Units 1 to 5 - Class 11

1. Physics is based on assumptions which is variously called a hypothesis, axiom, postulate etc. Choose the correct statement about them

(a) A hypothesis is a supposition without assuming that it is true
(b) An axiom is a self-evident truth
(c) A model is a theory proposed to explain observed phenomena
(d) All of these

Answer: d

2. If voltage V = (100 ± 5) volt and current I =(10 ± 0.2) A, the percentage error in resistance R is

(a) 5.20%
(b) 25%
(c) 7%
(d) 10%

Answer: c

Solution

Given voltage $V = (100 \pm 5)$ volt,
Current $I = (10 \pm 0.2)$ A
From ohm's law $V = IR$
$\therefore$ Resistance $R = \frac{V}{I}$
Maximum percentage error in resistance

$$\left(\frac{\Delta R}{R} \times 100\right) = \left(\frac{\Delta V}{V} \times 100\right) + \left(\frac{\Delta I}{I} \times 100\right)$$
$$= \left(\frac{5}{100} \times 100\right) + \left(\frac{0.2}{10} \times 100\right)$$

3. A plate has a length 5 ± 0.1cm and breadth 2 ± 0.01 cm Then the area of the plate is

(a) $10 \pm 0.1 cm^2$
(b) $10 \pm 0.01 cm^2$
(c) $10 \pm 0.001 cm^2$
(d) $10 \pm 1 cm^2$

Answer: a

4. If the velocity of light c, gravitation constant G and Planck's constant h are chosen as fundamental units, the dimensions of length L in the new system is:

(a) $[h^1c^1G^{-1}]$
(b) $[h^{1/2}c^{1/2}G^{-1/2}]$
(c) $[h^1c^{-3}G^1]$
(d) $[h^{1/2}c^{-3/2}G^{1/2}]$

Answer: d

5. Identify, the pair which has different dimensions:

(a) Planck's constant and angular momentum
(b) impulse and linear momentum
(c) angular momentum and frequency
(d) pressure and Young's modulus

Answer: b

6. The dimensional formula $[M^0L^2T^{-2}]$ stands for:

(a) torque
(b) angular momentum
(c) latent heat
(d) coefficient for thermal conductivity

Answer: c

7. The dimensional formula for Boltzmann's constant is identical to that of

(a) gravitational intensity
(b) latent heat
(c) surface tension
(d) universal gas constant

Answer: d

Solution

Boltzmann constant

$$k = \frac{\text{Energy}}{\text{Temperature}} = [ML^2\,T^{-2}\,\theta^{-1}]$$

Gas constant

$$R = \frac{PV}{T} = [ML^2\,T^{-2}\,\theta^{-1}]$$

8. The sun revolves around galaxy with speed of 250 km/s around the centre of milky way and its radius is 3 x 10^4 light year. The mass of milky way in (kg) is :

(a) 6 x 10^{41}
(b) 5 x10^{41}
(c) 4 x 10^{41}
(d) 3 x 10^{41}

Answer: d

Solution

Mass of galaxy is given by

$$M = \frac{v^2 r}{G}$$

Given, $v = 250$ km/s $= 250 \times 10^3$ m/s

$r = 3 \times 10^4$ light year $= 3 \times 10^4 \times 10^{16}$
$\approx 3 \times 10^{20}$ m.

$$\therefore\ M = \frac{(250 \times 10^3) \times 3 \times 10^{20}}{6.6 \times 10^{-11}} = 3 \times 10^{41} \text{ kg}$$

9. The 'kilowatt-hour' is the unit of

(a) time
(b) power
(c) energy
(d) force

Answer: c

10. Which of the following is not a green house gas?

(a) Oxygen
(b) Carbon Dioxide
(c) Carbon Monoxide
(d) Methane

Answer: a

11. What is the potential of platinum wire dipped into a solution of 0.1M in Sn^{2+} and 0.01M in Sn^{4+}?

(a) E°
(b) E° + 0.059
(c) E° + (0.059/2)
(d) E° - 0.059

Answer: c

12. Identify the pair whose dimensions are equal.

(a) Torque and work
(b) Stress and energy
(c) Force and stress
(d) Force and work

Answer: a

13. If M = Mass, L = Length, T = Time, and I = Electric Current, then the dimensional formula for electrical resistance R is given by

(a) $[R] = [M^1L^2T^{-3}I^{-2}]$
(b) $[R] = [M^1L^2T^{-3}I^2]$
(c) $[R] = [M^1L^2T^3I^{-2}]$
(d) $[R] = [M^1L^2T^3I^2]$

Answer: a

Solution

$$R = \frac{V}{I} = \frac{W}{QI} = \frac{W}{I^2 t}$$

$$[R] = \frac{[ML^2T^{-2}]}{[I^2][T]} = [M^1L^2T^{-3}I^{-2}]$$

14. A body is moving at a speed of 0.3 m/s. To measure its speed with an accuracy about 1%, using a sampling distance 3mm, the measuring clock should have a least count of the order of

(a) 0.1s
(b) 0.01s
(c) 0.001s
(d) 0.0001s

Answer: d

Solution

$$\text{Least count} = 1\% \times \frac{3 \times 10^{-3}}{0.3}$$
$$= \frac{1}{100} \times 0.01 = 0.0001 \text{ s}$$

15. If the acceleration due to gravity is $10 m/s^2$ and the units of length and time are changed to kilometer and hour respectively, the numerical value of the acceleration due to gravity is

(a) 360000
(b) 72000
(c) 36000
(d) 129600

Answer: d

Solution

$$n_2 = 10\left[\frac{m}{km}\right]\left[\frac{s}{h}\right]^{-2}$$
$$= 10\left[\frac{m}{1000\ m}\right]\left[\frac{s}{3600\ s}\right]^{-2}$$
$$= 129600$$

16. Identify, the pair which has different dimensions:

(a) Planck's constant and angular momentum
(b) impulse and linear momentum
(c) angular momentum and frequency
(d) pressure and Young's modulus

