal efficiency of a heat engine is gives as:

$$\eta = \frac{\text{Useful work done}}{\text{Heat absorbed (in energy units)}}$$

$$= \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1}$$

Since $Q_2 < Q_1$ the value of η is always less than unity.

16.

(a) Volume of 1 mole of a gas.

(b) Volume of 2 moles of gas.

17.

(a) It is meaningful, if both the scalars represent the same physical quantities.

(b) It is not permissible as the vector can only be added to another vector.

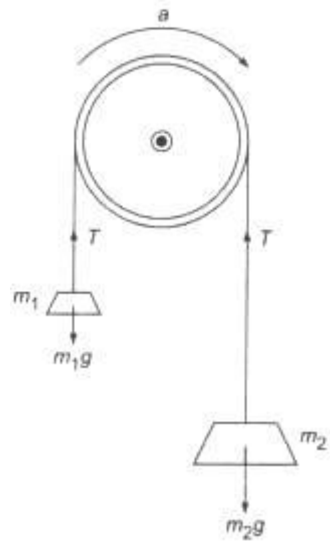
(c) It is permissible, e.g. mass multiplied with velocity.

(d) it is permissible, e.g. volume multiplied by density equals mass.

(e) It is permissible, if both the vectors represent the same physical quantity, otherwise not. For example we can add the forces, but not force and velocity.

(f) It is permissible.

18.



The pulley system with mass m_1 and m_2 is shown in the figure above. The tension T is same throughout.

For mass m_1: $\quad T - m_1g = m_1a \quad$ (i)

For mass m_2: $\quad m_2g - T = m_2a \quad$ (ii)

Adding (i) and (ii), we have,

$$(m_2 - m_1)g = (m_1 + m_1)a$$

or $$a = \left(\frac{m_2 - m_1}{m_2 + m_1}\right)g \qquad \text{(iii)}$$

Putting this value in (i) we get,

$$T = m_1g + m_1\left(\frac{m_2 - m_1}{m_2 + m_1}\right)g$$

$$= \frac{[m_1(m_2 - m_1) + m_1(m_2 - m_1)]}{(m_2 - m_1)}$$

$$T = \frac{2m_1m_2\,g}{(m_2 + m_1)} \qquad \text{(iv)}$$

$\therefore$ Thrust on the pulley is given by,

$$2T = \frac{4m_1m_2\,g}{(m_2 + m_1)}$$

19.

Yes, the expression K.E = 1/2 mv^2 holds for a variable force also. Suppose some variable force F acts on a body producing displacement S along the direction of the applied force. Then, the work done by the force which measures the kinetic energy of the body is given by

$$W = K.E = \int F\,ds$$

$$= \int ma\,ds \;(\because F = ma)$$

$$= \int m\frac{dv}{dt}dS\left(\because a = \frac{dv}{dt}\right)$$

$$= \int m\left(\frac{dv}{dS}\right)\left(\frac{dS}{dt}\right)dS$$

$$= \int mv\frac{dv}{dS}dS = \int mv\,dv$$

$$= m\int v\,dv$$

If the velocity of the body increase from u to v.

$$K.E = m\int_u^v v\,dv = m\frac{\left(v^2 - u^2\right)}{2}$$

for $u = 0$, $\quad K.E = \frac{1}{2}mv^2$

This agrees with the espression.

20.

In case of a soap bubble, there are two free surfaces.

Work done in blowing a soap bubble of radius R

is given by, $W = 2\times 4\pi R^2\sigma$

where σ is the surface tension of the soap solution.

Here, $\quad R = 0.1m,\ \sigma = 0.06\,Nm^{-2}$

$$W = 8\pi(0.1)^2\times 0.06\,J = .0151J$$

Similarly, work done in forming a bubble of radius 0.2m is,

$$W' = 8\pi(0.2)^2\times 0.06\,J = .0603\,J$$

Additional work done in doubling the radius of the bubble is given by

W' - W = 0.0603 J - 0.0151 J = 0.0452 J

21.

Let the thermal conductivity of brass be K.

Thermal conductivity of copper = 4 K.

Length of each rod = x

Suppose θ is the temperature of the junction of the two rods in equilibrium.

