If A, B and C are three sets such that $A \cap B = A \cap C$ and $A \cup B = A \cup C$, then

(a) $A = C$

(b) $B = C$

(c) $A \cap B = \phi$

(d) $A = B$

The graph of the function $y = f(x)$ is symmetrical about the line $x = 2$, then

(a) $f(x+2) = f(x-2)$

(b) $f(2+x) = f(2-x)$

(c) $f(x) = f(-x)$

(d) $f(x) = -f(-x)$

The domain of definition of the function

$$f(x)=\sqrt{\log_{10}\left(\frac{5x-x^2}{4}\right)}$$ is

(a) [1, 4]
(b) [1, 0]
(c) [0, 5]
(d) [5, 0]

Consider the following relations

$R = \{(x, y) \mid x, y$ are real numbers and $x = wy$ for some rational number $w\}$;

$S = \left\{\left(\frac{m}{n}, \frac{p}{q}\right) \middle| m, n, p \text{ and } q \text{ are integers such that } n, q \neq 0 \text{ and } qm = pn\right\}$. Then,

(a) R is an equivalence relation but S is not an equivalence relation

(b) Neither R nor S is an equivalence relation

(c) S is an equivalence relation but R is not an equivalence relation

(d) R and S both are equivalence relations

Let $R = \{(1, 3), (4, 2), (2, 4), (2, 3), (3, 1)\}$ be a relation on the set $A = \{1, 2, 3, 4\}$. The relation R is

(a) a function
(b) transitive
(c) not symmetric
(d) reflexive

The period of the function $f(x)=\sin^4 x+\cos^4 x$ is

(a) π

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

(c) 2π

(d) None of these

Let f be a function defined by $f(x)=(x-1)^2+1,(x\geq 1)$.

Statement I The set $\{x : f(x)=f^{-1}(x)\}=\{1,2\}$

Statement II f is bijection and

$$f^{-1}(x)=1+\sqrt{x-1}, x\geq 1$$

(a) Statement I is false, Statement II is true

(b) Statement I is true, Statement II is true; Statement II is a correct explanation of Statement I

(c) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I

(d) Statement I is true, Statement II is false

A real valued function $f(x)$ satisfies the functional equation

$$f(x-y)=f(x)f(y)-f(a-x)f(a+y),$$

where a is a given constant and $f(0)=1$, then $f(2a-x)$ is equal to

(a) $f(-x)$

(b) $f(a)+f(a-x)$

(c) $f(x)$

(d) $-f(x)$

The domain of $\sin^{-1}\left[\log_3\left(\frac{x}{3}\right)\right]$ is

(a) [1, 9]
(b) [–1, 9]
(c) [–9, 1]
(d) [–9, –1]

Let for $a \neq a_1 \neq 0$, $f(x)= ax^2 + bx + c$, $g(x)= a_1 x^2 + b_1 x + c_1$ and $p(x) = f(x) - g(x)$. If $p(x)=0$ only for $x=-1$ and $p(-2)=2$, then the value of $p(2)$ is

(a) 18 (b) 3 (c) 9 (d) 6

Let $f:(-1,1)\to B$ be a function defined by $f(x)=\tan^{-1}\left(\frac{2x}{1-x^2}\right)$, then f is both one-one and onto when B is in the interval

(a) $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$

(b) $\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$

(c) $\left[0,\frac{\pi}{2}\right)$

(d) $\left(0,\frac{\pi}{2}\right)$

The period of $\sin^2\theta$ is

(a) π^2

(b) π

(c) 2π

(d) $\frac{\pi}{2}$

Consider the following relation R on the set of real square matrices of order 3.

$R = \{(A, B) : A = P^{-1}BP$ for some invertible matrix $P\}$

Statement I R is an equivalence relation.

Statement II For any two invertible 3×3 matrices M and N, $(MN)^{-1} = N^{-1}M^{-1}$.

(a) Statement I is false, Statement II is true

(b) Statement I is true, Statement II is true; Statement II is correct explanation of Statement I

(c) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I

(d) Statement I is true, Statement II is false

Condition for equivalence relation A relation which is symmetric, reflexive and transitive is equivalence relation.

