CBSE Board
Class XI Physics
Sample Paper – 9

Q1. Position of a body with acceleration a is given by x = Ka^m t^n. Here t is time. Find the dimension of m and n

(a) m=1,n=1
(b) m=1,n=2
(c) m=2,n=1
(d) m=2,n=2

Sol. (b)

$[M^{O}LT^{O}] = [M^{O}L^{m}T^{-2m}]\, M^{o}L^{o}T^{n}$

$[M^{O}LT^{O} = [\![M^{O}L^{m}T^{n-2m}]$

On both the sides dimensions should be equal

$m = 1$

$n - 2m = 0, n = 2m = 2.$

Q2. The square root of the product of inductance and capacitance has the dimension of

(a) length
(b) mass
(c) time
(d) no dimension

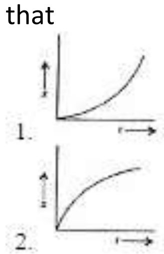
Sol. (c)

At resonance of LC circuit,

$\omega = \frac{1}{\sqrt{LC}} = or, T = 2\pi\sqrt{LC}$

$\therefore$ $\sqrt{LC}$ has dimension of time.

Q3. Figures show the displacement-time graphs of two particles moving along the x axis. We can say that



(a) Both the particles are having a uniformly retarded motion.
(b) Both the particles are having a uniformly accelerated motion.
(c) Particle (i) is having a uniformly accelerated motion while particle (ii) is having a uniformly retarded motion.
(d) Particle (i) is having a uniformly retarded motion while particle (ii) is having a uniformly accelerated motion

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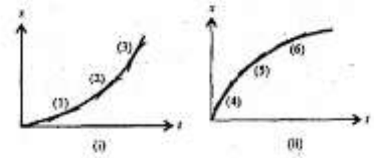
Sol. (c)



In Fig. (i) the slopes at 1, 2, 3 go on increasing. It means velocity goes on increasing. So this depicts uniform acceleration. In Fig. (ii) the slopes at 4, 5, 6 go on decreasing. It means velocity goes on decreasing. So this depicts uniform retardation.

Q4. A large number of bullets are fired in all directions with the same speed u . What is the maximum area on the ground on which these bullets will spread?

(a) $\frac{\pi v^2}{g}$
(b) $\frac{\pi v^4}{g^2}$
(c) $\frac{\pi^2 v^4}{g^2}$
(d) $\frac{\pi^2 v^2}{g^2}$

Sol. (b)

Maximum Range: $R_{max} = \frac{V^2 \sin 2\,(45°)}{g}$

$\Rightarrow = \frac{V^2}{g}$

Maximum Area $= \pi R_{max}^2 = \pi \left(\frac{V^2}{g}\right)^2 = \frac{\pi V^4}{g^2}.$

Q5. A hiker stands on the edge of a cliff 490 m above the ground and throws a stone horizontally with an initial speed, of 15 ms-1. The speed with which it hits the ground is

(a) 99 ms^{-1}
(b) 101 ms^{-1}
(c) 103 ms^{-1}
(d) 105 ms^{-1}

Sol. (a)

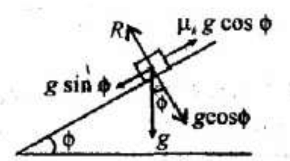
$v_y^2 = \mu_y^2 + 2a_y\, s_y$

$v_y^2 = 0^2 + 2(+9.8)(490) \Rightarrow v_y = 98 m/s$

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{15^2 + 98^2} = 99 ms^{-1}$

Q6. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by
(a) 2tan ϕ
(b) tan ϕ
(c) 2sin ϕ
(d) 2cos ϕ

Sol. (a)
For upper half smooth incline, component of g down the incline $= g \sin \phi$
$\therefore v^2 = 2(g \sin \phi)\frac{1}{2}$



For lower half rough incline, frictional retardation $= \mu_k g \cos \phi$
∴ Resultant acceleration $= g \sin \phi - \mu_k g \cos \phi$
∴ $0 = v^2(g \sin \phi - \mu_k g \cos \phi)\frac{1}{2}$
Or $0 = 2\,(g \sin \phi)\frac{1}{2} + 2g\,(\sin \phi - \mu_k \cos \phi)\frac{1}{2}$
Or $0 = \sin \phi + \sin \phi - \mu_k \cos \phi$
Or $\mu_k \cos \phi = 2 \sin \phi$ or $\mu_k = 2 \tan \phi$.

