Solution

NEET PHYSICS SAMPLE PAPER - 11 - 04

NEET-UG - Physics

Section A

1. **(a)** only iv

   Explanation: Work = force $\times$ distance

   = $[MLT^{-2}][L] = [ML^2T^{-2}]$

   Energy = $[ML^2T^{-2}]$

   Torque = $\vec{r} \times \vec{F}$ =[L] $\times$ $[MLT^{-2}] = [ML^2T^{-2}]$

2. **(b)** t^2

   Explanation: Given: Initial velocity of a body u = 0 ...(i)

   Let s be the distance covered by a body in time t

   $\therefore \quad s = ut + \frac{1}{2}at^2$ or $s = \frac{1}{2}at^2$ [using eqn. (i)]

   or $s \propto t^2$

3. **(a)** 1:1

   Explanation: Let u be the initial velocity of the projectile.

   For the angle of projection (45° + α), horizontal range is

   $R_1 = \frac{u^2 \sin 2(45^\circ+\alpha)}{g} = \frac{u^2 \sin(90^\circ+2\alpha)}{g} = \frac{u^2 \cos 2\alpha}{g}$

   For the angle of projection (45°- α), horizontal range is

   $R_2 = \frac{u^2 \sin 2(45^\circ-\alpha)}{g} = \frac{u^2 \sin(90^\circ-2\alpha)}{g} = \frac{u^2 \cos 2\alpha}{g}$

   $\therefore \quad \frac{R_1}{R_2} = 1$

4. **(a)** $\frac{F(m_2+m_3)}{m_1+m_2+m_3}$

   Explanation: Force experienced by mass $m_2 = (m_2 + m_3)a$

   $= \frac{(m_2+m_3)F}{(m_1+m_2+m_3)}$

5. **(d)** 0.0102

   Explanation: Let a = acceleration of the body.

   $v^2 = u^2 + 2as$ or $0 = 2a \times 5$

   $\therefore \quad a = -\frac{1}{10} = -0.1 m/s^2$ or Retardation = 0.1 m/s^2

   Now, F = mass $\times$ 0.1 = 0.1m

   Normal reaction, R - weight of the body = mg

   = m $\times$ 9.8N

   $\therefore \quad \mu = \frac{F}{R} = \frac{m \times 0.1}{m \times 9.8} = \frac{1}{98}$ = 0.0102

6. **(b)** 3.0

   Explanation: 3.0

7. **(a)** $m_1 >> m_2$

   Explanation: $m_1 >> m_2$

8. **(d)** 4 sin θ ms^{-1}

   Explanation: $T\cos\theta = Mg$ ...(i)

   $T\sin\theta = \frac{Mv^2}{r} = Mr\omega^2$ ...(ii)

   $= M(L\sin\theta)\omega^2$

   $\therefore \quad T = ML\omega^2 = ML(2\pi n)^2 = 4\pi^2 MLn^2$

$= 4\pi^2 ML\left(\frac{2}{\pi}\right)^2 = 16ML$

$= 16 \times 10^{-1} \times 1 = 1.6\text{N}$

$\omega = \frac{2}{\pi}\text{rev/sec} = \frac{2}{\pi} \times 2\pi = 4\text{rad/sec}$

Linear velocity

$v = r\omega = (L\sin\theta)\omega = \sin\theta \times 4 = 4\sin\theta\text{ms}^{-1}$

9. **(a)** 7.76 km s^{-1}

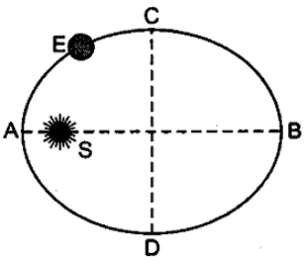
Explanation: $v_0 = \sqrt{\frac{gR^2}{R+h}} = \sqrt{\frac{9.8 \times (6.3 \times 10^6)^2}{6.38 \times 10^6 + 0.25 \times 10^8}}\ \text{ms}^{-1}$

= $6.38 \times 10^6 \sqrt{\frac{9.8}{6.63 \times 10^6}}\ \text{ms}^{-1}$

= 7.76×10^3 ms^{-1} = 7.76 km s^{-1}

10. **(c)** A

Explanation:



From the figure it is observed that speed of Earth will be maximum when its distance from Sun is minimum, it is due to mvr = constant.

So, the speed of motion of Earth will be maximum at point A.

