Sample paper 8

Question 1

What would be the scalar product between two vectors and ?

A. 37
B. 38
C. -38
D. -37
E. 36

Correct Answer : B

Explanation:

Scalar product is given by Therefore, B is the correct answer option.

Question 2

A train at rest starts from station A and travels to station B at a distance of 2 km in 4 minutes?
Consider the following statements.
1. Instantaneous speed of the train is 8.33 m/s
2. Average speed of the train is 8.33 m/s
3. Instantaneous acceleration of the train is 8.33 m/s^2
Which of the following statement(s) is/are true?

A. 1
B. 2
C. 3
D. Both 1 and 3
E. Both 2 and 3

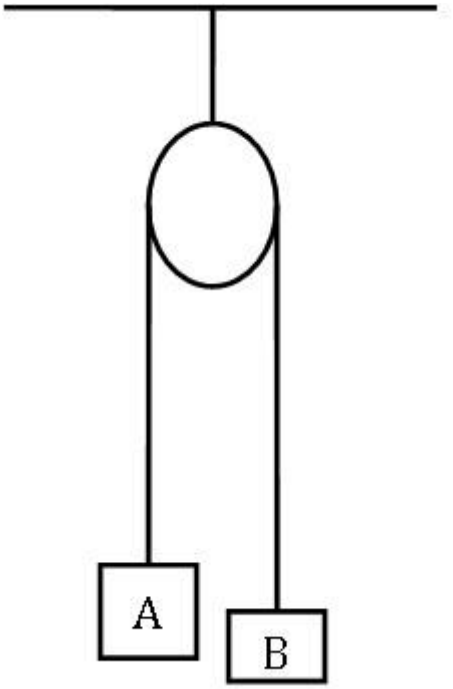
Correct Answer : B

Explanation:

Average speed = Total distance / Total time ---------- (1)
Total distance = 2 km and total time = 4 minutes.
Since, distance and time are given in kilometers and minutes we need to convert them into meters and seconds.
Average speed = 2000/240 = 8.33 m/s
Instantaneous acceleration is related to instantaneous speed. Hence, instantaneous acceleration cannot be found here. Thus, B is the correct answer option.

Question 3

Consider the figure given below for a system of two iron blocks connected with a common pulley. If the block A weighs 200 N, what would be the mass of the iron block B to keep the whole system in static equilibrium?



A. 20.41 kg
B. 15.57 kg
C. 22.23 kg
D. 34.45 kg
E. 21.45 kg

Correct Answer : A

Explanation:

As the whole system is in static equilibrium, there will be no motion in the blocks. Therefore,
Weight of A = Weight of B = 200 N
Weight of a body is given as
W = mg
200 = m x 9.8
m = 20.41kg
Therefore, A is the correct answer option.

Question 4

A boy of 45 kg jumps out of a window and just before reaching the ground his speed is 2 m/s. After he hits the ground he stops and the total time taken during this process is 1 s. What is the force exerted by the ground on the boy?

A. 45 N
B. 22.5 N
C. 180 N
D. 90 N
E. 85 N

Correct Answer : D

Explanation:

F = p/t and p = mv
p = 45*2
p = 90 kgm/s
F = 90/1 Or F = 90 N
Therefore, D is the correct answer option.

Question 5

If a ferry-wheel completes 100 rotations in 15 s, with what velocity is it rotating?

A. 41.87 rad/s
B. 42.34 rad/s
C. 40.56 rad/s
D. 45.45 rad/s
E. 6.67 rad/s

Correct Answer : A

Explanation:

Velocity with which the ferry-wheel is rotating is its angular velocity. It is given as
ω = (N*2π)/t ---------- (1)
Putting the values in equation 1 we get
ω = (100*2π)/15
ω = 41.87rad/s
Therefore, A is the correct answer option.

Question 6

A 5 kg block of ice, kept at some height, has the potential energy of 1000 Joules. What is the height at which the block has been kept?

A. 20.4 m
B. 21.2 m
C. 10.5 m
D. 11.4 m
E. 24.3 m

Correct Answer : A

Explanation:

Potential energy is given as
PE = mgh
1000 = 5*9.8*h
1000/5*9.8 = h
h = 20.4m
Hence, A is the correct answer option.

Question 7

For a body in SHM, the maximum displacement of the body on either sides of the equilibrium is known as

A. amplitude
B. wavelength
C. period
D. frequency
E. speed

Correct Answer : A

Explanation:

A body in SHM moves under a restoring force. The restoring force is always directed towards the equilibrium position. Displacement of a body in SHM is measured as the difference between the final position and the position of equilibrium. Amplitude in SHM is the maximum displacement of the body from the position of equilibrium. In other words, it can be said that amplitude is the maximum displacement of the body on either sides of the equilibrium as the body is SHM will continue performing a to and fro motion. Therefore, A is the correct answer option. Time period or period is the time taken to complete one cycle of oscillation. Hence, C is an incorrect option. Wavelength is the distance between two consecutive maxima or minima of a wave. Therefore, B is an incorrect answer option. Frequency of a body is defined as the number of oscillations about the equilibrium position per second. Therefore, D is an incorrect option. The magnitude of velocity with which the body in SHM moves is known as its speed. Therefore, E is an incorrect option.

