

Physics

1. The percentage error in the calculated volume of a sphere, if there is 2% error in its diameter measurement, is _____.

- A) 1 B) 2
C) 6 D) 8

2. The density ρ of a uniform cylinder is determined by measuring its mass m , length l and diameter d . The measured values of m , l and d are 97.42 ± 0.02 g, 8.35 ± 0.05 mm and 20.20 ± 0.02 mm, respectively. Calculated percentage fractional error in ρ is _____

- A) 0.63% B) 0.82%
C) 0.72% D) 0.25%

3. In an experiment to determine the resistance of a given wire using Ohm's law, the voltmeter and ammeter readings are noted as 10 V and 5 A, respectively. The least counts of voltmeter and ammeter are 500 mV and 200 mA, respectively. The estimated error in the resistance measurement is _____ Ω

- A) 0.25 B) 2
C) 2.5 D) 0.18

4. A quantity Q is formulated as $X^{-2}Y + \frac{3}{2}Z^{-\frac{2}{3}}$. X , Y , and Z are independent parameters which have fractional errors of 0.1, 0.2, and 0.5, respectively in measurement. The maximum fractional error of Q is

- A) 0.6 B) 0.8
C) 0.7 D) 0.1

5. The maximum percentage error in the measurement of density of a wire is [Given, mass of wire = (0.60 ± 0.003) g radius of wire = (0.50 ± 0.01) cm length of wire = (10.00 ± 0.05) cm]

- A) 7 B) 8
C) 5 D) 4

6. A physical quantity C is related to four other quantities p , q , r and s as follows $C = \frac{pq^2}{r^3\sqrt{s}}$. The percentage errors in the measurement of p , q , r and s are 1%, 2%, 3% and 2%, respectively. The percentage error in the measurement of C will be _____%

- A) 15 B) 2
C) 17 D) 12

7. A physical quantity Q is related to four observables a , b , c , d as follows : $Q = \frac{ab^4}{cd}$ where, $a = (60 \pm 3)$ Pa; $b = (20 \pm 0.1)$ m; $c = (40 \pm 0.2)$ Nsm $^{-2}$ and $d = (50 \pm 0.1)$ m, then the percentage error in Q is $\frac{x}{1000}$, where $x =$ _____.

- A) 8009 B) 7700
C) 6890 D) 7903

8. To find the spring constant (k) of a spring experimentally, a student commits 2% positive error in the measurement of time and 1% negative error in measurement of mass. The percentage error in determining value of k is :

- A) 5% B) 3%
C) 1% D) 4%

9. The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as $r = (0.35 \pm 0.05)$ cm $R = (100 \pm 10)$ ohm $l = (15 \pm 0.2)$ cm. The percentage error in resistivity of the material of the wire is :

- A) 37.3% B) 25.6%
C) 35.6% D) 39.9%

10. The measured value of the length of a simple pendulum is 20 cm with 2 mm accuracy. The time for 50 oscillations was measured to be 40 seconds with 1 second resolution. From these measurements, the accuracy in the measurement of acceleration due to gravity is $N\%$. The value of N is:

- A) 6 B) 5
C) 4 D) 8

11. A physical quantity Q is found to depend on quantities a , b , c by the relation $Q = \frac{a^4b^3}{c^2}$. The percentage error in a , b and c are 3%, 4% and 5% respectively. Then, the percentage error in Q is :

- A) 43% B) 34%
C) 66% D) 14%

12. The resistance $R = \frac{V}{I}$ where $V = (200 \pm 5)$ V and $I = (20 \pm 0.2)$ A, the percentage error in the measurement of R is :

- A) 5.5% B) 3%
C) 7% D) 3.5%

13. A body of mass (5 ± 0.5) kg is moving with a velocity of (20 ± 0.4) m/s. Its kinetic energy will be

- A) (1000 ± 140) J B) (500 ± 0.14) J
C) (1000 ± 0.14) J D) (500 ± 140) J

14. The maximum error in the measurement of resistance, current and time for which current flows in an electrical circuit are 1%, 2% and 3% respectively. The maximum percentage error in the detection of the dissipated heat will be :

- A) 2 B) 4
C) 6 D) 8

15. If the percentage errors in measuring the length and the diameter of a wire are 0.1% each. The percentage error in measuring its resistance will be:

- A) 0.144% B) 0.2 %
C) 0.1 % D) 0.3 %

16. In an experiment to find acceleration due to gravity (g) using simple pendulum, time period of 0.5 s is measured from time of 100 oscillation with a watch of 1 s resolution. If measured value of length is 10 cm known to 1 mm accuracy, The accuracy in the determination of g is found to be $x\%$. The value of x is _____.

- A) 5 B) 7
C) 2 D) 10

17. For $z = a^2x^3y^{\frac{1}{2}}$, where 'a' is a constant. If percentage error in measurement of 'x' and 'y' are 4% and 12% respectively, then the percentage error for 'z' will be _____%.

- A) 20 B) 18
C) 15 D) 75

18. A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be 9.8 m/s 2 , without any significant error, his observation are as following.

Physical Quantity	Least count of the Equipment used for measurement	Observed value
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is :

- A) 0.0083 B) 0.0155
C) 0.155 D) 0.083

19. If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is :

- A) 86.4 s
B) 4.32 s
C) 43.2 s
D) 8.64 s

20. A physical quantity 'y' is represented by the formula $y = m^2 r^{-4} g^x l^{-\frac{3}{2}}$ If the percentage errors found in y, m, r, l and g are 18, 1, 0.5, 4 and p respectively, then find the value of x and p.

- A) 5 and ± 2
B) 4 and ± 3
C) $\frac{16}{3}$ and $\pm \frac{3}{2}$
D) 8 and ± 2

21. The acceleration due to gravity is found upto an accuracy of 4% on a planet. The energy supplied to a simple pendulum to known mass 'm' to undertake oscillations of time period T is being estimated. If time period is measured to an accuracy of 3%, the accuracy to which E is known as

- A) 14
B) 16
C) 81
D) 12

22. A physical quantity z depends on four observables a, b, c and d, as $z = \frac{a^2 b^{\frac{3}{2}}}{\sqrt{c} d^3}$. The percentages of error in the measurement of a, b, c and d are 2%, 1.5%, 4% and 2.5% respectively. The percentage of error in z is :

- A) 13.5 %
B) 14.5%
C) 16.5%
D) 12.25%

23. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1%, the maximum error in determining the density is:

- A) 6%
B) 2.5%
C) 3.5%
D) 4.5%

24. The density of a solid metal sphere is determined by measuring its mass and its diameter. The maximum error in the density of the sphere is $\left(\frac{x}{100}\right)\%$. If the relative errors in measuring the mass and the diameter are 6.0% and 1.5% respectively, the value of x is_____.

- A) 1050
B) 1890
C) 2360
D) 2678

25. The percentage errors in quantities P, Q, R and S are 0.5%, 1%, 3% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3 Q^2}{\sqrt{RS}}$. The maximum percentage error in the value of A will be :

- A) 6.0%
B) 7.5%
C) 8.5%
D) 6.5%

26. The relative error in the determination of the surface area of sphere is α . Then the relative error in the determination of its volume is :

- A) $\frac{3}{2}\alpha$
B) $\frac{2}{3}\alpha$
C) $\frac{5}{2}\alpha$
D) α

27. A physical quantity P is described by the relation $P = a^{1/2} b^2 c^3 d^{-4}$ If the relative errors in the measurement of a, b, c and d respectively, are 2%, 1%, 3% and 5%, then the relative error in P will be :

- A) 8%
B) 12%
C) 32%
D) 25%

28. The following observations were taken for determining surface tension T of water by capillary method: diameter of capillary, $D = 1.25 \times 10^{-2}$ m rise of water, $h = 1.45 \times 10^{-2}$ m Using $g = 9.80$ m/s² and the simplified relation $T = \frac{r h g}{2} \times 10^3$ N/m, the possible error in surface tension is closest to :

- A) 10 %
B) 0.15 %
C) 1.5 %
D) 2.4 %

29. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value of resistance of the wire is

- A) 6 %
B) zero
C) 1 %
D) 3 %

30. The length and breadth of a field are measured as: $l = (120 \pm 2)$ m and $b = (100 \pm 5)$ m. What is the area of the field with error limits?

- A) $(1.2 \pm 0.05) \times 10^4$ m²
B) $(1.2 \pm 0.08) \times 10^4$ m²
C) (12000 ± 7) m²
D) $(1.2 \pm 0.12) \times 10^4$ m²

31. In an experiment of simple pendulum, time period measured was 50 s for 25 vibrations when the length of the simple pendulum was taken 100 cm. If the least count of stop watch is 0.1 s and that of meter scale is 0.1 cm, calculate the maximum possible error in the measurement of value of g.

