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# COMBINED COMPETITIVE (PRELIMINARY) EXAMINATION, 2013

**Serial No.** ____

## PHYSICS
## Code No. 16

**A**

***Time Allowed : Two Hours*** | ***Maximum Marks : 300***

## INSTRUCTIONS

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7. All items carry equal marks. Attempt ALL items. Your total marks will depend only on the number of correct responses marked by you in the Response Sheet.
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**ROUGH WORK**

1. Energy per unit volume is dimensionally equal to :
   (A) Pressure
   (B) Force
   (C) Density
   (D) Work

2. A particle of mass 2.2 g is traveling with a velocity of 2 m/s. The wavelength associated with the particle is ( $h = 6.6 \times 10^{-34}$ Js) :
   (A) $1.5 \times 10^{-31}$ m
   (B) $3.0 \times 10^{-35}$ m
   (C) 15 m
   (D) $20 \times 10^{-15}$ m

3. A person weighing 50 kg is standing in a lift moving up with an acceleration 2 m/s$^2$. His weight would be :
   (A) 50 kg
   (B) 60.2 kg
   (C) 50.4 kg
   (D) 58 kg

4. 50 g bullet is fired from a 10 kg gun with a speed of 400 m/s. The recoil velocity of the gun is :
   (A) 4 m/s
   (B) 2 m/s
   (C) 5 m/s
   (D) 3 m/s

5. The total momentum of two colliding bodies remains constant if the collision is :
   (A) inelastic
   (B) elastic
   (C) both (A) and (B)
   (D) none

6. A man weighing 60 kg carrying 20 kg bag climbs 20 steps each of 20 cm height in 10 sec. The power of the man is :
   (A) 313.6 W
   (B) 420.5 W
   (C) 255.4 W
   (D) 81.6 W

7. A block of mass 50 kg slides over a horizontal distance of 1 m and the coefficient of friction is 0.2. The work done against the friction is :
   (A) 66 J
   (B) 75 J
   (C) 68 J
   (D) 98 J

8. Uncontrolled fission chain reaction is the principle of :
   (A) proton bomb
   (B) hydrogen bomb
   (C) atom bomb
   (D) nuclear reactor

9. The radius of first orbit in the hydrogen atom is 0.5 Å, the radius of the third orbit is :
   (A) 1.0 Å
   (B) 4.5 Å
   (C) 6.0 Å
   (D) 2.0 Å

10. Asbestos sheets on roof tops will be blown away in cyclonic winds. This is explained by :
(A) Snell's law
(B) Stoke's law
(C) Bernoulli's theorem
(D) Stefen's theorem

11. A body falling through a liquid acquires a steady velocity called as :
(A) end velocity
(B) touch down velocity
(C) terminal velocity
(D) steady state velocity

12. A soap bubble of 10 cm radius is blown from water of surface tension 30 dynes/cm. The work done is :
(A) $70.5\times10^3$ erg
(B) $75.4\times10^3$ erg
(C) $69.7\times10^3$ erg
(D) $80.5\times10^3$ erg

13. The height of a geo-stationary satellite above the earth surface is :
(A) 36,000 km
(B) 3,000 km
(C) 20,000 km
(D) 16,000 km

14. A thin film of water with 0.05 mm thickness is in between two glass plates of area 100 $cm^2$ each. Surface tension of water is 70 dyne/cm, then the force required to separate the glasses is :
(A) $39\times10^5$ dyne
(B) $28\times10^5$ dyne
(C) $19\times10^5$ dyne
(D) $40\times10^5$ dyne

15. The escape velocity for a body on the earth is 11.2 km/s. If the radius of the earth is increased 4 times, then the escape velocity would be :
(A) 44.8 km/s
(B) 33.8 km/s
(C) 25.7 km/s
(D) 22.4 km/s

16. The ratio of value of g on earth to that of moon is 6 : 1. The time period of seconds pendulum on the surface of moon is :
(A) 6.8 s
(B) 7.8 s
(C) 4.8 s
(D) 5.8 s

17. The value of g is 980 $cm/s^2$. If the unit of length is taken as 1 km and unit of time as 1 minute, then the value of g becomes :
(A) 35.3 $km/min^2$
(B) 36.2 $km/min^2$
(C) 30.3 $km/min^2$
(D) 980 $km/min^2$