The converse of the contrapositive of the conditional $p \rightarrow \sim q$ is

(a) $p \rightarrow q$ (b) $\sim p \rightarrow \sim q$

(c) $\sim q \rightarrow p$ (d) $\sim p \rightarrow q$

Let $R = \{(3, 3), (6, 6), (9, 9), (12, 12), (6, 12), (3, 9), (3, 12), (3, 6)\}$ be a relation on the set $A = \{3, 6, 9, 12\}$. The relation is

(a) reflexive and symmetric only

(b) an equivalence relation

(c) reflexive only

(d) reflexive and transitive only

The domain of the function

$$f(x)=\frac{1}{\sqrt{|x|-x}}$$ is

(a) $(0,\infty)$

(b) $(-\infty,0)$

(c) $(-\infty,\infty)-\{0\}$

(d) $(-\infty,\infty)$

Let W denotes the words in the English dictionary define the relation R by

$R = \{(x, y) \in W \times W$: the words x and y have atleast one letter in common$\}$. Then, R is

(a) reflexive, symmetric and not transitive

(b) reflexive, symmetric and transitive

(c) reflexive, not symmetric and transitive

(d) not reflexive, symmetric and transitive

The function $f(x) = \log\left(x + \sqrt{x^2 + 1}\right)$, is

(a) an even function

(b) an odd function

(c) a periodic function

(d) neither an even nor an odd function

Let R be the set of real numbers.

Statement I $A = \{(x, y) \in R \times R : y - x$ is an integer$\}$ is an equivalence relation on R.

Statement II $B = \{(x, y) \in R \times R : x = \alpha y$ for some rational number $\alpha\}$ is an equivalence relation on R.

(a) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I

(b) Statement I is true, Statement II is false

(c) Statement I is false, Statement II is true

(d) Statement I is true, Statement II is true; Statement II is a correct explanation of Statement I

Condition for equivalence relation A relation which is symmetric, reflexive and transitive is equivalence relation.

The largest interval lying in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ for which the function

$f(x)=4^{-x^2}+\cos^{-1}\left(\frac{x}{2}-1\right)+\log(\cos x)$ is defined, is

(a) $[0, \pi]$

(b) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

(c) $\left[-\frac{\pi}{4}, \frac{\pi}{2}\right)$

(d) $\left[0, \frac{\pi}{2}\right)$

Domain of definition of the function $f(x)=\frac{3}{4-x^2}+\log_{10}(x^3-x)$, is

(a) $(1, 2)$

(b) $(-1,0)\cup(1,2)$

(c) $(1,2)\cup(2,\infty)$

(d) $(-1,0)\cup(1,2)\cup(2,\infty)$

Let $X = \{1, 2, 3, 4, 5\}$. The number of different ordered pairs (Y, Z) that can formed such that $Y \subseteq X, Z \subseteq X$ and $Y \cap Z$ is empty, is

(a) 5^2

(b) 3^5

(c) 2^5

(d) 5^3

Let R be the real line. Consider the following subsets of the plane $R \times R$

$S = \{(x, y) : y = x + 1 \text{ and } 0 < x < 2\}$

$T = \{(x, y) : x - y \text{ is an integer}\}$

Which one of the following is true?

(a) T is an equivalence relation on R but S is not

(b) Neither S nor T is an equivalence relation on R

(c) Both S and T are equivalence relations on R

(d) S is an equivalence relation on R but T is not

If $f : R \to R$ satisfies $f(x+y) = f(x) + f(y)$, for all $x, y \in R$ and $f(1) = 7$, then $\sum_{r=1}^{n} f(r)$ is

(a) $\frac{7n}{2}$

(b) $\frac{7(n+1)}{2}$

(c) $7n(n+1)$

(d) $\frac{7n(n+1)}{2}$

If g is the inverse of a function f and $f'(x)=\frac{1}{1+x^5}$, then $g'(x)$ is equal to

(a) $1+x^5$

(b) $5x^4$

(c) $\frac{1}{1+\{g(x)\}^5}$

(d) $1+\{g(x)\}^5$

Let $f(x)=(x+1)^2-1, x\geq -1$

Statement I The set $\{x : f(x)= f^{-1}(x)\}$

$= \{0,-1\}$

Statement II f is a bijection.

