VTUEEE Sample Question Paper

Physics

Question 1:

- A particle is moving in a circle of radius 'r' with a uniform speed 'v'. What is the magnitude of its acceleration?
    - (a) v/r
    - (b) v^2/r
    - (c) vr
    - (d) vr^2
- Solution:
    - The particle is undergoing uniform circular motion. In a uniform circular motion, the acceleration is directed towards the center of the circle and is called centripetal acceleration.
    - The magnitude of centripetal acceleration is given by the formula: $a = v^2/r$
    -
    - Therefore, the correct answer is (b) v^2/r.

Question 2:

- A block of mass 2 kg is placed on a horizontal surface. A horizontal force of 10 N is applied to the block. If the coefficient of kinetic friction between the block and the surface is 0.2, what is the acceleration of the block? ($g = 10\ m/s^2$)
    - (a) $3\ m/s^2$
    - (b) $4\ m/s^2$
    - (c) $5\ m/s^2$
    - (d) $6\ m/s^2$
- Solution:
    - First, calculate the frictional force: $F_{friction} = \mu * N$, where μ is the coefficient of kinetic friction and N is the normal force.
    - The normal force is equal to the weight of the block: $N = mg = 2\ kg * 10\ m/s^2 = 20\ N$.
    -
    - $F_{friction} = 0.2 * 20\ N = 4\ N$.
    - Now, calculate the net force acting on the block: F_{net} = Applied force - $F_{friction}$ = 10 N - 4 N = 6 N.
    - Using Newton's second law, $F_{net} = ma$, where a is the acceleration.
    - $a = F_{net} / m = 6\ N / 2\ kg = 3\ m/s^2$.
    - Therefore, the correct answer is (a) $3\ m/s^2$.

Question 3:

- What is the work done in moving a 2-coulomb charge from a point at 118 volts to a point at 128 volts?
    - (a) 10 J
    - (b) 20 J
    - (c) 236 J
    - (d) 256 J
- Solution:
    - The work done in moving a charge between two points is given by: W = q * ΔV, where q is the charge and ΔV is the potential difference.
    - ΔV = 128 V - 118 V = 10 V.
    - W = 2 C * 10 V = 20 J.
    - Therefore, the correct answer is (b) 20 J.

Question 4:

- A convex lens of focal length 20 cm forms a real image twice the size of the object. If the object distance is 'u', then find 'u'.
    - (a) -30 cm
    - (b) -40 cm
    - (c) -50 cm
    - (d) -60 cm
- Solution:
    - Magnification (m) = -v/u = -2 (real image is inverted)
    - v = 2u
    - Using the lens formula, 1/f = 1/v + 1/u
    - 1/20 = 1/(2u) + 1/u = 3/(2u)
    - 2u = 60
    - u = 30
    - Since it is an object distance, the value is negative.
    - Therefore, the correct answer is (a) -30 cm.

Question 5:

- A wire of resistance R is stretched to double its length. What is the new resistance of the wire?
    - (a) R/4
    - (b) R/2
    - (c) 2R
    - (d) 4R
- Solution:
    - When a wire is stretched, its volume remains constant.

    - If the length is doubled, the area of cross-section becomes half.
    - Resistance R = ρL/A, where ρ is resistivity, L is length, and A is the area.
    - New resistance R' = ρ(2L)/(A/2) = 4(ρL/A) = 4R.
    - Therefore, the correct answer is (d) 4R.

Question 6:

- A sound wave has a frequency of 500 Hz and a wavelength of 0.6 m. What is the speed of the sound wave?
    - (a) 200 m/s
    - (b) 300 m/s
    - (c) 400 m/s
    - (d) 500 m/s
- Solution:
    - The speed of a wave is given by the formula: v = fλ, where v is the speed, f is the frequency, and λ is the wavelength.
    - v = 500 Hz * 0.6 m = 300 m/s.
    - Therefore, the correct answer is (b) 300 m/s.

