DU PhD in Electronics

Topic:- DU_J19_PHD_ELEC

1) An electron beam with 3 eV energy strikes a crystal of cadmium sulfide (CdS) (bandgap E_g =2.45 eV). Electrons scattered by the crystal move at a velocity of 4.4×10^5 m/s. The scattered energy (in eV) of the electrons is

[Question ID = 14763]

1. 0.55 eV [Option ID = 29050]
2. 1 eV [Option ID = 29049]
3. 1.45 eV [Option ID = 29051]
4. 0.05 eV [Option ID = 29052]

Correct Answer :-

- 0.55 eV [Option ID = 29050]

2) An ideal photodiode is made of a material with a bandgap energy of 2.35 eV. It operates at 300 K and is illuminated by monochromatic light with wavelength of 400 nm. Its maximum efficiency is

[Question ID = 14772]

1. 80% [Option ID = 29088]
2. 25% [Option ID = 29085]
3. 75.7% [Option ID = 29086]
4. 48% [Option ID = 29087]

Correct Answer :-

- 75.7% [Option ID = 29086]

3) If line A of X-ray beam gives a first order reflection maxima at a glancing angle of 30° to the smooth face of a crystal and line B of *λ = 0.92 Å* gives a third order reflection maxima at an angle 60° from the face of same crystal, then the wavelength of line A is

[Question ID = 14769]

1. 3.36 Å [Option ID = 29073]
2. 6.72 Å [Option ID = 29076]
3. 0.84 Å [Option ID = 29075]
4. 1.59 Å [Option ID = 29074]

Correct Answer :-

- 1.59 Å [Option ID = 29074]

4) If *ψ = Keinβ* then the value of 'K' after normalization in the limits 0 to π is

[Question ID = 15449]

1. $\frac{1}{\sqrt{\pi}}$ [Option ID = 31794]
2. $\frac{1}{2}\sqrt{\pi}$ [Option ID = 31793]
3. $\sqrt{\pi}$ [Option ID = 31795]
4. $\sqrt{\frac{1}{2}\pi}$ [Option ID = 31796]

Correct Answer :-

- $\frac{1}{\sqrt{\pi}}$ [Option ID = 31794]

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5) In a microwave test bench, a dip is shown on the CRO display by rotating the micrometer of wavemeter, which indicates

[Question ID = 14785]

1. frequency of microwave signal is not same as frequency of wavemeter [Option ID = 29139]
2. frequency of microwave signal is zero [Option ID = 29137]
3. frequency of microwave signal is same as frequency of wavemeter [Option ID = 29138]
4. no signal propagates [Option ID = 29140]

Correct Answer :-

- frequency of microwave signal is same as frequency of wavemeter [Option ID = 29138]

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6) In a p-type Si sample the hole concentration is 8×10^{15} / cm^3 . The intrinsic carrier concentration is 4×10^{10} / cm^3 . The electron concentration is

[Question ID = 14766]

1. zero [Option ID = 29061]
2. $4 \times 10^{10}/cm^3$ [Option ID = 29062]
3. $1.5 \times 10^{25}/cm^3$ [Option ID = 29063]
4. $2 \times 10^{5}/cm^3$ [Option ID = 29064]

Correct Answer :-

- $2 \times 10^{5}/cm^3$ [Option ID = 29064]

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7) Sigma Electronics sells a microwave receiver (A) having an operating spot noise figure of 10 dB when driven by a source with effective noise temperature 130 K. Deltalink (B) sells a receiver with a standard spot noise figure of 6 dB when driven by a source with effective noise temperature 190 K. Zebrotronics (C) sells a receiver with standard spot noise figure of 6 dB when driven by a source with effective noise temperature 290 K. The best receiver to purchase is

[Question ID = 14782]

1. (A) [Option ID = 29125]
2. None [Option ID = 29128]
3. (C) [Option ID = 29126]
4. (B) [Option ID = 29127]

Correct Answer :-

- (B) [Option ID = 29127]

8) A silicon bar of 1μm long and 100 μm^2 in cross-sectional area is doped with $10^{17} cm^{-3}$ Phosphorus. The saturation velocity is 10^7 cm/sec. The current at 300 K with 10V applied is