(a) Statement I is false, Statement II is true

(b) Statement I is true, Statement II is true; Statement II is a correct explanation of Statement I

(c) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I

(d) Statement I is true, Statement II is false

A function f from the set of natural numbers to integers defined by

$$f(n)=\begin{cases}\dfrac{n-1}{2}, \text{when } n \text{ is odd}\\ -\dfrac{n}{2}, \text{when } n \text{ is even}\end{cases}$$

is

(a) one-one but not onto

(b) onto but not one-one

(c) one-one and onto both

(d) neither one-one nor onto

If $X = (4^n - 3n - 1 : n \in N)$ and $Y = \{9(n-1) : n \in N\}$; where N is the set of natural numbers, then $X \cup Y$ is equal to

(a) N

(b) $Y - X$

(c) X

(d) Y

For real x, let $f(x)=x^3+5x+1$, then

(a) f is one-one but not onto R

(b) f is onto R but not one-one

(c) f is one-one and onto R

(d) f is neither one-one nor onto R

The domain of the function, $f(x)=\frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$ is

(a) $[2,3]$
(b) $[2,3)$
(c) $[1,2]$
(d) $[1,2)$

Uncertainty in the position of an electron (mass = 9.1×10^{-31} kg) moving with a velocity 300 m s^{-1}, accurate upto 0.001% will be ($h = 6.63 \times 10^{-34}$ Js)

(a) 19.2×10^{-2} m

(b) 5.76×10^{-2} m

(c) 1.92×10^{-2} m

(d) 3.84×10^{-2} m

The value of Planck's constant is 6.63×10^{-34} J s. The speed of light is 3×10^{17} nm s^{-1}. Which value is closest to the wavelength in nanometer of a quantum of light with frequency of 6×10^{15} s^{-1}?

(a) 50
(b) 75
(c) 10
(d) 25

The electronic configuration of four elements are given below. Which elements does not belong to the same family as others?

(a) $[Xe]4f^{14}5d^{10}1s^2$ (b) $[Kr]4d^{10}5s^2$

(c) $[Ne]3s^23p^5$ (d) $[Ar]3d^{10}4s^2$

Calculate the wavelength (in nanometer) associated with a proton moving at $1.0 \times 10^{3}\ ms^{-1}$

(Mass of proton $= 1.67 \times 10^{-27}$ kg and $h = 6.63 \times 10^{-34}$ Js)

(a) 0.032 nm
(b) 0.40 nm
(c) 2.5 nm
(d) 14.0 nm

The number of spherical nodes in $3p$ orbitals are/is

(a) one
(b) three
(c) none
(d) two

Which electronic configuration of an element has abnormally high difference between second and third ionization energy?

(a) $1s^2, 2s^2, 2p^6, 3s^1$

(b) $1s^2, 2s^2, 2p^6, 3s^1 3p^1$

(c) $1s^2, 2s^2, 2p^6, 3s^2 3p^2$

(d) $1s^2, 2s^2, 2p^6, 3s^2$

The energy required to break one mole of Cl–Cl bonds in Cl_2 is 242 kJ/mol. The longest wavelength of light capable of breaking a single Cl–Cl bond is

(a) 594 nm
(b) 640 nm
(c) 700 nm
(d) 494 nm

The spectrum of He is expected to be similar to that

(a) H
(b) Li^+
(c) Na
(d) He^+

If the atomic number of an element is 33, it will be placed in the periodic table in the

(a) first group (b) third group

(c) fifth group (d) seventh group.

A gas absorbs photon of 355 nm and emits at two wavelengths. If one of the emission is at 680 nm, the other is at

(a) 1035 nm
(b) 325 nm
(c) 743 nm
(d) 518 nm

Uncertainty in position of a particle of 25 g in space is 10^{-5} m. Hence, uncertainty in velocity (ms^{-1}) is (Planck's constant, $h = 6.6 \times 10^{-34}$ Js)

(a) 2.1×10^{-28}

(b) 2.1×10^{-34}

(c) 0.5×10^{-34}

(d) 5.0×10^{-24}

Which of the following has the smallest size?