Question 7:

- A particle executes simple harmonic motion (SHM) with an amplitude of 10 cm and a time period of 2 s. What is its maximum velocity?
    - (a) 10π cm/s
    - (b) 20π cm/s
    - (c) 30π cm/s
    - (d) 40π cm/s
- Solution:
    - The maximum velocity in SHM is given by the formula: v_max = Aω, where A is the amplitude and ω is the angular frequency.
    - Angular frequency (ω) = 2π/T, where T is the time period.
    - ω = 2π/2 s = π rad/s.
    - v_max = 10 cm * π rad/s = 10π cm/s.
    - Therefore, the correct answer is (a) 10π cm/s.

Question 8:

- Two resistors, 4 Ω and 6 Ω, are connected in parallel. What is the equivalent resistance of the combination?
    - (a) 2.4 Ω
    - (b) 5 Ω
    - (c) 10 Ω
    - (d) 24 Ω
- Solution:

- For resistors in parallel, the equivalent resistance (R_eq) is given by: 1/R_eq = 1/R1 + 1/R2.
- 1/R_eq = 1/4 Ω + 1/6 Ω = (3 + 2)/12 Ω = 5/12 Ω.
- R_eq = 12/5 Ω = 2.4 Ω.
- Therefore, the correct answer is (a) 2.4 Ω.

Question 9:

- What is the kinetic energy of a body of mass 2 kg moving with a velocity of 5 m/s?
  - (a) 10 J
  - (b) 25 J
  - (c) 50 J
  - (d) 100 J
- Solution:
  - Kinetic energy (KE) is given by the formula: KE = (1/2)mv², where m is the mass and v is the velocity.
  - KE = (1/2) * 2 kg * (5 m/s)² = 25 J.
  - Therefore, the correct answer is (b) 25 J.

Question 10:

- If the temperature of a black body is doubled, by what factor does the rate of emission of radiation increase?
  - (a) 2
  - (b) 4
  - (c) 8
  - (d) 16
- Solution:
  - The rate of emission of radiation from a black body is proportional to the fourth power of its absolute temperature (Stefan-Boltzmann law): $P \propto T^4$.
  - If the temperature is doubled (T' = 2T), then the new rate of emission (P') is: $P' \propto (2T)^4 = 16T^4$.
  - Therefore, the rate of emission increases by a factor of 16.
  - The correct answer is (d) 16.

Question 11:

- A projectile is thrown with an initial velocity of u at an angle θ with the horizontal. What is the maximum height reached by the projectile?

(a) $\frac{u^2 \sin\theta}{g}$

(b) $\frac{u^2 \sin^2\theta}{g}$

(c) $\frac{u^2 \sin^2\theta}{2g}$

(d) $\frac{u^2 \sin\theta}{2g}$

Solution:

- The vertical component of the initial velocity is usinθ.
- Using the kinematic equation v2=u2+2as, where v=0 at the maximum height, u=usinθ, a=−g, and s=H (maximum height):

$$0 = (u \sin \theta)^2 - 2gH$$

$$H = \frac{u^2 \sin^2 \theta}{2g}$$

Therefore, the correct answer is (c) $\frac{u^2 \sin^2 \theta}{2g}$.

Question 12:

- What is the de Broglie wavelength of an electron moving with a momentum of p?
    - (a) ph
    - (b) hp
    - (c) hp
    - (d) hp1
- Solution:
    - The de Broglie wavelength (λ) is given by λ=ph, where h is Planck's constant and p is the momentum.
    - Therefore, the correct answer is (a) ph.

Question 13:

- What is the value of the gravitational acceleration at the center of the earth?
    - (a) g
    - (b) g/2
    - (c) 0
    - (d) 2g
- Solution:
    - At the centre of the earth, the gravitational acceleration is zero because the gravitational forces from all sides cancel each other out.
    - Therefore, the correct answer is (c) 0.