[Question ID = 14762]

1. 0.16 A [Option ID = 29047]
2. 0.8 A [Option ID = 29048]
3. 0.5 A [Option ID = 29046]
4. 1.2 A [Option ID = 29045]

Correct Answer :-

- 0.16 A [Option ID = 29047]

9) A silicon PN junction diode under reverse bias has depletion region of width 20 μm. Given, the relative permittivity of silicon, $\varepsilon_r = 12.7$ and the permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}$F/m. The depletion capacitance of the diode per square meter is

[Question ID = 14767]

1. 7.65 μF [Option ID = 29065]
2. 3 μF [Option ID = 29067]
3. 8.15 μF [Option ID = 29066]
4. 5.62 μF [Option ID = 29068]

Correct Answer :-

- 5.62 μF [Option ID = 29068]

10) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.65 and a cladding refractive index of 1.52. The numerical aperture (NA) of the fiber is

[Question ID = 14774]

1. 0.32 [Option ID = 29094]
2. 0.56 [Option ID = 29096]
3. 0.42 [Option ID = 29095]
4. 0.64 [Option ID = 29093]

Correct Answer :-

- 0.64 [Option ID = 29093]

11) A step-index fiber has numerical aperture (NA) of 0.16 and its core index (n_1) = 1.45. If core diameter = 0.6 *cm* and $\lambda = 0.9$ *nm* then normalized frequency of the fiber is _____

[Question ID = 14776]

1. 6.70×10^3 Hz [Option ID = 29103]
2. 1.67×10^3 Hz [Option ID = 29101]
3. 3.35×10^3 Hz [Option ID = 29102]
4. 1.83×10^3 Hz [Option ID = 29104]

Correct Answer :-

- 3.35×10^3 Hz [Option ID = 29102]

12) A three level laser emits laser light near the centre of visible band. If $E_2 - E_1 = 2.36\ eV$ then the wavelength of radiation is

[Question ID = 14777]

1. 550 nm [Option ID = 29105]
2. 670 nm [Option ID = 29107]
3. 620 nm [Option ID = 29108]
4. 450 nm [Option ID = 29106]

Correct Answer :-

- 550 nm [Option ID = 29105]

13) log(*1 + x*) = _____

[Question ID = 14750]

1. $-\left(x+\frac{x^2}{2}+\frac{x^3}{3}+\frac{x^4}{4}+\cdots\right)|x|<1$ [Option ID = 28997]
2. $x-\frac{x^3}{3}+\frac{x^5}{5}-\frac{x^7}{7}+\cdots$ [Option ID = 29000]
3. $1+x+x^2+x^3+\cdots$ [Option ID = 28999]
4. $x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\cdots|x|<1$ [Option ID = 28998]

Correct Answer :-

- $x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\cdots|x|<1$ [Option ID = 28998]

14) If the bandgap of GaAsP is 1.98 eV then the color of emitted light is

[Question ID = 14770]

1. Blue [Option ID = 29077]
2. Green [Option ID = 29078]
3. Yellow [Option ID = 29080]
4. Red [Option ID = 29079]

Correct Answer :-

- Red [Option ID = 29079]

15) A laser beam emerging from a laser tube operating at 800 nm has a cross-sectional diameter of 2 mm. The diameter of the beam at a distance of 1 km is approximately

[Question ID = 14779]

1. 10 cm [Option ID = 29116]
2. 10 mm [Option ID = 29113]
3. 80 cm [Option ID = 29114]
4. 8 cm [Option ID = 29115]

Correct Answer :-

- 80 cm [Option ID = 29114]

16) A Si sample ($n_i = 1.5 \times 10^{10}$ atoms/cm^3) is doped with 10^{17} As atoms/cm^3. The position of E_f related to E_i is

[Question ID = 14761]

1. 0.895 eV [Option ID = 29043]
2. 0.407 eV [Option ID = 29044]
3. 0.532 eV [Option ID = 29042]
4. 0.217 eV [Option ID = 29041]

Correct Answer :-

- 0.407 eV [Option ID = 29044]