11. **(c)** Material of the wire

Explanation: We know that the stress at which rupture occurs in a material is called its breaking stress. It depends only on the material of the wire.

12. **(b)** will contract but the final length will be greater than the original length

Explanation: The stress-strain graph of a ductile material is shown in the figure. Point A shows the limit of proportionality. Hooke's law is valid up to this limit. Point B shows the yield point. Material is elastic up to this point. If the material is strained up to this point, then on releasing it will regain its original shape and size But the material is deformed beyond this limit, say up to point 'P; then on release, it will follow the dotted line PQ. It means a deformation OQ will remain permanently. Hence, the final length of the wire will contract but the final length will be greater than the original length. Therefore, only this option is correct.

13. **(c)** zero

Explanation: As system is falling freely under gravity, hence effective value of acceleration of the system is zero. Hence, upthrust on the body due to liquid is also zero.

14. **(a)** $v \propto \frac{mg}{r\eta}$

Explanation: From the above equation it also follows that, $v_T \propto \frac{mg}{r\eta}$ [as (1 - $\frac{1-\sigma}{\rho}$) is dimensionless]

15. **(a)** 1

Explanation: The ratio between the re-emitted energy of a usual object and the re-emitted energy of a blackbody at the same temperature of the object is called emissivity and noted ε. This ratio depends on wavelength and is comprised between 0 and 1 and , the emissivity of a true blackbody equals 1.

16. **(c)** 5 : 3

Explanation: thermal resistance ,R= L/(KA)

where L- length of the rod ,K - thermal conductivity ,A - area of the rods

given $A_1 = A_2$ and $R_1 = R_2$

thus, $\frac{L_1}{K_1 \times A} = \frac{L_2}{K_2 \times A}$

$\frac{L_1}{L_2} = \frac{K_1}{K_2}$ = 5\3

17.

(c) 1.41

Explanation: For isothermal process, $P_1V_1 = P_2V_2$

or $PV = (2P)V_2$

$\therefore \quad V_2 = \frac{V}{2}$

For adiabatic process, $P_1V_1^{\gamma} = P_2V_2^{\gamma}$

$(2P)\left(\frac{V}{2}\right)^{\gamma} = \left(\frac{3}{4}P\right)V^{\gamma}$

$\therefore \gamma = 1.415$

18.

(d) P → 3, Q → 1, R → 4, S → 2

Explanation: Process (I) → Volume constant → Isochoric

Process (II) → Adiabatic

Process (III) → Temperature → Isothermal constant

Process (IV) → Pressure constant → Isobaric

19.

(d) $\frac{n_1T_1+n_2T_2}{n_1+n_2}$

Explanation: The average kinetic energy per molecule of a perfect gas = $\frac{3}{2}\mathrm{KT}$

Average kinetic energy of the molecles of the first gas = $\frac{3}{2}\mathrm{n_1KT_1}$

Average kinetic energy of the molecules of the second gas = $\frac{3}{2}\mathrm{n_2KT_2}$

Therefore, the total kinetic energy of the two molecules of gas before they are mixed

$\mathrm{K} = \frac{3}{2}\mathrm{n_1KT_1} + \frac{3}{2}\mathrm{n_2KT_2}$

$= \frac{3}{2}(\mathrm{n_1T_1} + \mathrm{n_2T_2}K)$ ...(1)

If T is the tmeperature of the mixture, then the kinetic energies of the molecules $(\mathrm{n_1} + \mathrm{n_2})$ is

$\mathrm{K'} = \frac{3}{2}(\mathrm{n_1} + \mathrm{n_2})\mathrm{KT}$ ...(2)

Since, there is no loss of energy K - K'

Equating (1) abd (2) we get

$\mathrm{n_1T_1} + \mathrm{n_2T_2} = (\mathrm{n_1} + \mathrm{n_2})\mathrm{T}$

$\mathrm{T} = \frac{\mathrm{n_1T_1}+\mathrm{n_2T_2}}{(\mathrm{n_1}+\mathrm{n_2})}$

20. **(a)** $\frac{2\pi}{\sqrt{3}}$

Explanation: Let x = 2 sin (ωt) ...(1)

Then $\mathrm{v_x} = 2\omega\cos(\omega\mathrm{t})$ ...(2) and $\mathrm{ax} = -2\omega^2\sin(\omega t)$ ...(3)

If x = 1 then sin ωt = 0.5

or $(\omega\mathrm{t}) = \frac{\pi}{6}$

put this value in eqn 2 and eqn 3 and then equate both

We get $\omega t = -\cot(\omega t)$

or $\omega = \sqrt{3}\mathrm{s}^{-1}$

T = $\frac{2\pi}{\sqrt{3}}$ sec

21.