18. The energy equivalent of one milligram of mass in ergs is :
(A) $9\times10^{18}$
(B) $9\times10^{19}$
(C) $9\times10^{17}$
(D) $6\times10^{20}$

19. Lorentz transformation equation is reduced to Galilean transformation equation when the relative velocity between two frames of reference is :
(A) very small
(B) very large
(C) zero
(D) infinity

20. A stone is thrown up vertically by a man and it fell into his hands after 3 sec. The initial velocity of the stone is ($g = 9.8\ m/s^2$) :
(A) 9.8 m/s
(B) 14.7 m/s
(C) 19.6 m/s
(D) 4.9 m/s

21. A person standing on a turntable is stretching his hands and he suddenly folds his hands close to his body then :
(A) linear momentum increases
(B) angular velocity decreases
(C) linear momentum decreases
(D) angular velocity increases

22. The physical quantity analogous to mass in circular motion is :
(A) moment of inertia
(B) force
(C) weight
(D) angular velocity

23. The mass of a rotating body is M, moment of inertia I, then its radius of gyration K is :
(A) $K = \sqrt{\frac{1}{M}}$
(B) $K = \sqrt{\frac{M}{1}}$
(C) $K = MI$
(D) $K = \sqrt{MI}$

24. 50 revolutions per second are equal to :
(A) 50 rad./s
(B) 50 $\pi$ rad./s
(C) 314 rad./s
(D) 620 rad./s

25. A stone of mass 2 kg strikes the ground with a K.E. of 400 J. The height from where it is dropped (neglect frictional force) ($g = 9.8\ m/s^2$) :
(A) 40.6 m
(B) 20.4 m
(C) 30.8 m
(D) 19.8 m

26. Oil flows through a pipe of 8 cm in diameter at an average velocity of 4 m/s. The amount of flow is :
(A) 3.2 $m^3/s$
(B) 0.032 $m^3/s$
(C) 0.02 $m^3/s$
(D) 0.04 $m^3/s$

27. A torque $\tau$ rotates a body through an angle $\theta$. The work done is :

(A) $W = \tau\theta$ (B) $W = \frac{T}{\theta}$

(C) $W = \frac{\tau^2}{\theta}$ (D) $W = \tau^2\theta$

28. Newton's second law of motion in case of a variable mass system can be written as (where M = total mass U, V, initial and final velocities) :

(A) $F = M\frac{dV}{dt} - U\frac{dM}{dt}$ (B) $F = \frac{d}{dt}(MV) - U\frac{dM}{dt}$

(C) $F = U\frac{dM}{dt} - \frac{d}{dt}(MV)$ (D) $F = M(V - U)$

29. A car engine develops 75 KW power when rotating at a speed of 1000 rpm. The torque of the engine (in $g.cm^2\ s^{-1}$) is :

(A) 825 (B) 750

(C) 716 (D) 520

30. When two bodies traveling with velocities v and u undergo perfectly inelastic collision, then their relative velocity is :

(A) $v - u$ (B) $v^2 - u^2$

(C) zero (D) $\frac{v}{u}$

31. A particle is executing SHM. Its amplitude is 10 cm and time period is 2 sec. Find its maximum velocity.

(A) 20 cm/s (B) 40.4 cm/s

(C) 31.4 cm/s (D) 36.8 cm/s

32. The length of a closed pipe is $l$ and the wavelength of fundamental note emitted is $\lambda$, then the wavelengths of 1st, 2nd and 3rd overtones are :

(A) $\frac{4l}{3}, \frac{4l}{5}, \frac{4l}{7}$ (B) $\frac{2l}{3}, \frac{2l}{5}, \frac{2l}{7}$

(C) $\frac{l}{3}, \frac{l}{5}, \frac{l}{7}$ (D) $l, 3l, 5l$

33. The velocity of sound at 0ºC is 320 cm/s. The temperature at which the velocity of sound becomes double :
(A) 640ºC (B) 819 ºC
(C) 160ºC (D) 1320 ºC

34. Two tuning forks when sounded together give 6 beats/sec. The frequency of one of the forks is 480 Hz. The other fork is loaded with wax, the number of beats increases. The frequency of second fork is :
(A) 486 Hz (B) 474 Hz
(C) 468 Hz (D) 492 Hz