17) Attenuator reduces the microwave power in

[Question ID = 14783]

1. uni-direction [Option ID = 29130]
2. None of these [Option ID = 29132]
3. multi-direction [Option ID = 29131]
4. bi-direction [Option ID = 29129]

Correct Answer :-

- bi-direction [Option ID = 29129]

18) A box contains 4 red balls and 6 black balls. Three balls are selected randomly from the box one after another, without replacement. The probability that the selected set contains one red ball and two black balls is

[Question ID = 14746]

1. *3/10* [Option ID = 28982]
2. *1/12* [Option ID = 28981]
3. *1/20* [Option ID = 28984]
4. *1/2* [Option ID = 28983]

Correct Answer :-

- *1/2* [Option ID = 28983]

19) Electron mobility in Si at room temperature (300 K) is 1400 cm^2 V^{-1}s^{-1}. The diffusion coefficient of electrons is

[Question ID = 14765]

1. 36.22 cm^2/s [Option ID = 29057]
2. 62.25 cm^2/s [Option ID = 29059]
3. 32.76 cm^2/s [Option ID = 29060]
4. 49.16 cm^2/s [Option ID = 29058]

Correct Answer :-

- 36.22 cm^2/s [Option ID = 29057]

20) In the Taylor series expansion of exp(x) + sin(x) about the point $x = \pi$, the coefficient of ($x - \pi$)2 is

[Question ID = 15451]

1. 0.5 exp(π) [Option ID = 31802]
2. exp(π) [Option ID = 31801]
3. exp(π) - 1 [Option ID = 31804]
4. exp(π) + 1 [Option ID = 31803]

Correct Answer :-

- 0.5 exp(π) [Option ID = 31802]

21) In the expression $6 + 8i = 10e^{j\theta}$, the value of θ is,

[Question ID = 14743]

1. 85.16° [Option ID = 28971]
2. 53.13° [Option ID = 28972]
3. 36.16° [Option ID = 28970]
4. 13.13° [Option ID = 28969]

Correct Answer :-

- 53.13° [Option ID = 28972]

22) In the interval [0,π] the equation $x = \cos x$

[Question ID = 15450]

1. exactly one solution [Option ID = 31799]
2. exactly two solutions [Option ID = 31797]
3. no solutions [Option ID = 31798]
4. an infinite number of solutions [Option ID = 31800]

Correct Answer :-

- exactly one solution [Option ID = 31799]

23) Choose the correct match out of the following options given below

Column I	**Column II**
P. 2nd order DEs	**1. Newton – Raphson method**
Q. Non-linear algebraic equations	**2. Gauss Elimination**
R. Linear algebraic equations	**3. Simpson's rule**
S. Numerical integration	**4. Runge-kutta method**

[Question ID = 14754]

1. P->4 Q->1 R->2 S->3 [Option ID = 29014]
2. P->4 Q->2 R->3 S->1 [Option ID = 29015]
3. P->4 Q->2 R->1 S->3 [Option ID = 29016]
4. P->1 Q->2 R->3 S->4 [Option ID = 29013]

Correct Answer :-

- P->4 Q->1 R->2 S->3 [Option ID = 29014]

24) Helical antenna has the following polarization

[Question ID = 14788]

1. vertical [Option ID = 29152]

2. linear [Option ID = 29149]
3. elliptical [Option ID = 29151]
4. circular [Option ID = 29150]

Correct Answer :-

- circular [Option ID = 29150]

25) Match the typical spectroscopic regions specified in Part-I with corresponding type of transitions in Part-II and choose the correct answer from the following options.