Answer: c

17. The dimensional formula $[M^0L^2T^{-2}]$ stands for:

(a) torque
(b) angular momentum
(c) latent heat
(d) coefficient for thermal conductivity

Answer: c

18. The SI unit of the coefficient of viscosity is :

(a) $N\text{-}m^2$
(b) N-s
(c) $N\text{-}s/m^2$
(d) $N\text{-}m^2/s$

Answer: c

Solution

Coefficient of viscosity is given by

$$\eta = \frac{F}{A\,(\Delta v_x/\Delta z)}$$

19. The dimensions of the quantity hv/c, where h is Planck's constant, v is the frequency and c is the velocity of light is:

(a) $[MT^{-1}]$
(b) $[MLT^{-1}]$
(c) $[MLT^{-2}]$
(d) $[ML^2T^2]$

Answer: b

Solution

The Dimensions of $h = [ML^2T^{-1}]$

Dimensions of $v = [T^{-1}]$

Dimensions of $c = [LT^{-1}]$

$$\therefore \text{ Dimensions of } \frac{hv}{c} = \frac{[ML^2T^{-1}][T^{-1}]}{[LT^{-1}]}$$
$$= [MLT^{-1}]$$

20. In an experiment to measure the height of a bridge by dropping stone into water, the error in measurement of time is 0.1 s at the end of 2 s, then the error in estimation of height of bridge will be :

(a) 0.49 m
(b) 0.98 m
(c) 1.37 m
(d) 1.96 m

Answer: b

21. An automobile is traveling at 50 km/hr can be stopped at a distance of 40m by applying brakes. If the same automobile is traveling at 90 km/hr, all other conditions remaining same and assuming no skidding, the minimum stopping in metres is

(a) 72
(b) 92.5
(c) 102.6
(d) 129.6

Answer: d

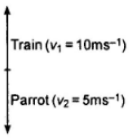
22. A train of 150m length is going towards north direction at a speed of 10m/s. A parrot flies at a speed of 5m/s towards south direction parallel to the railway track. The time taken by the parrot to cross the train is equal to:

(a) 12 seconds
(b) 8 seconds
(c) 15 seconds
(d) 10 seconds

Answer: d

Solution

Since, train and parrot are in opposite directions resultant velocity is added.



$$\therefore \quad v = v_1 + v_2 = 10 + 5 = 15\ ms^{-1}$$
$$\text{Time} = \frac{\text{distance}}{\text{speed}}$$
$$= \frac{150}{15} = 10\ s.$$

23. A body is moving with a uniform velocity of 10 m/s. When this body just crosses another body the second one starts and moves with a uniform acceleration of $5\ m/s^2$. They meet after how much seconds?

(a) 3
(b) 2
(c) 1
(d) 4

Answer: d

Solution

For first body $s = ut = 10 \times t$ ...(1)

For second body $s = ut + \frac{1}{2}at^2$

$$\therefore \quad s = 0 + \frac{1}{2} \times 5t^2 \quad ....(2)$$

From Eqs. (1) and (2), we get

$$t = \frac{20}{5} = 4\ s$$

24. A ball which is at rest is dropped from a height h metre. As it bounces off the floor its speed is 80% of what is just before touching the ground. The ball will then rise to nearly a height __ h

(a) 0.94
(b) 0.8
(c) 0.75
(d) 0.64

Answer: d

Solution

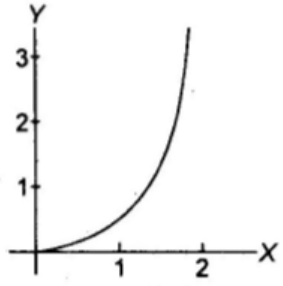
From equation of motion, we have

$$v^2 = u^2 - 2as$$

Given, $v - \frac{80}{100}v,\ u = 0,\ a = g,\ s = h$

$$\therefore \quad h' = \left(\frac{80}{100}\right)^2 \frac{v^2}{2g}$$
$$h' = 0.64\ h$$

25. If the figure below represents a parabola, identify the physical quantities representing Y and X for constant acceleration



(a) X = time, Y = velocity
(b) X = velocity, Y = time
(c) X = time, Y = displacement
(d) X = time, Y = acceleration

Answer: c

Solution

From equation of motion

$$s = ut + \frac{1}{2}at^2$$

where u is initial velocity, a is acceleration and t the time. Since, the body starts from rest. $u = 0$.

$$\therefore \quad s = \frac{1}{2}at^2$$

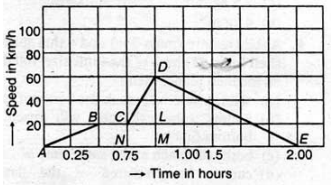
Comparing with general equation of parabola

$$Y = 4ax^2$$

we find that

X = time = t, Y = displacement = s.

26. A train moves from one station to another in 2 hours time. Its speed time graph during this motion is shown below. The maximum acceleration during the journey is



(a) 140 km/h^2
(b) 160 km/h^2
(c) 100 km/h^2
(d) 120 km/h^2

Answer: b

Solution

Maximum acceleration = max slope (CD)

$$= \frac{DL}{CL} = \frac{60 - 20}{1 - 0.75} = 160 \text{ km/h}^2$$

27. A body dropped from a height h with an initial speed zero reaches the ground with a velocity of 3 km/h. Another body of the same mass was dropped from the same height h with an initial speed of 4 km/h will reach the ground with a velocity of

(a) 3km/h
(b) 4 km/h
(c) 5 km/h
(d) 12 km/h

Answer: c

Solution

Ist case :

$$\left(3 \times \frac{5}{18}\right)^2 = 0^2 + 2 \times 10 \times h \Rightarrow h = \frac{5}{144} \text{ m}$$