35. A truck and car are moving in opposite directions with speeds 144 km/h and 72 km/h respectively. The truck blows a horn of 500 Hz and the frequency of sound as heard by car driver is (velocity of sound is 340 m/s) :
(A) 500 Hz (B) 550 Hz
(C) 575 Hz (D) 600 Hz

36. If the tension in a stretched string is increased 300%, then the increase in its frequency :
(A) increases $\sqrt{3}$ times (B) increases 3 times
(C) increases 9 times (D) doesn't depend on the tension

37. The equation of a transverse wave in a stretched string is given by $y = 5\sin 2\Pi\left(\frac{t}{0.04} - \frac{x}{50}\right)$. The velocity of the wave is :
(A) 0.04 cm/s (B) 1250 cm/s
(C) 100 cm/s (D) 650 cm/s

38. A rod of length 5 cm is clamped at the middle and vibrated, then its frequency is (velocity of sound is 330 cm/s) :
(A) 65 Hz (B) 330 Hz
(C) 33 Hz (D) 16.5 Hz

39. The waves used in SONAR are :
(A) radio waves (B) ultrasonic waves
(C) microwaves (D) X-rays

40. The shortest wavelength of ultrasonic waves emitted by bats is 0.33 cm. The height frequency emitted by it (velocity of sound is 330 cm) :
(A) $10^2$ Hz (B) $10^3$ Hz
(C) $10^4$ Hz (D) $10^5$ Hz

41. The rays which form image without any aberrations are :
(A) marginal rays
(B) paraxial rays
(C) both marginal and paraxial rays
(D) none of the above

42. The radius of curvatures of a double convex lens are 25 cm, –25 cm and the refractive index of the material is 1.5. The focal length is :
(A) 15 cm
(B) 25 cm
(C) 50 cm
(D) 60 cm

43. The planes having unit positive angular magnification are called :
(A) principal planes
(B) nodal planes
(C) focal planes
(D) central planes

44. A conversing and a diverging lens of focal length 10 cm are placed co-axially in air at 5 cm apart. The power of the combination (in dioptre) is :
(A) 10
(B) 5
(C) 2
(D) 20

45. When a lens with focal length f = 20 cm and dispersive power $\omega = 0.02$ is in contact with another lens of dispersive power $\omega = 0.06$. If the combination is achromatic doublet, then the other lens is :
(A) convex lens of 60 cm focal length
(B) concave lens of 60 cm focal length
(C) concave lens of 20 cm focal length
(D) convex lens of 20 cm focal length

46. When parallel rays are incident on a convex lens, the marginal rays and paraxial rays meet at different foci. This is called :
(A) coma
(B) astigmatism
(C) spherical aberration
(D) chromatic aberration

47. The eyepieces which are used in measuring the size of the image are :
(A) Huygen's
(B) Ramsden
(C) Both
(D) None

48. The velocity of light in air is $3\times 10^8$ m/s. If it travels in water of $\mu = 4/3$, then the velocity of light in water :
(A) $4\times10^8$ m/s
(B) $2.25\times10^8$ m/s
(C) $3.25\times10^8$ m/s
(D) $1.25\times10^8$ m/s

49. Two parallel slits of 0.3 cm apart are illuminated with a source of light of wavelength 5900 A°. Fringes are observed at 30 cm away from the slits. The fringe width is :

(A) 0.0059 cm (B) 0.0059 mm

(C) 0.009 cm (D) 0.003 cm

50. Colours exhibited by soap bubble and oil floating on water is explained by :

(A) diffraction (B) interference

(C) polarization (D) reflection

51. A transparent film of glass $\mu = 1.50$ is inserted in the path of one of the interfering beams of Michelson interferometer with light source of wavelength 4800 Å. Then 500 dark fringes shift across the field. Then the thickness of the film is :

(A) 1.50 mm (B) 0.5 mm

(C) 0.12 mm (D) 0.24 mm

52. In Fraunhofer diffraction the wavefronts are :

(A) Plane (B) Spherical

(C) Cylindrical (D) Elliptical

53. The rate of variation of the angle of diffraction ($\theta$) with the wavelength $d\theta/d\lambda$ is :

(A) dispersive power of grating (B) resolving power of grating

(C) magnification power of grating (D) none

$\frac{d\lambda}{\lambda_1 + \lambda_2}$

54. $\lambda_1, \lambda_2$ are two wavelengths that are just resolved, $\lambda$ is the mean wavelength, then resolving power is :