Part-I	Part-II
K. Infrared region	1. Electron transition involving valance electrons
L. Ultraviolet visible region	2. Nuclear transitions
M. X-ray region	3. Vibrational transitions of molecules
N. γ-ray region	4. Transitions involving inner shell electrons

[Question ID = 14775]

1. K->4 L->2 M->1 N->3 [Option ID = 29098]
2. K->3 L->4 M->1 N->2 [Option ID = 29100]
3. K->3 L->1 M->4 N->2 [Option ID = 29097]
4. K->1 L->2 M->3 N->4 [Option ID = 29099]

Correct Answer :-

- K->3 L->1 M->4 N->2 [Option ID = 29097]

26) The particular integral of $\frac{d^2y}{dx^2} + y = \cos 2x$ is

[Question ID = 14757]

1. $-\frac{1}{3}\sin 2x$ [Option ID = 29027]
2. $-\frac{1}{3}\cos 2x$ [Option ID = 29026]
3. $\frac{1}{3}\cos 2x$ [Option ID = 29025]
4. $\frac{1}{3}\sin 2x$ [Option ID = 29028]

Correct Answer :-

- $-\frac{1}{3}\cos 2x$ [Option ID = 29026]

27)

If the temperature at any point in space is given by $T = xy + yz + zx$, direction of T in the direction of vector $3\hat{i} - 4\hat{k}$ at the point $(1,1,1)$ is

[Question ID = 14755]

1. 3/5 [Option ID = 29018]
2. -5/2 [Option ID = 29017]
3. -5/3 [Option ID = 29020]

4. -2/5 [Option ID = 29019]

Correct Answer :-

- -2/5 [Option ID = 29019]

28)

Eigen values of the matrix $\begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -2i \\ 0 & 0 & 2i & 0 \end{bmatrix}$ are

[Question ID = 14756]

1. 1,0,2,3 [Option ID = 29021]
2. -1,1,0,3 [Option ID = 29024]
3. -1,1,0,2 [Option ID = 29023]
4. -2, -1, 1, 2 [Option ID = 29022]

Correct Answer :-

- -2, -1, 1, 2 [Option ID = 29022]

29)

$\int_0^2 \int_0^2 (x^2y + xy^3)\, dxdy$ equals to

[Question ID = 14747]

1. *20/3* [Option ID = 28987]
2. *40/3* [Option ID = 28986]
3. *0* [Option ID = 28988]
4. *4/3* [Option ID = 28985]

Correct Answer :-

- *40/3* [Option ID = 28986]

30)

The numerical solution of the equation $f(x) = x + \sqrt{x} - 3 = 0$ can be obtained using Newton-Raphson method. If the starting value is $x = 2$ for the iteration, the value of x that is to be used in the next step is

[Question ID = 14760]

1. 0.306 [Option ID = 29038]
2. 2.432 [Option ID = 29039]
3. 1.694 [Option ID = 29040]
4. 0.732 [Option ID = 29037]

Correct Answer :-

- 1.694 [Option ID = 29040]

31)

Given $x = \frac{ct}{(1-2t)}, y = \frac{ct^2}{(1-t)}$, where t is a parameter and c is a constant, then dy/dx in terms of t only is

[Question ID = 14745]

1. $\frac{(1-2t)}{2t(1-t)^2}$ [Option ID = 28979]
2. $\frac{2t(1-2t)^2}{(1-t)}$ [Option ID = 28980]
3. $\frac{t(1-2t)^2}{(1-t)}$ [Option ID = 28977]
4. $\frac{2(1-t)}{(1-2t)^2}$ [Option ID = 28978]

Correct Answer :-

- $\frac{2t(1-2t)^2}{(1-t)}$ [Option ID = 28980]

32) The value of $\text{Lim}_{x\to 8}\left(\frac{x^{\frac{1}{3}}-2}{x-8}\right) =$ _____

[Question ID = 14751]

1. *1* [Option ID = 29004]
2. *1/4* [Option ID = 29002]
3. *1/12* [Option ID = 29001]
4. *0* [Option ID = 29003]

Correct Answer :-

- *1/12* [Option ID = 29001]

33) For an *n*-channel MOSFET with a gate oxide (ε_r = 3.9) thickness of 10 nm, V_{th} = 0.6 V and W = 25 µm, L = 1 µm and electron mobility in channel, μ = 200 cm^2/V-s. The drain current at V_{GS} = 5 V and V_{DS} = 0.1 V is

[Question ID = 14778]

1. 7.51 × 10^{-4} A [Option ID = 29111]
2. 3.05 × 10^{-5} A [Option ID = 29109]
3. 5.1 × 10^{-6} A [Option ID = 29110]
4. 8 × 10^{-5} A [Option ID = 29112]