Q7. An aeroplane, which together with its load has a ma M = 9600 kg, is falling with an acceleration of a = 5 m/s^2. If a part of the load equal to m kg be thrown out, the aeroplane will begin to rise with an acceleration of a = 5 mls2. The value of m is
(a) 6400 kg
(b) 1600 kg
(c) 3200 kg
(d) 800 kg

Sol. (a)
Given M is the mass of the aeroplane. Lt R be the up thrust acting on it. Since it is falling down with an acceleration a, Mg-R=Ma
Let a mass m kg be thrown out. The remaining mass is (M - m) kg and now the plane begins to Rise up with an acceleration a m/s 2 .
Now R-(M-m) g = (M-m)a ...(ii)
Adding equations (i) and (ii),
$mg = (2m - m)a$
or, $m(g + a) = 2ma$
$\Longrightarrow m = \frac{2Ma}{a+g}\text{ kg} = \frac{2\times 9600\times 50}{5+10} = 6400\text{kg}$

Q8. A bomb of mass M at rest explodes into two fragments of masses m^1 and m^2. The total energy released in the explosion is E. If E_1 and E_2 represent the energies carried by masses m1 and m2 respectively, then which of the following is correct?

(a) $E_1 = \frac{m_2}{M} E$

(b) $E_1 = \frac{m_1}{m_2} E$

(c) $E_1 = \frac{m_1}{M} E$

(d) $E_1 = \frac{m_2}{m_1} E$

Sol. (a)

Q9. When a conservative force does positive work on a body, the potential energy of the body

(a) increases

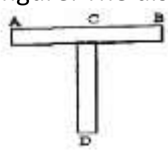
(b) decreases

(c) remains unaltered

(d) depends on the situation

Sol. (b)

Q10. Two identical thin uniform rods of length L each are joined to form T shape as shown in the figure. The distance of centre of mass from D is



(a) 0

(b) $\frac{L}{4}$

(c) $\frac{3L}{4}$

(d) L

Sol. (c)

$X_{cm} = \frac{m\left(\frac{L}{2}\right)+m(L)}{2m}$

Q11. Two particles of masses 2 kg and 3 kg are projected horizontally in opposite directions from the top of a tower of height 39.2 m with velocities 5 m/s and 10 m/s respectively. The horizontal range of the centre of mass of two particles is

(a) $8\sqrt{2}$ m in the direction of 2 kg

(b) $8\sqrt{2}$ m in the direction of 3 kg

(c) $\sqrt{8}$m in the direction of 2 kg

(d) $\sqrt{8}$ m in the direction of 3 kg

Sol. (b)

Range of COM $= \text{Vcm}\sqrt{\frac{2h}{g}}$

But $V_{cm} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$

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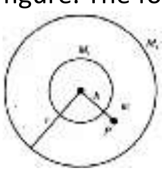
Q12. A stationary bomb explodes into two parts of masses in the ratio 2 : 3. If the heavier part moves with a velocity 6ms-1 towards east, then

a. the lighter part moves with velocity 9ms-1 towards west
b. the lighter part remains at rest
c. the velocity of the centre of mass of the two parts is zero after explosion.
d. the centre of mass moves along a parabolic path

(a) b & c are true
(b) a & d are true
(c) a & c are true
(d) a, c & d are true

Sol. (c)

Q13. Two concentric shells of uniform density having mass M_1 and M_2 are situated as shown in the figure. The force on the particle of mass m when it is located at r = b is



(a) $\frac{GM_1m}{b^2}$
(b) $\frac{GM_2m}{b^2}$
(c) $\frac{G(M_1+M_2)m}{b^2}$
(d) $\frac{G(M_1-M_2)m}{b^2}$

Sol. (a)
Since m is inside the shell M_2, the shell's. field for m is 0:
Hence, force on m is due to shell M_1 only.
$F = \frac{GM_1m}{b^2}$.

Q14. The question contains statement-1 (Assertion) and Statement-2 (Reason). It has four choices. You have to select the correct choice.
Assertion: A satellite moves round the earth in a circular orbit under the action of gravity. A person in the satellite experience a zero gravity field in the satellite.
Reason: The contact force by the surface on the person is zero.

(a) If statement-1 is true but statement 2 is false.
(b) If statement-1 is false and statement-2 is true.
(c) If both statement-1 and statement-2 are true and statement-2 is the correct explanation of statement-1.
(d) If both statement-1 and statement-2 are true but statement-2 is not the correct explanation of statement-1.

Sol. (b)
The person experiences zero net force as the force of gravity is balanced by the centrifugal force inside the satellite.