(A) $\frac{\lambda}{d\lambda}$ (B) $\frac{\lambda_1 + \lambda_2}{d\lambda}$

(C) (D) $\frac{d\lambda}{\lambda}$

55. The path difference between the ordinary and extra-ordinary ray in quarterwave plate is :

(A) $\frac{2\lambda}{3}$ (B) $\frac{\lambda}{4}$

(C) $\frac{3\lambda}{4}$ (D) $\frac{\lambda}{3}$

56. When elliptically polarized light is incident on a rotating Nicol prism the brightness in the field of view changes between :
(A) maximum and minimum
(B) maximum and zero
(C) minimum to zero
(D) no change in brightness

57. The antistoke lines in Raman effect have wavelength :
(A) greater than that of incident light
(B) equal to that of incident light
(C) less than that of incident light
(D) none

58. To induce laser action in active medium, the system should have :
(A) minimum two energy levels
(B) minimum three energy levels
(C) maximum three energy levels
(D) none of the above

59. The rays used in bloodless surgery :
(A) X-rays
(B) γ-rays
(C) Laser
(D) Cathode rays

60. The state of polarization of the ordinary and extra-ordinary rays coming out of a doubly refracting crystal is :
(A) partially polarized
(B) plane polarized
(C) circularly polarized
(D) elliptically polarized

61. The wavelengths of sodium D lines are 5890 Å and 5896 Å. Minimum number of lines on the grating to resolve them in the first order :
(A) 982
(B) 987
(C) 896
(D) 589

62. If P is pressure, V is volume and γ is the ratio of two specific heats of gas, then the relation $PV^{\gamma}$ is related :
(A) isothermal change
(B) adiabatic change
(C) both isothermal and adiabatic change
(D) none of the above

63. If dQ is the amount of heat supplied and dW is the work done, then in isothermal process :
(A) $dQ + dW = 0$
(B)
(C)
(D) $dW = \sqrt{dQ}$

64. A reversible heat engine is made to work first between 200 °C and 0 °C and then between 0°C and –200 °C. Its efficiency is :
(A) more between 0 °C and –200 °C
(B) more between 200 °C and 0 °C
(C) same in both ranges
(D) none of the above

65. The entropy of a reversible cycle is :
(A) infinity (B) zero
(C) intermediate (D) not stable

66. A decrease in the Helmholtz function of a system is equal to :
(A) change in temperature (B) external work done
(C) change in internal energy (D) all the above

67. In a gas the transport of momentum gives rise to the phenomenon of :
(A) viscosity (B) conduction
(C) diffusion (D) volume

68. Van der Waal's gas equation is obeyed by :
(A) ideal gases (B) real gases
(C) both ideal and real gas (D) none

69. Joule-Thomson effect is related to :
(A) adiabatic compression (B) adiabatic expansion
(C) isothermal expansion (D) isothermal compression

70. If the phase of the matter changes without change in temperature it is a :
(A) first order phase change (B) second order phase change
(C) third order phase change (D) none

$\frac{P}{\rho T}$

71. The specific heat of a solid is 5 cal/g/°C. Then heat required to raise its temperature by 20 °C is :
(A) 150 cal (B) 25 cal
(C) 100 cal (D) 15 cal

72. The ratio of specific heats of a gas is 1.4. Its specific heat at constant volume is 4.96 kcal/°K. Then the value of universal gas constant is :
(A) 1.894 (B) 1.489
(C) 1.84 (D) 1.984

73. P, T are ρ are the pressure, absolute temperature and density of an ideal gas, then :
(A) $\frac{PT}{\rho}$ = constant (B) $\frac{P\rho}{T}$ = constant
(C) $PT\rho$ = constant (D) = constant

74. For the system of diatomic gas the number of degrees of freedom are :
(A) 2 (B) 4
(C) 5 (D) 6

75. The mean K.E. of a gas molecule at T °K is given by the equation :
(A) $\frac{1}{2}kT$ (B) $\frac{3}{2}kT$
(C) $\frac{2}{3}kT$ (D) $2\ kT$

