BITSAT 2023 – 23 May (Shift 1) Question Paper with Answers (Memory Based)

Question 1. If work done on a body is positive, then what will be the sign of kinetic energy?

A. Increase
B. Decrease
C. Zero
D. Either increase or decrease

Answer: Increase.

Solution: If the work done by a force on a body is positive, then its kinetic energy increases. The work-energy theorem states that the work done on an object is equal to the change in its kinetic energy. When the work done is positive, it means that the force applied to the object is in the same direction as its motion, and thus the force is doing work on the object to increase its kinetic energy.

Mathematically, the work-energy theorem can be expressed as:

Work = Change in Kinetic Energy

If the work done (W) is positive, then the change in kinetic energy (ΔKE) is also positive. This indicates that the object's kinetic energy has increased, which means it has gained speed or motion as a result of the force applied to it.

It's important to note that the work done on a body is the net work, which takes into account all the forces acting on the object. If there are multiple forces acting on the body, the net work done by all the forces will determine the change in its kinetic energy.

Question 2. Mercury kept in the refrigerator has length L. If taken out in atmospheric pressure condition, length remains the same due to?

Answer: Due to the negligible thermal expansion of mercury at typical temperature ranges.

Solution: If mercury kept in a refrigerator is taken out into atmospheric pressure conditions, its length remains the same due to the negligible thermal expansion of mercury at typical temperature ranges.

Mercury is known to have a very low coefficient of thermal expansion, which means it expands or contracts very little with changes in temperature. This property makes it suitable for use in thermometers and other applications where precise measurements are required.

When mercury is kept in a refrigerator, it reaches a temperature close to the refrigerator's set temperature. Upon taking it out into atmospheric pressure conditions, although the temperature of the surroundings may change, the expansion or contraction of mercury due to the change in temperature is minimal and can be considered negligible. Therefore, the length of mercury remains approximately the same when exposed to atmospheric pressure conditions.

Question 3. Dipole placed in a sphere, what will be the electric flux?

Answer: Depends on the orientation of the dipole with respect to the surface of the sphere.

Solution: If a dipole is placed inside a sphere, the electric flux through the sphere will depend on the orientation of the dipole with respect to the surface of the sphere.

The electric flux through a closed surface is given by Gauss's law, which states that the total electric flux through a closed surface is equal to the enclosed charge divided by the permittivity of the medium.

If the dipole moment is aligned with the normal vector of the surface, the electric flux through the sphere will be zero. This is because the positive and negative charges of the dipole cancel each other's contributions to the electric field at every point on the surface, resulting in no net flux passing through.

If the dipole moment is not aligned with the normal vector of the surface, the electric flux through the sphere will be nonzero. In this case, the positive and negative charges of the dipole do not cancel each other completely, resulting in a net electric field passing through the surface of the sphere. This net electric field will lead to a non zero electric flux through the sphere.

Therefore, the electric flux through the sphere with a dipole inside will depend on the orientation of the dipole relative to the surface of the sphere.

Question 4. Work done in an isochoric process is always?

Answer: Zero.

Solution: In an isochoric process, also known as an isovolumetric process, the volume of a system remains constant. In such a process, the work done is always zero.

Work is defined as the energy transferred to or from a system due to the application of a force over a displacement. In an isochoric process, since there is no change in volume, there is no displacement of the system's boundaries, and therefore no work is done. The force may be applied, but if there is no displacement, the work done is zero.

Mathematically, the work done (W) in a process is given by the equation:

$W = \int F \cdot dx$

Where F is the applied force and dx is the displacement. Since dx is zero in an isochoric process, the integral becomes zero, resulting in no work done.

It's important to note that although no work is done in an isochoric process, heat can still be exchanged with the surroundings, resulting in changes in the system's internal energy. The internal energy change corresponds to the heat transfer into or out of the system.

Question 5. What is the probability of 53 Fridays in an ordinary year?

Answer: 1/7

Solution: To determine the probability of having 53 Fridays in an ordinary year, we need to consider the possible combinations of days of the week for each month and take into account leap years.

In an ordinary year, there are 365 days. This means that there will be 52 complete weeks of 7 days

each, which gives us 364 days. The remaining day can fall on any day of the week.

Since 7 does not divide evenly into 365, there will be one day left over. Therefore, there are two possibilities: either there will be 52 Fridays (with the remaining day falling on a different day of the week), or there will be 53 Fridays (with the remaining day falling on a Friday).

Hence, the probability of having 53 Fridays in an ordinary year is 1/7, or approximately 0.1429 (14.29%).

Question 6. Minimum value of 5cos2x + 5sin2x?

Answer: 2

Solution: To find the minimum value of the expression 5^cos(2x) + 5^sin(2x), we can use the fact that the range of both the cosine and sine functions is between -1 and 1.

Since 5^cos(2x) and 5^sin(2x) are both positive for any value of x, the minimum value of the expression occurs when both terms equal their minimum value of 1.

Therefore, the minimum value of 5^cos(2x) + 5^sin(2x) is 1 + 1 = 2.

Question 7. ∫1/(1 + sinx)?

Answer: tan x − sec x + C, where C is the integration constant.

Solution: We use one of the trigonometric identities to solve this. We will multiply the numerator and denominator by of 1/ (1 + sin x) by (1 – sin x). Then we get

∫1/(1 + sinx) dx

∫1/(1 + sin x) · (1 - sin x)/(1 - sin x) dx

= ∫(1 − sin x)/(1 − sin2x) dx

From trigonometric identities, we know that sin2x + cos2x = 1. From this,
cos2x = 1 – sin2x

Substituting this in the above integral,

= ∫(1 − sin x) / cos2x dx
= ∫ (1/cos2x) - (sin x)/(cos x) · (1/cosx) dx
= ∫ (sec2x – tan x sec x) dx
= tan x − sec x + C (∵∫ sec2x dx = tan x and ∫ tan x sec x dx = sec x)

Thus, ∫1 / (1 + sin x) dx = tan x − sec x + C, where C is the integration constant.

Question 8. Which substance is used in column Chromatography?

Answer: Al2O3 and Silica gel

Solution: The most commonly used adsorbent in column chromatography is Al2O3 and silica gel because these have high surface area and are porous in nature such that they absorb substances onto

the surface by intermolecular forces.

Question 9. State Boyle's Law.

Answer: Boyle's law is a relation concerning the compression and expansion of a gas at constant temperature. This empirical relation, formulated by the physicist Robert Boyle in 1662, states that the pressure

(p) of a given quantity of gas varies inversely with its volume (v) at constant temperature; i.e., in equation form, pv = k, a constant.

Question 10. Surface tension for a liquid is ½ of the other liquid and density is doubled, then if L1 = 10, then L2 = ?

Question 11. Triangular loop at intercepts (a, 0, 0), (0, a, 0) and (0, 0, a), then what is the magnetic moment?

Question 12. ∫√tanx/(√tanx + √cotx)?

Question 13. What are the products of the reaction between Chlorine water in hydrolysis?

Question 14. Mononitration of bromobenzene?

Question 15. Bromo toluene + Chlorine = A + H2O = B + conc NaOH = C + D?