IInd case :

$$v^2 = \left(4 \times \frac{5}{18}\right)^2 + 2 \times 10 \times \frac{5}{144}$$

$$\Rightarrow \quad v = 5 \times \frac{5}{18} \text{ m/s} = 5 \text{ km/h}$$

28. A box whose mass is 5kg lies on a spring balance inside a lift. The lift starts to ascend with an acceleration of 2m/s^2. The reading of the machine or balance is (g = 10 m/s^2)

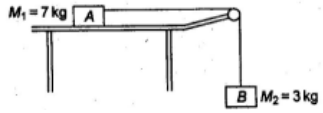
(a) 50 kg
(b) zero
(c) 49 kg
(d) 60 kg

Answer: d

Solution

Reading = $mg + ma = 5 \times 10 + 5 \times 2 = 60$ kg

29. A block A of mass 7 kg is placed on a frictionless table. A thread tied to it is passes over a frictionless pulley and carries a body B of mass 3 kg at the other end. The acceleration of the system is: (given g = 10m/s^2)



(a) 100m/s^2
(b) 3m/s^2
(c) 10m/s^2
(d) 30m/s^2

Answer: d

30. A block of mass 10 kg is placed on an inclined plane. When the angle of inclination is 30°, the block just begins to slide down the plane. The force of static friction is :

(a) 10 kg-wt
(b) 9.8 kg-wt
(c) 49 kg-wt
(d) 5 kg-wt

Answer: d

Solution

$$f_k = mg \sin\theta = 10 \times g \times \sin 30°$$
$$= 5g = 5 \text{ kg-wt}$$

31. A body is thrown vertically upwards with a velocity u. Find the true statement from the following

(a) Both velocity and acceleration are zero at its highest point
(b) Velocity is maximum and acceleration is zeroat the highest point
(c) Velocity is maximum and acceleration is g downwards at its highest point
(d) Velocity is zero at the highest point and maximum height reached is u^2/2g

Answer: d

32. A body is dropped freely from rest. The time taken by the body to cover a distance x is :

(a) √ (x/g)
(b) √ (2x/g)
(c) √ (g/x)
(d) √ (2g/x)

Answer: b

Solution

From equation of motion,

$$h = ut + \frac{1}{2}gt^2$$

Body is dropped from rest, hence $u = 0$.

$$\therefore \quad h = \frac{1}{2}gt^2$$

Given, $h = x$

$$\therefore \quad x = \frac{1}{2}gt^2$$

$$\Rightarrow \quad t = \sqrt{\frac{2x}{g}}$$

33. An insect crawls a distance of 4 m along north in 10 s and then a distance of 3 m along east in 5 s. The average velocity of the insect is :

(a) 7/15 m/s
(b) 1/5 m/s
(c) 5/15 m/s
(d) 12/15 m/s

Answer: c

Solution

Average velocity

$$= \frac{\text{Net displacement}}{\text{Total time}} = \frac{\sqrt{4^2 + 3^2}}{10 + 5}$$
$$= \frac{5}{15} \text{ m/s}$$

34. A ball is suspended with a string from the roof of a train moving with constant velocity. The ball will be :

(a) displaced backwards
(b) displaced forwards
(c) remaining suspended vertically
(d) oscillating

Answer: c

Solution

Since, train is moving with constant velocity, net acceleration on the ball is zero hence ball will be remaining suspended vertically

35. A car travels half the distance with constant velocity 40 km/h and the remaining half with a constant velocity of 60 km/h. The average velocity of the car in (km/h) is:

(a) 40
(b) 45
(c) 48
(d) 50

Answer: c

Solution

Let total distance travelled be x (km).

Time taken in covering first half distance,

$$t_1 = \frac{x/2}{40}\text{ h}$$

$$= \frac{x}{80}\text{ h}$$

Time taken in covering second half distance

$$t_2 = \frac{x/2}{60}\text{ h} = \frac{x}{120}\text{ h}$$

Total time taken, $t = t_1 + t_2$

$$= \frac{x}{60} + \frac{x}{120}$$

$$= \frac{5x}{240} h$$

Hence, average velocity of the car

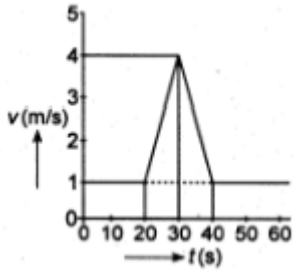
$$= \frac{\text{total distance}}{\text{total time}}$$

$$= \frac{x}{5x/240}$$

$$= \frac{240}{5}$$

$$= 48\text{ km/h}$$

36. Velocity-time (v - t) graph for a moving object is shown in the figure. Total displacement of the object during the time interval when there is non-zero acceleration and retardation is:



(a) 60m
(b) 50m
(c) 30m
(d) 40

Answer: c

Solution

Total displacement = area of triangle

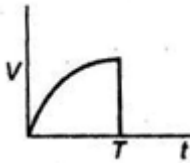
$$= \frac{1}{2} \times (40 - 20) \times 3$$

$$= 10 \times 3$$

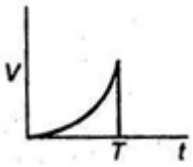
$$= 30\text{m}$$

37. A body is acted upon by a constant force from time t = 0 to a time t = T after which it does not experience any force. Which of the following graphs best rpresents the variation of the velocity of the body with time ?

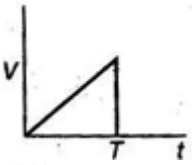
(a)



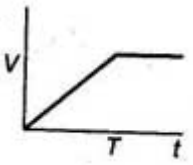
(b)



(c)



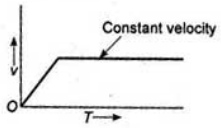
(d)



Answer: d

Solution

Rate of change of velocity gives acceleration. When body is acted upon by a constant force, it's velocity increases constantly with time, after which velocity is constant. Hence, acceleration is zero and particle does not experience any force.