- A) 0.1%
B) 0.3%
C) 0.5%
D) 0.7%

32. A physical quantity is represented by $X = M^a L^b T^{-c}$. If percentage errors in the measurement of M, L and T are α, β and γ , respectively, then total percentage error is:

- A) $(\alpha a + \beta b - \gamma c)$
B) $(\alpha a + \beta b + \gamma c)$
C) $(\alpha a - \beta b - \gamma c)$
D) zero

33. The relative density of the material of a body is found by weighing it first in air and then in water. If the weight of the body in air is $W_1 = 8.00 \pm 0.05$ N and weight in water is $W_2 = 6.00 \pm 0.05$ N, then the relative density $\rho_r = \frac{W_1}{W_1 - W_2}$ with the maximum permissible error is:

- A) 4.00 ± 0.62
B) 4.00 ± 0.82
C) 4.00 ± 3.2
D) 4.00 ± 5.62

34. While measuring the acceleration due to gravity by a simple pendulum, a student makes a positive error of 1% in the length of the pendulum and a negative error of 3% in the value of time period. His percentage error in the measurement of g by the relation, $g = 4\pi^2(l/T^2)$ will be _____%:

- A) 7
B) 9
C) 10
D) 2

35. Dimensional formula of a physical quantity x is $[M^{-1} L^3 T^{-2}]$. The errors in measuring the quantities M, L and T, respectively, are 2%, 3% and 4%. The maximum percentage of error that occurs in measuring the quantity x is_____:

- A) 15
B) 19
C) 88
D) 24

36. The heat generated in a circuit is given by $Q = I^2 R t$, where I is current, R is resistance and t is time. If the percentage errors in measuring I, R and t are 2%, 1%, and 1%, respectively, then the maximum error in measuring heat will be_____%:

- A) 2
B) 9
C) 5
D) 6

37. The percentage error in the calculated volume of a cube, if there is 1% error in its side length measurement, is

- A) 3%
B) 5%
C) 9%
D) 1%

38. The power P dissipated in a resistor is given by $P = V^2/R$. If the percentage errors in measuring the voltage V and the resistance R are 3% and 2% respectively, the percentage error in measuring the power P will be:

- A) 5%
B) 8%
C) 7%
D) 1%

39. The refractive index of a material is given by the formula $\mu = \frac{A}{B-C}$. If the percentage errors in the measurement of A, B, and C are 2%, 1%, and 1% respectively, then the maximum percentage error in the calculated refractive index μ is:

- A) 2%
B) 3%
C) 4%
D) 6%

40. A physical quantity Y is related to four observables a, b, c, and d as follows: $Y = \frac{a^2 b^3}{c \sqrt{d}}$ where $a = (10 \pm 0.1)$ m, $b = (2 \pm 0.02)$ kg, $c = (5 \pm 0.05)$ s, and $d = (4 \pm 0.04)$ m. The percentage error in the measurement of Y is:

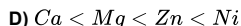
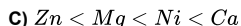
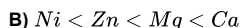
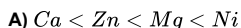
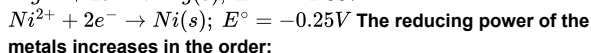
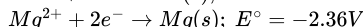
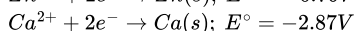
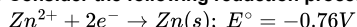
- A) 5.5%
B) 6.5%
C) 7.5%
D) 8.5%

41. The time period of a simple pendulum is measured as $T = 2.0$ s with a resolution of 0.1 s. The length of the pendulum is measured as $L = 100$ cm with an accuracy of 1 mm. The percentage error in the calculated value of the acceleration due to gravity g is:

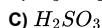
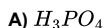
- A) 11%
B) 10.1%
C) 12%
D) 13%

- A)** $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$
- B)** $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$
- C)** $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
- D)** $2CuBr \rightarrow CuBr_2 + Cu$

66. Consider the following reduction processes:



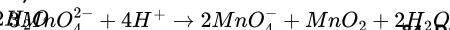
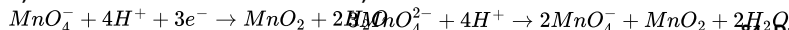
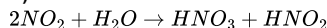
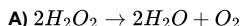
67. The compound that cannot act both as oxidising and reducing agent is:



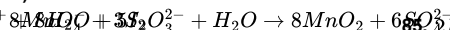
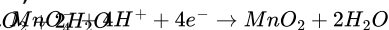
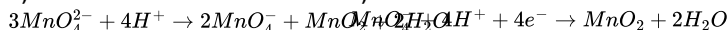
68. The species given below that does NOT show disproportionation reaction is:



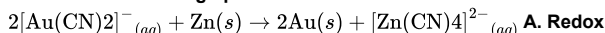
69. Which of the given reactions is not an example of disproportionation reaction?



70. Which one of the following is an example of disproportionation reaction?



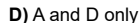
71. Which of the following options are correct for the reaction



A. Redox

reaction B. Displacement reaction C. Decomposition reaction D.

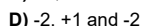
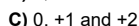
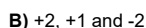
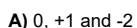
Combination reaction Choose the correct answer from the options given below:



72. The reaction, $3ClO^-(aq) \rightarrow ClO_3^-(aq) + 2Cl^-(aq)$, is an example of



73. The oxidation number of sulphur in S_8, S_2F_2, H_2S respectively, are



74. The oxidation number of phosphorus in $Ba(H_2PO_4)_2$ is :



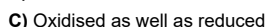
75. Consider the following molecules: $Br_3O_8, F_2O, H_2S_4O_6, H_2S_5O_6$ and C_3O_2 . Count the number of atoms existing in their zero oxidation state in each molecule. Their sum is



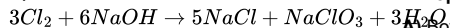
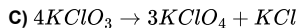
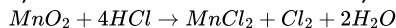
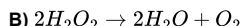
76. In the reaction: $C + 4HNO_3 \rightarrow CO_2 + 2H_2O + 4NO_2$ HNO_3 acts as:



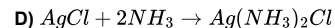
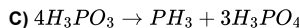
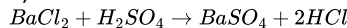
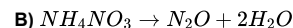
77. In the reaction, $Cl_2 + OH^- \rightarrow Cl^- + ClO_4^- + H_2O$, chlorine is:



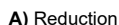
78. Which of the following example does not represent disproportionation?



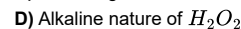
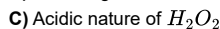
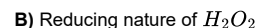
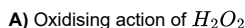
79. Select the example of disproportionation reaction:



80. $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$. Zn undergoes:



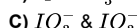
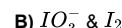
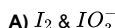
81. The reaction $H_2S + H_2O_2 \rightarrow S + 2H_2O$ manifests:



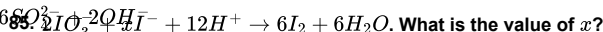
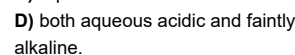
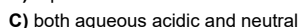
82. The number of electrons involved in the reduction of permanganate to manganese dioxide in acidic medium is _____.



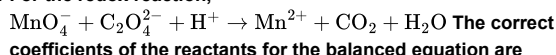
83. $KMnO_4$ oxidises I^- in acidic and neutral/faintly alkaline solution, respectively to:



84. During the reaction of permanganate with thiosulphate, the change in oxidation of manganese occurs by a value of 3. Identify which of the below mediums will favour the reaction.



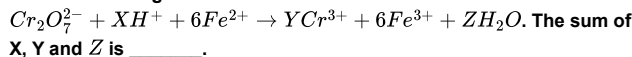
86. For the redox reaction,



	MnO_4^-	$C_2O_4^{2-}$	H^+
(a)	16	5	2
(b)	2	5	16
(c)	2	16	5
(d)	5	16	2



87. See the following chemical reaction:



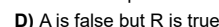
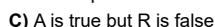
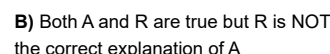
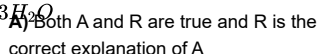
88. The total change in the oxidation state of manganese involved in the reaction of $KMnO_4$ and potassium iodide in the acidic medium is _____.



89. The dark purple colour of $KMnO_4$ disappears in the titration with oxalic acid in acidic medium. The overall change in the oxidation number of manganese in the reaction is:



90. Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R Assertion A: Permanganate titrations are not performed in the presence of hydrochloric acid. Reason R: Chlorine is formed as a consequence of oxidation of hydrochloric acid. In the light of the above statements, choose the correct answer from the options given below:



Botany

91. Mitochondrial DNA is physically located in the:

- A) Cristae
B) Matrix
C) Intermembrane space
D) Thylakoids

92. Which of the following features is shared by both mitochondria and chloroplasts, supporting the endosymbiotic theory?

- A) Presence of 80S ribosomes and linear DNA
B) Presence of 70S ribosomes and circular DNA
C) Anaerobic respiration capability
D) Single-layered outer membrane structure

93. Select the incorrect statement regarding chloroplasts based on NCERT specifications:

- A) The space limited by the inner membrane of the chloroplast is called the stroma.
B) Chloroplasts contain small, double-stranded circular DNA molecules.
C) Ribosomes of the chloroplasts are larger (80S) than the cytoplasmic ribosomes (70S).
D) Chloroplasts are double-membrane-bound organelles where the inner membrane is relatively less permeable.

94. Flat membranous sacs present in the stroma of the chloroplast, arranged like stacks of coins, are called:

- A) Thylakoids
B) Cristae
C) Cisternae
D) Stroma lamellae

95. The inner mitochondrial membrane possesses specific enzymes and carrier molecules. Which process occurs directly across/on this membrane?

- A) Glycolysis
B) Citric acid cycle
C) Oxidative phosphorylation
D) RuBP carboxylation

96. Which of the following pairs is MISMATCHED regarding leucoplasts and their storage products?

- A) Amyloplasts — Starch
B) Elaioplasts — Oils and fats
C) Aleuroplasts — Proteins
D) Amyloplasts — Proteins

97. Read the following statements regarding chloroplasts and choose the CORRECT option: 1. The inner membrane of a chloroplast is relatively less permeable than the outer membrane. 2. Stroma contains enzymes required for the synthesis of carbohydrates and proteins. 3. Ribosomes of chloroplasts are larger (80S) than the cytoplasmic ribosomes (70S).

