

# National Testing Agency

**Question Paper Name:** 226 PHYSICS 226 29th May Shift2 Set1  
**Subject Name:** PHYSICS 226  
**Creation Date:** 2019-05-29 19:31:03  
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## PHYSICS 226

**Group Number :** 1  
**Group Id :** 128206174  
**Group Maximum Duration :** 0  
**Group Minimum Duration :** 120  
**Revisit allowed for view? :** No  
**Revisit allowed for edit? :** No  
**Break time:** 0  
**Group Marks:** 100

## PART A

**Section Id :** 128206286  
**Section Number :** 1  
**Section type :** Online  
**Mandatory or Optional:** Mandatory  
**Number of Questions:** 35  
**Number of Questions to be attempted:** 35  
**Section Marks:** 100  
**Display Number Panel:** Yes  
**Group All Questions:** No

**Sub-Section Number:** 1  
**Sub-Section Id:** 128206464  
**Question Shuffling Allowed :** Yes

**Question Number : 1 Question Id : 12820610080 Question Type : MCQ Option Shuffling : No Display Question Number : Yes**  
**Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 2 Wrong Marks : 0**

One nanometer is equal to

- (a)  $0.1 \text{ \AA}$
- (b)  $10 \text{ \AA}$
- (c)  $100 \text{ \AA}$
- (d)  $1000 \text{ \AA}$

**Options :**

- 12820639839. A
- 12820639840. B
- 12820639841. C
- 12820639842. D

**Question Number : 2 Question Id : 12820610081 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 2 Wrong Marks : 0**

An x-ray beam consists of

- (a) Electrons
- (b) Protons
- (c) Neutrons
- (d) Photons

**Options :**

- 12820639843. A
- 12820639844. B
- 12820639845. C
- 12820639846. D

**Question Number : 3 Question Id : 12820610082 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 2 Wrong Marks : 0**

Longitudinal waves are

- (a) Plane polarized
- (b) Circularly polarized
- (c) Elliptically polarized
- (d) Unpolarized

**Options :**

- 12820639847. A
- 12820639848. B
- 12820639849. C
- 12820639850. D

**Question Number : 4 Question Id : 12820610083 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical**

**Correct Marks : 2 Wrong Marks : 0**

According to the Dulong-Petit law, the atomic heat which is a product of atomic weight and specific heat, of most of the elements in solid state

- (a) Is constant
- (b) Increases with atomic number
- (c) Decreases with atomic number
- (d) Does not depend on atomic weight

Options :

- 12820639851. A
- 12820639852. B
- 12820639853. C
- 12820639854. D

Question Number : 5 Question Id : 12820610084 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 2 Wrong Marks : 0

A thermocouple is a device to measure

- (a) Pressure
- (b) Volume
- (c) Density
- (d) Temperature

Options :

- 12820639855. A
- 12820639856. B
- 12820639857. C
- 12820639858. D

Sub-Section Number: 2  
Sub-Section Id: 128206465  
Question Shuffling Allowed : Yes

Question Number : 6 Question Id : 12820610085 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

If  $z = x + iy$ , the value of  $|\sin z|^2$  is

- (a)  $\sin^2 x + \sin^2 y$
- (b)  $\sin^2 x + \cos^2 y$
- (c)  $\sin^2 x + \sinh^2 y$
- (d)  $\sin^2 x + \cosh^2 y$

Options :

- 12820639859. A
- 12820639860. B
- 12820639861. C
- 12820639862. D

Question Number : 7 Question Id : 12820610086 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The angle between the vectors  $\vec{a} = \hat{i} + \hat{j}$  and  $\vec{b} = \hat{i} + \hat{j} + \hat{k}$  is

- (a)  $0^\circ$
- (b)  $45^\circ$
- (c)  $\cos^{-1}\left(\frac{1}{3}\right)$
- (d)  $\cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$

Options :

- 12820639863. A
- 12820639864. B
- 12820639865. C
- 12820639866. D

Question Number : 8 Question Id : 12820610087 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The function  $y = ax^2 - bx + c$ , where a, b, and c are positive and constants, has a minima at  $x =$