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Q15. The mass of the Earth is 81 times that of the Moon and the radius of the Earth is 3.5 times that of the Moon. The ratio of the acceleration due to gravity at the surface of the Moon to that at the surface of the Earth is
(a) 0.15
(b) 0.04
(c) 1
(d) 6

Sol. (a)
$g_{moon} = \frac{GM}{R^2}$
Where M and R are mass and radius of moon respectively ly.
$g_{earth} = \frac{G.(8\ 1M)}{(3.5\ R)^2}$
$g_{earth} = 6.61\ g_{moon}$
$\Rightarrow g_{moon} = \frac{1}{6.61}\ g_{earth} = 0.15\ g_{earth}$

Q16. Water rises in plant fibres due to
(a) osmosis
(b) fluid pressure
(c) viscosity
(d) capillarity

Sol. (d)

Q17. A ball hits the floor and rebounds. If the collision is in -elastic then
(a) the total momentum of the ball and earth is not conserved
(b) the kinetic energy during the collision is conserved
(c) the total momentum of the ball and earth is conserved
(d) both momentum and kinetic energy are not converved

Sol. (c)

Q18. Convection takes place
(a) only in gases
(b) only in liquids
(c) in solids and liquids
(d) in liquids and gases

Sol. (d)

Q19. A 6000W vessel of thermal capacity 200 J/K, contains 400g of water at 30°C. If heat is supplied to vessel at uniform rate and vessel loses no heat, then time taken to raise the temp to 60°C is
(a) 2s
(b) 7.4s
(c) 9.4s
(d) 3.4s

Sol. (c)
Work done = Total heat gained by water
$6000 \times \mathrm{t} = \mathrm{m\ s}\theta$
$6000 \times \mathrm{t} = 400 \times 10^{-3} \times 4200 \times 30 + 200 \times 30$
$\mathrm{t} = \frac{56400}{6000} = 9.4\ \mathrm{s}$

Q20. A process in which quantity of heat in the system does not change is called
(a) isochoric
(b) isobaric
(c) isothermal
(d) adiabatic

Sol. (d)

Q21. The fraction of the volume of a glass flask must be filled with mercury so that the volume of the empty space may be the same at all temperatures is
$(\alpha \text{ glass} = 9 \times 10^{-6} / {}^\circ\mathrm{C}, \gamma \text{ Hg} = 18.9 \times 10^{-5} / {}^\circ\mathrm{C})$
(a) $\frac{1}{2}$
(b) $\frac{1}{7}$
(c) $\frac{1}{4}$
(d) $\frac{1}{5}$

Sol. (b)
$\gamma_g V_g = \gamma\ V_1$

Q22. A brass rod and a steel rod are both measured at 0°C. Their lengths are found to be 150 cm and 150.2 cm respectively. At what common temperature will their lengths be equal.
$(\text{a' steel} = 12 \times 10^{-6} / {}^\circ\mathrm{C}, \text{a'brass} = 18 \times 10^{-6} / {}^\circ\ \mathrm{C})$
(a) 111.4 °C
(b) 167.°C
(c) 222.2°C
(d) 278.3°C

Sol. (c)
$\mathrm{t}^0\mathrm{C} = \mathrm{l}_1 - \mathrm{l}_2 / (\mathrm{l}_1\alpha_1 - \mathrm{l}_2\alpha_2)$

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Q23. The density of a lead 0°C is 11.34gm/ cc. What is the density of lead at 100° C, given the coefficient of leaner expansion of a lead $28 \times 10\ /°\mathrm{C}$
(a) 11.25 gm/cc
(b) 1.125gm/cc
(c) 52.5 gm/cc
(d) 13.52gm/cc

Sol. (a)
$d_1 = d_0\ (1 - \gamma\Delta t), \gamma = 3\alpha$

Q24. Assertion (A): A solid sphere $(\alpha = 2 \times 10^{-4}\ /°\mathrm{C})$ of radiuc 'r' is spinning about its diameter as axis with an angular speed w. If the temperature of sphere increases by 100°C, the ratio of new angular speed to original angular speed is 25:26
Reasion (R): Moment of inertia $\mathrm{I}^{\infty}\ \omega$
(a) A and R are correct and R is correct explanation for A
(b) A and R are correct and R is not correct explanation for A
(c) A is true and R is false
(d) A is wrong and R is true

Sol. (c)