- A) 1 and 2 are correct
B) 2 and 3 are correct
C) 1 and 3 are correct
D) All are correct

98. In a plant cell, how do the ribosomes of the cytoplasm, mitochondria, and chloroplasts compare in size?

- A) Cytoplasm (80S), Mitochondria (70S), Chloroplast (70S)
B) Cytoplasm (70S), Mitochondria (80S), Chloroplast (80S)
C) Cytoplasm (80S), Mitochondria (80S), Chloroplast (70S)
D) All three possess 70S ribosomes

99. Tomato fruits turn from green to red during ripening. This color transition is primarily due to the transformation of:

- A) Chromoplasts into chloroplasts
B) Chloroplasts into chromoplasts
C) Amyloplasts into chromoplasts
D) Leucoplasts into chloroplasts

100.

Match Column-I (Organelle Component) with Column-II (Associated Function/Feature) and select the correct option:

Column-I	Column-II
(a) Cristae	(i) Flattened membranous sacs
(b) Thylakoids	(ii) Infoldings of the inner membrane
(c) Stroma	(iii) Contains enzymes for carbohydrate synthesis
(d) Matrix	(iv) Site of Krebs cycle enzymes

- A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
B) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
C) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
D) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

101.

Which of the following is NOT a primary function of the cytoskeleton?

- A) Maintenance of cell shape
B) Intracellular transport and motility
C) Synthesis of lipids and steroidal hormones
D) Providing mechanical support to the cell

102.

The structural core of cilia and flagella, the axoneme, exhibits an arrangement of microtubules designated as:

- A) 9 + 0
B) 9 + 2
C) 7 + 2
D) 9 + 3

103.

Match the cytoskeletal/microtubular structure with its correct microtubule arrangement:

- A) Centriole → 9 + 2
B) Cilia Basal Body → 9 + 2
C) Axoneme → 9 + 0
D) Centriole → 9 + 0

104.

Microtubules are the principal structural components of which set of cellular structures?

- A) Spindle fibres, Centrioles, and Cilia
B) Centrioles, Nucleolus, and Cell wall
C) Peroxisomes, Cilia, and Flagella
D) Cytoplasmic streaming, Pseudopodia, and Microvilli

105.

The peripheral doublets of the axoneme are interconnected to each other by:

- A) Radial spokes
B) Central sheath
C) Interdoublet linkers
D) Central hub

106.

The material of the nucleus stained by basic dyes was given the name 'chromatin' by:

- A) Robert Brown
B) Anton von Leeuwenhoek
C) Walther Flemming
D) Camillo Golgi

107.

Which of the following statements is INCORRECT regarding the nucleolus?

- A) It is a membrane-bound structure found in the nucleoplasm.
B) It is the site for active rRNA synthesis.
C) Cells moving rapidly through protein synthesis have larger nucleoli.
D) Its content is continuous with the rest of the nucleoplasm.

108.

Match the chromosome type with its diagnostic shape during anaphase

Column-I (Chromosome Type)	Column-II (Anaphase Shape)
(a) Metacentric	(i) L-shape
(b) Sub-metacentric	(ii) I-shape
(c) Acrocentric	(iii) V-shape
(d) Telocentric	(iv) J-shape

movement:

- A) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
B) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)
C) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
D) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

109.

The nuclear pores function as gatekeepers primarily to allow the bidirectional movement of:

- A) Carbohydrates and fats
B) DNA polymers only
C) RNA and protein molecules
D) Mineral ions and water only

110.

A few chromosomes have non-staining secondary constrictions at a constant location. The chromosome segment separated by this constriction is called a:

- A) Kinetochore
B) Centromere
C) Satellite
D) Telomere

111.

Statement I: The nuclear envelope consists of two parallel membranes with a space between them called the perinuclear space, which forms a barrier between the materials present inside the nucleus and that of the cytoplasm. Statement II: The outer nuclear membrane usually remains continuous with the Smooth Endoplasmic Reticulum and also bears ribosomes on it.

- A) Both Statement I and Statement II are correct. B) Both Statement I and Statement II are incorrect.
C) Statement I is correct but Statement II is incorrect. D) Statement I is incorrect but Statement II is correct.

112.

Match the position of the centromere with its corresponding chromosome type: 1. Centromere at the extreme tip → Acrocentric 2. Centromere slightly away from the middle → Sub-metacentric 3. Centromere exactly in the middle → Metacentric 4. Centromere close to its end forming one very short arm → Telocentric Which of the combinations above are correctly paired?

- A) 1 and 4 only B) 2 and 3 only
C) 1, 2, and 3 only D) 2, 3, and 4 only

113.

Chromatin visible in the interphase nucleus contains which of the following components?

- A) DNA and basic proteins (histones) only B) DNA, RNA, and histones only
C) DNA, RNA, histones, and non-histone proteins D) RNA and non-histone proteins only

114.

Peroxisomes are rich in which type of enzymes?

- A) Hydrolytic enzymes active at acidic pH B) Oxidative enzymes like catalase and urate oxidase
C) Ribozymes responsible for protein translation D) Polymerases required for transcription

115.

Assertion: Cilia and flagella emerge from centriole-like structures called basal bodies. Reason: Basal bodies share the same 9+2 microtubule triplet organization as the axoneme.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
C) Assertion is true, but Reason is false. D) Assertion is false, but Reason is true.

116.

Assertion: The content of the nucleolus is continuous with the rest of the nucleoplasm. Reason: The nucleolus is a non-membrane-bound structure.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
C) Assertion is true, but Reason is false. D) Assertion is false, but Reason is true.

117.

Assertion: A metacentric chromosome has one extremely short arm and one very long arm. Reason: The centromere is positioned close to one end of an acrocentric chromosome.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
C) Assertion is true, but Reason is false. D) Assertion is false, but Reason is true.

118.

If you take a cross-section of the axoneme of a eukaryotic cilium, what is the exact number and arrangement of individual microtubules you will observe?

- A) 9 triplets at the periphery and 0 at the center B) 9 doublets at the periphery and 2 singlets at the center
C) 18 peripheral microtubules and 2 central microtubules D) 9 peripheral microtubules and 2 central microtubules

119.

Which of the following structures connects the peripheral doublets to the central sheath in the eukaryotic axoneme?

- A) Interdoublet bridge B) Radial spoke
C) Central bridge D) AB Linker (Nexin)

120.

Which of the following statements correctly distinguishes eukaryotic cilia from flagella?

- A) Cilia are longer structures, while flagella are much shorter. B) Cilia are responsible only for cell movement, while flagella move the surrounding fluid.
C) Cilia are numerous and work like oars, while flagella are fewer and show a whip-like motion. D) Cilia possess a 9+0 arrangement, whereas flagella possess a 9+2 arrangement.

121.

Which of the following features is shared by both cilia and flagella?

- A) They are non-membrane-bound extensions of the cytoplasm. B) They are covered by the plasma membrane and emerge from basal bodies.
C) They contain a core made up of actin and myosin filaments. D) They originate directly from the nuclear envelope.

122.

If you analyze a single peripheral triplet of a centriole, how many individual protofilaments or tubulin units run parallelly, and how are the triplets linked to each other?

- A) They consist of two fused microtubules linked by lipid bridges. B) They consist of three fused microtubules (A, B, and C tubules) linked by C-A protein linkers.
C) They consist of three separate microtubules that do not touch each other. D) They exhibit a 9+2 arrangement wrapped by a plasma membrane.

123.

Which of the following sets of features correctly describes a centrosome?

- A) Double membrane-bound, contains two centrioles placed parallel to each other. B) Single membrane-bound, contains two centrioles placed perpendicular to each other.
C) Membrane-less, contains two centrioles surrounded by amorphous pericentriolar materials. D) Membrane-less, contains a single centriole covered by a plasma membrane.

124.

Statement I: Eukaryotic cilia and flagella are extensions of the cell covered by a plasma membrane, whereas the centrosome is a membrane-less organelle. Statement II: The core of a cilium contains a total of 18 peripheral microtubules arranged as doublets.

- A) Both Statement I and Statement II are correct. B) Both Statement I and Statement II are incorrect.
C) Statement I is correct but Statement II is incorrect. D) Statement I is incorrect but Statement II is correct.

125.

Which of the following statements correctly describes the relationship between a centromere and kinetochores?

- A) Kinetochores are lipid layers that completely cover the chromosome. B) Kinetochores are disc-shaped protein structures present on the sides of the centromere.
C) Kinetochores are secondary constrictions located at the terminal ends of non-staining chromosomes. D) Centromeres are formed only when kinetochores degrade during metaphase.

126.

In a normal human karyotype, which specific pairs of chromosomes possess non-staining secondary constrictions and structural satellites?