38. A particle moving in one dimension with a constant acceleration of 2 m/s^2 is observed to cover a distance of 5 m during a particular interval of 1 s. The distance covered by the particle in the next 1 s interval is (in metre) :

(a) 5
(b) 6
(c) 7
(d) 10

Answer: c

39. From the top of a tower a stone is thrown up and reaches the ground in time $t_1 = 9$ s. A second stone is thrown down with the same speed and reaches the ground in time $t_2 = 4$ S. A third stone is released from rest and reaches the ground in time t3, which is equal to:

(a) 6.5s
(b) 6s
(c) 5/36 s
(d) 65s

Answer: b

Solution

Taking downward motion of the first stone from A to ground, we have

$$h = -ut_1 + \frac{1}{2} g t_1^2 \quad \text{....(1)}$$

Taking downward motion of second stone from A to ground, we have

$$h = ut_2 + \frac{1}{2} g t_2^2 \quad \text{....(2)}$$

Third stone

$$h = \frac{1}{2} g t_3^2 \quad \text{....(3)}$$

Multiplying Eq. (1) by t_2 and Eq. (2) by t_1 and adding, we get

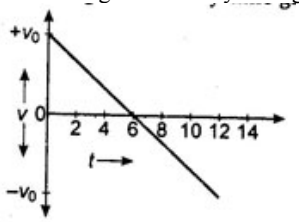
$$h(t_1 + t_2) = \frac{1}{2} g t_1 t_2 (t_1 + t_2)$$

$$\Rightarrow \quad h = \frac{1}{2} g t_1 t_2$$

From Eqs. (3) and (4), $t_3^2 = t_1 t_2$

or $t_3 = \sqrt{t_1 t_2} = \sqrt{9 \times 4} = 6\text{ s}$

40. Consider the given velocity-time graph. It represents the motion of:



(a) a projectile projected vertically upward, from a point
(b) an electron in the hydrogen atom
(c) a car with constant acceleration along a straight road
(d) a bullet fired horizontally from the top of a tower

Answer: a

41. Area under velocity-time curve over a given interval of time represents

(a) acceleration
(b) momentum
(c) velocity
(d) displacement

Answer: d

42. Two trains are moving with equal speed in opposite directions along two parallel railway tracks. If the wind is blowing with speed u along the track so that the relative velocities of the trains with respect to the wind are in the ratio 1:2, then the speed of each train must be

(a) 3u
(b) 2u
(c) 5u
(d) 4u

Answer: a
Solution

Let the speed of trains be v.

$$\therefore \quad \frac{v-u}{v+u}=\frac{1}{2}$$

$$\text{or} \quad 2v-2u=v+u$$

$$\text{or} \quad v=3u$$

43. Two balls are dropped to the ground from different heights. One ball is dropped 2s after the other but they both strike the ground at the same time. If the first ball takes 5s to reach the ground , then the difference in initial heights is ($g=10m/s^2$)

(a) 20m
(b) 80m
(c) 170m
(d) 40m

Answer: b

44. A ball is thrown vertically upwards with a velocity of 25m/s from the top of a tower of height 30m. How long will it travel before it hits ground

(a) 6s
(b) 5s
(c) 4s
(d) 12s

Answer: a

45. The enthalpy of vaporization of a substance is 840J/mol and its boiling point is -173°C. Its entropy of vaporization is

(a) 42 J/mol/K
(b) 21 J/mol/K
(c) 84 J/mol/K
(d) 8.4 J/mol/K

Answer: d

46. An example of a polar covalent compound is

(a) KCl
(b) NaCl
(c) CCl_4
(d) HCl

Answer: d

47. The relation between time t and distance x is t=a + bx, where a and b are constants. The acceleration is:

(a) -2ab
(b) 2b
(c) -2a
(d) 2a

Answer: c

48. Speeds of two identical cars are u and 4u at a specific instant. The ratio of the respective distances at which the two cars are stopped from that instance is

(a) 1:01
(b) 1:04
(c) 1:08
(d) 1:16

Answer: a

49. The area under acceleration-time graph gives:

(a) distance travelled
(b) change in acceleration
(c) force acting
(d) change in velocity

Answer: d
Solution

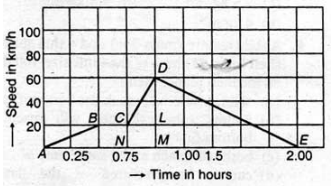
The area under acceleration time graph gives change in velocity.

50. From the top of a tower a stone is thrown up. It reaches the ground in t_1 seconds. A second stone is thrown down and It reaches the ground in t_2 seconds. A third stone is released and it reaches the ground in t_3 seconds. Then

(a) $t_3 = (t_1 + t_2) / 2$
(b) $t_3 = \sqrt{(t_1 t_2)}$
(c) $1/t_3 = 1/t_1 - 1/t_2$
(d) $t_3^2 = t_2^2 = t_2^2 - t_1^2$

Answer: b

51. A train moves from one station to another in 2 hours time. Its speed time graph during this motion is shown below. The maximum acceleration during the journey is



(a) 140 km/h^2
(b) 160 km/h^2
(c) 100 km/h^2
(d) 120 km/h^2

Answer: b
Solution

Maximum acceleration = max slope (CD)

$$=\frac{DL}{CL}=\frac{60-20}{1-0.75}=160\ km/h^2$$

52. A body dropped from a height h with an initial speed zero reaches the ground with a velocity of 3 km/h. Another body of the same mass was dropped from the same height h with an initial speed of 4 km/h will reach the ground with a velocity of

(a) 3km/h
(b) 4 km/h
(c) 5 km/h
(d) 12 km/h

Answer: c
Solution

Ist case :

$$\left(3\times\frac{5}{18}\right)^2=0^2+2\times10\times h\Rightarrow h=\frac{5}{144}\ m$$

IInd case :

$$v^2=\left(4\times\frac{5}{18}\right)^2+2\times10\times\frac{5}{144}$$

$$\Rightarrow \quad v=5\times\frac{5}{18}\ m/s=5\ km/h$$

53. A particle moves along a semicircle of radius 10 m in 5 s. The velocity of the particle is :

(a) 2πm/s
(b) 4πm/s
(c) 2m/s
(d) 4m/s

Answer: a

54. A simple pendulum has a time period of 1 s. In order to increase the time period to 2 s :

(a) the mass of the bob should be doubled
(b) the length of the pendulum should be doubled
(c) the length of the pendulum should be increased by a factor of 4
(d) the length of the pendulum should be decreased by a factor of 4

Answer: c

Solution

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

Given, $T_1 = 1s$, $l_1 = l$, $T_2 = 2s$.