76. The densities of two gases are in the ratio of 1 : 4. The mean free paths of the molecules are in the ratio :
(A) 1 : 4 (B) 4 : 1
(C) 2 : 1 (D) 1 : 2

77. The absorptive power of a black body at all wavelengths is :
(A) zero (B) infinity
(C) 1 (D) $\frac{1}{2}$

78. At a given temperature the ratio of emissivity of a body to its absorptivity is equal to :
(A) absorptivity of black body (B) emissivity of black body
(C) permittivity of a body (D) none

79. According to Planck's hypothesis, the harmonic oscillations in a black body emit radiation :
(A) continuously (B) discretely
(C) either continuously or discretely (D) none

80. The absolute temperature of an ideal gas is a measure of its :
(A) translational K.E. (B) vibrational energy
(C) total energy (D) potential energy

81. A gas does 5 J of work while expanding adiabatically. The change in internal energy is :
(A) 0 (B) –5 J
(C) –15 J (D) –10 J

82. A charge of 2 coulombs is kept in an electric field of intensity 4 N/C. The force experienced by it is :
(A) 8 N
(B) 4 N
(C) zero
(D) 2 N

83. The potential of the earth is :
(A) infinity
(B) zero
(C) 1
(D) varies with location

84. The force between two equal charges is F. If the distance is increased 2 times and one of the charges is made 4 times greater, then the force between them becomes :
(A) 16 F
(B) 4 F
(C) 2 F
(D) F

85. In a coil of 3 turns the magnetic flux changes from zero to $25\times10^{-7}$ Weber in 2.5 milliseconds. The induced emf is :
(A) 10 mV
(B) 1 mV
(C) 3 mV
(D) 2.5 mV

86. Three capacitors of capacities 1 µF, 2 µF, 3 µF are connected such that the second and third are in series and first is in parallel. The resultant capacitance is :
(A) 1.1 µF
(B) 2.2 µF
(C) 3.3 µF
(D) 4.4 µF

87. A dielectric material of 4 mm thickness is kept between two plates of a capacitor and the plates are moved 3.2 mm away to restore the original capacity. The dielectric constant of the material is :
(A) 3.2
(B) 5
(C) 6.4
(D) 8

88. 2 Ω and 3 Ω resistances are connected with a cell of emf 6 V. The potential drops across the resistors respectively are :
(A) 3.6 V, 2.4 V
(B) 3 V, 3 V
(C) 2.4 V, 3.6 V
(D) 2.6 V, 3.4 V

89. In a closed loop if i is the current through a resistance R and E is the emf then :
(A) $\sum iR = \sum E$
(B) $\sum iE = \sum R$
(C) $\sum R = \sum E$
(D) $\sum iRE = 0$

90. The intensity of magnetic induction at a point due to a current carrying conductor is B. If the current is doubled and distance is also doubled, then the induction is :

(A) 4 B (B) 2 B

(C) B (D) B/2

91. The self inductance of the coil of wire of 600 turns is 108 mH. The self inductance of the coil with 500 turns is :

(A) 90 mH (B) 100 mH

(C) 110 mH (D) 115 mH

92. An inductance of 1 Henry and negligible resistance is connected to an ac source of 200 V and 50 Hz. The current in it is :

(A) 200 A (B) 4.6 A

(C) 6.4 A (D) 0.64 A

93. If LCR series circuit is connected to ac source across capacitor :

(A) current leads voltage by $\pi/2$ (B) voltage leads current by $\pi/2$

(C) current and voltage are in phase (D) current leads voltage by $\pi$

94. An LCR series ac circuit has the values of the resistance 400 Ω, capacitive reactance 400 Ω and inductive reactance 100 Ω, then the total impedance of the circuit :

(A) 200 Ω (B) 400 Ω

(C) 500 Ω (D) 800 Ω

95. In an electromagnetic wave, the cross product of electric field E and magnetic field B gives :

(A) amplitude (B) frequency

(C) velocity (D) direction of travel

96. A particle of charge 2 coulombs is passing parallel in a magnetic field 4 Tesla with a velocity 5 cm/s. The force on particle is :

(A) 40 N (B) 4 N

(C) zero (D) 8 N

97. A Van de Graff generator produces a potential difference of $4.8 \times 10^6$ volt. If it is used to accelerate a deuterium nucleus, the energy of the nucleus is :