Rate of flow of heat energy through brass = rate of flow of heat energy through copper

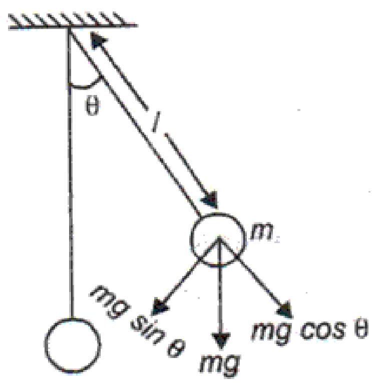
$$\frac{K.A.(100-\theta)}{x} = \frac{4K.A.(\theta-0)}{x}$$

$$\text{Or} \quad (100-\theta) = 4(\theta-0)$$

$$\text{Or} \quad 5\theta = 100$$

$$\theta = \frac{100}{5} = 200°C$$

OR



Restoring force is provided by the portion $mg\sin\theta$ of gravitational force.

Since it acts perpendicular to length l, the restoring torque= $-mg\sin\theta l$

Also, $\tau = I\alpha = ml^2\alpha$

$\therefore ml^2\alpha = -mg\sin\theta l$

$\alpha = -\frac{g\sin\theta}{l}$

For small oscillations, $\sin\theta \cong \theta$

$\therefore \alpha = -\frac{g}{l}\theta$

$\frac{d^2\theta}{dt^2} = -\frac{g}{l}\theta$ i.e., $\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$

giving $\omega = \sqrt{\frac{g}{l}}$ and $T = 2\pi\sqrt{\frac{l}{g}}$

Time period doesn't depend on mass of bob.

22.

(i) A, because for producing the same strain, more stress is required in case of the material A.

(ii) A, because it has a greater plastic range.

(iii) B, because it has a lesser plastic range.

(iv) A is stronger as it can beat greater stress before the wire of this material will break.

23.

(i) Kelvin's statements: It is impossible to obtain a continuous supply of energy by cooling a body below the coldest of its surrounding.

(ii) Clausius' statement: It is impossible for a self-acting machine, unaided by any external agency, to transfer heat from a body at a lower temperature to a body at a higher temperature.
In other words, heat cannot by itself (i.e. without the performance of work by an external agency) pass from a cold to a hot body.

(iii) Planck's statement: It is impossible to construct an engine which, operating in a cycle will produce an effect other than extracting heat from a reservoir and performing an equivalent amount of work.

24.

(i) It states that equal volumes of all gases under identical conditions of temperature and pressure, contain the same number of molecules.

(ii) The rates of diffusion of two gases are inversely proportional to the square roots of their densities (when determined under identical condition).

(iii) The resultant pressure exerted by a mixture of gases or vapours, which do not interact in any way, is equal to the sum of their individual (or partial) pressures.

25.

$$x(t) = \int \upsilon \, dt = \int (-12t + 12)dt$$

$$= -12\frac{t^2}{2} + 12t + c$$

$$= -6t^2 + 12t + c$$

Since, at t = 0, x(0) = 5, therefore, c = 5

Therefore, $x(t) = -6t^2 + 12t + 5$ m

Also, $a = \frac{dv}{dt}$

$$= -12 \text{ m/s}^2$$

26.

(a) Presence of mind and concern for his friend.

(b) Suppose the two stones collide at a distance h from the top

Equation of motion of falling stone is

$$h = 0 \times t + \frac{1}{2}gt^2 = \frac{1}{2}gt^2 \qquad \text{(i)}$$

Equation of motion of stone thrown vertically up is

$$100 - h = 25t - \frac{1}{2}gt^2 \qquad \text{(ii)}$$

From equations (i) and (ii), we get

$$100 = 25t$$

$$\therefore t = 4 \text{ s}$$

Thus, from equation (i), we get

$$h = \frac{1}{2} \times 9.8 \times 4^2 = 78.4 \text{ m}$$

Therefore, height from the ground is

$$\text{Height} = 100 - 78.4 = 21.6 \text{ m}$$

27.

(i) The action on the floor by the man in case (i) is given by

$R = m_1g + m_2g = (m_1 + m_2)g$

where m_1 = 25 kg (mass required to be lifted)

And m_2 = 50 kg (mass of man)

R = (75 × 9.8) N = 735 N

The action on the floor by the man in case (ii) is given by

$R = m_2g - m_1g = (m_2 - m_1)g$

= (50 - 25)g = (25 × 9.8)

R = 245 N

Since the action of the man on the floor in case (ii) is less than in case (i) and since the floor can yield a normal force of 700 N, therefore, the man should prefer mode (ii) to lift the weight.

