Physics

1. A body falls freely for 10 sec. Its average velocity during this journey (take g = 10 ms-2)
   a. 100 ms-1
   b. 10 ms-1
   c. 50 ms-1
   d. 5 ms-1

Solution:

Answer: (c)
Given:-
g = 10 m/s2
t = 10 sec
Initial velocity (u) = 0 m/s
S = ut + (1 / 2) gt2
S = 0 + (1 / 2) ×10 × 102
Vavg. = 500 / 10 = 50 m/s

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2. Three projectiles A, B and C are projected at an angle of 30°, 45°, and 60° respectively. If RA, RB, and RC are ranges of A, B and C respectively, then (the velocity of projection is the same for A, B & C).
   a. RA = RB = RC
   b. RA = RC > RB
   c. RA < RB < RC
   d. RA = RC < RB

Solution:

Answer: (d)
RA = RC < RB
R = u2 sin θ / g
RA = u2 sin 60o / g = (√3 / 2) (u2 / g), RB = u2 sin 90o / g = (u2 / g)
RC = u2 sin 120o / g = (u2 / g) cos 30o = (u2 / g) × (√3 / 2)
Therefore, RA = RC < RB

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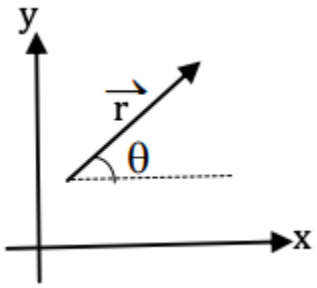
3. The component of a vector r along x-axis has a maximum value if
   a. r is along + ve x-axis
   b. r is along with + ve y-axis
   c. r is along – ve y-axis
   d. r makes an angle of 45° with the x-axis

Solution:

Answer: (a)



rx = |r|cos θ
(rx) = |r| cos max
rx = |r| cos θ
cos θ is the maximum of θ = 0
θ = 0
r is along +ve x-axis

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4. Maximum acceleration of the train in which a 50 kg box lying on its floor will remain stationary (Given: Coefficient of static friction between the box and the floor of the train is 0.3 and g = 10 ms-2)
   a. 5.0 ms-2
   b. 3.0 ms-2
   c. 1.5 ms-2
   d. 15.0 ms-2

Solution:

Answer: (b)
μ = 0.3
m = 50 kg
g = 10 m/s2
f = μmg
The box kept on the floor of the train remains stationary if the pseudo force acting on the box is balanced by frictional force.
ma = μmg
a = μg = 0.3 × 10 = 3.0 m/s2

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5. A 12 kg bomb at rest explodes into two pieces of 4 kg and 8 kg piece is 20 Na, the kinetic energy of the 8 kg piece is -
   a. 25 J
   b. 20 J
   c. 50 J
   d. 40 J

Solution:

Answer: (a)
The initial momentum of the system is zero.
According to the law of conservation of momentum.

Initial momentum = final momentum
So, the final momentum of the system must also be zero.
Hence, the momentum of an 8kg piece must be equal, opposite to the momentum of a 4kg piece.
8kg. piece, P = 20 NS
K.E. of 8kg piece, K = P2 / 2m
(20)2 / (2 * 8) = 25 J

Chemistry

1. The half-life period of a 1st order reaction is 60 minutes. What percentage will be left over after 240 minutes?
   a. 6.25 %
   b. 1.25%
   c. 5%
   d. 6 %

Solution:

Answer: (a)
Given that:
Half-life (t1/2) = 60 min.
Percentage left after 240 min =?
From Ist order kinetic equation t1/2 = (2.303 / k) log {a / (a - [a / 2])}
t1/2 = (2.303 / k) log 2
k = [2.303 / 60] log 2 min-1
Again from Ist order kinetic equation t = (2.303 / k) log (a / [a - x])
log (a / [a - x]) = [t . k] / [2.303]
= [240 min × 2.303 × log 2] / [60 × 2.303]
log (a / [a - x]) = 4log 2
(a / [a - x]) = 24
(a / [a - x]) = 16
If initial concentration (a) is taken as 100%
Then, % of the reactant left after 240 min = 100 / [a - x] = 16
[a - x] = [100 / 16] %
[a - x] = 6.25%

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2. Which of the following is not a colligative property?
   a. Osmotic pressure
   b. Optical activity
   c. Depression
   d. Elevation in Boiling point

Solution:

Answer: (b)
Colligative properties of solutions are properties that depend upon the concentration of

solute molecules or ions, but not upon the identity of the solute. Colligative properties include vapour pressure lowering, boiling point elevation, freezing point depression and osmotic pressure. Whereas optical activity is the ability of a chiral molecule to rotate the plane of plane-polarized light. So, optical activity is not a colligative property.