(a) Al^{3+} (b) F^{-}

(c) Na^{+} (d) Mg^{2+}

The electrons identified by quantum numbers n and l

(1) $n = 4, l = 1$ (2) $n = 4, l = 0$

(3) $n = 3, l = 2$ (4) $n = 3, l = 1$

can be placed in the order of increasing energy as

(a) (3)<(4)<(2)<(1) (b) (4)<(2)<(3)<(1)

(c) (2)<(4)<(1)<(3) (d) (1)<(3)<(2)<(4)

Which one of the following groupings represents a collection of iso electronic species?(Atomic numbers of Cs = 55, Br = 35)

(a) Na^+, Ca^{2+}, Mg^{2+}

(b) N^{3-}, F^-, Na^+

(c) Be, Al^{3+}, Cl^-

(d) Ca^{2+}, Cs^+, Br^-

Which of the following elements has the maximum electron affinity?

(a) I (b) Br

(c) Cl (d) F

In an organic compound of molar mass 108 g mol^{-1} C, H and N atoms are present in 9 : 1 : 3.5 by weight. Molecular formula can be

(a) $C_6H_8N_2$ (b) $C_7H_{10}N$

(c) $C_5H_6N_3$ (d) $C_4H_{18}N_3$

The number of d-electrons retained in Fe^{2+} (atomic number Fe = 26) ion is

(a) 3 (b) 4 (c) 5 (d) 6

Ionic radii are

(a) inversely proportional to effective nuclear charge

(b) inversely proportional to square of effective nuclear charge

(c) directly proportional to effective nuclear charge

(d) directly proportional to square of effective nuclear charge.

Number of atoms in 560 g of Fe

(atomic mass = 56 g mol^{-1}) is

(a) twice that of 70 g N (b) half tha t of 20 g H

(c) Both (a) and (b) (d) None of these

The de-Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of 10 m/s is approximately

(Planck's constant, $h = 6.63 \times 10^{-34}$ Js)

(a) 10^{-33} m (b) 10^{-31} m

(c) 10^{-16} m (d) 10^{-25} m

Which one of the following orders is not in accordance with the property stated against it?

(a) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy

(b) $F_2 > Cl_2 > Br_2 > I_2$: Oxidising power

(c) $HI > HBr > HCl > HF$: Acidic property in water

(d) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity

In the reaction,

$$2Al(s) + 6HCl(aq) \longrightarrow 2Al^{3+}(aq) + 6Cl^{-}(aq) + 3H_2(g)$$

(a) 6L HCl (aq) is consumed for every 3L $H_2(g)$ produced

(b) 33.6 L $H_2(g)$ is produced regardless of temperature and pressure for every mole Al that reacts

(c) 67.2 L $H_2(g)$ at STP is produced for every mole Al that reacts

(d) 11.2 L $H_2(g)$ at STP is produced for every mole HCl (aq) consumed

Which of the following sets of quantum numbers is correct for an electron in $4f$ orbital?

(a) $n=4, l=3, m=+4, s=+1/2$

(b) $n=4, l=4, m=-4, s=-1/2$

(c) $n=4, l=3, m=+1, s=+1/2$

(d) $n=3, l=2, m=-2, s=+1/2$

Among the elements Ca, Mg, P and Cl, the order of increasing atomic radii is

(a) Mg < Ca < Cl < P

(b) Cl < P < Mg < Ca

(c) P < Cl < Ca < Mg

(d) Ca < Mg < P < Cl

The density of a solution prepared by dissolving 120 g of urea (mol. mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is

(a) 0.50 M
(b) 1.78 M
(c) 1.02 M
(d) 2.05 M

The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant = $1.097 \times 10^7\ m^{-1}$)

(a) 91 nm

(b) 192 nm

(c) 406 nm

(d) 9.1×10^{-8} nm

The correct order of the decreasing ionic radii among the following isoelectronic species is

(a) $Ca^{2+} > K^{+} > S^{2-} > Cl^{-}$

(b) $Cl^{-} > S^{2-} > Ca^{2+} > K^{+}$

(c) $S^{2-} > Cl^{-} > K^{+} > Ca^{2+}$

(d) $K^{+} > Ca^{2+} > Cl^{-} > S^{2-}$

The molarity of a solution obtained by mixing 750 mL of 0.5 M HCl with 250 mL of 2M HCl will be

(a) 0.875 M
(b) 1.00 M
(c) 1.75 M
(d) 0.0975 M

In a multielectron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic and electric fields?