Question 8

A tuning fork is making a sound between the frequency range of 200 Hz and 1000 Hz. Which of the following is a correct representation for the range of wavelength of sound that the tuning fork is making? (Speed of sound in airis340 m/s)

A. $0.14\ m \leq \lambda \leq 0.7\ m$
B. $0.54\ m \leq \lambda \leq 1.7\ m$
C. $0.34\ m \leq \lambda \leq 1.7\ m$
D. $0.24\ cm < \lambda < 1.7\ cm$
E. $0.54\ cm \leq \lambda \leq 1\ cm$

Correct Answer : C

Explanation:

Speed of thesoundwave is given as
$v = f\lambda$ ---------- (1)
At lower frequency range
$340 = 200 * \lambda$ Or $\lambda = 1.7m$
At higher frequency range
$340 = 1000 * \lambda$ Or $\lambda = 0.34\ m$
The range of wavelength is $0.34\ m < \lambda < 1.7\ m$.
Therefore, C is the correct answer option.

Question 9

A cubical wooden block of side 0.2 m is floating on the surface of water in such a way that some part of wooden surface is outside it. What percentage of the wooden surface is outside the water? (Density of wood = 700 kg/m^3)

A. 10 %
B. 20 %
C. 25 %
D. 35 %
E. 30 %

Correct Answer : E

Explanation:

SG = ρ body / ρ water
SG = 700 / 1000
SG = 0.7
%SG = 0.7*100
%SG = 70%
Therefore, 70 % of the block is inside the water and 30 % of the block is outside the water. Hence, E is the correct answer option.

Question 10

What is the coefficient of performance of heating and cooling between temperature range of 370 k and 270 K?

A. 2.5 and 1.5
B. 1.7 and 2.5
C. 3.7 and 2.7
D. 4.7 and 5.6
E. 1.5 and 0.5

Correct Answer : C

Explanation:

$COP_{Heating} = T_{hot} / (T_{hot} - T_{cold})$
$COP_{Heating} = 370 / (370-270)$
$COP_{Heating} = 3.7$
COP of cooling is given as
$COP_{cooling} = COP_{Heating} - 1$
$COP_{cooling} = 3.7$ Or $COP_{cooling} = 2.7$
Therefore, C is the correct answer option.

Question 11

What is the dipole moment between an electron and a proton separated by a distance of 1 nm?

A. $3.6*10^{-28}$ Cm
B. $4.5*10^{-28}$ Cm
C. $4.5*10^{-26}$ Cm
D. $1.6*10^{-28}$ Cm
E. $3.2*10^{-28}$ Cm

Correct Answer : D

Explanation:

P = Qd
The distance is in nm so we need to convert it into m.
1nm = 10^{-9} m
Putting the values in the equation we get
P = $1.6*10^{-19}*10^{-9}$ Or P = $1.6*10^{-28}$ Cm
Hence, D is the correct answer option.

Question 12

For a conductor having a cross section of $2*10^{-4};m^2$, average drift velocity of the electrons flowing through it is 10^{-3} m/s. If the density of free electrons in the conductor is $6*10^{24}$ m^{-3} , what is the current flowing through the conductor? (Charge on electron = $1.6*10^{-19}$)

A. 0.45 A
B. 0.045 A
C. 0.27 A
D. 0.31 A
E. 0.19 A

Correct Answer : E

Explanation:

Current flowing through the conductor is given as
$I = neAv_d$
$I = 6*10^{24}*1.6*10^{-19}*10^{-3}$
$I = 9.6*10^{5}*2*10^{-7}$ Or I = 0.19 A
Hence, E is the correct answer option.

Question 13

A circular coil of radius 0.1 m consists of 10 turns. If the current flowing through the coil is measured to be 1.5 A, what would be the magnetic field at the center of the coil? (Permeability of free space is $4\pi*10^{-7}WbA^{-1}m^{-1}$)

A. $8.5*10^{-5}$ T
B. $7.42*10^{-5}$ T
C. $9.42*10^{-5}$ T
D. $6.32*10^{-5}$ T
E. $5.52*10^{-5}$ T

Correct Answer : C

Explanation:

Magnetic field at the center of a coil due to the current flowing in it is given as
$B = (\mu_o / 4\pi)(2\pi nI / r)$
$B = (4\pi*10^{-7} / 4\pi) * (2\pi*10*1.5 / 0.1)$
$B = 10^{-7}*942$ Or $B = 9.42*10^{-5}$ T
Hence, C is the correct answer option.

Question 14

A small water drop on a surface is viewed through a glass. If the real depth of the water drop is 15 cm, what will be the apparent depth of the water drop? (Refractive index of glass =1.5 and refractive index of air = 1)

A. 5 cm
B. 7.5 cm
C. 8.4 cm
D. 1.5 cm
E. 10 cm

Correct Answer : E

Explanation:

The apparent depth is given as
${}_{glass}\mu^{air} = (\mu_{glass}) / (\mu_{air})$ = (real depth) / (apparent depth)
(1.5) / (1) = (15 cm) / (apparent depth)
apparent depth = 10 cm
Hence, E is the correct answer option.

Question 15

Work function of Nickel is 5.01 eV. What is the threshold frequency for Nickel? (Planck's constant = $6.6*10^{-34}$Js)

A. $1.2 * 10^{15}$Hz
B. $0.56* 10^{15}$Hz
C. $4.56* 10^{15}$Hz
D. $3.67* 10^{14}$Hz
E. $2.23* 10^{15}$Hz

Correct Answer : A

Explanation:

$\Phi = hv_o$
Work function is given in eV so, we need to convert it into Joules.
$8.02*10^{-19} = 6.6*10^{-34}*v_o$
$v_o = (8.02*10^{-19}) / (6.6*10^{-34})$
$v_o = 1.21*10^{15}$Hz
Therefore, A is the correct answer option.