Kinematics Important Questions With Answers

NEET Physics 2023

1. Two equal vectors have a resultant equal to either of them. The angle between them is:
   a) 60^o b) 90^o c) 100^o **d) 120^o**

   Solution : -

   Given: first vector (P) = A
   second vector (Q) = A
   resultant vector (R) = A
   Now, $R = \sqrt{P^2 + Q^2 + 2PQ \quad cos\theta}$
   $A = \sqrt{A^2 + A^2 + 2A^2 cos\theta}$
   or $A = \sqrt{2A^2(1 + cos\theta)}$
   or $A^2 = 2A^2(1 + cos\theta)$
   or $cos\theta = -\frac{1}{2}$
   or $\theta = 120^o$

2. If the time of flight of a projectile is doubled, what happens to the maximum height attained?
   a) Halved b) Remains unchanged c) Doubled **d) Becomes four times**

   Solution : -

   From above question; $\frac{\Delta h}{T^2} = \frac{g}{g}$
   If T is doubled, h becomes four times.

3. The direction of $\vec{A}$ is vertically upward and direction of $\vec{B}$ is in north direction. The direction of $\vec{A} \times \vec{B}$ will be:
   a) western direction b) eastern direction c) at 45° upward in north d) vertically downward

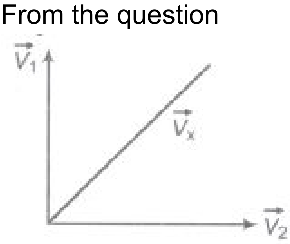
   Solution : -

   Direction of vector $\vec{A}$ is along z-axis
   $\therefore \vec{A} = a\hat{k}$
   $\therefore \vec{B} = b\hat{j}$
   Now, $\vec{A} \times \vec{B} = a\hat{k} \times b\hat{j} = ab(-i)$
   Hence, the direction is $\vec{A} \times \vec{B}$ is along west.

4. If $|V_1+V_2|= |V_1- V_2|$ and V_2 is finite, then:
   a) V_1 is parallel to V_2 b) $V_1=V_2$ **c) $V_1$and V_2 are mutually perpendicular** d) $|V_1|=|V_2|$

   Solution : -

   From the question



   $|\vec{v}_1 + \vec{v}_2| = |\vec{v}_1 - \vec{v}_2|$
   Now, $|\vec{V}_{net}| = |\vec{V'}_{net}|$
   Hence $\vec{v}_1$ and $\vec{v}_2$ will be mutually perpendicular

5. A stone is dropped from the top of a tall cliff and n seconds later another stone is thrown vertically downwards with a velocity u. Then the second stone overtakes the first, below the top of the cliff at a distance given by

a) $\frac{g}{2}[\frac{n(u-\frac{gn}{2})}{(u-gn)}]^2$ b) $\frac{g}{2}[\frac{n(\frac{u}{2}-gn)}{(u-gn)}]^2$ c) $\frac{g}{2}[\frac{n(\frac{u}{2}-gn)}{(\frac{u}{2}-gn)}]^2$ d) $\frac{g}{5}[\frac{(u-gn)}{(\frac{u}{2}-gn)}]^2$

6. In case of a projectile, where is the angular momentum minimum?

a) At the starting point b) At the highest point c) On return to the ground

d) At some location other than those mentioned above

7. If power (P), surface tension (S) and Planck's constant (h) are arranged so that the dimensions of time in their dimensional formulae are in ascending order, then which of the following is correct?

a) P,S,h b) P,h,S c) S,P,h d) S,h,P

8. Which of the following is not the name of a physical quantity?

a) Time b) Impulse c) Mass **d) Kilogram**

Solution : -

The kilogram represents the unit of a physical quantity and not the physical quantity.

9. Match the Column I with Column II.

Column I (Physicalquantity)		Column II (Dimensional formula)	
(A)	Permittivity of free space	(p)	$[M^0L^0T^{-1}]$
(B)	Radiant flux	(q)	$[ML^3T^{-3}A^{-2}]$
(C)	Resistivity	(r)	$[ML^2T^{-3}]$
(D)	Hubble constant	(s)	$[M^{-1}L^{-3}T^4A^2]$

a) A - p, B - q, C - r, D - s b) A - q, B - p, C - s, D - r **c) A - s, B - r; C - q. D - P** d) A - r, B - s, C - p, D - q

10. Which of the following is not a unit of time?

a) Parsec b) Year c) Second d) Hour

Solution : -

Parsec is the unit of distance.