(A) $n=1,\ l=0, m=0$

(B) $n=2, l=0, m=0$

(C) $n=2, l=1, m=1$

(D) $n=3, l=2, m=1$

(E) $n=3, l=2, m=0$

(a) (D) and (E)

(b) (C) and (D)

(c) (B) and (C)

(d) (A) and (B)

What is the value of electron gain enthalpy of Na^+ if IE_1 of Na = 5.1 eV?

(a) –5.1 eV (b) –10.2 eV

(c) +2.55 eV (d) +10.2 eV

A car starting from rest, accelerates at the rate f through a distance s, then continues at constant speed for time t and then decelerates at the rate $f/2$ to come to rest. If the total distance travelled is 15 s, then

(a) $s = ft$

(b) $s = \frac{1}{6} ft^2$

(c) $s = \frac{1}{2} ft^2$

(d) None of these

Consider a car moving on a straight road with a speed of 100 ms^{-1}. The distance at which car can be stopped, is [$\mu_k = 0.5$]

(a) 800 m
(b) 1000 m
(c) 100 m
(d) 400 m

A cricketer catches a ball of mass 150 gm in 0.1 sec moving with speed 20 m/s, then he experiences force of

(a) 300 N (b) 30 N

(c) 3 N (d) 0.3 N.

A particle located at $x = 0$ at time $t = 0$, starts moving along the positive x-direction with a velocity v that varies as $v = \alpha\sqrt{x}$. The displacement of the particle varies with time as

(a) t^2 (b) t (c) $t^{1/2}$ (d) t^3

A player caught a cricket ball of mass 150 g moving at a rate of 20 m/s. If the catching process is completed in 0.1 s, the force of the blow exerted by the ball on the hand of the player is equal to

(a) 150 N
(b) 3 N
(c) 30 N
(d) 300 N

A block of mass 10 kg placed on rough horizontal surface having coefficient of friction m = 0.5, if a horizontal force of 100 N acting on it then acceleration of the block will be

(a) 10 m/s²
(b) 5 m/s²
(c) 15 m/s²
(d) 0.5 m/s².

The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is $x = 0$ at $t = 0$, then its displacement after unit time ($t = 1$) is

(a) $v_0 + 2g + 3f$

(b) $v_0 + \frac{g}{2} + \frac{f}{3}$

(c) $v_0 + g + f$

(d) $v_0 + \frac{g}{2} + f$

A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force.

Consider $g = 10\ \text{m/s}^2$.

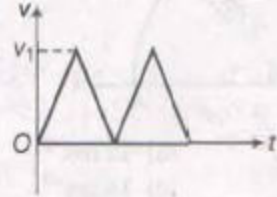
(a) 4 N (b) 16 N (c) 20 N (d) 22 N

A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s^2. What would be the reading on the scale ? (g = 10 m/s^2)

(a) zero
(b) 400 N
(c) 800 N
(d) 1200 N

Consider a rubber ball freely falling from a height $h = 4.9$ m onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic. Then, the velocity as a function of time the height as function of time will be

(a)



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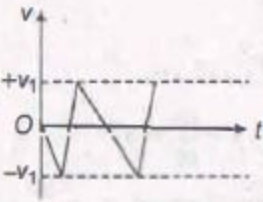
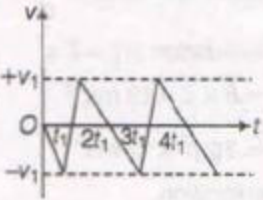
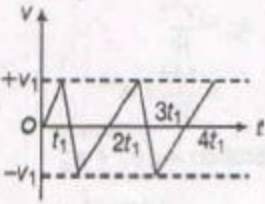


(c)



(d)



A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45° with the initial vertical direction is

(a) $Mg(\sqrt{2}+1)$
(b) $Mg\sqrt{2}$
(c) $\frac{Mg}{\sqrt{2}}$
(d) $Mg(\sqrt{2}-1)$

A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, the force exerted by the rope on the block is

(a) $\frac{Pm}{M+m}$ (b) $\frac{Pm}{M-m}$ (c) P (d) $\frac{PM}{M+m}$

For a particle in uniform circular motion the acceleration **a** at a point $P(R,\theta)$ on the circle of radius R is (here, θ is measured from the x-axis)

