3000 Physics Formulas By Bank of MCQs

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Measurements

Smallest unit of measurement by;
Measurement tape → 1 cm or 1mm
Meter rule or half meter rule → 0.1 cm or 1 mm
Vernier caliper → 0.01 cm or 0.1 mm
Screw gauge → 0.001 cm or 0.01 mm
θ = s/r
2π rad = 3600
3600 = 1 revolution
1 radian = 57.30
1 degree = 60 minute
1 minute = 60 seconds
Angle at circle is 2π radian.
Angle at sphere is 4π steradian.
Volume of slid cylinder = πr2l
Area of sphere = 4πr2
Volume of sphere = 4/3 πr3
Dimension of velocity = [LT-1]
Dimension of acceleration= [LT-2]
Energy of photon; E = hf
Time period of pendulum; T = 2π √(l/g)

Vectors and equilibrium

Commutative property of vector= A+B = B+A
Fx =F cosθ
Fy = Fsinθ
F = √(〖Fx〗^2- 〖Fy〗^2)
A.B = AB cos θ
A x B = AB sin θ
Scalar product; work and power
Vector product; torque
τ = r x F
First condition of equilibrium; ∑F = 0
Second condition of equilibrium; ∑τ = 0

Motion and Force

v = s/t
a = v/t
vf = vi +at
s = vit + ½ at2
2as = vf2 – vi2
S = vave x t
Vave =(vi + vf)/2
g = 9.8 ms-2 = 32 ft-2
F = ma
a = v/t
P = mv
P = F t
Impulse; J = F x t = ΔP
J = ΔP
Law of conservation of momentum; Δp = 0
Elastic collision in one dimension; [v1 + v2] = [v1'+ v2']
Magnitude of projectile velocity; Vf = √(v_fx^2+ 〖v_fy^2〗^)
Height of projectile; H = vi2sin2θ/2g
Time of flight; T = 2 vi sinθ/g
Time of summit or time to reach to highest point; T = vi sinθ/g
Range; R = vi2 sin 2θ/g
Rmax = vi2/g
R = Rmax at 450

Work and Energy

W = Fd cosθ
Power; p=W/t or p =Fv
1 watt = Js-1
1 hp = 746 watts
K.E = ½ mv2
P.E = mgh
Efficiency = output/input = W x D/P x d
Circular motion
Absolute potential energy =Fr = - GmMe/Re (- because work is done against gravity)
Gravitational potential = E/m = GMe/Re
For escape velocity compare K.E with Absolute potential energy; vesc = √(〖2GM〗_e/r_e) → vesc = √(〖2gr〗_e)
G = 6.67 x 10-11 Nm2kg-2
Re = 6.4 x 106 m
Me = 6 x 1024 kg
Vesc = 11.2 x 103 ms-1
Wh = K.E + fh → (Wh = loss in potential energy)
Loss in P.E = Gain inn K.E + work done against friction
E = mc2 →(c= 3 x 108 ms-1)

Rotational and circular motion

Angular velocity; ω = Δθ/Δt
Angular acceleration; α = Δω/Δt → a = α x r
v = r ω
Fc = mv2/r
ac = -(v2/r)
Centrifugal force= mv2/r
F sin θ = mv2/r
F cos θ = mg
Tan θ = v2/gr
Torque = r F = rma = rm (rα) =(r2m)α = I α
Moment of inertia; I = mr2
Ring or thin walled cylinder inertia(I) = MR2
Disc or solid cylinder inertia = ½ MR2
Disc inertia = ½ M (R22 + R12)
Solid sphere inertia = 2/5 MR2
Solid rod or meter stick inertia = 1/12 Ml2
Rectangular plate inertia = 1/12 M (a2+b2)
Angular momentum = L = r x p = r mv = rmrω =r2mω = Iω
L = rmv → L/t = rmv/t = rma = rF = τ
L/t = τ
Linear kinetic energy = ½ mv2
Rotational kinetic energy = ½ Iω2
Velocity of hoop = v = √gh
Velocity of disc = v = √(4/3 gh)
Critical velocity = v = 7.9 km2
The orbital velocity = v =√(〖GM〗_e/r)
Lift at rest → T =w
Lift moving downward → T = w – ma
Lift moving upward → T = w + ma
Lift falling freely = T mg-ma = 0
Frequency for artificial satellite → f = 1/2π √(g/r)

Fluid dynamics

Drag force → Fd = 6 πη r v
Terminal velocity → vt = 〖2ρgr〗^2/(9η)
Continuity equation → A1 v1 = A2 v2
Av=ΔV/Δt = constant
Δm/Δt = ρ ΔV/Δt
Bernoulli's Equation = P + ½ ρv2 + ρgh = constant
Torricelli's Theorem → v = √2gh
Flow meter or the venture meter → v1 =√(2gh/((A_1^2)/(A_2^2)-1))