- (a)  $\frac{b}{2a}$
- (b)  $\frac{a}{2b}$
- (c)  $\frac{b}{a}$
- (d)  $\frac{a}{b}$

Options :

- 12820639867. A
- 12820639868. B
- 12820639869. C
- 12820639870. D

Question Number : 9 Question Id : 12820610088 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

A particle of mass m moves in a circle of radius r with uniform angular speed  $\omega$ . The work done by the centripetal force in half of a complete rotation is

- (a) 0
- (b)  $2\pi m\omega^2 r^2$
- (c)  $\pi m\omega^2 r^2 / 2$
- (d)  $2\pi m\omega^2$

Options :

- 12820639871. A
- 12820639872. B
- 12820639873. C

Question Number : 10 Question Id : 12820610089 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The equation of motion of a particle of mass  $m$  in one dimension is

$$m \frac{d^2x}{dt^2} = -ax - 3bx^2 - 4cx^3$$

where  $a$ ,  $b$  and  $c$  are constants of appropriate dimension. The quantity that remains constant during its motion is

- (a)  $\frac{1}{2}mx'^2 + \frac{1}{2}ax^2 + bx^3 + cx^4$   
 (b)  $\frac{1}{2}mx'^2 + ax^2 + bx^3 + cx^4$   
 (c)  $\frac{1}{2}mx'^2 + \frac{1}{2}ax^2 + \frac{1}{3}bx^3 + cx^4$   
 (d)  $\frac{1}{2}mx'^2 + ax^2 + \frac{1}{3}bx^3 + \frac{1}{4}cx^4$

Options :

12820639875. A

12820639876. B

12820639877. C

12820639878. D

Question Number : 11 Question Id : 12820610090 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

Consider a two-dimensional quantum harmonic oscillator with frequency  $\omega$ . How many energy levels are there with energy  $11\hbar\omega$ ?

- (a) 5  
 (b) 8  
 (c) 11  
 (d) 21

Options :

12820639879. A

12820639880. B

12820639881. C

12820639882. D

Question Number : 12 Question Id : 12820610091 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

For a hydrogen atom the spacing between successive energy levels is given by  $\Delta_n = E_{n+1} - E_n$ , where  $n$  is the quantum number. Which of the following statements is true?

- (a)  $\Delta_n$  is constant
- (b)  $\Delta_n$  increases as  $n$  increases
- (c)  $\Delta_n$  decreases as  $n$  increases
- (d)  $\Delta_n$  increases and then decreases with  $n$

Options :

12820639883. A

12820639884. B

12820639885. C

12820639886. D

Question Number : 13 Question Id : 12820610092 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

If  $\hbar$  is the reduced Planck's constant,  $c$  is the speed of light, and  $G$  is the universal gravitational constant, which of the following has the dimension of length?

- (a)  $\frac{\hbar G}{c^2}$
- (b)  $\sqrt{\frac{\hbar c}{8\pi G}}$
- (c)  $\sqrt{\frac{\hbar G}{c^5}}$
- (d)  $\sqrt{\frac{\hbar G}{c^3}}$

Options :

12820639887. A

12820639888. B

12820639889. C

12820639890. D

Question Number : 14 Question Id : 12820610093 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

An ideal gas undergoes isothermal expansion at temperature  $T$  from volume  $V_1$  to  $V_2$ . The entropy change per mole is

- (a)  $R \left( \frac{V_2}{V_1} \right)$
- (b)  $R \left( \frac{V_1}{V_2} \right)$
- (c)  $R \ln \left( \frac{V_2}{V_1} \right)$
- (d)  $R \ln \left( \frac{V_1}{V_2} \right)$

Options :

- 12820639891. A
- 12820639892. B
- 12820639893. C
- 12820639894. D

Question Number : 15 Question Id : 12820610094 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

In a two-level atom the energy gap is  $E$ . The probability of finding the atom in the excited state at temperature  $T$  will be

- (a)  $\exp - \left( E / K_B T \right)$
- (b)  $\frac{1}{1 + \exp - \left( E / K_B T \right)}$
- (c)  $\frac{\exp \left( E / K_B T \right)}{1 + \exp - \left( E / K_B T \right)}$
- (d)  $\frac{\exp - \left( E / K_B T \right)}{1 + \exp - \left( E / K_B T \right)}$

