LOGIC BLOOM · JEE PHYSICS

Errors in *Measurement*

Units & Measurements · **JEE Main & Advanced PYQ Practice**

20 questions on absolute error, mean absolute error, relative and percentage error, and combination of errors, all with detailed solutions.

20 MCQs | Main + Advanced | Full Error Analysis | Detailed Solutions

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PART I · QUESTIONS

Errors in Measurement – 20 MCQs

Single correct answer. Weighted toward absolute and mean absolute error, then relative, percentage and combination of errors.

Attempt all 20 before checking the key. Questions tagged JEE Main (crimson) or JEE Advanced (teal) by difficulty. Constants and true values are as given.

Q1 JEE MAIN MEAN VALUE

In an experiment the period of oscillation of a pendulum is measured five times giving 2.63, 2.56, 2.42, 2.71 and 2.80 s. The mean period (arithmetic mean) is:

(A) 2.50 s

(B) 2.62 s

(C) 2.56 s

(D) 2.72 s

Q2 JEE MAIN ABSOLUTE ERROR

For the same pendulum readings (2.63, 2.56, 2.42, 2.71, 2.80 s; mean 2.62 s), the absolute error in the third reading (2.42 s) is:

(A) 0.09 s

(B) 0.06 s

(C) 0.18 s

(D) 0.20 s

Q3 JEE MAIN MEAN ABSOLUTE ERROR

For the pendulum readings (2.63, 2.56, 2.42, 2.71, 2.80 s; mean 2.62 s), the mean absolute error is closest to:

A 0.11 s

B 0.20 s

C 0.02 s

D 0.06 s

Q4 JEE MAIN REPORTING RESULT

The final result of the pendulum experiment (mean 2.62 s, mean absolute error 0.11 s) should be reported as:

A (2.62 ± 0.11) s

B (2.62 ± 0.53) s

C 2.62 s

D (2.62 ± 0.04) s

Q5 JEE MAIN MEAN ABSOLUTE ERROR

Four measurements of a length give 1.24, 1.26, 1.28 and 1.22 cm. The mean absolute error is:

A 0.01 cm

B 0.06 cm

C 0.02 cm

D 0.04 cm

Q6 JEE MAIN MEAN ABSOLUTE ERROR

Five readings of a resistance are 1.23, 1.24, 1.26, 1.25, 1.22 Ω (mean 1.24 Ω). The mean absolute error is:

A 0.008 Ω

B 0.012 Ω

C 0.05 Ω

D 0.02 Ω

Q7 JEE MAIN ABSOLUTE ERROR

A single measurement of a rod gives 2.56 cm while its true (standard) length is 2.50 cm. The absolute error in the measurement is:

A 2.56 cm

B 0.02 cm

C 0.06 cm

D 0.6 cm

Q8 JEE MAIN CONCEPT

Which statement about mean absolute error is correct?

A It is always dimensionless

B It can be negative

C It equals the sum of the absolute errors

D It has the same units as the measured quantity

Q9 JEE MAIN RELATIVE ERROR

The diameter of a wire measured with a screw gauge in five trials shows a mean of 0.500 mm and a mean absolute error of 0.002 mm. The relative error is:

A 0.002

B 0.001

C 0.04

D 0.004

Q10 JEE MAIN PERCENTAGE ERROR

A measurement is recorded as (5.00 ± 0.05) cm. The percentage error is:

A 0.5%

B 5%

C 1%

D 0.05%

Q11 JEE MAIN PERCENTAGE ERROR

The mean value of a quantity is 10.2 units with mean absolute error 0.12 units. The percentage error is approximately:

A 12%

B 1.2%

C 0.12%

D 2.4%

Q12 JEE MAIN PERCENTAGE ERROR

If the percentage error in a measurement of mass is 2% and the mass is measured as 50.0 g, the absolute error is:

A 1.0 g

B 0.5 g

C 2.0 g

D 0.1 g

Q13 JEE MAIN COMBINATION: SUM

Two quantities are A = (10.0 ± 0.1) and B = (5.0 ± 0.2). The result of A + B is:

A (15.0 ± 0.3)

B (15.0 ± 0.15)

C (15.0 ± 0.02)

D (15.0 ± 0.1)

Q14 JEE MAIN COMBINATION: DIFFERENCE

For A = (10.0 ± 0.1) and B = (5.0 ± 0.2), the result of A − B is:

A (5.0 ± 0.15)

B (5.0 ± 0.3)

C (5.0 ± 0.02)

D (5.0 ± 0.1)

Q15 JEE MAIN COMBINATION: QUOTIENT

The voltage across a resistor is V = (100 ± 5) V and the current is I = (10 ± 0.2) A. The percentage error in the resistance R = V/I is:

A 2%

B 3%

C 5%

D 7%

Q16 JEE ADV COMBINATION: PRODUCT

Two resistances A = (10 ± 0.1) Ω and B = (5 ± 0.1) Ω are multiplied in a calculation Z = AB. The absolute error in Z is:

A 0.03

B 3.0

C 1.5

D 0.2

Q17 JEE ADV COMBINATION: POWER

The acceleration due to gravity is found from $g = 4\pi^2L/T^2$. If the percentage error in L is 1% and in T is 2%, the percentage error in g is:

A 7%

B 1%

C 5%

D 3%

Q18 JEE ADV COMBINATION: POWER

A physical quantity $Z = A^2B^3/C$. If the percentage errors in A, B and C are each 1%, the percentage error in Z is:

A 5%

B 1%

C 3%

D 6%

Q19 JEE ADV COMBINATION: POWER

The density of a sphere is $\rho = m / (\frac{2}{3}\pi r^3)$. If the percentage error in mass m is 1% and in radius r is 0.5%, the percentage error in density is:

A 2.5%

B 1%

C 1.5%

D 3.5%

Q20 JEE ADV COMBINATION: POWER

In an experiment to measure Young's modulus $Y = MgL / (\pi r^2 l)$, the percentage errors are: M 1%, L 1%, r 0.5%, l 2% (take g exact). The maximum percentage error in Y is:

(A) 3.5%

(B) 5%

(C) 4%

(D) 6.5%

PART II · ANSWER KEY & SOLUTIONS

Detailed Solutions

Quick-check grid first (Advanced answers in teal), then full working for every question.

Q1 B	Q2 D	Q3 A	Q4 A	Q5 C	Q6 B	Q7 C	Q8 D	Q9 D	Q10 C	Q11 B	Q12 A
Q13 A	Q14 B	Q15 D	Q16 C	Q17 C	Q18 D	Q19 A	Q20 B				

Q1 Correct: B *2.62 s*

The mean (true value estimate) is the arithmetic average: (2.63 + 2.56 + 2.42 + 2.71 + 2.80)/5 = 13.12/5 = **2.624 s ≈ 2.62 s**. The mean of repeated readings is always taken as the best estimate of the true value.

Q2 Correct: D *0.20 s*

Absolute error in a reading = |reading − mean| = |2.42 − 2.624| = **0.204 s ≈ 0.20 s**. Absolute error is always taken as a positive magnitude, so drop the sign.

Q3 Correct: A *0.11 s*

The absolute errors are |2.63−2.624|=0.006, |2.56−2.624|=0.064, |2.42−2.624|=0.204, |2.71−2.624|=0.086, |2.80−2.624|=0.176. Their mean = (0.006+0.064+0.204+0.086+0.176)/5 = 0.536/5 = **0.107 ≈ 0.11 s**. The mean absolute error is the average of the individual absolute errors.

Q4 Correct: A *(2.62 ± 0.11) s*

A measured quantity is reported as mean ± mean absolute error, so the period is **(2.62 ± 0.11) s**. This states both the best estimate and the uncertainty around it.

Q5 Correct: C *0.02 cm*

Mean = (1.24+1.26+1.28+1.22)/4 = 5.00/4 = 1.25 cm. Absolute errors: 0.01, 0.01, 0.03, 0.03. Mean absolute error = (0.01+0.01+0.03+0.03)/4 = 0.08/4 = **0.02 cm**.

