PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

"Errors , curve fitting and data analysis" - CSIR NET Physics PYQs

Electronics . All PYQs (2015-2025) with answer key

20 questions . Answer key included

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Q1. [Dec 2015] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2015 Dec	3.5 M

Two data sets A and B consist of 60 and 10 readings of a voltage measured using voltmeters of resolution of $1mV$ and $0.5mV$ respectively. The uncertainty in the mean voltage obtained from the data sets A and B are U_A and U_B, respectively. If the uncertainty of the mean of the combined data sets is U_{AB} then which of the following statements is correct?

1. $U_{AB} < U_A$ and $U_{AB} > U_B$
2. $U_{AB} < U_A$ and $U_{AB} < U_B$
3. $U_{AB} > U_A$ and $U_{AB} < U_B$
4. $U_{AB} > U_A$ and $U_{AB} > U_B$

Q2. [June 2015] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2015 June	3.5 M

The viscosity η of a liquid is given by Poiseuille's formula $\eta = \frac{\pi P a^4}{8IV}$. Assume that l and V can be measured very accurately, but the pressure P has an rms error of 1% and the radius a has an independent rms error of 3%. The rms error of the viscosity is closest to

1. 2%
2. 4%
3. 12%
4. 13%

Q3. [Dec 2016] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2016 Dec	5M

The resistance of a sample is measured as a function of temperature, and the data are shown below.

$T(^\circ C)$	2	4	6	8
$R(\Omega)$	90	105	110	115

The slope of R vs T graph, using a linear least-squares fit to the data, will be

1. $6\Omega/\circ C$
2. $4\Omega/\circ C$
3. $2\Omega/\circ C$
4. $8\Omega/\circ C$

Q4. [June 2016] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2016 June	3.5M

Using dimensional analysis, Planck defined a characteristic temperature T_P from powers of the gravitational constant G, Planck's constant h, Boltzmann constant k_B and the speed of light c in vacuum. The expression for T_P is proportional to

1. $\sqrt{\frac{hc^5}{k_B^2 G}}$
2. $\sqrt{\frac{hc^3}{k_B^2 G}}$
3. $\sqrt{\frac{G}{hc^4 k_B^2}}$
4. $\sqrt{\frac{hk_B^2}{Gc^3}}$

Q5. [June 2016] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2016 June	5M

The decay constants f_p of the heavy pseudo-scalar mesons, in the heavy quark limit, are related to their masses m_p by the relation $f_p = \frac{a}{\sqrt{m_p}}$, where a is an empirical parameter to be determined. The values $m_p = 6400 \pm 160\text{MeV}$ and $f_p = 180 \pm 15$ MeV correspond to uncorrelated measurements of a meson. The error on the estimate of a is

1. $175(\text{MeV})^{3/2}$
2. $900(\text{MeV})^{3/2}$
3. $1200(\text{MeV})^{3/2}$
4. $2400(\text{MeV})^{3/2}$

Q6. [Dec 2017] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2017 Dec	5M

Two physical quantities T and M are related by the equation $T = \frac{2\pi}{a}\sqrt{\frac{M+b}{2}}$, where a and b are constant parameters. The variation of T as a function of M was recorded in an experiment to determine the value of a graphically. Let m be the slope of the straight line when T^2 is plotted vs M, and δm be the uncertainty in determining it. The uncertainty in determining a is

1. $\frac{a}{2}\left(\frac{\delta m}{m}\right)$
2. $a\left(\frac{\delta m}{m}\right)$
3. $\frac{b}{2a}\left(\frac{\delta m}{m}\right)$
4. $\frac{2\pi}{a}\left(\frac{\delta m}{m}\right)$

Q7. [June 2017] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2017 June	3.5M

The experimentally measured values of the variables x and y are 2.00 ± 0.05 and 3.00 ± 0.02 respectively. What is the error in the calculated value of $z = 3y - 2x$ from the measurements?