Options :

- 12820639895. A
- 12820639896. B
- 12820639897. C
- 12820639898. D

Question Number : 16 Question Id : 12820610095 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The black body radiation emitted from a cavity of volume  $V$  at temperature  $T$  has chemical potential equal to ( $N$  is the number of photons emitted)

- (a)  $N$
- (b)  $0$
- (c)  $1/T$
- (d)  $V/T$

Options :

- 12820639899. A
- 12820639900. B
- 12820639901. C
- 12820639902. D

Question Number : 17 Question Id : 12820610096 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

Consider a momentum conservation experiment, where two masses  $m_1$  and  $m_2$  are collided head-on with velocities  $v_1$  and  $v_2$ , respectively, the measured values are  $m_1=200\pm 2$  g,  $v_1=5.5\pm 0.1$  m/s, and  $v_2=10\pm 0.4$  m/s. What is the fractional error associated with mass  $m_2$  of the other body?

- (a)  $\pm 7.7$
- (b)  $\pm 0.77$
- (c)  $\pm 10.1$
- (d)  $\pm 0.07$

Options :

- 12820639903. A
- 12820639904. B
- 12820639905. C
- 12820639906. D

Question Number : 18 Question Id : 12820610097 Question Type : MCQ Option Shuffling : No Display Question Number : Yes Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

An electron has a speed of 300 m/s, accurate to 0.01%. With what accuracy can we determine the position of the electron? (mass of electron  $=9.1\times 10^{-31}$  kg, Planck's constant  $=6.6\times 10^{-34}$  J.s)

- (a) 2.4 nm
- (b) 2.4  $\mu\text{m}$
- (c) 2.4 mm
- (d) 2.4 cm

Options :

- 12820639907. A
- 12820639908. B
- 12820639909. C



12820639910. D

Question Number : 19 Question Id : 12820610098 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

A 100 W electric bulb has an efficiency of 2.5%. Assuming it is a point source, the intensity at a distance of 3 m will be

- (a)  $2.5 \text{ W/m}^2$
- (b)  $25 \text{ W/m}^2$
- (c)  $0.025 \text{ W/m}^2$
- (d)  $0.022 \text{ W/m}^2$

Options :

12820639911. A

12820639912. B

12820639913. C

12820639914. D

Question Number : 20 Question Id : 12820610099 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

A 2 mW laser light is emitted at a frequency of  $6 \times 10^{14}$  Hz. How many photons on average are emitted by this source per second? (Planck's constant =  $6.6 \times 10^{-34}$  J.s)

- (a)  $1 \times 10^{15}$
- (b)  $2 \times 10^{15}$
- (c)  $3 \times 10^{15}$
- (d)  $5 \times 10^{15}$

Options :

12820639915. A

12820639916. B

12820639917. C

12820639918. D

Question Number : 21 Question Id : 12820610100 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The adiabatic compressibility of an ideal gas is equal to (P is pressure and V is volume)

- (a)  $1/P$
- (b)  $P/V$
- (c)  $P$
- (d)  $V/P$

Options :

12820639919. A

12820639920. B

12820639921. C

12820639922. D

Question Number : 22 Question Id : 12820610101 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

What is the entropy change when 1 kg of ice at  $0^{\circ}\text{C}$  melts reversibly to water at the same temperature? (latent heat of melting of ice =  $79.6\text{ cal/g}$ )

- (a)  $122\text{ kJ.K}^{-1}$
- (b)  $12.2\text{ kJ.K}^{-1}$
- (c)  $1.22\text{ kJ.K}^{-1}$
- (d)  $0.122\text{ kJ.K}^{-1}$

Options :

12820639923. A

12820639924. B

12820639925. C

12820639926. D

Question Number : 23 Question Id : 12820610102 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

A burst of  $10^{14}$  electrons uniformly accelerated to an energy of 15 MeV is stopped by a copper target block of mass 100 g. Assuming the block is thermally insulated, what is the rise in its temperature? (specific heat of copper is  $0.09\text{ cal/g.K}$ )

- (a) 6.3 K
- (b) 0.4 K
- (c) 1.7 K
- (d) 5.1 K

Options :

12820639927. A

12820639928. B

12820639929. C

12820639930. D

Question Number : 24 Question Id : 12820610103 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

Which of the following quantities has the same physical dimension as that of  $\frac{h}{e^2}$ , where h is Planck's constant and e is electronic charge?