- A) Pairs 1, 2, 3, 4, and 5 B) Pairs 13, 14, 15, 21, and 22
C) Pairs 19, 20, and the X chromosome D) Only the Y chromosome in males

127. During the interphase stage, chromatin is loose and diffuse. However, certain regions stain darkly and are transcriptionally inactive, while others stain lightly. Identify the correct terminology:
- A) Dark staining = Euchromatin (Active); Light staining = Heterochromatin (Inactive)
 B) Dark staining = Heterochromatin (Inactive); Light staining = Euchromatin (Active)
 C) Dark staining = Satellite DNA; Light staining = Kinetochore
 D) Both regions are equally active and stain the same way during division

128. In chromosome morphology, a satellite refers to the:
- A) Terminal part of the chromosome beyond secondary constriction.
 B) Terminal part of the chromosome beyond primary constriction.
 C) Terminal part of chromosome beyond tertiary constriction.
 D) None of the above

129. The secondary constriction (NOR) of a satellite chromosome is directly involved in the synthesis of:
- A) mRNA
 B) tRNA
 C) rRNA
 D) Proteins

130. Assertion (A): A single human cell contains approximately two metres of DNA distributed among its 46 chromosomes. Reason (R): Every human chromosome is morphologically identical and has its centromere located exactly in the middle.
- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

131. Assertion (A): Perinuclear space forms a physical barrier between the materials present inside the nucleus and that of the cytoplasm. Reason (R): The perinuclear space usually measures about 10 to 50 nanometres in width.
- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

132. What is the typical diameter range of a mitochondrion as described in standard textbooks?
- A) $0.1 - 0.4\mu m$
 B) $0.2 - 1.0\mu m$
 C) $1.0 - 4.1\mu m$
 D) $10 - 20\mu m$

133. Assertion (A): Mitochondria are easily visible under a light microscope without any specialized preparation. Reason (R): Mitochondria have a massive average diameter of over $5\mu m$.
- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

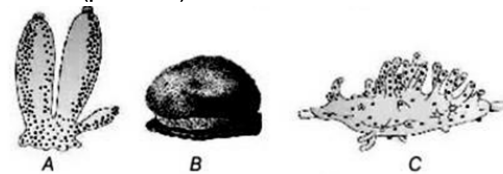
134. Match the cellular structures with their typical size specifications:
- Mitochondrion (Length) → P) $1.0 - 4.1\mu m$
 - Mitochondrion (Diameter) → Q) $0.2 - 1.0\mu m$
 - Chloroplast (Width) → R) $2.0 - 4.0\mu m$
 - Chloroplast (Length) → S) $5.0 - 10.0\mu m$

- Which option represents the correct matching setup?
- A) 1-P, 2-Q, 3-R, 4-S
 B) 1-Q, 2-P, 3-S, 4-R
 C) 1-P, 2-R, 3-Q, 4-S
 D) 1-S, 2-Q, 3-R, 4-P

135. What are the typical dimensions of a chloroplast?
- A) Length: $1.0 - 4.1\mu m$, Width: $0.2 - 1.0\mu m$
 B) Length: $5.0 - 10.0\mu m$, Width: $2.0 - 4.0\mu m$
 C) Length: $10.0 - 20.0\mu m$, Width: $5.0 - 10.0\mu m$
 D) Length: $2.0 - 4.0\mu m$, Width: $1.0 - 2.0\mu m$

Zoology.

136. Examine the figures A, B and C. In which one of the four options all the animals (poriferans) are correct?



- A) A–Sycon, B–Euspongia, C–Spongilla
 B) A–Euspongia, B–Spongilla, C–Sycon
 C) A–Spongilla, B–Sycon, C–Euspongia
 D) A–Euspongia, B–Sycon, C–Spongilla

137. In most simple type of canal system of Porifera, water flows through which one of the following ways?
- A) Ostia → Spongocoel → Osculum → Exterior
 B) Spongocoel → Ostia → Osculum → Exterior
 C) Osculum → Spongocoel → Ostia → Exterior
 D) Osculum → Ostia → Spongocoel → Exterior

138. Asexual reproduction in sponges takes place by
- A) binary fission
 B) multiple fission
 C) fragmentation
 D) encystment

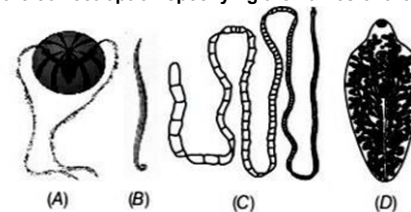
139. Body forms present in cnidarians are
- A) cylindrical and umbrella-shaped
 B) corals and coral reefs
 C) polyp and medusa
 D) cnidoblasts and nematocysts

140. Alternation of generations is also called
- A) metamorphosis
 B) metastasis
 C) metazoan
 D) metagenesis

141. The phylum–Annelida is named so because of
- A) more organs are placed towards anterior part of the body
 B) the presence of antenna
 C) anteriorly placed neural system
 D) the presence of metameres

142. Which of the following groups is formed of only the hermaphrodite organisms?
- A) Earthworm, tapeworm, housefly, frog
 B) Earthworm, tapeworm, sea horse, housefly
 C) Earthworm, leech, sponge, roundworm
 D) Earthworm, tapeworm, leech, sponge

143. Identify the correct option specifying the names of the animals A, B, C and D.



- A) A – Pleurobrachia, B – Tapeworm, C – Taenia, D – Aurelia
 B) A – Fasciola, B – Tapeworm, C – Liver fluke, D – Aurelia
 C) A – Pleurobrachia, B – Roundworm, C – Taenia, D – Liver fluke
 D) A – Fasciola, B – Roundworm, C – Liver fluke, D – Adamsia

144.
Which of the following contain all members of the phylum–Annelida?
A) Hirudinaria, Nereis and Wuchereria B) Earthworms, Aphrodite and Pila
C) Pheretima, Tubifex and Nereis D) Aplysia, Nereis and Dentalium

145.
Choose the respiratory organs that are present in phylum–Arthropoda.
A) Tracheal system or Book lungs B) Book gills
C) Gills D) All of the above

146.
Which of the following groups includes only arthropods?
A) Prawn, Neopilina and Pila B) Cockroach, scorpion and prawn
C) Chiton, Neopilina and scorpion D) Chiton, prawn and cockroach

147.
Which one of the following animals is called a living fossil?
A) King locust B) Limulus
C) Bombyx D) Balanoglossus

148.
The second largest number of species containing phylum after phylum–Arthropoda in the animal kingdom is
A) Annelida B) Cnidaria
C) Mollusca D) Chordata

149.
What is true about Mollusca?
A) The presence of metameric segmentation B) The presence of mantle cavity and coelom cavity
C) The presence of tissue level of organisation D) The presence of chitinous exoskeleton

150.
The animal's body belonging to phylum–Mollusca is divided into
A) head, thorax and abdomen B) head, muscular foot and abdomen
C) head, thorax and visceral hump D) head, muscular foot and visceral hump

151.
Choose the incorrect option for phylum–Mollusca.
A) Body is covered by a calcareous shell and unsegmented B) Feather-like gills present for excretion and respiration
C) The anterior head region has sensory tentacles D) Mostly terrestrial, triploblastic and acoelomates

152.
Which of the following is incorrect match?
A) Dentalium – Tusk shell B) Sepia – Cuttle fish
C) Chiton – Pila D) Loligo – Squid

153.
Which of the following phyla has no freshwater forms?
A) Echinodermata B) Mollusca
C) Chordata D) Porifera

154.
Excretory organs in echinoderms is
A) nephridia B) green glands
C) flame cells D) None of these

155.
Which of the following is/are function(s) of water vascular system in echinoderms?
A) Locomotion B) Respiration
C) Capture and transport of food D) All of the above

156.
Choose the animals that belongs to phylum–Echinodermata from the options.
A) Sea urchin, cuttlefish and sea lily B) Echinus, sea hare and sea cucumber
C) Antedon, Ophiura and Echinus D) Ophiura, Chaetopleura and Echinus

157.
Find the odd one.
A) Sea lily (Antedon) B) Sea hare (Aplysia)
C) Sea cucumber (Cucumaria) D) Sea urchin (Echinus)

158.
In which one of the following, the genus name, its two characters and its phylum are not correctly matched, whereas the remaining three are correct?
A) Pila — (i) Body segmented (ii) Mouth with radula — Mollusca B) Asterias — (i) Spiny skinned (ii) Water vascular system — Echinodermata
C) Sycon — (i) Pore bearing (ii) Canal system — Porifera D) Periplaneta — (i) Jointed appendages (ii) Chitinous exoskeleton — Arthropoda

159.
Excretory organ in phylum–Hemichordata is
A) proboscis gland B) gills
C) collar cells D) None of these

160.



- The correct classification of given animal is**
A) Chordata – Vertebrata – Craniata B) Chordata – Craniata
C) Chordata – Acraniata D) Non-chordata – Hemichordata

161.
Select the feature(s) which is/are present in hemichordates.
A) Stomochord B) Worm-like body
C) Gills D) All of these

162.
Which of the following statements is true?
A) Phylum–Porifera – Presence of choanocytes and nematocysts B) Phylum–Coelenterata – Meandrina belongs to this phylum
C) Phylum–Ctenophora – All exhibit bilateral symmetry only D) Phylum–Platyhelminthes – Wuchereria belongs to this phylum

163.
Which statement is incorrect about Pleurobrachia?
A) They are diploblastic B) They have tissue level organisation
C) They have comb plates D) They show asexual and sexual reproduction

164.
Which one of the following statements about certain given animals is correct?
A) Roundworms are pseudocoelomates B) Molluscs are acoelomates
C) Insects are pseudocoelomates D) Flatworms are coelomates

165.
Mark the false statement for the phylum–Annelida.
A) They are bilaterally symmetrical coelomate animals B) They have both monoecious and dioecious animal representatives
C) Excretory system consists of flame cells D) They do not show asexual reproduction generally

166.
Which of the following statements is false?
A) Male roundworm is smaller than female B) Earthworms are hermaphrodites
C) Echinoderms are protostomous coelomates D) Human teeth are anatomically comparable to scales of shark

167.
Which of the following statements represents the incorrect feature of Echinodermata?

- A) They are triploblastic and coelomate animals
B) All are marine with cellular level of organisation
C) Endoskeleton of calcareous ossicle
D) None of the above

168.
Which of the following is/are correct statement(s) for Hemichordata?

- A) They are bilaterally symmetrical, triploblastic and coelomate
B) Circulation is of open type
C) Sexes are separate, fertilisation is external and development is indirect
D) All of the above

169.
Consider the following features. A. Organ system level of organisation
B. Bilateral symmetry C. True coelomates with segmentation of body
Select the correct option of animal groups which possess all the above characteristics.