1 parsec = 3.08 x 10^{16} m

Parsec is the distance at which average radius of earth's orbit sub tends an angle of 1 arc second.

11. Assertion: Kinematic equations are exact and are always correct.

Reason : The definitions of instantaneous velocity and acceleration are true only for motion in which the magnitude and direction of acceleration are constant during the course of motion.

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

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

c) If assertion is true but reason is false. **d) If both assertion and reason are false.**

12. The dimensions of Planck's constant are the same as that of

a) linear impulse b) work c) linear momentum **d) angular momentum**

13. particle moving with uniform acceleration has average velocities v_1 v_2 and v_3 over the successive intervals of time t_l, t_2 and t_3 respectively. The value of $\frac{(\nu_1-\nu_2)}{(\nu_2-\nu_3)}$ will be

a) $\frac{t_1-t_2}{t_2-t_3}$ b) $\frac{t_1-t_2}{t_2+t_3}$ c) $\frac{t_1+t_2}{t_2-t_3}$ **d)** $\frac{t_1+t_2}{t_2+t_3}$

14. A bullet fired at an angle of 30° with the horizontal hits the ground 3 km away. By adjusting its angle of projection can one hope to hit a target 5 km away? (Assume the muzzle speed to be fixed and neglect air resistance).

a) Not possible b) Possible c) Information insufficient d) None of these

Solution : -

Angle of projection (θ) = 30°

Horizontal range (R) = 3 km = 3000 m

Horizontal range (R)= $\frac{u^2 sin2\theta}{g}$

or $\frac{u^2}{g} = \frac{R}{sin\,2\theta} or \frac{u^2}{g} = \frac{3000}{sin\,60^\circ} = \frac{3000}{\sqrt{3}/2}$

or $\frac{u^2}{g} = \frac{6000}{\sqrt{3}}$ .....(i)

When bullet is fired at an angle of projection 45°, then horizontal range is maximum.

15. A particle is fired with speed u making angle 9 with the horizontal. Its potential energy at the highest point is:

a) $\frac{1}{2}$mu^2 sin^2 θ b) $\frac{1}{2}$mu^2 cos^2 θ c) $\frac{1}{2}$mu^2 d) $\frac{1}{2}$mu^2 sin^2 2θ

Solution : -

The vertical component of velocity is reduced to zero. The corresponding kinetic energy is converted into potential energy (law of conservation of energy).

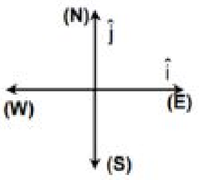
PE=$\frac{1}{2}$m(usinθ)^2=$\frac{1}{2}$mu^2 sin^2 θ

16. A particle is moving eastward with a velocity of 5 m/s. In 10 seconds, the velocity changes to 5 m/s northwards. The average acceleration in this time is:

a) 1/$\frac{1}{\sqrt{2}}$ m/sec^2 (towards north-west) b) 1/$\sqrt{2}$ m/sec^2 (towards north-east)

c) 1/$\sqrt{2}$m/sec^2 (towards north-west) d) $\frac{1}{\sqrt{2}}$ m/sec^2 (towards north)

Solution : -



$\vec{a} = \frac{\overrightarrow{v_f}+\overrightarrow{v_i}}{t}$

$= \frac{5\hat{j}-5\hat{i}}{10} = \frac{1}{2}\hat{j} - \hat{i}$

$\therefore a = \frac{1}{\sqrt{2}}ms^{-2}$ towards north west

17. At a height 0.4 m from the ground, the velocity of a projectile in vector form is: $\vec{v}$ =$(6\hat{i} + 2\hat{j})$ m/s. The angle of projection is: (g == 10m/s^2)

a) 45° b) 60° **c) 30°** d) tan^{-1} (3/4)