Question 14:

- If the radius of the earth shrinks by 1% keeping the mass constant, then the acceleration is due to gravity on the surface of the earth.
    - (a) Increases by 2%
    - (b) Decreases by 2%
    - (c) Increases by 1%
    - (d) Decreases by 1%
- Solution:
    - g=R2GM

    - If R decreases by 1%, then $R' = 0.99R$
    - $g' = (0.99R)2GM = 0.9801g \approx 1.02g$
    - Therefore g increases by approximately 2%.
    - The correct answer is (a) Increases by 2%.

Question 15:

- What is the unit of magnetic flux?
    - (a) Tesla
    - (b) Weber
    - (c) Ampere
    - (d) Henry
- Solution:
    - The unit of magnetic flux is Weber.
    - Therefore, the correct answer is (b) Weber.

Question 16:

- What is the value of the refractive index of a vacuum?
    - (a) 0
    - (b) 1
    - (c) Infinity
    - (d) 1.5
- Solution:
    - The refractive index of vacuum is 1.
    - Therefore, the correct answer is (b) 1.

Chemistry

Question 1:

- What is the pH of a 0.001 M solution of HCl?
    - (a) 1
    - (b) 2
    - (c) 3
    - (d) 4
- Solution:
    - HCl is a strong acid, so it completely dissociates in water.
    - $[H^+] = 0.001\ M = 10^{-3}\ M$.
    - $pH = -\log[H^+] = -\log(10^{-3}) = 3$.
    - Therefore, the correct answer is (c) 3.

Question 2:

- Which of the following elements has the highest ionization energy?
    - (a) Sodium (Na)
    - (b) Potassium (K)
    - (c) Fluorine (F)
    - (d) Chlorine (Cl)
- Solution:
    - Ionization energy increases across a period and decreases down a group.
    - Fluorine (F) is located in the top right corner of the periodic table, making it have the highest ionization energy of the provided choices.
    - Therefore, the correct answer is (c) Fluorine (F).

Question 3:

- What is the chemical formula of calcium carbonate?
    - (a) $CaCO_3$
    - (b) $CaCl_2$
    - (c) $Ca(OH)_2$
    - (d) CaO
- Solution:
    - Calcium carbonate is composed of calcium ions (Ca^{2+}) and carbonate ions (CO_3^{2-}).
    - Therefore, the chemical formula is $CaCO_3$.
    - Therefore, the correct answer is (a) $CaCO_3$.

Question 4:

- Which of the following is an example of a transition metal?
    - (a) Sodium (Na)
    - (b) Magnesium (Mg)
    - (c) Iron (Fe)
    - (d) Aluminum (Al)
- Solution:
    - Transition metals are located in the d-block of the periodic table.
    - Iron (Fe) is a transition metal.
    - Therefore, the correct answer is (c) Iron (Fe).

Question 5:

- What is the oxidation number of sulfur in H_2SO_4?
    - (a) +2
    - (b) +4
    - (c) +6
    - (d) -2

- Solution:
    - In H_2SO_4, the oxidation number of hydrogen is +1 and oxygen is -2.
    - Let the oxidation number of sulfur be x.
    - 2(+1) + x + 4(-2) = 0
    - 2 + x - 8 = 0
    - x = +6
    - Therefore, the correct answer is (c) +6.

Question 6:

- Which of the following is an example of an alkali metal?
    - (a) Calcium (Ca)
    - (b) Sodium (Na)
    - (c) Magnesium (Mg)
    - (d) Aluminum (Al)
- Solution:
    - Alkali metals are located in Group 1 of the periodic table.
    - Sodium (Na) is an alkali metal.
    - Therefore, the correct answer is (b) Sodium (Na).

Question 7:

- What is the product formed when an acid reacts with a base?
    - (a) Salt and water
    - (b) Hydrogen gas
    - (c) Oxygen gas
    - (d) A metal
- Solution:
    - An acid reacts with a base to form salt and water (neutralization reaction).
    - Therefore, the correct answer is (a) Salt and water.