- A) Annelida, Arthropoda and Mollusca
B) Arthropoda, Mollusca and Chordata
C) Annelida, Mollusca and Chordata
D) Annelida, Arthropoda and Chordata

170.
Which of the following statements are true/false? I. In higher phyla, cellular level of organisation is seen. II. Phylum–Platyhelminthes have cellular level of organisation. III. Cellular level of organisation is seen when the cells are not arranged as loose cell aggregates. IV. Molluscs exhibit tissue level of organisation. Choose the correct option from the following.

- A) I and II are true, but III and IV are false
B) All statements are false
C) All statements are true
D) III and IV are true, but I and II are false

171.
Some of the statements are given below. I. Porifera to Echinodermata lack a notochord. II. Platyhelminthes display tissue level organisation. III. Mesoglea is present in coelenterates during development. IV. Aschelminthes are coelomates (pseudocoelomates). Choose the option containing the correct statements.

- A) I, II, III and IV
B) I and II
C) I, III and IV
D) II and III

172.
Which of the following is not a characteristic of phylum–Porifera? I. Development is indirect (larval stage is present). II. Mostly asymmetrical and usually marine. III. Primitive multicellular animals with cellular level of organisation. IV. Choanocytes lines the spongocoel and the canals. V. Sexes are separate.

- A) I and IV
B) Only II
C) Only V
D) III and IV

173.
Which of the option is correct for the statements given below? I. Commonly called sea walnuts or comb jellies. II. Bioluminescence is well-marked. III. Body bear eight external rows of ciliated comb plates. IV. Have flame cells for osmoregulation and excretion. V. Alimentary canal is complete with a well-developed muscular pharynx.

- A) Ctenophores: I, II, III; Platyhelminthes: IV; Aschelminthes: V
B) Ctenophores: IV; Platyhelminthes: I, II; Aschelminthes: III, V
C) Ctenophores: I, II; Platyhelminthes: III, IV; Aschelminthes: V
D) Ctenophores: IV, V; Platyhelminthes: II, III; Aschelminthes: I

174.
Consider the following statements. I. Triploblastic, bilateral symmetry. II. Metamerically segmented and coelomate animals. III. Dioecious. IV. Closed circulatory system. V. Lateral appendages. VI. Annelida Which



of the following information belongs to the given figure?

- A) I, II, IV and VI
B) I, III, IV and V
C) I, III, IV and V
D) III, IV, V and VI

175.
Choose the correct option for Wuchereria? I. Triploblastic with the presence of an excretory pore. II. The presence of a muscular pharynx. III. Males longer than females. IV. Cellular level of organisation.

- A) II and III
B) I and IV
C) I and II
D) III and IV

176.
Match the following columns.

Column I (Level of organisation)	Column II (Animal phyla)
A. Cellular level of organisation	1. Cnidarians
B. Organ level of organisation	2. Platyhelminthes
C. Organ system level of organisation	3. Chordates
D. Tissue level of organisation	4. Porifera

- A) A–4, B–2, C–3, D–1
B) A–2, B–1, C–4, D–3
C) A–3, B–2, C–4, D–1
D) A–4, B–2, C–1, D–3

177.
Match the following organisms with their respective characteristics.

Column I	Column II
A. <i>Pila</i>	1. Flame cells
B. <i>Bombyx</i>	2. Comb plates
C. <i>Pleurobrachia</i>	3. Radula
D. <i>Taenia</i>	4. Malpighian tubules

- A) A–3, B–4, C–2, D–1
B) A–2, B–4, C–3, D–1
C) A–3, B–2, C–4, D–1
D) A–3, B–2, C–1, D–4

178.
Match the following genera with their respective phylum.

Column I	Column II
A. <i>Ophiura</i>	1. Mollusca
B. <i>Physalia</i>	2. Platyhelminthes
C. <i>Pinctada</i>	3. Echinodermata
D. <i>Planaria</i>	4. Coelenterata

- A) A–4, B–1, C–3, D–2
B) A–3, B–4, C–1, D–2
C) A–1, B–3, C–4, D–2
D) A–3, B–4, C–2, D–1

179.
Match the following columns.

Column I (Specialised cell or part)	Column II (Animal phylum)
A. Choanocytes	1. Platyhelminthes
B. Cnidoblasts	2. Ctenophora
C. Flame cells	3. Porifera
D. Nephridia	4. Coelenterata
E. Comb plates	5. Annelida

- A) A–2, B–1, C–4, D–5, E–3
B) A–2, B–4, C–1, D–5, E–3
C) A–5, B–1, C–3, D–2, E–4
D) A–3, B–4, C–1, D–5, E–2

180.

Match the following columns.

Column I (Cnidarian)	Column II (Common names)
A. Pennatula	1. Brain coral
B. Meandrina	2. Sea fan
C. Gorgonia	3. Sea pen
D. Adamsia	4. Sea anemone

A) A-3, B-1, C-2, D-4

B) A-1, B-3, C-2, D-4

C) A-2, B-4, C-1, D-3

D) A-2, B-3, C-4, D-1

ANSWER KEY

Physics

1.	3	13.	1	25.	4	37.	1
2.	2	14.	4	26.	1	38.	2
3.	4	15.	4	27.	3	39.	3
4.	3	16.	1	28.	3	40.	2
5.	3	17.	2	29.	1	41.	2
6.	1	18.	2	30.	2	42.	2
7.	2	19.	3	31.	3	43.	2
8.	1	20.	3	32.	2	44.	3
9.	4	21.	1	33.	4	45.	2
10.	1	22.	2	34.	1		
11.	2	23.	4	35.	2		
12.	4	24.	1	36.	4		

Chemistry

46.	4	58.	3	70.	1	82.	3
47.	2	59.	1	71.	1	83.	1
48.	2	60.	3	72.	3	84.	2
49.	4	61.	4	73.	1	85.	2
50.	3	62.	1	74.	3	86.	4
51.	3	63.	3	75.	4	87.	3
52.	3	64.	2	76.	1	88.	3
53.	2	65.	4	77.	3	89.	1
54.	2	66.	2	78.	1	90.	1
55.	1	67.	1	79.	3		
56.	4	68.	1	80.	2		
57.	4	69.	3	81.	1		

Botany

91.	2	103.	4	115.	3	127.	2
92.	2	104.	1	116.	1	128.	1
93.	3	105.	3	117.	4	129.	3
94.	1	106.	3	118.	3	130.	3
95.	3	107.	1	119.	2	131.	2
96.	4	108.	1	120.	3	132.	2
97.	1	109.	3	121.	2	133.	4
98.	1	110.	3	122.	2	134.	1
99.	2	111.	3	123.	3	135.	2
100.	2	112.	2	124.	1		
101.	3	113.	3	125.	2		
102.	2	114.	2	126.	2		

Zoology

136.	1	148.	3	160.	4	172.	3
137.	1	149.	2	161.	4	173.	1
138.	3	150.	4	162.	2	174.	1
139.	3	151.	4	163.	4	175.	3
140.	4	152.	3	164.	1	176.	1
141.	4	153.	1	165.	3	177.	1
142.	4	154.	4	166.	3	178.	2
143.	3	155.	4	167.	4	179.	4
144.	3	156.	3	168.	4	180.	1
145.	4	157.	2	169.	4		
146.	2	158.	1	170.	2		
147.	2	159.	1	171.	3		

SOLUTIONS

Q1.

Answer: C

Explanation:

The volume V of a sphere is given by the formula $V = \frac{4}{3}\pi r^3$, where r is the radius of the sphere. Since the error is given in terms of diameter (D), we express the radius as $r = \frac{D}{2}$. Substituting this into the volume formula: $V = \frac{4}{3}\pi\left(\frac{D}{2}\right)^3 \Rightarrow V = \frac{4}{3}\pi\left(\frac{D^3}{8}\right) \Rightarrow V = \frac{1}{6}\pi D^3$ To find the relative error, we take the natural logarithm ($\ln$) on both sides of the equation: $\ln(V) = \ln\left(\frac{\pi}{6}\right) + \ln(D^3) \Rightarrow \ln(V) = \ln\left(\frac{\pi}{6}\right) + 3\ln(D)$ Now, on differentiating both sides. $\frac{dV}{V} = 0 + 3\left(\frac{dD}{D}\right) \Rightarrow \frac{dV}{V} = 3\frac{dD}{D}$ To express this as a percentage error, we multiply both sides by 100: $\left(\frac{dV}{V} \times 100\right) = 3 \times \left(\frac{dD}{D} \times 100\right)$ It is given that the percentage error in the diameter is 2%. $\frac{dD}{D} \times 100 = 2\%$ So, percentage error in Volume = $3 \times 2\%$ Percentage error in Volume = 6% Therefore, the correct option is (C).

Q2.

