Test Your fiziks concepts!

Topic: Quantum Mechanics

(For CSIR NET-JRF, GATE, JEST and TIFR Aspirants)

Q. The commutator $\left[x^2, p^2\right]$ is

(a) $2i\hbar xp$ (b) $2i\hbar(xp+px)$ (c) $2i\hbar px$ (d) $2i\hbar(xp-px)$

Ans.: (b)

Solution.: $\left[x^2, p^2\right] = x\left[x, p^2\right] + \left[x, p^2\right]x = xp\left[x, p\right] + x\left[x, p\right]p + p\left[x, p\right]x + \left[x, p\right]px$

$\left[x^2, p^2\right] = xp(i\hbar) + x(i\hbar)p + p(i\hbar)x + (i\hbar)px = 2i\hbar(xp+px).$

fiziks

Physics by fiziks

Learn Physics in Right Way

Test Your fiziks concepts!

Topic: Electronics

(For IIT-JAM, JEST, TIFR and CUET Aspirants)

Q. The ratio of maximum to minimum resistance that can be obtained with N 1-Ω resistors is

(a) N (b) N^2 (c) 1 (d) ∞

Ans.: (b)

Solution.: Resistance in series is maximum and minimum in parallel combination

$$R_s = 1+1+1+1+.....N = N\,;\ \frac{1}{R_p} = \frac{1}{1}+\frac{1}{1}+\frac{1}{1}+\frac{1}{1}+\frac{1}{1}.....= N \ \Rightarrow \frac{R_s}{R_p} = N \times N = N^2$$

fiziks
Physics by fiziks
Learn Physics in Right Way

H.No. 40-D, G.F., Jia Sarai, Near IIT, Hauz Khas, New Delhi-16
Phone: 011-26865455/+91-9871145498, Website: www.physicsbyfiziks.com, Email: fiziks.physics@gmail.com

Test Your fiziks concepts!

Topic: Modern Physics

(For PGT: KVS, NVS, DSSSB, State Education Boards, etc.)

Q. Light described by the equation

$$E=(90V/m)\left[\sin\left(6.28\times10^{15}s^{-1}\right)t+\ \sin\left(12.56\times10^{15}s^{-1}\right)t\right]$$

is incident on a metal surface. The work function of the metal is $2.0eV$. Maximum kinetic energy of the photoelectrons will be,

(a) $2.14eV$ (b) $4.28eV$ (c) $6.24eV$ (d) $12.56eV$

Ans.: (c)

Solution: $K_{\max}=\hbar\omega-W$

For given wave maximum kinetic energy is for highest ω so $\omega=12.56\times10^{15}\sec^{-1}$

$$\hbar\omega=\frac{6.6\times10^{-34}J\,s\times12.56\times10^{15}s^{-1}}{2\pi}=\frac{82.8\times10^{-19}J}{6.28\times1.6\times10^{-19}}eV=8.24eV$$

$$K_{\max}=\hbar\omega-W\Rightarrow8.24eV-2.0eV=6.24eV$$

Physics by fiziks
Learn Physics in Right Way

Test Your fiziks concepts!

Topic: Quantum Mechanics

(For CSIR NET-JRF, GATE, JEST and TIFR Aspirants)

Q. If the operators A and B satisfy the commutation relation $[A,B]=I$, where I is the identity operator, then

(a) $[e^A,B]=e^A$ (b) $[e^A,B]=[e^B,A]$

(c) $[e^A,B]=[e^{-B},A]$ (d) $[e^A,B]=I$

Ans.: (a)

Solution.: $[A,B]=I$ and $e^A=\left[1+\frac{A}{1}+\frac{A^2}{\lfloor 2}+.....\right]$

$$[e^A,B]=\left[1+\frac{A}{1}+\frac{A^2}{\lfloor 2}+.....,B\right]=[1,\ B]+[A,\ B]+\frac{[A^2,\ B]}{\lfloor 2}+\frac{[A^3,\ B]}{\lfloor 3}....$$

$$[e^A,B]=0+I+\frac{A[A,\ B]+[A,\ B]A}{2!}+\frac{A[A^2,B]+[A^2,B]A}{3!}+....$$

$[e^A,\ B]=1+A+\frac{A^2}{2!}+....=e^A$ where $[A,B]=I$, $[A^2,B]=2A$ and $[A^3,B]=3A^2$.

Physics by fiziks
Learn Physics in Right Way

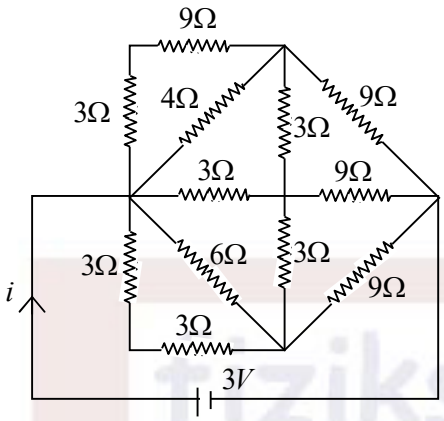
H.No. 40-D, G.F., Jia Sarai, Near IIT, Hauz Khas, New Delhi-16
Phone: 011-26865455/+91-9871145498, Website: www.physicsbyfiziks.com, Email: fiziks.physics@gmail.com

Test Your fiziks concepts!