Question 8:

- What is the empirical formula of a compound with the molecular formula $C_6H_{12}O_6$?
    - (a) $C_2H_4O_2$
    - (b) CH_2O
    - (c) $C_3H_6O_3$
    - (d) $C_6H_{12}O_6$
- Solution:
    - The empirical formula is the simplest whole-number ratio of atoms in a compound.
    - The simplest ratio of $C_6H_{12}O_6$ is CH_2O.
    - Therefore, the correct answer is (b) CH_2O.

Question 9:

- Which gas is commonly known as laughing gas?
    - (a) Nitrogen dioxide (NO_2)
    - (b) Nitrous oxide (N_2O)
    - (c) Carbon monoxide (CO)
    - (d) Sulfur dioxide (SO_2)
- Solution:
    - Nitrous oxide (N_2O) is commonly known as laughing gas.
    - Therefore, the correct answer is (b) Nitrous oxide (N_2O).

Question 10:

- What is the process of converting a solid directly into a gas called?
    - (a) Melting
    - (b) Boiling
    - (c) Sublimation
    - (d) Condensation
- Solution:
    - The process of converting a solid directly into a gas is called sublimation.
    - Therefore, the correct answer is (c) Sublimation.

Question 11:

- Which of the following is an allotrope of carbon?
    - (a) Water
    - (b) Diamond
    - (c) Salt
    - (d) Sugar
- Solution:
    - Diamond is an allotrope of carbon.
    - Therefore, the correct answer is (b) Diamond.

Question 12:

- What is the chemical formula of ammonia?
    - (a) H_2O
    - (b) CO_2
    - (c) NH_3
    - (d) CH_4
- Solution:
    - The chemical formula of ammonia is NH_3.
    - Therefore, the correct answer is (c) NH_3.

Question 13:

- Which of the following is a noble gas?
    - (a) Oxygen
    - (b) Nitrogen
    - (c) Helium
    - (d) Hydrogen
- Solution:
    - Helium is a noble gas.
    - Therefore, the correct answer is (c) Helium.

Question 14:

- What is the process of rusting an example of?
    - (a) Reduction
    - (b) Oxidation
    - (c) Neutralization
    - (d) Sublimation
- Solution:
    - Rusting is an oxidation process.
    - Therefore, the correct answer is (b) Oxidation.

Question 15:

- What is the main component of natural gas?
    - (a) Ethane
    - (b) Propane
    - (c) Methane
    - (d) Butane
- Solution:
    - Methane is the main component of natural gas.
    - Therefore, the correct answer is (c) Methane.

Mathematics

Question 1:

- If $f(x) = x^3 - 6x^2 + 11x - 6$, then what are the roots of $f(x) = 0$?
    - (a) 1, 2, 3
    - (b) -1, -2, -3
    - (c) 0, 1, 2
    - (d) 1, -2, 3

- Solution:
    - We can factor the polynomial: f(x) = (x - 1)(x - 2)(x - 3).
    - Setting f(x) = 0, we get (x - 1)(x - 2)(x - 3) = 0.
    - Therefore, the roots are x = 1, 2, 3.
    - The correct answer is (a) 1, 2, 3.

Question 2:

- What is the derivative of y = sin(2x)?
    - (a) cos(2x)
    - (b) 2cos(2x)
    - (c) -cos(2x)
    - (d) -2cos(2x)
- Solution:
    - Using the chain rule, dy/dx = cos(2x) * d(2x)/dx = cos(2x) * 2 = 2cos(2x).
    - The correct answer is (b) 2cos(2x).

Question 3:

- What is the integral of ∫(2x + 1) dx?
    - (a) $x^2 + x + C$
    - (b) $x^2 + C$
    - (c) $2x^2 + x + C$
    - (d) 2x + C
- Solution:
    - ∫(2x + 1) dx = ∫2x dx + ∫1 dx = $2(x^2/2) + x + C = x^2 + x + C$.
    - The correct answer is (a) $x^2 + x + C$.