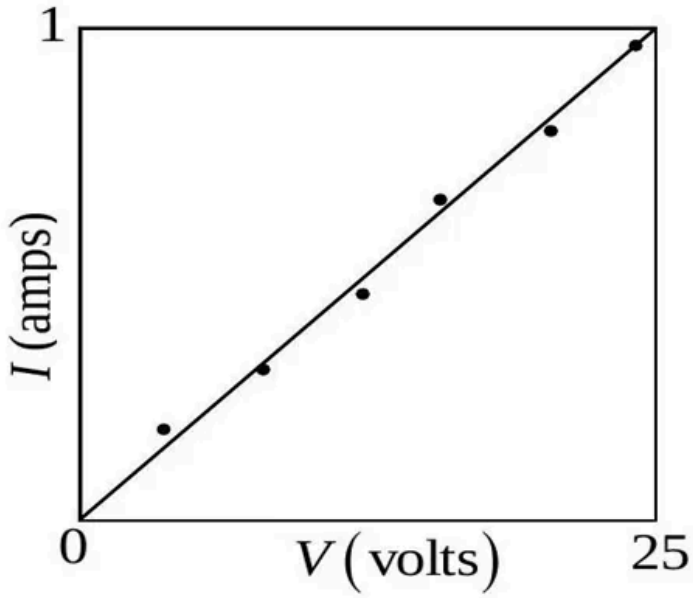
1. 0.12
2. 0.05
3. 0.03
4. 0.07

Q8. [June 2017] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2017 June	5M

Both the data points and a linear fit to the current vs voltage of a resistor are shown in the graph below.



If the error in the slope is $1.255 \times 10^{-3}\Omega^{-1}$, then the value of resistance estimated from the graph is

1. $(0.04 \pm 0.8)\Omega$
2. $(25.0 \pm 0.8)\Omega$
3. $(25 \pm 1.25)\Omega$
4. $(25 \pm 0.0125)\Omega$

Q9. [Dec 2019] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2019 Dec	3.5M

A student measures the displacement x from the equilibrium of a stretched spring and reports it be 100μ m with a 1% error. The spring constant k is known to be 10 N/m with 0.5% error.

The percentage error in the estimate of the potential energy $V = \frac{1}{2}kx^2$ is

1. 0.8%
2. 2.5%
3. 1.5%
4. 3.0%

Q10. [June 2019] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2019 June	3.5M

In an experiment to measure the acceleration due to gravity g using a simple pendulum, the length and time period of the pendulum are measured to three significant figures. The mean value of g and the uncertainty δg of the measurements are then estimated using a calculator from a large number of measurements and found to be $9.82147\ \mathrm{m/s^2}$ and $0.02357\ \mathrm{m/s^2}$, respectively. Which of the following is the most accurate way of presenting the experimentally determined value of g ?

1. $9.82 \pm 0.02\ \mathrm{m/s^2}$
2. $9.8215 \pm 0.02\ \mathrm{m/s^2}$
3. $9.82147 \pm 0.02357\ \mathrm{m/s^2}$
4. $9.82 \pm 0.02357\ \mathrm{m/s^2}$

Q11. [June 2021] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2021 June	3.5M

In an experiment, the velocity of a non-relativistic neutron is determined by measuring the time (~ 50 ns) it takes to travel from the source to the detector kept at a distance L. Assume that the error in the measurement of L is negligibly small. If we want to estimate the kinetic energy T of the neutron to within 5% accuracy, i.e., $|\delta T/T| \leq 0.05$, the maximum permissible error $|\delta T|$ in measuring the time of flight is nearest to