Topic: Electronics

(For IIT-JAM, JEST, TIFR and CUET Aspirants)

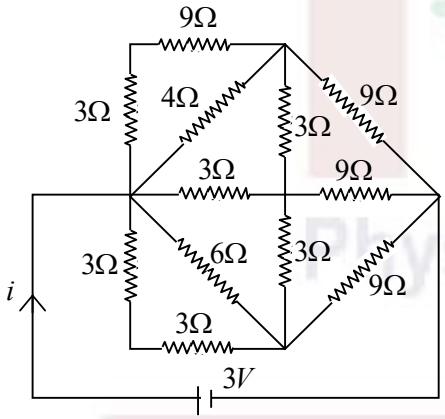
Q. The current i flowing through the following circuit is



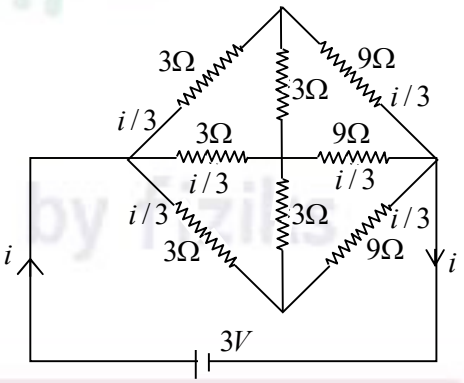
(a) $1.0A$ (b) $0.75A$ (c) $0.6A$ (d) $0.5A$

Ans.: (b)

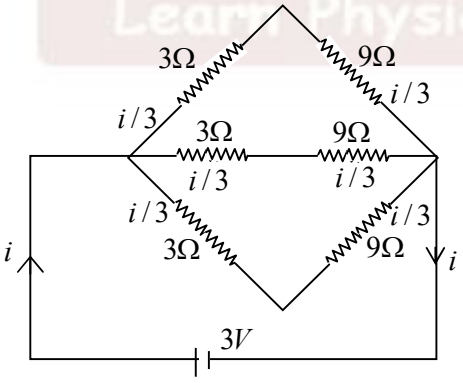
Solution.:



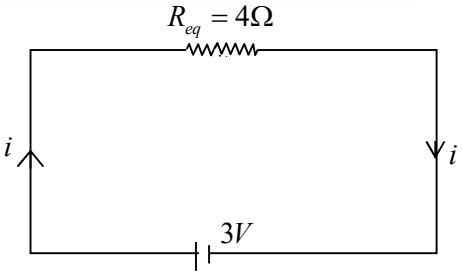
≡



≡



≡



Thus current $i = \dfrac{3V}{4\Omega} = 0.75A$

Test Your fiziks concepts!

Topic: Modern Physics

(For PGT: KVS, NVS, DSSSB, State Education Boards, etc.)

Q. $X-$rays of wavelength $0.24\ nm$ are Compton scattered and the scattered beam is observed at an angle of 60° relative to the incident beam. The Compton wavelength of the electron is $0.00243\,nm$. The kinetic energy of scattered elections in eV is:

(a) 21 (b) 23 (c) 25 (d) 28

Ans.: (c)

Solution.: $\lambda = 0.24\,nm,\ \lambda_C = 0.00243$ and $\theta = 60^0$

$$\because \lambda' - \lambda = \lambda_C\left(1-\cos\theta\right) \Rightarrow \lambda' = \lambda + \lambda_C\left(1-\cos\theta\right)$$

$$\Rightarrow \lambda' = 0.24 + 0.00243\left(1-\frac{1}{2}\right) = 0.24 + 0.00243\times\frac{1}{2} = 0.24 + 0.00121 = 0.2412nm$$

Kinetic Energy of scattered electron

$$K.E. = \frac{hc}{\lambda} - \frac{hc}{\lambda'} = 6.6\times10^{-34}\times3\times10^{8}\left(\frac{1}{0.24} - \frac{1}{0.2412}\right)\times\frac{1}{10^{-9}}\,Joules$$

$$\Rightarrow K.E. = \frac{19.8\times10^{-26}}{10^{-9}}\left(4.17-4.15\right) = \frac{19.8\times10^{-26}}{10^{-9}}\times0.02 = 396\times10^{-20}\ \ Joules$$

$$\Rightarrow K.E. = \frac{396\times10^{-20}}{1.6\times10^{-19}}\ eV = 24.75\ eV$$

Learn Physics in Right Way

H.No. 40-D, G.F., Jia Sarai, Near IIT, Hauz Khas, New Delhi-16
Phone: 011-26865455/+91-9871145498, Website: www.physicsbyfiziks.com, Email: fiziks.physics@gmail.com