Solution : -

v^2 = u^2 - 2gh

or u^2 = v^2 + 2gh

or $u_x^2 + u_y^2 = u_x^2 + u_y^2 + 2h$

As Ux = Ux

$\therefore u_y^2 + u_y^2 + 2gh$

or $u_y^2 = (2)^2 + 2 \times 10 \times 0.4 = 12$

$\therefore u_y = \sqrt{12} = 2\sqrt{3}m/s$

and $U_x = U_x$ = 6m/s

∴ tanθ=$\frac{u_y}{u_x} = \frac{2\sqrt{3}}{6} = \frac{1}{\sqrt{3}}$

∴ θ = 30°.

18. The diagonals of a parallelogram are represented by vectors$\vec{P} = 5\hat{i} - 4\hat{j} + 3\hat{k}$ and $\vec{q} = 3\hat{i} + 2\hat{i} - \hat{k}$. Then the area of the parallelogram is:

a) $\sqrt{171}$ unit b) $\sqrt{72}$ unit c) 171 unit d) 72 unit

19. A body is moving along a circular path with constant speed u. What is the change in velocity, when the angle described by the body at the centre of the circle is θ?

a) Zero **b) 2u sin$\frac{\theta}{2}$** c) 2u sin θ d) 2u sin 2θ

Solution : -

Here, $v_1 = v_2 = v$

So, Δv=$|\overrightarrow{v_2} - \overrightarrow{v_1}|$

Δv=$\sqrt{v^2 + v^2 - 2v^2cos\theta} = 2vsin\frac{\theta}{2}$

20. **Assertion:** If $\hat{i}$ and $\hat{j}$ are unit vectors along x-axis and y-axis respectively, the magnitude of vector $\hat{i}$+$\hat{j}$ will be $\sqrt{2}$.

Reason: Unit vectors are used to indicate a direction only.

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

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

c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -

Since $\hat{i}$ and $\hat{j}$ are unit vectors, their magnitude A A are $|\hat{i}|$ = 1 and $|\hat{j}|$ = 1. Magnitude of resultant vector is equal to $\sqrt{|\hat{i}|^2 + |\hat{j}|^2} = \sqrt{(1)^2 + (1)^2} = \sqrt{2}$

21. The number of significant figures in 0.06900 is

a) 5 **b) 4** c) 2 d) 3

22. Percentage errors in the measurement of mass and speed are 2% and 3% respectively. The error in the estimation of kinetic energy obtained by measuring mass and speed will be

a) 8% b) 2% c) 12% d) 10%

23. The position of an object moving along x-axis is given by x = a + bt^2, where a = 8.5 m and b = 2.5 m s^{-2} and t is measured in seconds. The instantaneous
velocity of the object at t = 2 s is

a) $5ms^{-1}$ **b) 10 ms^{-1}** c) 15 m s^{-1} d) 20 m s^{-1}

24. A body is projected with velocity v_1 from the point A. At the same time, another body is projected vertically upwards from B with velocity v2. The point B lies vertically below the highest point of the trajectory of body projected from point A. For both the bodies to collide, $\frac{v_1}{v_2}$ should be

a) 2 **b) 1/2** c) $\sqrt{3/2}$ d) 1

Solution : -

The two bodies will collide at the highest point if both cover the same vertical height in the same time. so
$\frac{v_1^2 sin^2 30^o}{2g} = \frac{v_2^2}{2g} or \frac{v_2}{v_1} = sin30^o = \frac{1}{2}$

25. A car moving along a straight road with speed of 144 km h^{-1} is brought to a stop within a distance of 200 m. How long does it take for the car to stop?