$\therefore \quad \frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$

$\Rightarrow \quad \frac{1}{2} = \sqrt{\frac{l_1}{l_2}}$

$\Rightarrow \quad l_2 = 4l_1$

Hence, length of pendulum should be increased by a factor of 4.

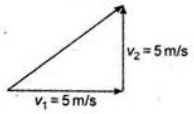
55. A particle is moving, eastwards with a velocity of 5 m/s. in 10 s, its velocity changes to 5 m/s northwards. The average acceleration in this time is :

(a) zero
(b) $1/\sqrt{2}$ m/s^2 towards north-west
(c) $1/\sqrt{2}$ m/s^2 towards north-east
(d) 1/2 m/s^2 towrds north-west

Answer: b

Solution

Average acceleration $= \frac{\Delta \vec{v}}{\Delta t}$



$\Delta v = \sqrt{{v_1}^2 + {v_2}^2} = \sqrt{5^2 + 5^2} = 5\sqrt{2}$

$\therefore$ Average acceleration $= \frac{5\sqrt{2}}{10} = \frac{1}{\sqrt{2}}$ m/s^2.

towards north-west .

56. A bomb is fixed from a canon with a velocity of 1000 m/s making an angle of 30° with the horizontal (g = 9.8m/s ^{2}). Time taken by bomb to reach the highest point is :

(a) 40s
(b) 30s
(c) 51s
(d) 25s

Answer: c

Solution

$T = \frac{u \sin\theta}{g}$

Given, $u = 1000$ m/s,

$\theta = 30°$, $g = 9.8$ m/s^2.

$T = \frac{1000 \times \sin 30°}{9.8} = 51$ s

57. A toy cyclist completes one round of a square track of side 2 m in 40s. What will be the displacement at the end of 3 min ?

(a) 52m
(b) zero
(c) 16m
(d) $2\sqrt{2}$ m

Answer: d

Solution

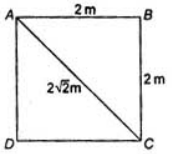
Displacement is distance from initial to final position.

In 40 s — 1 round

In $3 \times 60 = 180$ s — $4\frac{1}{2}$ round

Displacement for 4 rounds is zero.

For $\frac{1}{2}$ round, length of diagonal = $2\sqrt{2}$ m.



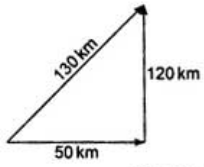
58. A boat travels 50 km east, then 120 km north and finally it comes back to the starting point through the shortest distance. The total time of journdy is 3 h. What is the average velocity, in km/h, over the entire trip ?

(a) zero
(b) 100
(c) 17
(d) 33.33

Answer: b

Solution

$\text{Time} = \frac{\text{distance}}{\text{average velocity}}$



$\Rightarrow \quad \text{Average velocity} = \frac{\text{distance}}{\text{time}}$

$v = \frac{130 + 120 + 50}{3} = \frac{300}{3} = 100$ km/h

59. If two vectors A=2i+3j+4k and B=i+2j-nk are perpendicular then the value of n is :

(a) 1
(b) 2
(c) 3
(d) 4

Answer: b

Solution

The scalar product of two vector's is

$\vec{A} \cdot \vec{B} = AB \cos\theta$

When $\theta = 90°$, then $\cos 90° = 0$

$\vec{A} \cdot \vec{B} = 0$

$(2\hat{i} + 3\hat{j} + 4\hat{k}) \cdot (\hat{i} + 2\hat{j} - n\hat{k}) = 0$

$\Rightarrow \quad 2 + 6 - 4n = 0$

$\Rightarrow \quad n = \frac{8}{4} = 2$

60. The position of a particle is given by r= $(2t^2)$i + (3t)j + 4k ,where t is in seconds and the coefficients have proper units for r to be in metre. The a(t) of the particle at t = 1 s is

(a) 4 ms^{-2} along y-direction
(b) 3 ms^{-2} along x-direction
(c) 4 ms^{-2} along x-direction
(d) 2 ms^{-2} along z-direction

Answer: c

Solution

Distance, $\vec{r} = 2t^2\,\hat{i} + 3t\hat{j} + 4\hat{k}$

Velocity, $\vec{v} = \frac{d\vec{r}}{dt} = 4t\hat{i} + 3\hat{j}$

Acceleration, $a = \frac{dv}{dt} = 4\hat{i}$

$= 4$ m/s^2 in the x-direction.

61. Mean free path of a gas molecule is

(a) inversely proportional to number of molecules per unit volume
(b) inversely proportional to diameter of the molecule
(c) directly proportional to the square root of the absolute temperature
(d) directly proportional to the molelcular mass

Answer: a

Solution

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

where, n = number of molecules/unit volume

d = diameter of the molecule.

Hence, mean free path of a gas molecule is inversely proportional to number of molecules per unit volume.