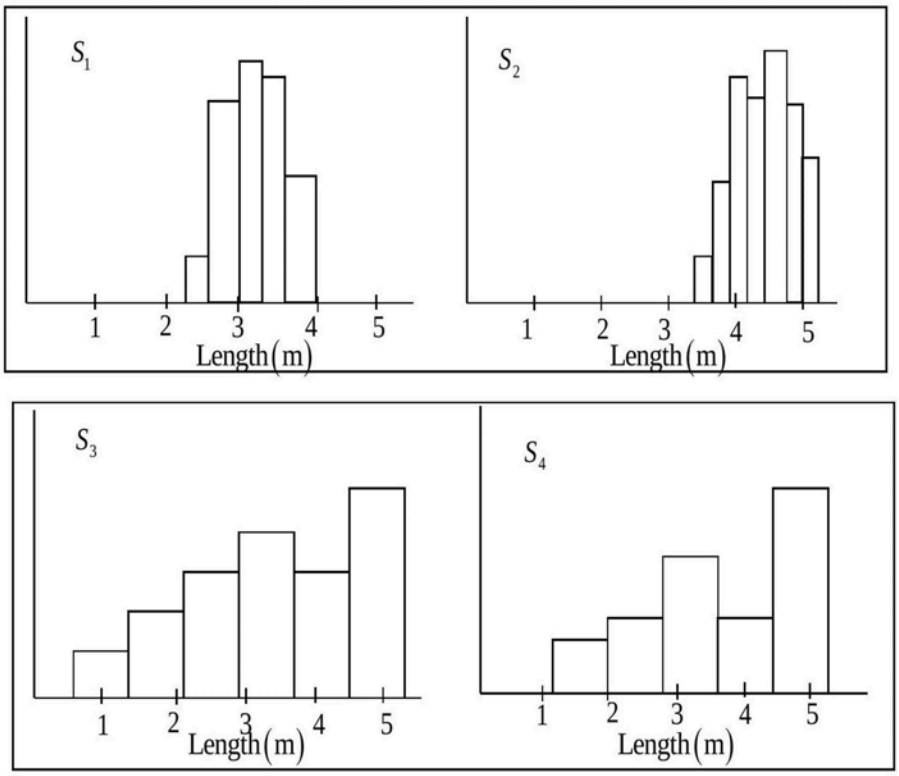
1. 1.75 ns
2. 0.75 ns
3. 2.25 ns
4. 1.25 ns

Q12. [June 2022] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2022 June	3.5M

Four students (S_1, S_2, S_3 and S_4) make multiple measurements on the length of a table. The binned data are plotted as histograms in the following figures.



If the length of the table, specified by the manufacturer, is $3m$, the student whose measurements have the minimum systematic error, is

1. S_2
2. S_1
3. S_4
4. S_3

Q13. [Dec 2023] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2023 Dec	3.5 M

In the measurement of a radioactive sample, the measured counts with and without the sample for equal time intervals are $C = 500$ and $B = 100$, respectively. The errors in the measurements of C and B are $|\Delta C| = 20$ and $|\Delta B| = 10$, respectively. The net error $|\Delta Y|$ in the measured counts from the sample $Y = C - B$, is closet to

1. 22
2. 10
3. 30
4. 43

Q14. [Dec 2023] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2023 Dec	5 M

Gauge factor of a strain gauge is defined as the ratio of the fractional change in resistance $\left(\frac{\Delta R}{R}\right)$ to the fractional change in length $\left(\frac{\Delta L}{L}\right)$. A metallic strain gauge with a gauge factor 2 has a resistance of 100Ω under unstrained condition. An aluminum foil with Young's modulus $Y = 70GN/m^2$ is installed on the metallic gauge. Keeping the foil within its elastic limit, a stress of $0.2GN/m^2$ is applied on the foil. The change in the resistance of the gauge will be closest to

1. 0.14Ω
2. 1.23Ω
3. 0.28Ω
4. 0.56Ω

Q15. [June 2023] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2023 June	3.5M

A DC motor is used to lift a mass M to a height h from the ground. The electric energy delivered to the motor is VIt, where V is the applied voltage, I is the current and t the time for which the motor runs. The efficiency e of the motor is the ratio between the work done by the motor and the energy delivered to it. If $M = 2.00 \pm 0.02 kg, h = 1.00 \pm 0.01\ m$, $V = 10.0 \pm 0.1\ V, I = 2.00 \pm 0.02\ A$ and $t = 300 \pm 15\ s$, then the fractional error $|\delta e/e|$ in the efficiency of the motor is closest to