(a) $-\frac{v^2}{R}\cos\theta\,\mathbf{i}+\frac{v^2}{R}\sin\theta\,\mathbf{j}$

(b) $-\frac{v^2}{R}\sin\theta\,\mathbf{i}+\frac{v^2}{R}\cos\theta\,\mathbf{j}$

(c) $-\frac{v^2}{R}\cos\theta\,\mathbf{i}-\frac{v^2}{R}\sin\theta\,\mathbf{j}$

(d) $\frac{v^2}{R}\mathbf{i}+\frac{v^2}{R}\mathbf{j}$

If a body losses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest?

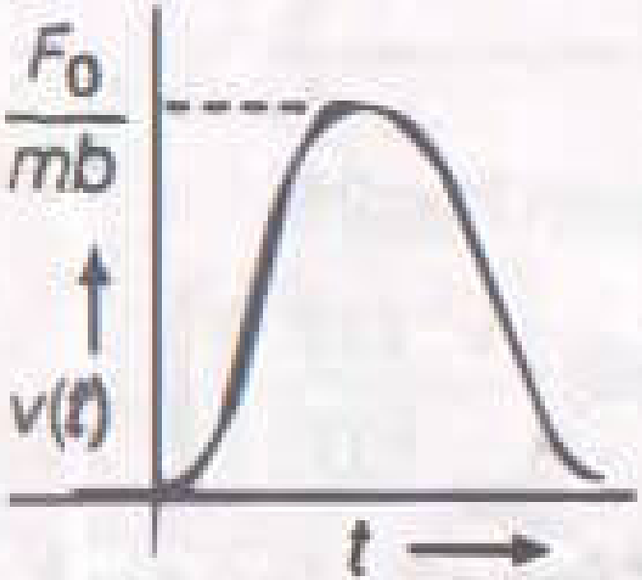
(a) 1 cm (b) 2 cm (c) 3 cm (d) 4 cm

A marble block of mass 2 kg lying on ice when given a velocity of 6 ms^{-1} is stopped by friction in 10 s. Then, the coefficient of friction is

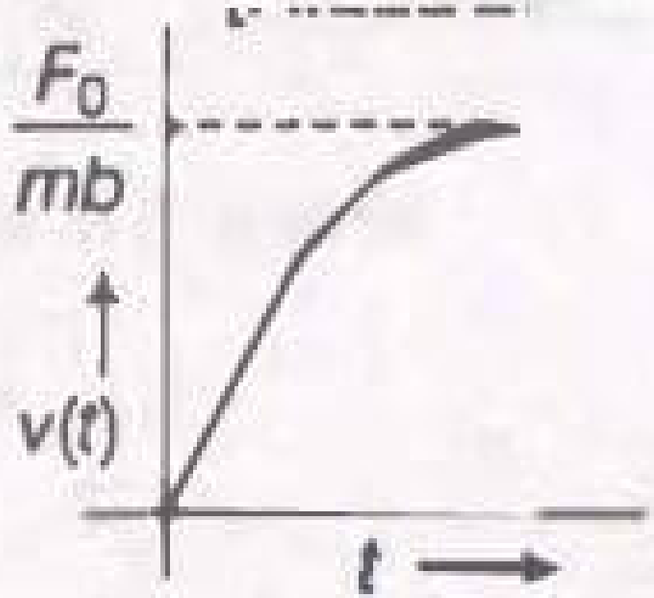
(a) 0.02 (b) 0.03 (c) 0.06 (d) 0.01

A particle of mass m is at rest at the origin at time $t = 0$. It is subjected to a force $F(t) = F_0 e^{-bt}$ in the x-direction. Its speed $v(t)$ is depicted by which of the following curves?