62. The heat capacity per mole of water is (R is universal gas constant)

(a) 9 R
(b) (9/2) R
(c) 6 R
(d) 5 R

Answer: a

Solution

Molar specific heat of water

= molar mass of water × specific heat of water

$$= \frac{18\,g}{mol} \times \frac{1\,cal}{g\,^\circ C}$$

$$= 18\,\frac{cal}{mol\,^\circ C}$$

$$= 9R$$

[where, $R = 2$ cal $mol^{-2\circ}C^{-1}$]

63. A bullet is to be fired with a speed of 2000 m/s to hit a target 200 m away on a level ground. If g =10 m/s^2, the gun should be aimed

(a) directly at the target
(b) 5 cm below the target
(c) 5 cm above the target
(d) 2 cm above the target

Answer: c

Solution

Horizontal distance of target is 200 m.

Speed of bullet = 2000 ms^{-1}.

Time taken by bullet to cover the horizontal distance

$$t = \frac{200}{2000} = \frac{1}{10}\,s$$

During $\frac{1}{10}$ s, the bullet will fall down vertically due to gravitational acceleration.

Therefore, height above the target, so that the bullet hits the target is

$$h = ut + \frac{1}{2}gt^2 = \left(0 \times \frac{1}{10}\right) + \frac{1}{2} \times 10 \times (0.1)^2$$

$$= 0.05\,m = 5\,cm$$

64. The resultant of two vectors P and Q is R. If the magnitude of Q is doubled, the new resultant becomes perpendicular to P. Then the magnitude of R is

(a) P+Q
(b) Q
(c) P
(d) (P+Q)/2

Answer: b

Solution

In first case

$$R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta} \quad \ldots(i)$$

where θ is the angle between P and Q.

In second case,

$$(\vec{P} + 2\vec{Q}) \cdot \vec{P} = 0$$

or $\vec{P} \cdot \vec{P} + 2(\vec{Q} \cdot \vec{P}) = 0$

or $P^2 + 0 = 0$

or $P = 0$

Putting $P = 0$ in Eq. (i), we get

$$R = \sqrt{0 + Q^2 + 0} = Q$$

65. A motor car is moving with a speed of 20 m/s on a circular track of radius 100 m. If its speed is increasing at the rate of 3 m/s, its resultant acceleration is

(a) 3m/s^2
(b) 5m/s^2
(c) 2.5m/s^2
(d) 3.5m/s^2

Answer: b

Solution

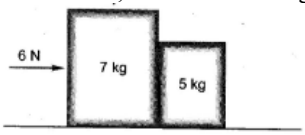
Resultant acceleration,

$$a = \sqrt{a_c^2 + a_t^2}$$

$$= \sqrt{\left(\frac{v^2}{r}\right) + (3)^2} = \sqrt{\left(\frac{20 \times 20}{100}\right)^2 + 9}$$

$$= \sqrt{16 + 9} = 5\,ms^{-2}$$

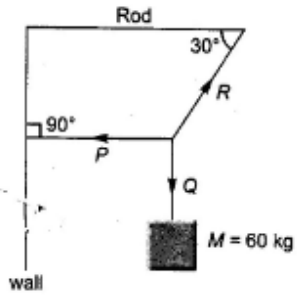
66. Two blocks of masses 7 kg and 5 kg are placed in contact with each other on a smooth surface. If a force of 6 N is applied on the heavier mass, the force on the lighter mass is



(a) 3.5N
(b) 2.5N
(c) 7N
(d) 5N

Answer: b

67. A body of mass 60 kg suspended by means of three strings P. Q and R as shown in the figure is in equilibrium. The tension in the string P is



(a) 130.9gN
(b) 60gN
(c) 50gN
(d) 103.9gN

Answer: d

68. While driving a car around a curve of 200 m radius, the driver notices that a simple pendulum hung to the roof of the car is making an angle of 15° to the horizontal. The speed of the car in km/h is

(a) 60.5
(b) 72.5
(c) 82.5
(d) 92.5

Answer: d

69. Moment of a couple is called

(a) impulse
(b) couple
(c) torque
(d) angular momentum

Answer: c

Solution

Torque is defined as the cross product of

$$\tau = r \times F$$

where r is distance from axis of rotation, F the force. Torque is also known as rotational force. It is also called moment or couple,

70. Physical independence of a force is a consequence of:

(a) third law of motion
(b) second law of motion
(c) first law of mation
(d) all of the above

Answer: c

Solution

First law of motion states that a body does not alter its state of motion without the influence of an external force. That is, there is no change in the velocity of a body (neither in magnitude nor in direction) unless some force acts on that body. Hence, physical independence of force is a consequence of first law of motion.

71. In the motion of a rocket, physical quantity which is conserved is:

(a) angular momentum
(b) linear momentum
(c) force
(d) work

Answer: b

Solution

The rocket exerts an action-force on the gas-je in the backward direction, while the gas jet exerts a reactionary force on the rocket in the forward direction. These are the internal forces in the (rocket + gas) system. In the absence of the external forces, the total momentum of the system (rocket + gas) is constant.

72. The recoil velocity of a 4kg rifle that shoots a 0.050 kg bullet at a speed of 280 m/s is:

(a) +3.5 m/s
(b) -3.5 m/s
(c) - √3.5 m/s
(d) + √3.5 m/s

Answer: b

Solution

From law of conservation of momentum, momentum before collision = momentum after collision.

Let v be the recoil speed of rifle

$$m_1u_1 = -Mv$$

$$0.05 \times 280 = -4 \times v$$

$$\Rightarrow \quad v = -\frac{0.05 \times 280}{4} = -3.5 \text{ms}^{-1}$$

73. A ball of mass 0.5kg with a velocity of 2m/s strikes a wall normally and bounces back with the same speed. if the time of contact between the ball and wall is 10^{-3} s, the average force exerted by the wall on the ball is

(a) 1125 N
(b) 1000 N
(c) 500 N
(d) 2000 N

Answer: d

Solution

$$\text{Impulse} = mv - (-mv)$$

$$= 0.5 \times 2 - (-0.5 \times 2) = 2$$

$$\text{Hence, } F = \frac{2}{10^{-3}} = 2000 \text{ N}$$

74. When a bullet is fired at a target, its velocity decreases by half after penetrating 30 cm into it. The additional thickness it will penetrate before coming to rest is