Correct Answer :-

- 7.51 × 10^{-4} A [Option ID = 29111]

34) For $z^6 + z^3 + 1 = 0$, the general solution is

[Question ID = 14744]

1. $e^{-4i\pi/3}$ [Option ID = 28975]

2. $e^{-j\pi/3}$ [Option ID = 28976]
3. $e^{j\pi/3}$ [Option ID = 28974]
4. $e^{2j\pi/3}$ [Option ID = 28973]

Correct Answer :-

- $e^{2j\pi/3}$ [Option ID = 28973]

35) A small concentration of minority carriers is injected into a homogeneous Semiconductor crystal at one point. An electric field of 10 V/cm is applied across the crystal and this moves the minority carriers by a distance of 1 cm in 20 µsec. The mobility (in cm^2 /v-sec) of carriers is

[Question ID = 14768]

1. 5000 [Option ID = 29072]
2. 2000 [Option ID = 29069]
3. 4000 [Option ID = 29071]
4. 3000 [Option ID = 29070]

Correct Answer :-

- 5000 [Option ID = 29072]

36) Let the continuous random variable X denote the current measured in a thin copper wire in milli amperes (mA). Assume that the range of X is $4.9 \leq x \leq 5.1$ and $f(x) = 5$. The probability that a current is less than 5mA is

[Question ID = 14748]

1. 0.4 [Option ID = 28990]
2. 0.2 [Option ID = 28992]
3. 0.5 [Option ID = 28989]
4. 0.3 [Option ID = 28991]

Correct Answer :-

- 0.5 [Option ID = 28989]

37) A transmission line has a characteristic impedance of 75 Ω and a resistance of 5 Ω/m. If the line is distortion less, the attenuation constant (in Np/m) is

[Question ID = 14792]

1. 0.066 [Option ID = 29167]
2. 0.033 [Option ID = 29168]
3. 0.022 [Option ID = 29165]
4. 0.055 [Option ID = 29166]

Correct Answer :-

- 0.066 [Option ID = 29167]

38) A transmitting antenna with a 300 MHz carrier frequency produces 4 kW of power. If both antennas has unity power gain, the power received by another antenna at a distance of 2 km is

[Question ID = 14791]

1. 8.44 mW [Option ID = 29161]
2. 4.4 µW [Option ID = 29163]
3. 11.8 mW [Option ID = 29162]

4. 6.33 µW [Option ID = 29164]

Correct Answer :-

- 6.33 µW [Option ID = 29164]

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39) The power in power meter is displayed as -25 dB, when connected at the output of 30 dB attenuator. The input power applied to this attenuator is

[Question ID = 14789]

1. 10.2 mW [Option ID = 29154]
2. 3.16 mW [Option ID = 29156]
3. 1.5 mW [Option ID = 29155]
4. 5 mW [Option ID = 29153]

Correct Answer :-

- 3.16 mW [Option ID = 29156]

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40) The short-circuit current delivered by a 10 cm by 10 cm photocell (with 100% quantum efficiency) illuminated by monochromatic light of 400 nm wavelength with a power density of 1000 W/m^2 is

[Question ID = 14773]

1. 6.85A [Option ID = 29092]
2. 5A [Option ID = 29089]
3. 8.32A [Option ID = 29091]
4. 3.2A [Option ID = 29090]

Correct Answer :-

- 3.2A [Option ID = 29090]

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41) The recursion relation to solve $x - e^{-x}$ using Newton Raphson method is

[Question ID = 14758]

1. $x_{n+1} = e^{-x_n}$ [Option ID = 29029]
2. $x_{n+1} = x_n - e^{-x_n}$ [Option ID = 29030]
3. $x_{n+1} = (1+x_n)^2 \frac{e^{-x_n} - 1}{1+e^{-x_n}}$ [Option ID = 29032]
4. $x_{n+1} = (1+x_n)\frac{e^{-x_n}}{1+e^{-x_n}}$ [Option ID = 29031]