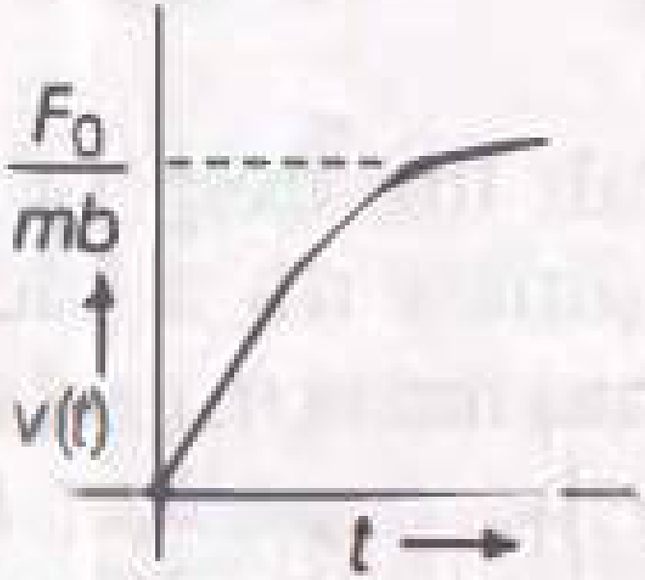
(a)



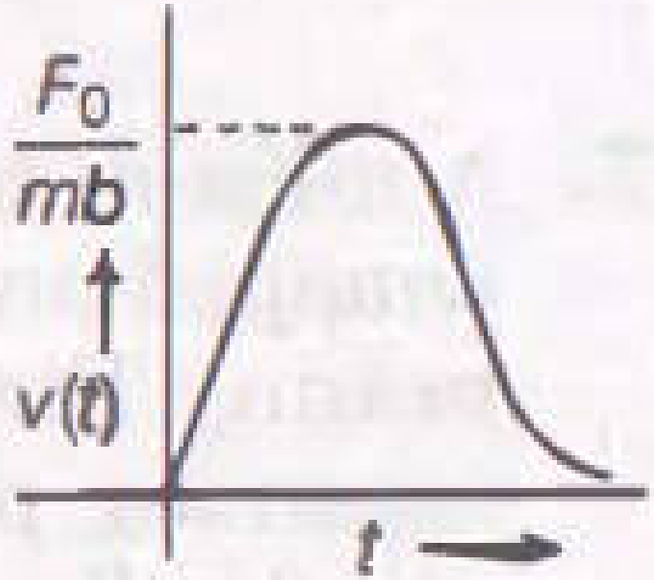
(b)



(c)



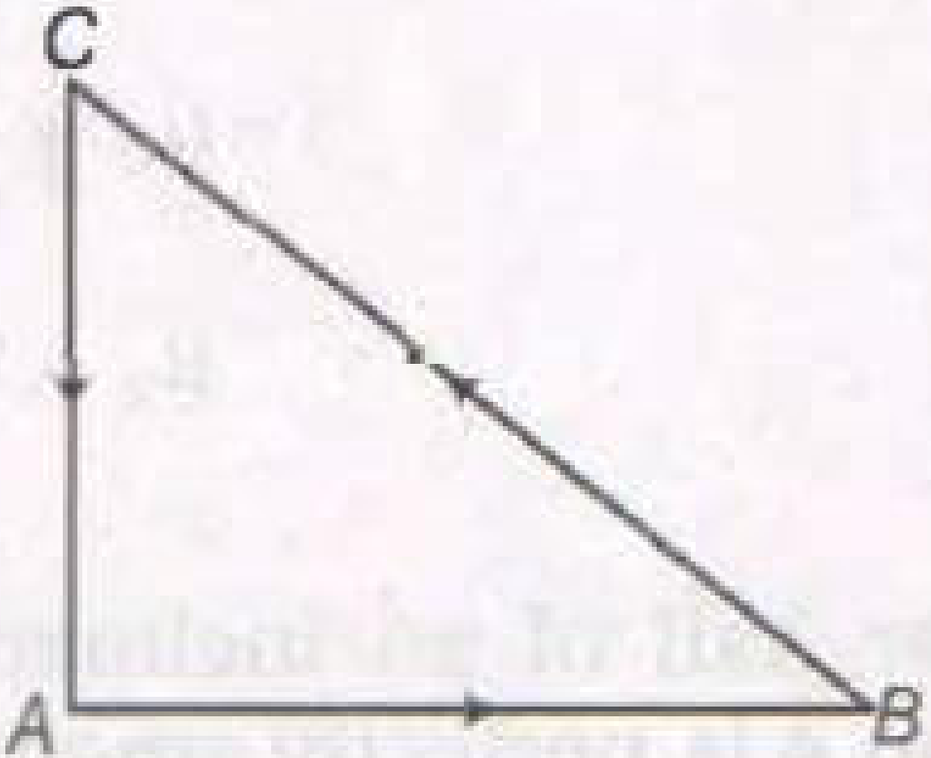
(d)