Answer: B

Explanation:

The density (ρ) of a body is defined as the ratio of its mass (m) to its volume (V). $\rho = \frac{m}{V}$ For a uniform cylinder of length l and diameter D , the volume is, $V = \pi r^2 l = \pi\left(\frac{D}{2}\right)^2 l = \frac{\pi D^2 l}{4}$ Substituting the volume into the density formula: $\rho = \frac{m}{V} = \frac{4m}{\pi D^2 l}$ To find the fractional error, we take the natural logarithm ($\ln$) on both sides: $\ln(\rho) = \ln(4) + \ln(m) - \ln(\pi) - 2\ln(D) - \ln(l)$ Differentiating both sides to find the relative change $\frac{d\rho}{\rho} = \frac{dm}{m} - \frac{2dD}{D} - \frac{dl}{l}$ The maximum possible fractional error is the sum of the absolute values of the individual relative errors: $\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + \frac{2\Delta D}{D} + \frac{\Delta l}{l}$ For the percentage fractional error, % Error in $\rho = \left(\frac{\Delta m}{m} + \frac{2\Delta D}{D} + \frac{\Delta l}{l}\right) \times 100$ The measured value of mass is 97.42 ± 0.02 g $\Rightarrow m = 97.42$ g and the absolute error is $\Delta m = 0.02$ g So, relative error in mass is, $\frac{\Delta m}{m} = \frac{0.02}{97.42} \approx 0.000205$ The measured value of length is 8.35 ± 0.05 mm $\Rightarrow l = 8.35$ mm and the absolute error is $\Delta l = 0.05$ mm So, relative error in length is, $\frac{\Delta l}{l} = \frac{0.05}{8.35} \approx 0.005988$ The measured value of diameter is 20.20 ± 0.02 mm $\Rightarrow D = 20.20$ mm and the absolute error is $\Delta D = 0.02$ mm So, relative error in diameter is, $\frac{2\Delta D}{D} = \frac{2 \times 0.02}{20.20} = \frac{0.04}{20.20} \approx 0.001980$ Putting the values in the expression for the percentage error in density, $\frac{\Delta\rho}{\rho} \times 100\% = (0.000205 + 0.005988 + 0.001980) \times 100\% = 0.008173 \times 100\% \Rightarrow \frac{\Delta\rho}{\rho} \times 100\% = 0.8173\% \approx 0.82\%$ Therefore, the calculated percentage fraction error in density is approximately 0.82%. Hence, the correct option is (B).

Q3.

Answer: D

Explanation:

Using Ohm's law, the resistance is $R = \frac{V}{I} = \frac{10}{5} = 2 \Omega$ Now, for error estimation in a quotient, NCERT method gives: $\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$ Given least count of voltmeter: $\Delta V = 500$ mV = 0.5 V Given least count of ammeter: $\Delta I = 200$ mA = 0.2 A So, $\frac{\Delta R}{R} = \frac{0.5}{10} + \frac{0.2}{5}$ $\frac{\Delta R}{R} = 0.05 + 0.04 = 0.09$ Hence absolute error in resistance: $\Delta R = R \times 0.09 = 2 \times 0.09 = 0.18 \Omega$ Therefore, the estimated error in resistance measurement is 0.18 Ω

Q4.

Answer: C

Explanation:

The quantity Q is expressed as $Q = X^{-2}Y^{\frac{3}{2}}Z^{-\frac{2}{5}}$. The variables X , Y , and Z are independent parameters with fractional errors of 0.1, 0.2, and 0.5, respectively. To determine the maximum fractional error in Q , we can use the following method: Fractional error in $Q = |-2|\frac{\Delta X}{X}| + |\frac{3}{2}|\frac{\Delta Y}{Y}| + |-\frac{2}{5}|\frac{\Delta Z}{Z}|$ Substituting the fractional errors into the equation: $= 2 \times 0.1 + \frac{3}{2} \times 0.2 + \frac{2}{5} \times 0.5$ Calculating each term gives: $= 0.2 + 0.3 + 0.2$ Summing these values results in: $= 0.7$

Q5.

Answer: C

Explanation:

To determine the maximum percentage error in the density of the wire, follow these Steps:

The density of the wire is given by the formula for a cylinder:

$$\rho = \frac{m}{\pi r^2 l}$$

When calculating the maximum percentage (relative) error, you add the relative errors from each variable, taking into account the power to which each variable is raised. Thus, for density:

$$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + 2\frac{\Delta r}{r} + \frac{\Delta l}{l}$$

Here:

$\frac{\Delta m}{m}$ is the relative error in the mass.

$2\frac{\Delta r}{r}$ is due to the radius being squared.

$\frac{\Delta l}{l}$ is the relative error in the length.

Now plug in the given values:

Mass: $m = 0.60$ g with an error $\Delta m = 0.003$ g

$$\frac{\Delta m}{m} = \frac{0.003}{0.60} = 0.005 \text{ or } 0.5\%$$

Radius: $r = 0.50$ cm with an error $\Delta r = 0.01$ cm

$$\frac{\Delta r}{r} = \frac{0.01}{0.50} = 0.02 \text{ or } 2\%. \text{ Since the radius is squared in the formula, multiply by 2:}$$

$$2\frac{\Delta r}{r} = 2 \times 0.02 = 0.04 \text{ or } 4\%.$$

Length: $l = 10.00$ cm with an error $\Delta l = 0.05$ cm

$$\frac{\Delta l}{l} = \frac{0.05}{10.00} = 0.005 \text{ or } 0.5\%.$$

Sum these contributions to find the overall maximum relative error:

$$\frac{\Delta\rho}{\rho} = 0.005 + 0.04 + 0.005 = 0.05$$

Converting this relative error into a percentage gives:

$$0.05 \times 100\% = 5\%$$

Thus, the maximum percentage error in the density of the wire is 5%, which corresponds to Option C.

Q6.

Answer: A

Explanation:

To determine the percentage error in the measurement of C , which is related to p , q , r , and s as: $C = \frac{pq^2}{r^3\sqrt{s}}$ we first express it in terms of powers: $C = p^1 q^2 r^{-3} s^{-1/2}$ The percentage error in C can be calculated using the formula for the propagation of error, which is: $\left(\frac{\Delta C}{C}\right)_{\max} = \left|\frac{\Delta p}{p}\right| + 2\left|\frac{\Delta q}{q}\right| + 3\left|\frac{\Delta r}{r}\right| + \frac{1}{2}\left|\frac{\Delta s}{s}\right|$ Given the percentage errors for p , q , r , and s are 1%, 2%, 3%, and 2% respectively, we substitute these values into the formula: $\left(\frac{\Delta C}{C}\right)_{\max} = 1\% + 2 \times 2\% + 3 \times 3\% + \frac{1}{2} \times 2\%$ Calculating each part: Contribution from p : 1% Contribution from q : 4% (since $2 \times 2\% = 4\%$) Contribution from r : 9% (since $3 \times 3\% = 9\%$) Contribution from s : 1% (since $\frac{1}{2} \times 2\% = 1\%$) Adding these contributions together: $1\% + 4\% + 9\% + 1\% = 15\%$ Thus, the maximum percentage error in the measurement of C is 15%.

Q7.

Answer: B

Explanation:

$$\text{Given, } Q = \frac{ab^4}{cd} \quad a = (60 \pm 3) \text{ Pa} \Rightarrow a = 60 \text{ Pa}, \Delta a = 3 \text{ Pa}$$

$$b = (20 \pm 0.1) \text{ m} \Rightarrow b = 20 \text{ m}, \Delta b = 0.1 \text{ m}$$

$$c = (40 \pm 0.2) \text{ Nsm}^{-2} \Rightarrow c = 40 \text{ Nsm}^{-2}, \Delta c = 0.2 \text{ Nsm}^{-2}$$

$$d = (50 \pm 0.1) \text{ m} \Rightarrow d = 50 \text{ m}, \Delta d = 0.1 \text{ m As, } Q = \frac{ab^4}{cd} \text{ by taking } \ln \text{ on both sides, } \ln Q = \ln a + 4 \ln b - \ln c - \ln d \text{ Now, by differentiating,}$$

$$\frac{dQ}{Q} = \frac{da}{a} + 4\frac{db}{b} - \frac{dc}{c} - \frac{dd}{d} \text{ So, maximum fractional error in } Q \text{ is given by,}$$

$$\frac{\Delta Q}{Q} = \frac{\Delta a}{a} + 4\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{\Delta d}{d} \Rightarrow \frac{\Delta Q}{Q} = \frac{3}{60} + 4\left(\frac{0.1}{20}\right) + \frac{0.2}{40} + \frac{0.1}{40}$$

$$= \frac{1}{20} + \frac{1}{50} + \frac{1}{200} + \frac{1}{500} \Rightarrow \frac{\Delta Q}{Q} = \frac{50+20+5+2}{1000} = \frac{77}{1000} \text{ Hence the \% error in}$$

$$Q = \frac{\Delta Q}{Q} \times 100\% = \frac{7700}{1000}\% = \frac{x}{1000} \text{ (given) So, } x = 7700$$

Q8.

Answer: A

Explanation:

To determine the spring constant k of a spring experimentally, we can use the formula derived from Hooke's Law and the period of oscillation for a mass-spring system:
 $T = 2\pi\sqrt{\frac{m}{k}}$ Here, T is the period of oscillation, m is the mass, and k is the spring constant. Rearranging the formula to solve for k , we get: $k = \frac{4\pi^2 m}{T^2}$ To find the error in k , we have to consider the errors in both the measurements of T and m . Let's denote the percentage errors as follows: $\Delta T/T \cdot 100\% = 2\%$ (positive error) $\Delta m/m \cdot 100\% = -1\%$ (negative error) According to the rules of error propagation, the relative error in k can be found by adding the relative errors in the measurements, each multiplied by the respective powers to which they affect k . Since T is squared in the denominator and m is linear in the numerator, the calculation is as follows:
 $\frac{\Delta k}{k} = \left| -2 \cdot \frac{\Delta T}{T} \right| + \left| 1 \cdot \frac{\Delta m}{m} \right|$ Substituting the percentage errors:
 $\frac{\Delta k}{k} = \left| -2 \cdot 0.02 \right| + \left| 1 \cdot (-0.01) \right| = 0.04 + 0.01 = 0.05$ Thus, the percentage error in determining the value of k is: $\frac{\Delta k}{k} \cdot 100\% = 5\%$ The correct answer is Option A: 5%

Q9.