Correct Answer :-

- $x_{n+1} = (1+x_n)\frac{e^{-x_n}}{1+e^{-x_n}}$ [Option ID = 29031]

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42) The temperature required to generate electron-hole pairs in silicon (E_g = 1.1 eV) is (given electron charge=1.6×10^{-19} J, Boltzman constant k =1.38×10^{-23} J/°K)

[Question ID = 14764]

1. 1522 K [Option ID = 29053]
2. 4174 K [Option ID = 29056]
3. 8502 K [Option ID = 29055]
4. 1130 K [Option ID = 29054]

Correct Answer :-

43) The source of microwaves in a microwave oven is

[Question ID = 14786]

1. klystron [Option ID = 29141]
2. cyclotron [Option ID = 29144]
3. gyratron [Option ID = 29142]
4. magnetron [Option ID = 29143]

Correct Answer :-

- magnetron [Option ID = 29143]

44) The operating frequency of source in the microwave oven is

[Question ID = 14787]

1. 1.45 GHz [Option ID = 29146]
2. 4.45 GHz [Option ID = 29148]
3. 3.45 GHz [Option ID = 29145]
4. 2.45 GHz [Option ID = 29147]

Correct Answer :-

- 2.45 GHz [Option ID = 29147]

45) The line width of a He-Ne laser is 0.01 nm and the cross-sectional area of the beam is 0.01 cm^2. If the output power is 1mW, the radiation intensity per unit wavelength (in Watt/cm^3) is

[Question ID = 14780]

1. 10^{-8} [Option ID = 29118]
2. 10^{10} [Option ID = 29117]
3. 10^{8} [Option ID = 29119]
4. 10^{-10} [Option ID = 29120]

Correct Answer :-

- 10^{8} [Option ID = 29119]

46) The application of VSWR meter to measure

[Question ID = 14784]

1. air pressure [Option ID = 29136]
2. light intensity [Option ID = 29134]
3. SWR [Option ID = 29133]
4. scattering parameter [Option ID = 29135]

Correct Answer :-

- SWR [Option ID = 29133]

47) The dependence of Doppler broadened line width of a laser transition on temperature, *T* is given as

[Question ID = 14781]

1. T [Option ID = 29121]
2. T^2 [Option ID = 29124]
3. $T^{-1/2}$ [Option ID = 29122]
4. $T^{1/2}$ [Option ID = 29123]

Correct Answer :-

- $T^{-1/2}$ [Option ID = 29122]

48) The return loss of a device is found to be 40 dB. The voltage standing wave ratio (VSWR) and magnitude of reflection coefficient are respectively

[Question ID = 14790]

1. -1.02 and 0.1 [Option ID = 29158]
2. 1.02 and 0.01 [Option ID = 29159]
3. 2.44 and 0.02 [Option ID = 29160]
4. 0.81 and 0.1 [Option ID = 29157]

Correct Answer :-

- 1.02 and 0.01 [Option ID = 29159]

49) The de Broglie wavelength of an electron accelerated to a potential of 2kV is _____

[Question ID = 14771]

1. 3.46×10^{-11} m [Option ID = 29084]
2. 5.49×10^{-9} m [Option ID = 29083]
3. 1.73×10^{-11} m [Option ID = 29082]
4. 2.74×10^{-9} m [Option ID = 29081]

Correct Answer :-

- 2.74×10^{-9} m [Option ID = 29081]

50) The following equation needs to be numerically solved using the Newton-Raphson method *$x^3 + 4x - 9 = 0$. The iterative equation for this purpose is (k – indicates the interation level)*

[Question ID = 14753]

1. $x_{k+1} = \frac{3x_k^3+9}{2x_k^2+4}$ [Option ID = 29011]
2. $x_{k+1} = x_k + 3x_k^2 + 4$ [Option ID = 29012]
3. $x_{k+1} = \frac{4x_k^3+3}{9x_k^2+2}$ [Option ID = 29010]
4. $x_{k+1} = \frac{2x_k^3+9}{3x_k^2+4}$ [Option ID = 29009]

Correct Answer :-

- $x_{k+1} = \frac{2x_k^3+9}{3x_k^2+4}$ [Option ID = 29009]