(ii)

(a) The tension developed in string when the animal climbs up with an acceleration of 6 ms^{-2} is given by

T = m (g + a)

= 40 (10 + 6) = 640 N

(b) The tension developed in the string when the animal climbs down with an acceleration of 4 ms^{-2} if given by

T = m (g - a)

= 40 (10-4) = 240 N

(c) When the animal climbs up with a uniform speed of 5 ms^{-1}, acceleration is zero and the tension developed is given by

$T = mg = 40 \times 10 = 400$ N

(d) As the animal falls down the rope nearly under gravity, the tension in the string is given by

$T = m (g - a)$

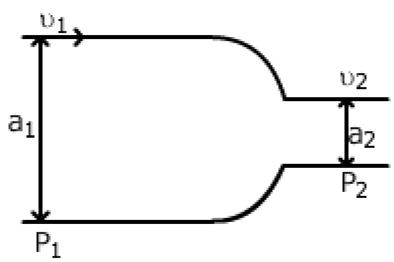
But a = g, for free fall

$T = m (g - g) = 0$

Since the string can withstand a maximum tension of 600 N, hence the rope will break only in the first case (a).

OR

Laminar flow occurs when a fluid flows in parallel layers, with no disruption between the layers.



$$P_1 + \frac{1}{2}\rho v^2{}_1 = P_2 + \frac{1}{2}\rho v^2{}_2 \text{ and } a_1 v_1 = a_2 v_2$$

Therefore, $P_2 = P_1 + \frac{1}{2}\rho\left(v_1^2 - v_2^2\right)$

$$= P_1 + \frac{1}{2}\rho\left[v_1^2 - \left(\frac{a_1}{a_2}\right)^2 v_1^2\right]$$

$$= P_1 + \frac{1}{2}\rho v_1^2\left[1 - \left(\frac{a_1}{a_2}\right)^2\right]$$

$$= 4 \times 10^4 + \frac{1}{2} \times 10^3 \times 4\left[1 - \frac{4 \times 10^{-4}}{1 \times 10^{-4}}\right]$$

$$= 4 \times 10^4 - 0.6 \times 10^4$$

$$= 3.4 \times 10^4 \text{ P}_a$$

28.

(i) The body having a large reflectivity (or bright surface) is a poor absorber of heat radiations. The poor absorbers are poor radiators. Therefore, a body with a large reflectivity is a poor emitter.

(ii) Brass is a good conductor of heat. When we touch the brass tumbler, the heat is quickly transferred from the fingertips to the tumbler. Thus, we feel colder touching the brass (or any other) tumbler on a chilly day.

(iii) The temperature of the red hot iron in the oven is given by $E_1 = \sigma T^4$. However, when the iron is taken out in the open (T_0), then its radiant energy is given by $E_2 = \sigma\left(T^4 - T_0^4\right)$. Therefore, the pyrometer will measure a low value for the red hot iron in the open.

(iv) The atmosphere acts as a blanket over the earth and does not allow earth's heat to be radiated during the night.

(v) Because steam contains more heat in the form of latent heat (540 cal/g) than water.

OR

For each spring, spring constant is k

In series spring constant is $\frac{k}{2}$

In parallel spring constant is 2k.

$$T_{\text{series}} = 2\pi\sqrt{\frac{m}{k/2}} = 2\pi\sqrt{\frac{2m}{k}}$$

$$T_{\text{Parallel}} = 2\pi\sqrt{\frac{m}{2k}} = 2\pi\sqrt{\frac{m}{2k}}$$

$$T_{\text{series}} = 2T_{Parallel}$$

29.

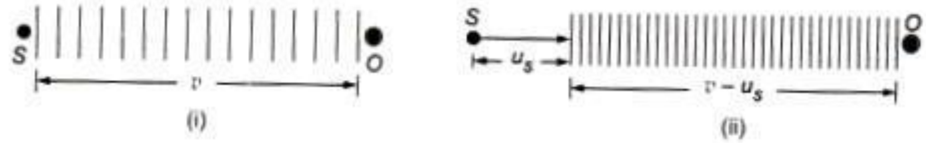


Fig. 1

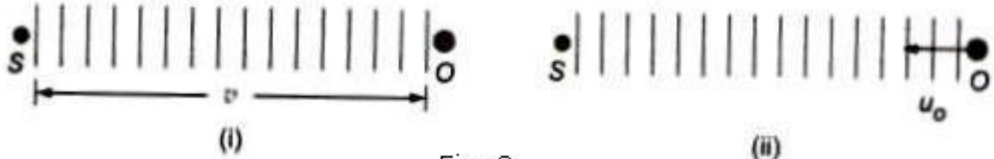


Fig. 2

(a) **When source alone is in motion towards an observer**: The source (S) of sound is moving towards the stationary observer (O) with velocity, say u_s. Let *n* be the frequency of the sound waves. Thus, the source emits *n* waves per second.
Let *v* be the velocity of the sound waves.