- (a) Magnetic flux
- (b) Electrical resistance
- (c) Magnetic field
- (d) Electrical resistivity

Options :

- 12820639931. A
- 12820639932. B
- 12820639933. C
- 12820639934. D

Question Number : 25 Question Id : 12820610104 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The crystal structure of CsCl is a simple cubic lattice. Each unit cell of CsCl will contain

- (a) 1 atom
- (b) 2 atoms
- (c) 3 atoms
- (d) 4 atoms

Options :

- 12820639935. A
- 12820639936. B
- 12820639937. C
- 12820639938. D

Question Number : 26 Question Id : 12820610105 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

Which of the following is responsible for the existence of the Fermi surface in metals?

- (a) Nuclear force
- (b) Coulomb repulsion between electrons
- (c) Bose-Einstein condensation
- (d) Pauli exclusion principle

Options :

- 12820639939. A
- 12820639940. B
- 12820639941. C
- 12820639942. D

Question Number : 27 Question Id : 12820610106 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

What would be the frequency of the photon produced when an electron of energy 20 keV is brought to rest in a collision with a heavy nucleus?

- (a)  $4.84 \times 10^{18}$  Hz
- (b)  $5 \times 10^{18}$  Hz
- (c)  $4.23 \times 10^{18}$  Hz
- (d)  $3.84 \times 10^{18}$  Hz

Options :

- 12820639943. A
- 12820639944. B
- 12820639945. C
- 12820639946. D

Question Number : 28 Question Id : 12820610107 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

During radioactive decay a nucleus emits a gamma ray with energy of 1.35 MeV. What is the wavelength of this photon?

- (a) 920 fm
- (b) 920 nm
- (c) 920 pm
- (d) 920 Å

Options :

- 12820639947. A
- 12820639948. B
- 12820639949. C
- 12820639950. D

Question Number : 29 Question Id : 12820610108 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

Consider a planet of mass,  $m$ , in circular motion with angular momentum,  $L$ . The planet orbits a star of mass,  $M$  and the orbit radius is  $r$ . If the radius of the orbit is changed from  $r$  to  $r/2$ , what would be the new value of angular momentum?

- (a)  $L$
- (b)  $L/2$
- (c)  $L/\sqrt{2}$
- (d)  $\sqrt{2}L$

Options :

- 12820639951. A
- 12820639952. B
- 12820639953. C
- 12820639954. D

Question Number : 30 Question Id : 12820610109 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

A sodium vapour lamp emits yellow light corresponding to two wavelengths 589 and 589.59 nm. What is the minimum number of rulings must a diffraction grating have to resolve these two lines in the first order?

- (a) 589
- (b) 700
- (c) 900
- (d) 1000

Options :

12820639955. A

12820639956. B

12820639957. C

12820639958. D

Question Number : 31 Question Id : 12820610110 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

A sinusoidal wave moving along a string in the x-direction is described by

$$y(x, t) = 0.002 \sin(10x - 120t)$$

What is the propagation speed of the wave?

- (a) 12 m/s
- (b) 10 m/s
- (c) 120 m/s
- (d) 1200 m/s

Options :

12820639959. A

12820639960. B

12820639961. C

12820639962. D

Question Number : 32 Question Id : 12820610111 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

At time  $t=0$ , a series RC circuit is connected to an emf of 9 V. How long will it take for the capacitor to reach 8 V?