Oscillation

Frequency → f=1/T
Angular frequency → ω = 2πf
Time period → T = 2π/ω
Velocity of projection → vy = ω√(r^2-x^2)
Simple pendulum time period → T = 2π √(L/g)
Simple pendulum potential energy = ½ kx2
Simple pendulum kinetic energy = ½ kx02 -½ kx2
Total energy of simple pendulum = ½ kx02
Resonance frequency = Fn = nf1
Phase → θ =ω t

Waves

Transverse wave speed → v=√(T x L)/M or v=√(T)/m
Longitudinal waves speed → v=√(E)/ρ
Phase change→ 2π = λ
Phase difference → δ = 2π/λ
Speed of sound by newton → v = √((ρ_m gh)/ρ) = 281 ms-1
Laplace correction → v = √((〖γρ〗_m gh)/ρ) = 332 ms-1

Chap No.11 ELECTROSTATICS

1 e = 1.602 x 10-19 C
Q = ne
Coulomb's Law; F = k (q1 q2)/r2
K = 1/4πεo
K = 9.0 x 109 N m2 C-2
εo = 8.85 x 10 -12 C2 N-1 m-2
εr = ε/ε0
Fmed = (F vac)/εr
E = F/q = V/d = K q/r2
Φ = E A cos θ = N m2 C-1
Φ = Q/ε0
E due to sheet of charge; E = σ/2ε
E due to charge palates; E = σ/ε
V = W/Q = U/Q
Volt = Joule / Coulomb
Electric potential energy; U = K Qq/r
Electric potential; V = W/Q = Fr/Q = K Q/r
Potential Gradient = E = -ΔV/Δr
1 eV =1.602 x 10-19 C x 1V → (1 eV = 1.602 x 10-19 J)
C = Q/V = C V-1 = farad
Charge density; σ = Q/A
Cvac = Q/V = (ε0 A)/d = (ε0 εr A)/d
εr = Cmed / Vvac
Capacitors In Series;
Q = Q1 = Q2 =Q3
V =V1 + V2 + V3
1/Ce = 1/C1 + 1/C2 + 1/C3
Capacitors In Parallel;
Q = Q1 = Q2 = Q3
V = V1 + V2 +V3,
Ce = C1 + C2 + C3
Electric dipole; P = q d
Energy = U = UV/2= CV2/(2) = 1/2 (A ε0 εr)/d (Ed)2
Energy density; μ=U/Ad=1/2 εo εr E2
Maximum charge on capacitor = C x e.m.f
q/q0 = 63.2 % →for charging
q/q0 = 36.7 % →for discharging
q = q0 (1-e-t/RC) →for charging
q = q0 e-t/RC →for discharging

CURRENT ELECTRICITY

Current, I = Q/t → C s-1 = A
Drift velocity order = 10-5 m/s.
V = IR
Tan θ = I/V = 1/R
Resistance, R = V/I → 1Ω = 1V/1A
R = ρ L/A → Ω.m
Conductance, G = 1/R → Siemen(S) or mho
Conductivity, σ = 1/ρ =L/RA →mho/m or S/m
Pure metals R inc with T inc.
Electrolytes and insulators, R dec with T inc.
ΔR = αR0 T → RT = R0 (1+αT)
Temperature co-efficient of Resistance, α = RT – R0/R0T → K-1
Resistivity, ρ T = ρ 0 (1+αT) OR α = ρ T – ρ 0/ ρ 0T → K-1
Electromotive Force, ε = W/q → 1 volt = 1 joule/coulomb
Open circuit, I = 0 so V= ε
Terminal Voltage, Vt = ε - Ir
Power, P = W/t = VI → 1 Watt = 1V x 1A
1 kWh = 1 unit of electrical energy
1 J = 1W x 1s
Maximum output power, (Pout)max = ε2 /4r = ε2 /4R
Thermo emf, ε = αT + ½ βT2
KCL, ΣI = 0
KVL, Σε = ΣV = ΣIR
KCL based on L.O.C.O.CHARGE
KVL based on L.O.C.O.ENERGY
Wheatstone Bridge, X = PQ/R
Potentiometer, ε2 /ε1 = I2 /I1
Tan θ = I/V = 1/R

ELECTROMAGNETISM

Force on current carrying wire, F=BIL sin θ.
Magnetic field or magnetic induction, B = F/IL →1 tesla =1 NA-1 m-1 = 1 Wb m-2
1 T = 104 G
Magnetic Flux, Φ = B A cos θ → 1 Wb = 1 N m A-1.
Ampere's Law, B ∝ I/r = μ0 (I/2πr) OR ΣB.ΔL = μ0 I
Bnet = B1 + B2
Magnetic field due to current carrying solenoid, B = μ0 n I → n=N/L
Motion of charge particle in uniform magnetic field, F=q v B sin θ
Centripetal Force = Magnetic force → mv2/r = qvB
Time period of charge particle in B, T = 2πm/qB
Frequency of charge particle in B, f = qB/2πm
Velocity selector, FE = FM → qE = qvB → v = E/B
Torque on current carrying coil, τ = NBIA cos θ
Pestoring torque, τ = C θ
Galvanometer, NBIA cos θ = C θ → I = Cθ/NAB → I ∝ θ
Conversion of galvanometer into ammeter, small R connected in parallel
Conversion of galvanometer into voltmeter, large R in series are connected
Ammeter, Rs = Rg Ig / (I – Ig) → Ideal ammeter → 0 R
Voltmeter, Rh = (V/I¬g) – Rg → Ideal voltmeter → infinite R