Question 4:

- If A = [[1, 2], [3, 4]], what is the determinant of A?
    - (a) -2
    - (b) 2
    - (c) 10
    - (d) -10
- Solution:
    - det(A) = (1 * 4) - (2 * 3) = 4 - 6 = -2.
    - The correct answer is (a) -2.

Question 5:

- What is the value of sin(π/3)?
    - (a) 1/2
    - (b) √3/2

    - (c) $1/\sqrt{2}$
    - (d) 1
- Solution:
    - $\sin(\pi/3) = \sin(60°) = \sqrt{3}/2$.
    - The correct answer is (b) $\sqrt{3}/2$.

Question 6:

- What is the equation of a line passing through (1, 2) and (3, 4)?
    - (a) $y = x + 1$
    - (b) $y = 2x$
    - (c) $y = x - 1$
    - (d) $y = 2x + 1$
- Solution:
    - Slope (m) = (4 - 2) / (3 - 1) = 2 / 2 = 1.
    - Using point-slope form, $y - 2 = 1(x - 1)$, which gives $y = x + 1$.
    - The correct answer is (a) $y = x + 1$.

Question 7:

- What is the value of $\log_2(8)$?
    - (a) 2
    - (b) 3
    - (c) 4
    - (d) 8
- Solution:
    - $\log_2(8) = \log_2(2^3) = 3$.
    - The correct answer is (b) 3.

Question 8:

- What is the sum of the first 10 terms of the arithmetic progression 2, 4, 6, 8, ...?
    - (a) 90
    - (b) 100
    - (c) 110
    - (d) 120
- Solution:
    - $a = 2, d = 2, n = 10$.
    - Sum (S) = $(n/2)[2a + (n - 1)d] = (10/2)[2(2) + (10 - 1)2] = 5[4 + 18] = 5 * 22 = 110$.
    - The correct answer is (c) 110.

Question 9:

- What is the value of $\lim(x \to 0) \sin(x)/x$?

    - (a) 0
    - (b) 1
    - (c) ∞
    - (d) -1
- Solution:
    - $\lim(x \to 0) \sin(x)/x = 1$.
    - The correct answer is (b) 1.

Question 10:

- What is the area of a circle with radius 5?
    - (a) 5π
    - (b) 10π
    - (c) 25π
    - (d) 100π
- Solution:
    - Area = $\pi r^2 = \pi(5^2) = 25\pi$.
    - The correct answer is (c) 25π.

Question 11:

- What is the value of $\cos(\pi/2)$?
    - (a) 0
    - (b) 1
    - (c) -1
    - (d) 1/2
- Solution:
    - $\cos(\pi/2) = \cos(90°) = 0$.
    - The correct answer is (a) 0.

Question 12:

- What is the equation of a circle with center (0, 0) and radius 3?
    - (a) $x^2 + y^2 = 3$
    - (b) $x^2 + y^2 = 6$
    - (c) $x^2 + y^2 = 9$
    - (d) $(x-3)^2 + (y-3)^2 = 9$
- Solution:
    - The equation of a circle is $(x-h)^2 + (y-k)^2 = r^2$, where (h,k) is the center and r is the radius.
    - $x^2 + y^2 = 3^2 = 9$.
    - The correct answer is (c) $x^2 + y^2 = 9$.

Question 13:

- What is the value of 5!?
    - (a) 20
    - (b) 60
    - (c) 120
    - (d) 720
- Solution:
    - 5! = 5 * 4 * 3 * 2 * 1 = 120.
    - The correct answer is (c) 120.

Question 14:

- If vectors a = i + 2j and b = 3i - j, find a + b.
    - (a) 4i + j
    - (b) 2i + 3j
    - (c) 4i - 3j
    - (d) 2i - j
- Solution:
    - a + b = (1 + 3)i + (2 - 1)j = 4i + j.
    - The correct answer is (a) 4i + j.

Question 15:

- What is the derivative of e^x?
    - (a) x*e^(x-1)
    - (b) e^x
    - (c) 1
    - (d) 0
- Solution:
    - The derivative of e^x is e^x.
    - The correct answer is (b) e^x.