Q25. The coefficient of linear expansion of glass is a'_g per °C and the cubical expansion of mercury is $\tilde{a}$ m per °C. The volume of the bulb of a mercury thermometer at 0°C is V0 and cross-section of the capillary at T°C, if the mercury just fills the bulb at 0°C?
(a) $\frac{V_0 T\ (\gamma_m + 3\alpha_g)}{A_0(1+2\alpha_g T)}$
(b) $\frac{V_0 T\ (\gamma_m - 3\alpha_g)}{A_0\ (1+2\alpha_g T)}$
(c) $\frac{V_0 T\ (\gamma_m + 2\alpha_g)}{A_0\ (1+3\alpha_g T)}$
(d) $\frac{V_0 T\ (\gamma_m + 2\alpha_g)}{A_0\ (1+3\alpha_g\ T)}$

Sol. (b)
Expansion in mercury $= V_0\ \gamma_m\ T$
Expansion in bulb $= V_0\ 3\alpha_g\ T$
Apparent expansion in mercury $V_0\ \gamma_m\ T - V_0\ 3\alpha_g\ T$
$= \Delta l = \frac{V_0\ \gamma_m\ T - V_0\ 3\alpha_g\ T}{A_0\ (1+2\alpha_g\ T)}$
The length of mercury coloumn
$h = \Delta l = \frac{V_0\ T(\gamma_m - 3\alpha_g)}{A_0(1+2\alpha_g T)}$

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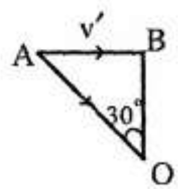
Q26. A sound wave has a frequency of 500 Hz and a velocity of 400 m/s. What is the distance between the two particles having phase difference of 60°?
(a) 13.3 cm
(b) 10.0 cm
(c) 60 cm
(d) 100 cm

Sol. (a)
$\lambda = \frac{400}{500} = 0.8\ \text{m}$
Distance between 2 particles with a phase difference of 60°
$= \frac{\lambda\phi}{2\pi} = \frac{0.8\times\pi}{3\times2\pi} = \frac{0.8}{6} = 0.133\ \text{m} = 13.3\ \text{cm}$
$1 \rightarrow 2\pi$
$? \rightarrow \pi/3$
$(\text{i.e.}\ \pi/3 = \phi)$

Q27. A man on the ground finds that when he sees a jet plane just over his a head, sound is heard at an angle of 30° with the vertical from left. The velocity of sound is v, then velocity of jet plane is
(a) $\left(2/\sqrt{3}\right)$ V
(b) $\left(\sqrt{3}/2\right)$ V
(c) 2v
(d) v/2

Sol. (d)


AB represents distance moved by jet plane
AO represents distance moved by sound during same time.
From fig $\frac{AB}{OA} = \sin 30° \Rightarrow \frac{v'\times t}{v\times t} = \frac{1}{2} \Rightarrow v' = v/2$

Q28. A pipe closed at one end resonates to its fundamental frequency of 400 Hz. out of the following 4 frequencies. Which frequencies can the pipe resonate1.800 2.1200 3.1600 4.2000
(a) 1 & 2 only
(b) 2 & 3 only
(c) 2 & 4 only
(d) 1, 2 & 3 only

Sol. (c)
The ratio of frequencie s in the closed pipe are 1: 3 : 5
∴ Frequencie s of overtones present in the closed pipe are 400 Hz, 1200 Hz, 2000 Hz

Q29. If an open pipe sounded with a tuning fork having frequency 256 / s, resonance occurs at 35 cm and 105 cm, the velocity of sound is
(a) 360 m/s
(b) 512 m/s
(c) 524 m/s
(d) all of these

Sol. (a)

30. The length of an organ pipe is 30 cm. The change in length required to maintain the frequency unchanged if temperature falls from 27°C to 7°C is
(a) increase in length by 1 cm
(b) decrease in length by 1 cm
(c) increase in length by 2 cm
(d) decrease in length by 2 cm

Sol. (b)
Frequency of organ pipe of $\alpha \frac{v}{\ell}$

$$\frac{f_{27}}{f_7} = \frac{v_{27}}{v_7} \times \frac{\ell_7}{\ell_{27}} \Rightarrow But\, \frac{v_{27}}{v_7} = \sqrt{\frac{T_{27}}{T_7}}$$

$$\therefore But\ \frac{f_{27}}{f_7} = 1 \quad \therefore 1 = \sqrt{\frac{T_{27}}{T_7}} \times \frac{\ell_7}{\ell_{27}}$$

$$\frac{\ell_7}{\ell_{27}} = \sqrt{\frac{280}{300}} \Rightarrow \quad \ell_7 = \sqrt{\frac{28}{30}} \times 30 = 29\ cm$$