ELECTROMAGNETIC INDUCTION

Faraday's Law, ε ∝ N (ΔΦ/Δt) → ε = N (ΔΦ/Δt)
Lenz Law, ε = –N (ΔΦ/Δt)
Flux motional emf, ε = Blv sin θ
Rate of work done, W= Bilv
Rate of production of electrical energy, energy =ε I
W = energy → Bilv = εI → ε = Blv
Power, P = F v
ε = L ΔI/Δt or ε = N ΔΦ/Δt → LI = NΦ
Self-Inductance, L = NΦ /I
ε = M ΔI/Δt or ε = N ΔΦ/Δt → MI = NΦ
Mutually inductance, M = NΦ /I
F = 1/T
Induced emf, ε = NAB cosωt or NAB ω sinωt
ε = εmax sin ωt
Back emf, V = ε + IR
Ns / Np = Vs / Vp = Ip /Is

PHYSICS OF SOLIDS

Elastic modulus = Stress/(Strain)
Tensile stress = F/A
Tensile strain = ΔL/L
Young modulus = (F/A)/(ΔL/L) = Nm-2
Shear stress = F/A
Shear strain = Δx/y = tan θ
Shear modulus = rigidity modulus = (F/A)/(Δx/y) = F/Aθ
Bulk or volume stress = F/A
Bulk modulus (in fluids) = Δp = F/A
Volume strain =- ΔV/V
Bulk modulus = (F/A)/(-ΔV/V) = Δp/(- ΔV/V)
Stress ∝ strain (Hook's law)
A = π r2
W = ½Fe (work done on stretching wire).
Strain energy = ½ F e
Strain energy per unit volume = 1/2 (F x e)/(A x l) = ½ (stress) (strain)

DAWN OF MODERN PHYSICS

E = m0 c2
L= L0 √((1=v2)/c2)
T = t0 √((1=v2)/c2)
M = m0 √((1=v2)/c2)
λmax T = 0.2898 x 10-2 m k (Wein's displacement law)
E = σ T4 (Steffan-Bolts Law)
σ = 5.67 x 10-8 Wm-1 K-4
E = n h f
K.Emax = e V0
K.Emax = h f – Φ
H f0 = Φ = hc/λ
K.Emax = hf - Hf0
Hf = K.E +hf'
P= E/c
Δλ =E/(m0 c) 1-cosθ
1/f' = 1/f + E/(m0 c) 1-cosθ
Ephoton = Eelectron + Epositron
Photon rest mass energy = 2m0c2 = 1.02 MeV
h/fc = mve- + mve+
λ = h/p = h/mv
Δp = h/λ and Δx = λ
(Δp)(Δx) = h
(ΔE)(Δt) = h

ATOMIC SPECTRA

1/(λ) = R (1/(P2) - 1/(n2))
R =E0 / hc
R == 1.097 x 107m-1.
mvr = nh/2π.
h = planks constant = 6.6256 x 10-34 j s.
E = hf = En – Ep
rn = (n2 h2)/(4 π k m e2)
En = - (2 π2 2 k m e4)/(n2 h2)
En =-E0/(n2) = 2.17 x 10-18 j/ n2 = +13.6 ev/ n2
rn = n2 r1 → r1 = 0.53 0A.
1 0A = 10- m
2πr=nλ
eV → hfmax = hc/λmin
λmin = hc/eV
excited state for 10-8 s.
metastable state for 10-3 s

NUCLEAR PHYSICS

Nuclear size is of the order of 10-14 m.
The mass of the nucleus is of the order of 10-27 kg.
½ mv2 = Vq
Bqv = mv2/r
Bqv = mv2/r → m = Bqr/v
½ mv2 = Vq → v2 = 2Vq/m
So m = qr2B2/2V
Δm = Zmp + Nmn – M(A,Z)
The binding energy in MeV is 931 x Δm.
The binding energy per nucleon = Eb/A.
0n1 → 1H1 + -1β0 + antineutrino 12 MIN
ΔN/Δt =-λN
R =- ΔN/Δt =λN
N= N0e-λt
1 Bq = 1 decay per second
1 Ci = 3.70 x 1010 decay/s
λT ½ = 0.693
The charge on u,t and c, in term of electron is +2/3e.
The charge on s,t and b in term of electron is -1/3e.
proton =2U→D.