A ball whose kinetic energy is E, is projected at an angle of 45° to the horizontal. The kinetic energy of the ball at the highest point of its flight will be

(a) E (b) $\frac{E}{\sqrt{2}}$ (c) $\frac{E}{2}$ (d) zero

Three forces start acting simultaneously on a particle moving with velocity **v**. These forces are represented in magnitude and direction by the three sides of a ΔABC (as shown). The particle will now move with velocity



(a) less than **v**
(b) greater than **v**
(c) $|v|$ in the direction of largest force BC
(d) **v**, remaining unchanged

A bob of mass m attached to an inextensible string of length l is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the vertical support. About the point of suspension,

(a) angular momentum is conserved

(b) angular momentum changes in magnitude but not in direction

(c) angular momentum changes in direction but not in magnitude

(d) angular momentum changes both in direction and magnitude

The coordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time t is given by

(a) $3t\sqrt{\alpha^2 + \beta^2}$

(b) $3t^2\sqrt{\alpha^2 + \beta^2}$

(c) $t^2\sqrt{\alpha^2 + \beta^2}$

(d) $\sqrt{\alpha^2 + \beta^2}$

A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of 5 ms^{-2}, the reading of the spring balance will be

(a) 24 N
(b) 74 N
(c) 15 N
(d) 49 N

The physical quantities not having same dimensions are

(a) torque and work

(b) momentum and Planck's constant

(c) stress and Young's modulus

(d) speed and $(\mu_0 \varepsilon_0)^{-1/2}$

A ball is thrown from a point with a speed v_0 at an angle of projection θ. From the same point and at the same instant, a person starts running with a constant speed v_0 to 2
catch the ball. Will the person be able to catch the ball? If yes, what should be the angle of projection?

(a) Yes, 60°
(b) Yes, 30°
(c) No
(d) Yes, 45°

A machine gun fires a bullet of mass 40 g with a velocity 1200 ms^{-1}. The man holding it, can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most?

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

Which of the following units denotes the dimensions $[ML^2/Q^2]$, where Q denotes the electric charge?

(a) Wb/m^2
(b) henry (H)
(c) H/m^2
(d) weber (Wb)

Which of the following statements is false for a particle moving in a circle with a constant angular speed?

(a) The velocity vector is tangent to the circle

(b) The acceleration vector is tangent to the circle

(c) The acceleration vector points to the centre of the circle

(d) The velocity and acceleration vectors are perpendicular to each other

The upper half of an inclined plane with inclination ϕ is perfectly smooth, while the lower half is rough. A body starting from restat the top will again come to rest at the bottom, if the coefficient of friction for the lower half is given by

(a) $2 \sin \phi$ (b) $2 \cos \phi$ (c) $2 \tan \phi$ (d) $\tan \phi$

A body of mass $m = 3.513$ kg is moving along the x-axis with a speed of $5.00\ \text{ms}^{-1}$. The magnitude of its momentum is recorded as

(a) $17.6\ \text{kg ms}^{-1}$
(b) $17.565\ \text{kg ms}^{-1}$
(c) $17.56\ \text{kg ms}^{-1}$
(d) $17.57\ \text{kg ms}^{-1}$

A ball is released from the top of a tower of height h metre. It takes T second to reach the ground. What is the position of the ball in $\frac{T}{3}$ second?

(a) h / 9 m from the ground
(b) $7h$ / 9 m from the ground
(c) $8h$ / 9 m from the ground
(d) $17h$ / 18 m from the ground

A smooth block is released at rest on a 45° incline and then slides a distance d. The time taken to slide is n times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

(a) $\mu_k = 1 - \frac{1}{n^2}$

(b) $\mu_k = \sqrt{1 - \frac{1}{n^2}}$

(c) $\mu_s = 1 - \frac{1}{n^2}$

(d) $\mu_s = \sqrt{1 - \frac{1}{n^2}}$