a) 5 s **b) 10 s** c) 15 s d) 20 s

26. The horizontal range of a projectile is 4√3 times its maximum height. Its angle of projection will be:

a) 45° b) 60° c) 90° **d) 30°**

Solution : -

$R = \frac{u^2 sin2\theta}{g} and \quad H = \frac{u^2 sin^2\theta}{2g}$

$But,\ R = 4\sqrt{3}H$

$\frac{u^2 sin2\theta}{g} = 4\sqrt{3}\left(\frac{u^2 sin^2\theta}{2g}\right)$

$sin2\theta = 4\sqrt{3}\frac{sin^2\theta}{2}$

$2sin\theta\ cos\theta = \frac{4\sqrt{3}sin^2\theta}{2}$

$\frac{1}{\sqrt{3}} = \frac{sin\theta}{cos\theta} = tan\theta$

$\therefore \theta = 30^o$

27. Given that both A and B are greater than 1. The magnitude of $\vec{A} \times \vec{B}$ cannot be:

a) equal to AB b) less than AB **c) more than AB** d) equal to A/B

Solution : -

$|\vec{A} \times \vec{B}|$ = AB sin θ and sin θ < 1.

Also, AB sin 9 can be equal to A/B, when sin θ = $\frac{1}{B^2}$.

28. In an experiment, the period of oscillation of a simple pendulum was observed to be 2.63 s, 2.56 s, 2.42 s, 2.71 s and 2.80 s. The mean absolute error is

a) 0.01 cm b) 0.5 mm **c) 0.01 mm** d) 0.5 cm

29. The value of universal gravitational constant G = 6.67 X 10^{-11} N m^2 kg^{-2}. The value of G in units of g^{-1} cm^3 s^{-2} is

a) 6.67 x 10^{-8} b) 6.67 x 10^{-7} c) 6.67 X 10^{-9} d) 6.67 x 10^{-10}

Solution : -

$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
$= 6.67 \times 10^{-11} \times (kg\ m\ s^{-2})\ (m^2)\ (kg)^{-2}$
$= 6.67 \times 10^{-11} \times [(1000g) \times (100\ cm) \times s^{-2}] \times (100\ cm^2) \times (1000g)^{-2}$
$= 6.67 \times 10^{-8}\ g^{-1}\ cm^3\ s^{-2}$

30. Resultant of two vectors $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ is of magnitude P. If $\overrightarrow{F_2}$ is reversed, then resultant is of magnitude Q.What is the value of P^2+Q^2?

a) $F_1^2 + F_2 2$ b) $F_1^2 - F_2^2$ c) $2(F_1^2 - F_2^2)$ **d) $2(F_1^2 + F_2^2)$**

Solution : -

$F_1^2 + F_2^2 + 2F^1F^2 cos\theta = P^2$
$F_1^2 + F_2^2 - 2F^1F^2 cos\theta = P^2$
Hence, $P^2 + Q^2 = 2(F_1^2 + F_2^2)$

31. If unit vectors $\hat{A}$ and $\hat{B}$ are inclined at an angle θ then I$\hat{A}$-$\hat{B}$ I is

a) 2sin$\frac{\theta}{2}$ b) 2cos$\frac{\theta}{2}$ c) 2tan$\frac{\theta}{2}$ d) tanθ

Solution : -

$\left|\hat{A}-\hat{B}\right|^2 = \left|\hat{A}\right|^2 + \left|\hat{B}\right|^2 - 2\hat{A}.\hat{B}$
= 2 - 2cosθ = 2(1 - cosθ) $\therefore \left(\left|\hat{A}\right| + \left|\hat{B}\right| = 1\right)$
= $2\left(2sin^2\frac{\theta}{2}\right) = 4sin^2\frac{\theta}{2}$ or $\left|\hat{A}-\hat{B}\right| = 2sin\frac{\theta}{2}$

32. What is the length of the arc of a circle of radius 30 cm which subtends an angle $\frac{\pi}{6}$ at the centre?

a) 11.7 cm b) 14.7 cm c) 16.7 cm **d) 15.7 cm**

Solution : -

Here, θ = $\frac{\pi}{6}$, r = 30 cm
As θ = $\frac{l}{r}$ ⇒ l = θr = $\frac{\pi}{6}$ × 30 cm = $\frac{3.14}{6} \times 30$ cm = 15.7 cm