1. 0.05
2. 0.09
3. 0.12
4. 0.15

Q16. [Dec 2024] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2024 Dec	3.5M

A DC motor operating at a voltage V and a current I is used to lift a mass m to a height h. The percentage uncertainty in the measurement of time t is 5% and that for the other parameters (V, I, m and h) are 1% each. If the measurements are independent and the errors are random, the uncertainty in the estimation of the efficiency $\left(\frac{\text{output power}}{\text{input power}}\right)$ of the motor is closest to

1. 3.1%
2. 5.4%
3. 4.8%
4. 6.3%

Q17. [Dec 2024] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2024 Dec	3.5M

The following table shows the relationship between an independent quantity x and an experimentally measured quantity y.

x	0	1	2	3	4	5
y	0.1	2.1	8.1	17.9	32.2	49.7

The relationship between x and y is best represented by

1. $y \propto x^3$
2. $y \propto e^x$
3. $y \propto x^2$
4. $y \propto \sqrt{x}$

Q18. [June 2024] . 3.5 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2024 June	3.5M

A set of 100 data points yields an average $\bar{x} = 9$ and a standard deviation $\sigma_x = 4$. The error in the estimated mean is closest to

1. 3.0
2. 0.4
3. 4.0
4. 0.3

Q19. [June 2024] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2024 June	5M

An astronomer observes 500 objects and classifies them as either of type A or type B. She finds 148 objects to be of type B. Assuming a binomial distribution, the best estimate of the fraction of type A objects and its associated standard deviation respectively are

1. 0.704,0.002
2. 0.70,0.02
3. 0.704,0.031
4. 0.72,0.03

Q20. [Dec 2025] . 5.0 marks

Electronics > "Errors , curve fitting and data analysis"

CSIR NET	2025 Dec	5M	MMP

A thermistor measures an object's temperature T, by measuring its resistance R according to $R = AT^{-n}$, where A and n are positive constants. The observed resistances for different values of temperature (including environmental and instrumental sources of error) are given in table. The estimated value of the exponent n, from the above data, is closest to

1. 2.0
2. 0.8
3. 1.3
4. 2.7

$T(K)$	$R(\Omega)$
250	140
300	110
350	90

Answer Key

20 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Electronics	"Errors , curve fitting and data analysis"	**2**
Q2	Electronics	"Errors , curve fitting and data analysis"	**3**
Q3	Electronics	"Errors , curve fitting and data analysis"	**2**
Q4	Electronics	"Errors , curve fitting and data analysis"	**1**
Q5	Electronics	"Errors , curve fitting and data analysis"	**3**
Q6	Electronics	"Errors , curve fitting and data analysis"	**1**
Q7	Electronics	"Errors , curve fitting and data analysis"	**1**
Q8	Electronics	"Errors , curve fitting and data analysis"	**2**
Q9	Electronics	"Errors , curve fitting and data analysis"	**2**
Q10	Electronics	"Errors , curve fitting and data analysis"	**4**
Q11	Electronics	"Errors , curve fitting and data analysis"	**4**
Q12	Electronics	"Errors , curve fitting and data analysis"	**2**
Q13	Electronics	"Errors , curve fitting and data analysis"	**1**
Q14	Electronics	"Errors , curve fitting and data analysis"	**4**
Q15	Electronics	"Errors , curve fitting and data analysis"	**1**
Q16	Electronics	"Errors , curve fitting and data analysis"	**2**
Q17	Electronics	"Errors , curve fitting and data analysis"	**3**
Q18	Electronics	"Errors , curve fitting and data analysis"	**2**
Q19	Electronics	"Errors , curve fitting and data analysis"	**2**
Q20	Electronics	"Errors , curve fitting and data analysis"	**3**

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