(A) 9.6 MeV (B) 4.8 MeV

(C) 6.8 MeV (D) 2.4 Me V

98. In a cyclotron, the radius of the dees is 15 cm and the magnetic field applied is 1500 gauss. The e/m of proton is 9600 esu/g. Then the velocity of the emergent protons is :
(A) $2161\times10^7$ m/s
(B) $7502\times10^7$ m/s
(C) $4169\times10^7$m/s
(D) $3896\times10^7$ m/s

99. The particles that are accelerated to high energies in betatron are :
(A) neutrons
(B) electrons
(C) $\alpha$-particles
(D) elementary particles

100. Hall effect can be used to determine :
(A) charge in a conductor
(B) type of the majority charges in a conductor
(C) thickness of a conductor
(D) voltage across the conductor

101. The rms value of potential difference in a circuit is 120 V. Then the maximum value of potential difference nearly is :
(A) 170 V
(B) 60 V
(C) 240 V
(D) 200 V

102. The magnetic moment of a substance is zero. Then it is a :
(A) diamagnetic material
(B) paramagnetic material
(C) ferromagnetic material
(D) ferrimagnetic material

103. The permeability of a paramagnetic material is numerically :
(A) infinity
(B) $< 1$
(C) zero
(D) $> 1$

104. Domain theory explains about the :
(A) diamagnetism
(B) paramagnetism
(C) ferromagnetism
(D) ferrimagnetism

105. The energy of an electron in the first orbit in hydrogen atom is –13.6 eV and the energy of the electron in second orbit is :
(A) –6.8 eV
(B) –1.5 eV
(C) 6.8 eV
(D) –3.4 eV

106. When cathode rays are scattered by a target material then the X-rays produced are :
(A) continuous X-rays
(B) characteristic X-ray
(C) both continuous and characteristic
(D) none

107. A light of wavelength 3000 Å is incident on a photometer. The value of its work function approximately is ($h = 6.6 \times 10^{-34}$ J.s, $c = 3 \times 10^{8}$ m/s$^2$) :

(A) 0 eV
(B) 4.11 eV
(C) 6.2 eV
(D) 3.2 eV

108. Compton effect is experimentally observed for :

(A) visible
(B) ultravoilet
(C) X-rays
(D) γ-rays

109. The matter waves associated with a particle can travel :

(A) with the velocity of sound
(B) faster than light waves
(C) travel slower than sound waves
(D) none of the above

110. Tunnel effect explains :

(A) α-decay
(B) β–decay
(C) gamma-decay
(D) all the above

111. The mass defect in formation of a nucleus having 6 nucleons is 0.012 amu. The average binding energy (in MeV ) is (1 amu = 931 MeV ) :

(A) $0.02 \times 10^{-3}$
(B) $1.86 \times 10^{-3}$
(C) $1862 \times 10^{-3}$
(D) 1862

112. Among the elementary particles heavy particles are :

(A) leptons
(B) baryons
(C) mesons
(D) photons

113. The catalyst in the carbon nitrogen cycle of fusion :

(A) nitrogen
(B) carbon
(C) oxygen
(D) helium

114. In a full-wave rectifier, the input frequency is 50 Hz, the output frequency of the rectifier is :

(A) 50 Hz
(B) 100 Hz
(C) 25 Hz
(D) 200 Hz

115. A tank circuit :

(A) produces electromagnetic oscillations
(B) amplifies signals
(C) rectifies the signals
(D) all the above

116. The part that is used to control the flow of electrons in a triode is :

(A) plate
(B) filament
(C) grid
(D) cathode

117. Boron is doped into a pure semiconductor material. The resulting material is :

(A) p-type
(B) p-n type
(C) n-type
(D) insulator

118. The depletion region of p-n junction diode contains :

(A) electrons
(B) holes
(C) no charge carriers
(D) both holes and electrons

119. In a pnp transistor, the p-n junction is forward biased, in npn transistor the n-p junction is :

(A) forward biased
(B) reverse biased
(C) not biased
(D) either forward or reverse biased

120. Universal logic gates are :

(A) AND and OR
(B) OR and X-OR
(C) AND and NAND
(D) NAND and NOR

**ROUGH WORK**

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