Q6 **Correct: B** *0.012 Ω*

Absolute errors from the mean 1.24: 0.01, 0.00, 0.02, 0.01, 0.02. Mean absolute error = (0.01+0.00+0.02+0.01+0.02)/5 = 0.06/5 = **0.012 Ω**.

Q7 **Correct: C** *0.06 cm*

When a true value is known, absolute error = |measured − true| = |2.56 − 2.50| = **0.06 cm**. This differs from the repeated-reading case only in that the reference is the accepted true value rather than the mean.

Q8 **Correct: D** *It has the same units as the measured quantity*

The mean absolute error is an average of absolute errors, each of which is |reading − mean|, so it carries the **same units as the quantity itself** (unlike relative error, which is dimensionless). It is the *average*, not the sum, and being an average of magnitudes it can never be negative.

Q9 **Correct: D** *0.004*

Relative error = mean absolute error / mean value = 0.002 / 0.500 = **0.004**. Relative error is a pure number (no units); multiplying by 100 would give the percentage error, 0.4%.

Q10 **Correct: C** *1%*

Percentage error = (absolute error / measured value) × 100 = (0.05 / 5.00) × 100 = **1%**. Percentage error is simply the relative error expressed per hundred.

Q11 **Correct: B** *1.2%*

Percentage error = (0.12 / 10.2) × 100 ≈ **1.2%**. Always divide the (mean) absolute error by the mean value before multiplying by 100.

Q12 **Correct: A** *1.0 g*

Absolute error = (percentage error / 100) × measured value = (2/100) × 50.0 = **1.0 g**. This is the reverse of the usual calculation: given the percentage, recover the absolute error.

Q13 Correct: A *(15.0 ± 0.3)*

For a **sum**, the absolute errors add: Δ(A+B) = ΔA + ΔB = 0.1 + 0.2 = 0.3. So A + B = **(15.0 ± 0.3)**. The same absolute-error addition applies to a difference.

Q14 Correct: B *(5.0 ± 0.3)*

For a **difference**, the absolute errors still *add* (they never subtract): Δ(A−B) = ΔA + ΔB = 0.1 + 0.2 = 0.3. So A − B = **(5.0 ± 0.3)**. Note the absolute error grew while the value shrank, so a difference of nearly equal quantities can have a huge percentage error.

Q15 Correct: D *7%*

For a **quotient**, the relative (percentage) errors add: %error in R = %error in V + %error in I = (5/100)×100 + (0.2/10)×100 = 5% + 2% = **7%**. Products and quotients combine by adding relative errors, not absolute ones.

Q16 Correct: C *1.5*

For a product, relative errors add: ΔZ/Z = ΔA/A + ΔB/B = 0.1/10 + 0.1/5 = 0.01 + 0.02 = 0.03. Then ΔZ = 0.03 × Z = 0.03 × 50 = **1.5**. Compute the relative error first, then multiply by the value of Z.

Q17 Correct: C *5%*

A power contributes its exponent times the base's percentage error. Here %g = %L + 2(%T) = 1% + 2(2%) = **5%**. The period appears squared, so its error counts double, which is why timing is the critical measurement in a pendulum experiment.

Q18 Correct: D *6%*

Each factor contributes its exponent (as a magnitude) times its percentage error: %Z = 2(%A) + 3(%B) + 1(%C) = 2(1) + 3(1) + 1(1) = **6%**. Exponents always add their contributions regardless of whether the factor is in the numerator or denominator.

Q19 Correct: A *2.5%*

%ρ = %m + 3(%r) = 1% + 3(0.5%) = 1% + 1.5% = **2.5%**. The radius is cubed, so its error is tripled: for volume-type quantities the length error always dominates.

Q20 **Correct: B** *5%*

%Y = %M + %L + 2(%r) + %l = 1 + 1 + 2(0.5) + 2 = 1 + 1 + 1 + 2 = **5%.** The radius term is doubled because r is squared. In maximum-error problems every contribution is added as a positive magnitude, giving the worst case.

KEEP GOING · ON THE APP

Don't just solve 20.
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