If the source was at rest, *n* waves emitted by S would have occupied a distance *v* in one second. The first wave travels a distance *v* when *n*th wave is just emitted by S, as shown in figure 1 (i).

True wavelength, $\lambda = \frac{v}{n}$

As the source has moved a distance u_s towards O, in one second *n* waves emitted by S will occupy a distance (v - u_s) as shown in figure 1 (ii). Therefore, the wavelength will be reduced. Let the reduced wavelength be λ' and apparent frequency n'.

$$\therefore \lambda' = \frac{(v - u_s)}{n}$$

But $n' = \frac{v}{\lambda'} = \frac{vn}{(v - u_s)}$

$$\therefore n' = \frac{nv}{(v - u_s)}$$

Clearly then, $n' > n$

(b) When S moves away from the observer:

In this case, the n waves emitted by S in one second will occupy a distance $(v + u_s)$

$$\therefore \lambda' = \frac{v + u_s}{n}$$

Or $n' = \frac{v}{\lambda'} = \frac{vn}{(v + u_s)}$

$$\therefore n' = \frac{nv}{(v + u_s)}$$

Clearly then, $n' < n$.

(c) when observer alone is in motion towards the source.

If the observer was at rest, he would receive n waves in one second, where n is true frequency of the sorce S. When O moves towards the stationary S, in addition to the n waves per second he will receive waves contained in u_o(Fig 2).

In other words, O will receive $\frac{u_o}{\lambda}$ additional waves in one second.

$\therefore$ Apparent frequency (or pitch) received by O.

$$n' = n + \frac{u_o}{\lambda} = n + \frac{u_o}{v/n}$$

$$= n + \frac{nu_o}{v} = n\left(1 + \frac{u_o}{v}\right)$$

$$= \left(\frac{v + u_o}{v}\right)n$$

$$\text{or } n' = n\left(\frac{v + u_o}{v}\right)$$

Clearly, then $n' > n$

(d) When O is in motion away from stationary S:

In this case, the observer will receive in one second n waves minus the number of waves contained in a distance u_o.

$$\therefore\ n' = n - \frac{u_o}{\lambda} = n - \frac{u_o}{v/n}$$

$$= n\left(\frac{v - u_o}{v}\right)$$

Clearly, $n' < n$

(e) When source and observer both are in motion towards each other :

Consider only S moving towards stationary O.

Therefore, the apparent frequency n_1 is given by,

$$n_1 = \frac{nv}{(v - u_s)} \qquad \text{.............(i)}$$

But in addition, O is also moving therefore the apparent frequency n' in terms of n_1 will be given by,

$$n' = n_1\left(\frac{v + u_o}{v}\right)$$

$$= \frac{nv}{(v - u_s)} \times \left(\frac{v + u_o}{v}\right)$$

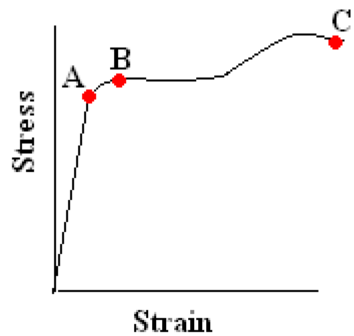
[Putting the value of n_1 from (i)]

$$= n\left(\frac{v + u_0}{v - u_s}\right)$$

Clearly, then $n' > n$

OR

Hooke's law states that for small deformations, stress is directly proportional to the strain.



In the region from O to A, the curve is linear. The strain is directly proportional to the stress. Beyond the point A, known as the proportional limit, the relation between stress and strain is not linear.

The point B on the graph is known as the elastic limit. Up to this point stress and strain are not directly proportional but the body returns to its original dimensions if the stress is removed.

Fracture point corresponds to point C on the graph at which the material breaks.