(a) 30 cm
(b) 40 cm
(c) 10 cm
(d) 50 cm

Answer: c

75. Two equal forces are acting at a point with an angle of 60° between them. If the resultant force is equal to 40√3N, the magnitude of each force is

(a) 40 N
(b) 20 N
(c) 80 N
(d) 30 N

Answer: a

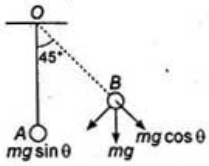
76. A weight 10 kgwt is suspended by a string is pulled by a horizontal force such that the string makes an angle 45° with the vertical, then the horizontal force is equal to

(a) 10 kg wt
(b) 10√ 2 kg wt
(c) 10/√2 kg wt
(d) √ 2kg wt

Answer: c

Solution

The restoring force is given by



$$F = -mg \sin\theta$$

when $\theta = 45°, m = 10$ kg

$$\therefore \quad F = -\frac{10}{\sqrt{2}} \text{ kg wt}$$

77. A man of mass 60 kg is standing on a spring balance inside a lift. If the lift falls freely downwards, then the reading of the spring balance will be :

(a) zero
(b) 60 kgf
(c) < 60kgf
(d) > 60kgf

Answer: a

Solution

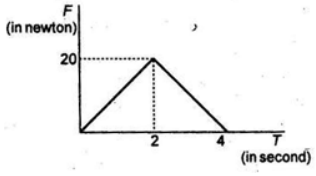
When lift falls freely downward, then

$$mgR = ma$$

Here, $a = g$

$\therefore$ $R = 0$

78. A body is initially at rest on a smooth surface. A force F, whose time variation is shown in the adjacent figure acts on it for a duration of 4 s. The momentum of the ball at the end of the 4 s is (in N-s):



(a) 10
(b) 20
(c) 30
(d) 40

Answer: d

Solution

From the definition of impulse, we have

$$Fdt = dp$$

Momentum is area under F- t graph.

$$\therefore dp = \left(\frac{1}{2} \times \text{base} \times \text{height}\right) + \left(\frac{1}{2} \text{ base} \times \text{height}\right)$$

$$dp = \frac{1}{2} \times 2 \times 20 + \frac{1}{2} \times 2 \times 20$$

$$dp = 40$$

79. Two forces of 5 N and 12 N simultaneously act on a particle. The net force on the particle is

(a) 17 N only
(b) 12 N
(c) 13 N
(d) between 7 N and 17 N

Answer: c

Solution

Net force

$$F = \sqrt{F_1^2 + F_2^2} = \sqrt{(5)^2 + (12)^2} = 13 \text{ N}$$

80. A block released from rest from the top of a smooth inclined plane of inclination 450 takes time t to reach the bottom. The same block released from rest from top of a rough inclined plane of the same inclination takes time 2t to reach the bottom. The coefficient of friction is:

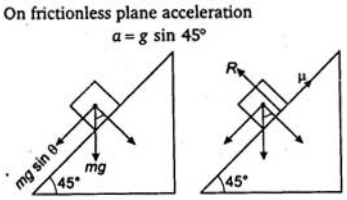
(a) 0.75
(b) 0.5
(c) 0.25
(d) 0.4

Answer: a

Solution

On frictionless plane acceleration

$a = g \sin 45°$



On frictional plane

$a = g(\sin 45° - \mu \cos 45°)$

Let h be length of plane, then

$h = ut + \frac{1}{2}gt^2$

81. Newton's second and third laws of motion lead to the conservation of

(a) linear momentum
(b) angular momentum
(c) potential energy
(d) kinetic energy

Answer: a

82. A large force is acting on a body for a short time. The impulse imparted is equal to the change in

(a) acceleration
(b) momentum
(c) energy
(d) velocity

Answer: b

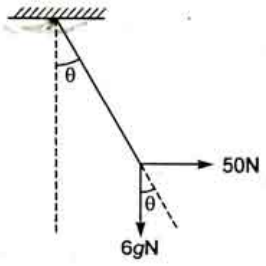
83. A mass of 6kg is suspended by a rope of length 2m from a ceiling. A force of 50N in the horizontal direction is applied at the mid-point of the rope. The angle made by the rope with the vertical in equilibrium is

(a) 50°
(b) 60°
(c) 30°
(d) 40°

Answer: d

Solution

$\tan\theta = \frac{50}{6g} = 0.83$



$\tan\theta = \tan 40°$

$\theta = 40°$

84. A shell at rest at the origin explodes into three fragments of masses1 kg, 2 kg and m kg. The 1 kg and 2 kg pieces fly off with speed of 5m/s along x-axis and 6m/s along y-axis respectively. If the m kg piece flies off with a speed of 6.5m/s the total mass of the shell must be

(a) 4kg
(b) 5kg
(c) 3.5kg
(d) 4.5kg

Answer: b

85. If the road is unbanked and the co-efficient of friction between the road and the tyres is 0.8, then the maximum speed with which an automobile can move around a curve of 84.5 m radius without slipping ($g=10m/s^2$) is

(a) 26m/s
(b) 67.6m/s
(c) 13m/s
(d) 36.7m/s

Answer: a

86. In a properly biased transistor

(a) both depletion layers are equally large
(b) both depletion layers are equally small
(c) emitter base depletion layer is large but base collector depletion layer is small
(d) emitter base depletion layer is small but base collector depletion layer is large

Answer: d

87. A ball of mass 0.5kg with a velocity of 2m/s strikes a wall normally and bounces back with the same speed. if the time of contact between the ball and wall is 10^{-3} s, the average force exerted by the wall on the ball is

(a) 1125 N
(b) 1000 N
(c) 500 N
(d) 2000 N
(e) 5000 N

Answer: d

Solution

Impulse $= mv - (-mv)$

$= 0.5 \times 2 - (-0.5 \times 2) = 2$

Hence, $F = \frac{2}{10^{-3}} = 2000$ N

88. When a bullet is fired at a target, its velocity decreases by half after penetrating 30 cm into it. The additional thickness it will penetrate before coming to rest is