- (a) RC
- (b)  $1/RC$
- (c)  $RC \ln 9$
- (d)  $\ln 9$

Options :

12820639963. A

12820639964. B

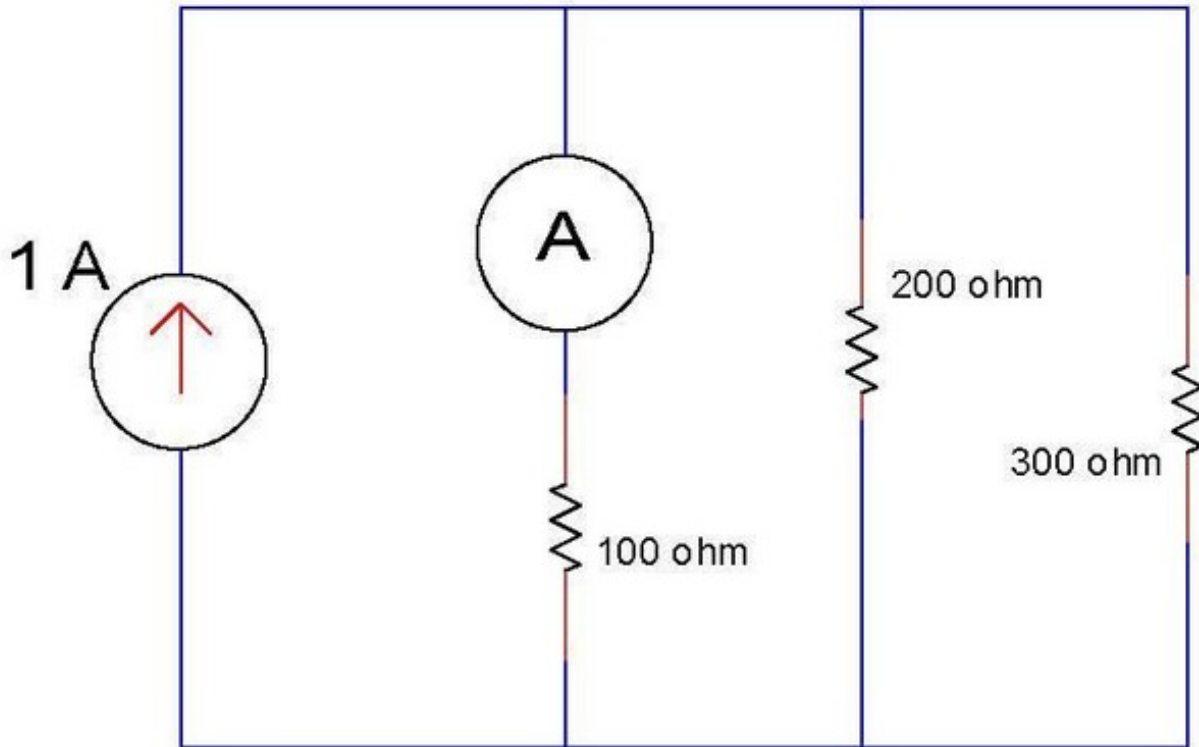
12820639965. C

12820639966. D

Question Number : 33 Question Id : 12820610112 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

The reading in the ammeter A is



(a) 0.5454 A

(b) 5.5450 A

(c) 5.4555 A

(d) 1.5455 A

Options :

12820639967. A

12820639968. B

12820639969. C

12820639970. D

Question Number : 34 Question Id : 12820610113 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

Resistances  $R_1$  and  $R_2$  are connected in parallel and  $I$  is the total current flowing in the circuit.  $I_1$  is the current flowing through  $R_1$ . Which of the following conditions will produce minimum joule heating in the circuit?

(a)  $I_1 = I \left( \frac{R_2}{R_1 + R_2} \right)$

(b)  $I_1 = I_2 \left( \frac{R_2}{R_1 + R_2} \right)$

(c)  $I_1 = I_2 \left( \frac{R_2}{R_1} \right)$

(d)  $I_1 = I_2 \left( \frac{R_1}{R_2} \right)$

Options :

12820639971. A

12820639972. B

12820639973. C

12820639974. D

Question Number : 35 Question Id : 12820610114 Question Type : MCQ Option Shuffling : No Display Question Number : Yes  
Single Line Question Option : No Option Orientation : Vertical

Correct Marks : 3 Wrong Marks : 0

If a signal passing through a gate is inhibited by sending a LOW into one of the inputs, and the output is HIGH, the gate is

(a) an AND gate

(b) a NAND gate

(c) a NOR gate

(d) an OR gate

Options :

12820639975. A

12820639976. B

12820639977. C

12820639978. D