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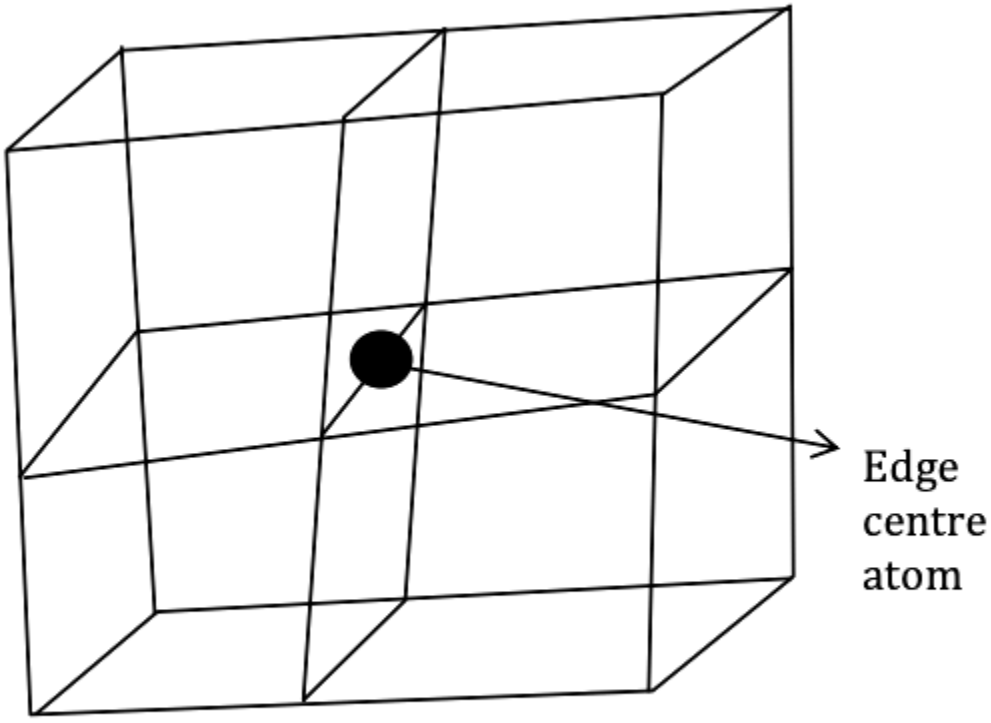
3. The contribution of the particle at the edge centre to a particular unit cell is,
   a. 1 / 2
   b. 1 / 4
   c. 1
   d. 1 / 8

Solution:

Answer: (b)

An atom present at the edge centre of a unit cell is shared by four unit cells.



Space lattice formed by four unit cell

The contribution from each edge centre atom is thus ¼.

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4. When an electrolyte is dissociated in solution, the van't Hoff's factor (i) is,
   a. > 1
   b. < 1
   c. = 0
   d. = 1

Solution:

Answer: (a)
Van't Hoff factor is the ratio of the concentration of particles formed when a substance is dissolved to the concentration of the substance by mass.
i = measured value / Calculated value
Electrolytes are dissociated in the solutions, for dissociation in the absence of association, the Van't Hoff factor is i > 1.

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5. 0
6. Which of the following is incorrect in a galvanic cell?
   a. Oxidation occurs at anode
   b. Reduction occurs at cathode
   c. The electrode at which electrons are gained is called the cathode.
   d. The electrode at which electrons are lost is called the cathode.

Solution:
Answer: (d)
Galvanic Cell is also called as voltaic Cell. In Galvanic Cell at Cathode reduction will take place (gain of e– will take place). So it acts as a sink of electrons. On Cathode positive polarity developed. The anode is of negative polarity. On the anode, oxidation will take place. So it acts as a source of electrons.

Mathematics

1. Write the set builder form A = {–1, 1}

a. A = {x : x is a real number}
b. A = {x : x is an integer}
c. A = {x : x is a root of the equation x2 = 1}
d. A = {x : x is a root of the equation x2 + 1 = 0}

Answer: c
Consider the set A {–1, 1}
Here –1 and 1 are the roots of the equation x2–1 = 0
So set A in set builder form can be written as
A = {x : x is a root of equation x2 – 1 = 0}

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2. If the operation ⊕ is defined by a ⊕ b = a2 + b2 for all real number 'a' and 'b', then (2 ⊕ 3) ⊕ 4 = _____

a. 181
b. 182
c. 184

d. 185

Answer: d
Given that
a ⊕ b = a2 + b2
We have
(2 ⊕3) ⊕4 = (22 + 32) ⊕4
= (4 + 9) ⊕4
= 13 ⊕4 {Using given condition}
= 132 + 42
= 169 + 16
= 185

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3. If z=(3+i)3(3i+4)2(8+6i)2, then |z| is equal to
   a. 0
   b.1
   c. 2
   d. 3

Answer: c

$$Z = \frac{(\sqrt{3}+i)^3(3i+4)^2}{(8+6i)^2}$$

$$|Z| = \left|\frac{(\sqrt{3}+i)^3(3i+4)^2}{(8+6i)^2}\right|$$

$$|Z| = \left|\frac{|\sqrt{3}+i|^3\,|3i+4|^2}{|8+6i|^2}\right|$$

{using the identify $|a + ib| = \sqrt{a^2+b^2}$

$$|Z| = \frac{(3+1)^{\frac{3}{2}}(9+16)^{\frac{2}{2}}}{(64+36)^{\frac{2}{2}}}$$

$$|Z| = \frac{(8)(25)}{(100)}$$

$$|Z| = 2$$

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4. If α and β are the roots of x2 – ax + b2 = 0, then a2 + b2 = 0, then a2 + b2 is equal to _____

a. a2 –2b2
b. 2a2– b2
c. a2 – b2

d. a2 + b2

Answer: a

Given Q. E $\Rightarrow x^2 - ax + b^2 =$ O (α, β)

Sum of root $\Rightarrow \alpha + \beta = a$

Product of root $\Rightarrow \alpha\beta = b^2$

Now $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

$= (a)^2 - 2b^2$