33. A car moving with a speed of 50 km h^{-1} can be stopped by applying brakes after moving atleast 6 m. If the same car is moving at a speed of 100 km h^{-1} the minimum stopping distance is :

a) 6 m b) 12 m c) 18 m **d) 24 m**

34. Which of the following relations is dimensionally correct?

a) 1 u = 931.5 MeV **b) 1 u = 931.5 MeV/c^2** c) l u = 1.67 x $l0^{-27}$J d) None of these

35. Resultant of two vectors $\vec{A}$ and $\vec{B}$ is inclined at 45° to either of them. What is the magnitude of resultant?

a) A+B b) A-B **c) $\sqrt{A^2+B^2}$** d) $\sqrt{A^2-B^2}$

Solution : -

Since, the resultant is equally inclined at 45° to both $\vec{A}$ and $\vec{B}$ therefore, angle between $\vec{A}$ and $\vec{B}$ is 90°. In this case A should be equal to B.

36. A projectile is fired from the surface of the earth with a velocity of 5 m/s and angle 9 with the horizontal. Another projectile fired from another planet with a velocity of 3 m/s at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is (in m/sz) (given g = 9.8 m/sz)

a) 3.5 b) 5.9 c) 16.3 d) 110.8

Solution : -

We see that the equation of trajectory of oblique projectile is :

$y = x \quad tan\theta - \frac{g}{2v^2cos^2\theta}x^2$

From the question, same angle and trajectory relates to similar range of two projectiles, so :

$\frac{u_c^2 sin2\theta}{2g_c} = \frac{u_p^2 sin2\theta}{2g_p}$

$\frac{5^2 sin2\theta}{2\times9.8} = \frac{3^2 sin2\theta}{2g_p}$

Now, $g_p = \frac{9.8\times9}{25} = 3.52 m/s^2$

37. After one second the velocity of a projectile makes an angle of 45° with the horizontal. After another one second it is travelling horizontally. The magnitude of its initial velocity and angle of projection are: (g = 10m/s ^{2})

a) 14.62 m/s, 60° b) 14.62 mis, $\tan^{-1}(2)$ **c) 22.36 m/s, $\tan^{-1}$ (2)** d) 22.36 m/s, 60°

Solution : -

Total time of flight is T = 4 s.

If u is its initial speed and 8 is the angle of projection, then

$T = \frac{2usin\theta}{g} = 4$ or u sinθ = 2g ... (i)

After 1sec, second velocity vector makes an angle of 45° with horizontal, i.e.,

$V_x = V_y$

or u cos θ = u sin θ - gt

or u cos θ = 2g - g (∵ t=1)

or u cos θ = g ...(ii)

Squaring and adding eqn. (i) and eqn. (ii), we get;

$u^2 = 5g^2 = 5(10)^2 m^2/s2$

∴ u = 22. 36 m/s

Dividing eqn. (i) by eqn. (ii), we get;

tan θ=2 or θ= $\tan^{-1}$ (2).

38. The range R of projectile is same when its maximum heights are h_1 and h_2. What is the relation between R, h_1, and h_2?

a) $R = \sqrt{h_1 h_2}$ b) $R = \sqrt{2h_1 h_2}$ c) $R = 2\sqrt{h_1 h_2}$ **d)** $R = 4\sqrt{h_1 h_2}$

Solution : -

Range is same for angles of projection θ and (90° -θ)

$\therefore R = \frac{u^2 sin2\theta}{g} = h_1 = \frac{u^2 sin^2\theta}{2g}$ and $h_2 = \frac{u^2 cos^2\theta}{2g}$

Hence, $\sqrt{h_1 h_2} = \frac{u^2 sin\theta cos\theta}{2g}$

$= \frac{1}{4}\left[\frac{u^2 sin2\theta}{g}\right] = \frac{R}{4}.$

39. Stopping distance of a moving vehicle is directly proportional to

a) square of the initial velocity b) square of the initial acceleration c) the initial velocity d) the initial acceleration

40. A particle moves along a straight line OX. At a time t (in second) the distance x (in meters) of the particle is given by $x = 40 + 12t - t^3$. How long would the particle travel before coming to rest?