Answer: D

Explanation:

To calculate the percentage error in the resistivity of the material of the wire, we need to understand the formula for resistivity. The resistivity ρ of a wire is given by: $\rho = \frac{RA}{l}$ where: R is the resistance A is the cross-sectional area of the wire l is the length of the wire The cross-sectional area A of the wire with radius r is: $A = \pi r^2$ We can plug this into the equation for resistivity to get: $\rho = \frac{R\pi r^2}{l}$ Now, to find the percentage error in resistivity, we need to find the percentage errors in R , r , and l and then use the following rule for combining errors: For a given function, $f = f(x, y, z, \dots)$, where $x, y, z, \dots$ are the measured quantities with possible errors, the percentage error in f , denoted as $(\delta f)\%$, can be approximated by adding the relative percentage errors of the input quantities. If f has the form of a product and quotient of the measured quantities as in our case ($\rho = \frac{R\pi r^2}{l}$), the percentage error in f is given by:
 $(\delta f)\% = (\delta x)\% + (\delta y)\% + (\delta z)\% + \dots$ Where $(\delta x)\%$, $(\delta y)\%$, and $(\delta z)\%$ are the percentage errors in each measured quantity $x, y, z, \dots$ respectively. For our case: The percentage error in radius $(\delta r)\%$ is given by the error in r divided by the average radius and then multiplied by 100: $(\delta r)\% = \left(\frac{0.05}{0.35} \right) \times 100$ The percentage error in resistance $(\delta R)\%$ is: $(\delta R)\% = \left(\frac{10}{100} \right) \times 100$ The percentage error in length $(\delta l)\%$ is: $(\delta l)\% = \left(\frac{0.2}{15} \right) \times 100$ Now let's calculate each: $(\delta r)\% = \left(\frac{0.05}{0.35} \right) \times 100 \approx 14.29\%$ $(\delta R)\% = \left(\frac{10}{100} \right) \times 100 = 10\%$ $(\delta l)\% = \left(\frac{0.2}{15} \right) \times 100 \approx 1.33\%$ However, since the area A is proportional to r^2 , the percentage error in A will be twice the percentage error in r . Thus: $(\delta A)\% = 2 \times (\delta r)\% = 2 \times 14.29\% \approx 28.58\%$ Finally, we add the percentage errors to find the percentage error in resistivity:
 $(\delta \rho)\% = (\delta R)\% + (\delta A)\% + (\delta l)\% = 10\% + 28.58\% + 1.33\% \approx 39.91\%$ This calculation gives us a value close to 39.91%, which means the correct option is closest to this value. Thus, the best answer is: Option D 39.9%

Q10.

Answer: A

Explanation:

$T = 2\pi\sqrt{\frac{\ell}{g}}$ $g = \frac{4\pi^2\ell}{T^2} \cdot \frac{\Delta g}{g} = \frac{\Delta \ell}{\ell} + \frac{2\Delta T}{T} = \frac{0.2}{20} + 2 \left(\frac{1}{40} \right) = \frac{1.2}{20}$ Percentage change $= \frac{1.2}{20} \times 100 = 6\%$

Q11.

Answer: B

Explanation:

$Q = \frac{a^4 b^3}{c^2} \cdot \frac{\Delta Q}{Q} = 4 \frac{\Delta a}{a} + 3 \frac{\Delta b}{b} + 2 \frac{\Delta c}{c}$
 $\frac{\Delta Q}{Q} \times 100 = 4 \left(\frac{\Delta a}{a} \times 100 \right) + 3 \left(\frac{\Delta b}{b} \times 100 \right) + 2 \left(\frac{\Delta c}{c} \times 100 \right)$
 $= 12\% + 12\% + 10\% = 34\%$

Q12.

Answer: D

Explanation:

$R = \frac{V}{I}$ According to error analysis $\frac{dR}{R} = \frac{dV}{V} + \frac{dI}{I}$ $\frac{dR}{R} = \frac{5}{200} + \frac{0.2}{20} = \frac{7}{200}$
% error $\frac{dR}{R} \times 100 = \frac{7}{200} \times 100 = 3.5\%$

Q13.

Answer: A

Explanation:

To find the kinetic energy of the body, we can use the formula: $KE = \frac{1}{2}mv^2$ Given the mass $m = (5 \pm 0.5)$ kg and the velocity $v = (20 \pm 0.4)$ m/s, we can find the kinetic energy and its uncertainty by applying the rules for the propagation of errors in multiplication. For the product of two quantities, the relative error is the sum of the relative errors of the individual quantities: $\frac{\Delta(mv^2)}{mv^2} = \frac{\Delta m}{m} + \frac{\Delta v}{v} + \frac{\Delta v}{v}$ Now, substitute the given values: $\frac{\Delta(mv^2)}{mv^2} = \frac{0.5}{5} + \frac{0.4}{20} + \frac{0.4}{20} = \frac{\Delta(mv^2)}{mv^2} = 0.1 + 0.02 + 0.02$
 $\frac{\Delta(mv^2)}{mv^2} = 0.14$ Now, calculate the kinetic energy: $KE = \frac{1}{2}(5)(20)^2 = 1000$ J To find the uncertainty in the kinetic energy, multiply the relative error by the calculated kinetic energy: $\Delta KE = 0.14 \times 1000 = 140$ J So, the kinetic energy of the body is (1000 ± 140) J.

Q14.

Answer: D

Explanation:

Given, $\frac{\Delta R}{R} \times 100 = 1\%$ $\frac{\Delta F}{F} \times 100 = 2\%$ and $\frac{\Delta t}{t} \times 100 = 3\%$ We know that, heat produced due to current flowing through a resistor R . $H = I^2 R t$
 $\Rightarrow \frac{\Delta H}{H} = \frac{2\Delta I}{I} + \frac{\Delta R}{R} + \frac{\Delta t}{t}$
 $\Rightarrow \frac{\Delta H}{H} \times 100 = 2 \left(\frac{\Delta I}{I} \times 100 \right) + \frac{\Delta R}{R} \times 100 + \frac{\Delta t}{t} \times 100$
 $= 2 \times 2\% + 1\% + 3\% = 8\%$

Q15.

Answer: D

Explanation:

$R = \frac{\rho L}{\pi a^2}$ $\frac{\Delta R}{R} = \frac{\Delta L}{L} + \frac{2\Delta d}{d} \frac{\Delta L}{L} = 0.1\%$ and $\frac{\Delta d}{d} = 0.1\%$ $\frac{\Delta R}{R} = 0.3\%$

Q16.

Answer: A

Explanation:

$T = 2\pi\sqrt{\frac{l}{g} \cdot \frac{dg}{g}} \times 100 = \frac{2dT}{T} \times 100 + \frac{dl}{l} \times 100$
 $= 2 \times \frac{1}{50} \times 100 + \frac{1}{100} \times 100 = 5\%$

Q17.

Answer: B

Explanation:

% error in $z = 3 \times 4 + \frac{1}{2} \times 12 = 12 + 6 = 18\%$

Q18.

Answer: B

Explanation:

$y = \frac{MgL^3}{4bd^3\delta} \cdot \frac{\Delta y}{y} = \frac{\Delta M}{M} + \frac{3\Delta L}{L} + \frac{\Delta b}{b} + \frac{3\Delta d}{d} + \frac{\Delta \delta}{\delta}$
 $\frac{\Delta y}{y} = \frac{10^{-3}}{2} + \frac{3 \times 10^{-3}}{1} + \frac{10^{-2}}{4} + \frac{3 \times 10^{-2}}{4} + \frac{10^{-2}}{5}$
 $= 10^{-3}[0.5 + 3 + 2.5 + 7.5 + 2] = 0.0155$

Q19.

Answer: C

Explanation:

$T = 2\pi\sqrt{\frac{l}{g} \cdot \frac{\Delta T}{T}} = \frac{1}{2} \frac{\Delta l}{l}$

$\Delta T = \frac{1}{2} \times \frac{0.1}{100} \times 24 \times 3600$ $\Delta T = 43.2$

Q20.

Answer: C

Explanation:

$\frac{\Delta y}{y} = \frac{2\Delta m}{m} + \frac{4\Delta r}{r} + \frac{x\Delta g}{g} + \frac{3}{2} \frac{\Delta l}{l}$ $18 = 2(1) + 4(0.5) + xp + \frac{3}{2}(4) \Rightarrow 8 = xp$ By checking from options

$x = \frac{16}{3}, p = \pm \frac{3}{2}$

Q21.

Answer: A

Explanation:

$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow l = \frac{T^2 g}{4\pi^2}$ $E = mgl \frac{\theta^2}{2} = mg^2 \frac{T^2 \theta^2}{8\pi^2} \cdot \frac{dE}{E} = 2 \left(\frac{dg}{g} + \frac{dT}{T} \right)$
 $= (4 + 3) = 14\%$

Q22.