(b) $\frac{2\pi}{\sqrt{b}}$

Explanation: As acceleration = $-\omega^2$x and a = -bx, so on

comparing equations

ω^2 = b

$\omega = \sqrt{b}$

Time period T = $\frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{b}}$

22.

(d) 660 Hz

Explanation: Phase difference of 1.6π corresponds to path difference of 40 cm. Hence, phase difference of 2π will correspond to a path difference of 50 cm, i.e., λ = 50 cm or 0.5 m

$\therefore$ n = $\frac{v}{\lambda} = \frac{330}{0.5}$ = 660 Hz.

23.

(c) more from a wider pipe

Explanation: more from a wider pipe

24. **(a)** 2mv

Explanation: Here, a ball of mass m moving with velocity v collides elastically with wall hence, momentum is p_i = mv

The ball rebounds from wall hence, final momentum is p_f = −mv

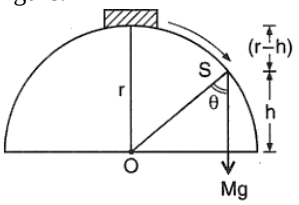
Change in momentum is $\Delta p = p_i - p_f$

Δp = mv −(−mv) = 2mv

25.

(d) $\frac{2r}{3}$

Explanation: The block will lose contact with the surface of the hemisphere when the centripetal acceleration becomes equal to the component of acceleration due to gravity along the radius. Suppose it happens at point S as shown in the adjoining figure.



The velocity at the point S is given by v = $[2g (r - h)^{1/2}]$

The centripetal acceleration should be equal to the component of g along SO.

i.e., $\frac{v^2}{r}$ = g cos θ

or $\frac{2g(r-h)}{r} = g \times \frac{h}{r}$

or 2(r - h) = h or $h = \frac{2r}{3}$

26. **(a)** At the centre of the sphere

Explanation: Gravitational potential inside a solid sphere at distance r from the centre is,

$V = -\frac{GM}{2R^3}(3R^2 - r^2)$

At the centre r = 0, so $V = V_{min.} = \frac{3}{2}\frac{GM}{R}$ (Note: Gravitational potential is always negative. So, its maximum value is zero)

Section B

27.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: On an unbanked road, friction provides the necessary centripetal force $\frac{mv^2}{r}$ = F = R = μmg

$\therefore v = \sqrt{\mu rg}$

Thus with increase in friction, safe velocity also increases. When the road is banked with angle of θ then its limiting velocity is given by $v = \sqrt{\frac{rg(\tan\theta+\mu)}{1-\mu\tan\theta}}$

Thus limiting velocity increase with banking of road.

28. **(a)** If both assertion and reason are true and reason is the correct explanation of assertion.

Explanation: Both assertion and reason are true and the reason is the correct explanation of assertion.

$h = ut - \frac{1}{2}gt^2$ and $v^2 = u^2 - 2gh$

The above equations are independent of mass.

29. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: The maximum height to which a projectile rises above the point of projection is, $H = \frac{u^2\sin^2\theta}{2g}$, which is independent of mass.

30. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

31.

(b) If both assertion and reason are true but reason is not the correct explanation of assertion.

Explanation: Assertion is correct according to newtons law andThe magnitude of this force F is equal to the product of the mass m of the object and acceleration a of the frame of reference. The direction of the force is opposite to the direction of acceleration.

F = -ma

The Reason is also correct.

But both are independent as there is no relation between assertion and reason.

32. **(a)** Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation: Assertion and reason both are correct statements and reason is correct explanation for assertion.

33.

(d) A is false but R is true.

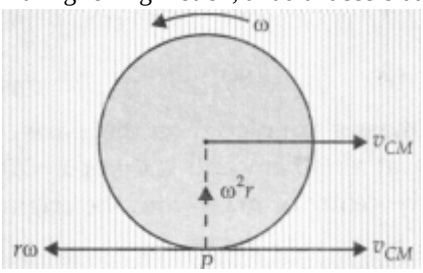
Explanation: Work done W = $\vec{F} \cdot \vec{s}$. For retarding, the force $\vec{F}$ should be inclined to $\vec{s}$ at angle θ such that $\frac{\pi}{2} < \theta < \pi$. For this angle cos θ is negative, so work done is negative. Here negative work done implies that some external force is applied to change the state of a body.