(a) 30 cm
(b) 40 cm
(c) 10 cm
(d) 50 cm
(e) 20 cm

Answer: c

89. Two equal forces are acting at a point with an angle of 60° between them. If the resultant force is equal to $40\sqrt{3}$N, the magnitude of each force is

(a) 40 N
(b) 20 N
(c) 80 N
(d) 30 N
(e) 10 N

Answer: a

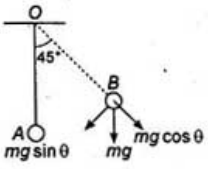
90. A weight 10 kgwt is suspended by a string is pulled by a horizontal force such that the string makes an angle 45° with the vertical, then the horizontal force is equal to

(a) 10 kg wt
(b) $10\sqrt{2}$ kg wt
(c) $10/\sqrt{2}$ kg wt
(d) $\sqrt{2}$kg wt
(e) None of these

Answer: c

Solution

The restoring force is given by



$F = -mg \sin\theta$

when $\theta = 45°, m = 10$ kg

$\therefore \quad F = -\frac{10}{\sqrt{2}}$ kg wt

91. A man of mass 60 kg is standing on a spring balance inside a lift. If the lift falls freely downwards, then the reading of the spring balance will be :

(a) zero
(b) 60 kgf
(c) < 60kgf
(d) > 60kgf
(e) 60 kg + weight of the spring

Answer: a
Solution

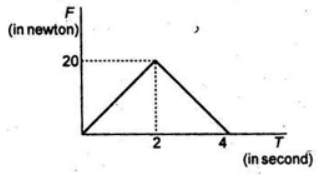
When lift falls freely downward, then

$$mgR = ma$$

Here, $a = g$

$\therefore$ $R = 0$

92. A body is initially at rest on a smooth surface. A force F, whose time variation is shown in the adjacent figure acts on it for a duration of 4 s. The momentum of the ball at the end of the 4 s is (in N-s):



(a) 10
(b) 20
(c) 30
(d) 40
(e) 50

Answer: d
Solution

From the definition of impulse, we have

$$Fdt = dp$$

Momentum is area under F- t graph.

$$\therefore dp = \left(\frac{1}{2} \times \text{base} \times \text{height}\right) + \left(\frac{1}{2} \text{ base} \times \text{height}\right)$$

$$dp = \frac{1}{2} \times 2 \times 20 + \frac{1}{2} \times 2 \times 20$$

$$dp = 40$$

93. Two forces of 5 N and 12 N simultaneously act on a particle. The net force on the particle is

(a) 17 N only
(b) 12 N
(c) 13 N
(d) between 7 N and 17 N
(e) 7 N only

Answer: c
Solution

Net force

$$F = \sqrt{F_1^2 + F_2^2} = \sqrt{(5)^2 + (12)^2} = 13\,\text{N}$$

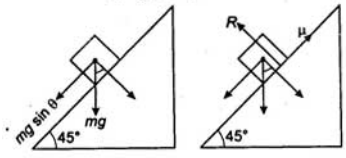
94. A block released from rest from the top of a smooth inclined plane of inclination 450 takes time t to reach the bottom. The same block released from rest from top of a rough inclined plane of the same inclination takes time 2t to reach the bottom. The coefficient of friction is:

(a) 0.75
(b) 0.5
(c) 0.25
(d) 0.4
(e) 0.33

Answer: a
Solution

On frictionless plane acceleration

$$a = g \sin 45°$$



On frictional plane

$$a = g\,(\sin 45° - \mu \cos 45°)$$

Let h be length of plane, then

$$h = ut + \frac{1}{2}gt^2$$

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(a) linear momentum
(b) angular momentum
(c) potential energy
(d) kinetic energy
(e) force

Answer: a

96. A large force is acting on a body for a short time. The impulse imparted is equal to the change in

(a) acceleration
(b) momentum
(c) energy
(d) velocity
(e) displacement

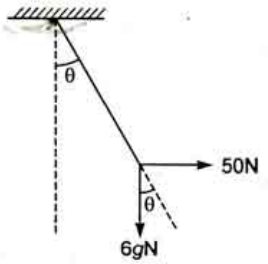
Answer: b

97. A mass of 6kg is suspended by a rope of length 2m from a ceiling. A force of 50N in the horizontal direction is applied at the mid-point of the rope. The angle made by the rope with the vertical in equilibrium is

(a) 50°
(b) 60°
(c) 30°
(d) 40°
(e) 45°

Answer: d
Solution

$$\tan\theta = \frac{50}{6g} = 0.83$$



$$\tan\theta = \tan 40°$$

$$\theta = 40°$$

98. A shell at rest at the origin explodes into three fragments of masses1 kg, 2 kg and m kg. The 1 kg and 2 kg pieces fly off with speed of 5m/s along x-axis and 6m/s along y-axis respectively. If the m kg piece flies off with a speed of 6.5m/s the total mass of the shell must be

(a) 4kg
(b) 5kg
(c) 3.5kg
(d) 4.5kg
(e) 5.5kg

Answer: b

99. If the road is unbanked and the co-efficient of friction between the road and the tyres is 0.8, then the maximum speed with which an automobile can move around a curve of 84.5 m radius without slipping ($g=10m/s^2$) is

(a) 26m/s
(b) 67.6m/s
(c) 13m/s
(d) 36.7m/s
(e) 8.2m/s

Answer: a

100. Different forces in different contexts of physics actually arise from only a small number of fundamental forces in nature. The truth about them is that the

(a)
Gravitational force is the force of mutual attraction between any two objects by virtue of their masses
(b) Electromagnetic force is the force between charged particles
(c)
The strong nuclear force binds protons and neutrons in a nucleus
(d) All of these

Answer: d