a) 24 m b) 40 m **c) 56 m** d) 16 m

Solution : -

Distance travelled by the particle is

$x = 40 + 12t - t^3$

We know that velocity is rate of change of distance

i.e., $\upsilon = \frac{dx}{dt}$

$\upsilon = \frac{d}{dt}(40 + 12t - t^3)$

$= 0 + 12 - 3t^2$

But final velocity υ = 0

$12 - 3t^2 = 0$ or $t^2 = \frac{12}{3} = 4$ s

or t = 2s

Hence, distance travelled by the particle before coming to rest given by

$x = 40 + 12(2) - (2)^3 = 56$ m

41. In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively. The dimensions of Y in MKSQ system are

a) $[M^{-3}L^{-2}T^4Q^4]$ b) $[M^{-2}L^{-1}T^5Q^3]$ c) $[M^{-1}L^{-2}T^4Q^4]$ d) $[M^{-3}L^{-1}T^4Q^4]$

42. The displacement of a particle is given by $x = (t - 2)^2$ where x is in metres and t in seconds. The distance covered by the particle in first 4 seconds is

a) 4 m **b) 8 m** c) 12 m d) 16 m

43. The distances covered by a freely falling body in its first, second, third, ..., n^{th} seconds of its motion

a) forms an arithmetic progression b) forms a geometric progression

c) do not form any well defined series

d) form a series corresponding to the difference of square root of the successive natural numbers.

44. Assertion : Angle and angular displacement are dimensionless quantities.

Reason : Angle is equal to arc length divided by radius.

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

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

c) If assertion is true but reason is false. d) If both assertion and reason are false.

45. Match the Column I with Column II.

Column I (Units)		Column II (Dimensional formulae)	
(A)	Pa s	(p)	$[M^0L^2T^{-2}K^{-1}]$
(B)	Magnetic induction	(q)	$[MLT^{-3}K^{-1}]$
(C)	Absorbed dose	(r)	$[ML^{-1}T^{-1}]$
(D)	Luminous flux	(s)	$[ML^2T^{-2}K^{-1}]$

a) A - q, B - p, C - r, D - s b) A -p, B - q, C - s, D - r **c) A - r; B - s, C - p, D - q** d) A - s, B - r, C - q, D - P

46. Which of the following is the essential characteristic of a projectile?

a) Initial velocity inclined to the horizontal b) Zero velocity at the highest point

c) Constant acceleration perpendicular to the velocity **d) None of the above**

Solution : -

In a projectile motion, it is not necessary that initial velocity must be inclined to the horizontal. Further, only vertical component of velocity is zero at the highest point. Also, constant acceleration is perpendicular to velocity only at the highest point.

47. A particle is projected with a velocity u making an angle 0 with the horizontal. At any instant, its velocity V is at right angles to its initial velocity u; then V is:

a) u cosθ b) u tan θ **c) u cot θ** d) u sec θ

Solution : -

Because horizontal component of velocity remains constant in projectile motion, hence,

u cos θ = V cos (90° - θ)

ucos θ=V sin θ or V=ucotθ.

48. Which of the following properties of laser beam can be used to measure long distances?

a) It is very intense. b) It is highly monochromatic. c) It is an unidirectional beam of light. **d) All of these**

Solution : -

A laser is a source of very intense, monochromatic and undirectional beam of light. These properties of a laser light can be exploited to measure long distances.

49. One car moving on a straight road covers one third of the distance with 20 km/hr and the rest with 60 km/hr. The average speed is :

a) 40 km/hr b) 8 0km/hr c) $46\frac{2}{3}$ km/hr **d) 36 km/hr**

Solution : -

Average Speed = $\frac{Total\ distance}{Total\ time}$

$= 0 = \frac{x}{t_1+t_2} = \frac{x}{\frac{x/3}{v_1}+\frac{2x/3}{v_2}}$

$= \frac{3v_1v_2}{v_2+2v_1} = \frac{3\times20\times60}{60+2\times20}$

= 36 km/h

50. A cricketer can throw a ball to a maximum horizontal distance of 100 m. The speed with which he throws the ball is: (to the nearest integer)

a) $30ms^{-1}$ b) $42\ ms^{-1}$ **c) $32\ ms^{-1}$** d) $35\ ms^{-1}$ e) $40\ ms^{-1}$