34.

(d) A is false but R is true.

Explanation:

During rolling motion, a radial acceleration acts towards the centre. So the point of contact moves vertically upwards.



On a smooth surface, the sphere will only slide. Rolling is not possible without friction.

35.

(c) A is true but R is false.

Explanation: A is true but R is false.

36. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

37.

(c) A is true but R is false.

Explanation: Let a uniform cylinder of length l have volume V. Then its uniform cross-sectional area,

$A = \frac{V}{l}$

Let a force F be applied to compress the cylinder; then stress in it will be S = F/A and the strain will be,

$\sigma = \frac{S}{Y} = \frac{F/A}{Y} = \frac{F}{AY}$

where Y is Young's modulus of elasticity of the material of the cylinder.

Volumetric strain, $\sigma_V = \sigma(1 - 2\mu)$

where μ is Poisson's ratio

or $\sigma_V = \frac{F}{AY}(1 - 2\mu)$

Decrease in volume

$\Delta V = V\sigma_V = Al\frac{F}{AY}(1 - 2\mu) = \frac{Fl}{Y}(1 - 2\mu)$

Since, ΔV is independent of A and is directly proportional to original length l, hence only this option is correct.

38. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

39.

(c) Assertion is correct statement but reason is wrong statement.

Explanation: Assertion is correct statement but reason is wrong statement.

40.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: Assertion and reason both are correct statements but reason is not correct explanation for assertion.

41.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: Helium is monoatomic and hydrogen is diatomic. Helium has smaller number of degrees of freedom than hydrogen. So $\frac{C_P}{C_V}$ for helium is more than that for hydrogen.

42.

(c) Assertion is correct statement but reason is wrong statement.

Explanation: $v_{\text{rms}} = \sqrt{\frac{3KT}{M}}$ and $v_{\text{max.}} = \sqrt{\frac{2KT}{M}}$

$\therefore v_{rms} > v_{max}$. Most probable speed is that v^hich is possessed by the large number of molecules in the given system. There are other molecules whose speed is greater than this speed and some other, whose speed is less than this value. That is why root mean square speed of all the molecules become greater than the most probable speed.

43.

(d) A is false but R is true.

Explanation: As $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$.

At same temperature, v_{rms} oc $\frac{1}{\sqrt{M}}$,

i.e., at the same temperature root-mean square speed of molecules of lighter gases will be more.

44.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: Mean free path of molecules is given by

$\lambda = \frac{1}{\sqrt{2}n\pi d^2}$

where n is number of molecules per unit volume, d is diameter of molecules. From this $n = \frac{N}{V} = \frac{N}{m}\rho$. Therefore $\lambda \propto \frac{1}{\rho}$, mean free path is inversely proportional to the density of gas molecules.

45.

(c) Assertion is correct statement but reason is wrong statement.

Explanation: Due to friction of air, the amplitude gradually decreases with time.

46.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: In a satellite, g = 0 and hence time period is infinity.

47.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: $T = 2\pi\sqrt{\frac{l}{g}}$

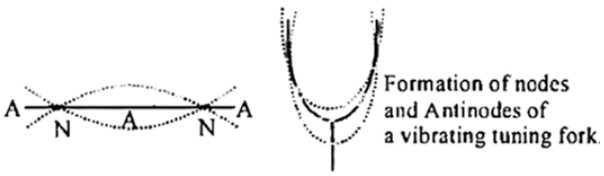
The value of g is less on moon, so T is large.

48.

(d) A is false but R is true.

Explanation: In tuning fork, standing wave of second harmonics are produced. The standing waves produced when two waves of equal amplitude, frequency but in opposite phase superimpose.

Thus the standing waves in tuning fork are produced only when two arms (or pronges) vibrate in opposite phase. Both the arms vibrates with equal frequency as tuning fork is a device which produce a pure tone. (A sound wave having a single frequency is called a pure tone).



Formation of nodes and Antinodes of a vibrating tuning fork

49.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: A string is not stretchable i.e., compressions and rarefaction, cannot be produced in strings. Therefore, longitudinal waves in strings are not possible. String do have elasticity of shape. Therefore, waves on strings are transverse.

50. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation: Both A and R are true and R is the correct explanation of A.