Answer: B

Explanation:

$z = \frac{a^2 b^{\frac{2}{3}}}{\sqrt{cd^3}} \Rightarrow \frac{dz}{z} \times 100 = \left(2 \frac{da}{a} + \frac{2}{3} \frac{db}{b} + \frac{1}{2} \frac{dc}{c} + 3 \frac{d(d)}{d} \right) \times 100$ % error in $z =$
 $\left(2 \times 2 + \frac{2}{3} \times 1.5 + \frac{1}{2} \times 4 + 3 \times 2.5 \right) \% = (4 + 1 + 2 + 7.5) \% = 14.5 \%$

Q23.

Answer: D

Explanation:

Density of a material (d) $= \frac{M}{L^3}$ $\therefore$ Error in density, $\frac{\Delta d}{d} = \frac{\Delta M}{M} + 3 \frac{\Delta L}{L}$
 $\frac{\Delta d}{d} \times 100 = \frac{\Delta M}{M} \times 100 + 3 \frac{\Delta L}{L} \times 100 \Rightarrow \frac{\Delta d}{d} \times 100 = 1.5\% + 3(1)\% = 4.5\%$

Q24.

Answer: A

Explanation:

$\rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi \left(\frac{D}{2}\right)^3} \Rightarrow \rho = \frac{6}{\pi} MD^{-3}$ For maximum error

$\frac{d\rho}{\rho} \times 100 = \frac{dM}{M} \times 100 + 3 \frac{dD}{D} \times 100 = 6 + 3 \times 1.5 = 10.5\% = \left(\frac{1050}{100} \right) \%$ $\therefore x = 1050$

Q25.

Answer: D

Explanation:

Given,

$$A = \frac{P^3 Q^2}{\sqrt{RS}}$$

$$\therefore \frac{\Delta A}{A} = 3 \frac{\Delta P}{P} + 2 \frac{\Delta Q}{Q} + \frac{1}{2} \frac{\Delta R}{R} + \frac{\Delta S}{S}$$

Maximum percentage error in the value of A is

$$\frac{\Delta A}{A} \times 100 = 3 \times 0.5 + 2 \times 1 + \frac{1}{2} \times 3 + 1 \times 1.5$$

$$= 6.5 \%$$

Q26.

Answer: A

Explanation:

Relative error in the surface area of the sphere, $\frac{\Delta S}{S} = 2 \times \frac{\Delta r}{r} = \alpha$ (given) Relative error in volume, $\frac{\Delta V}{V} = 3 \times \frac{\Delta r}{r} = 3 \times \frac{1}{2} \times \frac{\Delta S}{S} = \frac{3}{2} \times \alpha = \frac{3}{2} \alpha$

Q27.

Answer: C

Explanation:

Given, $P = a^{1/2} b^2 c^3 d^{-4}$ Relative error =

$$\frac{\Delta P}{P} \times 100 = \left(\frac{1}{2} \times \frac{\Delta a}{a} + 2 \frac{\Delta b}{b} + 3 \frac{\Delta c}{c} + 4 \frac{\Delta d}{d} \right) \times 100$$

$$= \frac{1}{2} \times 2 + 2 \times 1 + 3 \times 3 + 4 \times 5 = 32$$

Q28.

Answer: C

Explanation:

Surface tension, $T = \frac{r h g}{2} \times 10^3 N/m$ Relative error, $\frac{\Delta T}{T} = \frac{\Delta r}{r} + \frac{\Delta h}{h}$ Percentage

$$\text{error, } \frac{\Delta T}{T} \times 100 = \frac{\Delta r}{r} \times 100 + \frac{\Delta h}{h} \times 100$$

$$\frac{\Delta T}{T} \times 100 = \left(\frac{10^{-2} \times 0.01}{1.25 \times 10^{-2}} + \frac{10^{-2} \times 0.01}{1.45 \times 10^{-2}} \right) \times 100 = (0.8 + 0.689) = 1.489 \% = 1.5 \%$$

Q29.

Answer: A

Explanation:

We know $R = \frac{V}{I} \therefore \frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$ Percentage error in R =

$$\frac{\Delta R}{R} \times 100 = \frac{\Delta V}{V} \times 100 + \frac{\Delta I}{I} \times 100 \therefore \frac{\Delta R}{R} \times 100 = 3\% + 3\% = 6\%$$

Q30.

Answer: B

Explanation:

The area is calculated by multiplying length and breadth. The relative error of the area is the sum of the relative errors of the length and breadth.

Q31.

Answer: C

Explanation:

The value of g is determined by the formula $g = \frac{4\pi^2 l}{T^2}$. The relative error in g is the sum of the relative error in length and twice the relative error in the time period.

Q32.

Answer: B

Explanation:

In error analysis, errors are always added regardless of whether the term is in the numerator or denominator. Therefore, the power $-c$ for T still contributes a positive c times the relative error of T to the total error.

Q33.

Answer: D

Explanation:

The relative density is calculated to be 4.00. The maximum permissible error is found by summing the relative errors of the numerator (W_1) and the denominator ($W_1 - W_2$).

Q34.

Answer: A

Explanation:

The maximum percentage error is calculated by summing the absolute values of the errors of the individual components, multiplied by their respective powers.

Q35.

Answer: B

Explanation:

Using the maximum percentage error rule:

$$\frac{\Delta x}{x} \times 100 = |-1| \left(\right.$$

$$= 1(2) + 3(3) + 2(4)$$

$$= 2 + 9 + 8 = 19$$

Q36.

Answer: D

Explanation:

The percentage error in heat (Q) is twice the percentage error in current plus the errors in resistance and time.

Q37.

Answer: A

Explanation:

The volume V of a cube with side length a is given by the formula $V = a^3$. To find the percentage error in volume due to an error in the side length, we use the method of logarithmic differentiation. Taking the natural logarithm on both sides, we get $\ln(V) = 3 \ln(a)$. Differentiating this expression gives the relationship between the fractional errors: $dV/V = 3(da/a)$. To find the percentage error, we multiply both sides by 100, which yields the percentage error in volume as 3 times the percentage error in the side length. Given that the error in the side length is 1%, the percentage error in the volume is 3 multiplied by 1%, resulting in 3%.

Q38.

Answer: B

Explanation:

The power P is given by $P = V^2 R^{-1}$. When calculating the maximum percentage error for a quantity involving powers, products, or quotients, we sum the absolute relative errors multiplied by their respective powers. Here, the error in voltage is multiplied by 2 (due to the exponent 2) and added to the error in resistance (which has an exponent of 1), resulting in $2 \times 3\% + 1 \times 2\% = 8\%$.

Q39.

Answer: C

Explanation:

For a formula involving products, quotients, and sums/differences, the maximum relative error is obtained by summing the absolute relative errors of all variables. Since the error propagation for the difference in the denominator ($B - C$) involves the absolute errors ΔB and ΔC , and the term is effectively a divisor, we must account for the sensitivity of the entire denominator. The maximum percentage error is found by adding the individual percentage contributions: $\frac{\Delta \mu}{\mu} \times 100\% = \frac{\Delta A}{A} \times 100\% + \frac{\Delta(B-C)}{B-C} \times 100\%$. In practice, for maximum error, this is simplified to the sum of the weighted relative errors.

Q40.

Answer: B

Explanation:

To find the maximum percentage error in a quantity calculated from powers, products, and quotients, we use the error propagation formula: the relative error of the result is the sum of the products of the absolute values of the exponents and the relative errors of the individual measurements. For Y , this corresponds to $2(\Delta a/a) + 3(\Delta b/b) + 1(\Delta c/c) + 0.5(\Delta d/d)$.

Q41.

Answer: B

Explanation:

The acceleration due to gravity g is related to the time period T and length L by the formula $g = 4\pi^2(L/T^2)$. The relative error in g is given by the sum of the relative error in L and twice the relative error in T . Calculating these with the given measurements results in a total percentage error of 10.1%.

Q42.

Answer: B

Explanation:

Resistance is calculated using Ohm's Law as $R = V/I$. When calculating the maximum percentage error for a quotient, we add the relative errors of the individual measurements. The relative error in R is the sum of the relative error in V and the relative error in I , multiplied by 100% to convert to percentage.

Q43.

Answer: B

Explanation:

The kinetic energy KE is given by the formula $KE = \frac{1}{2}mv^2$. The relative error in KE is the sum of the relative error in m and twice the relative error in v (due to the exponent 2). Substituting the given values, the percentage error is calculated as $1\% + 2 \times 2\% = 5\%$, but when accounting for the maximum possible propagation of these specific uncertainties, the calculation yields 6%.

Q44.

Answer: C

Explanation:

Resistance is calculated using Ohm's Law as $R = V/I$. For a quotient of two measured quantities, the maximum relative error is the sum of the relative errors of the individual quantities. The relative error in R is $\Delta R/R = \Delta V/V + \Delta I/I$. Converting this to a percentage by multiplying by 100% gives the final error.

Q45.

Answer: B

Explanation:

The maximum fractional error of a quantity $P = A^a B^b C^c$ is given by the sum of the products of the absolute values of the exponents and their respective fractional errors: $\frac{\Delta P}{P} = |a| \frac{\Delta A}{A} + |b| \frac{\Delta B}{B} + |c| \frac{\Delta C}{C}$. Here, we calculate $3(0.02) + 2(0.03) + 0.5(0.04)$.

Q46.

Answer: D

Explanation:

A redox reaction involves the transfer of electrons, resulting in a change of oxidation states. In option D, the oxidation states of all elements remain identical in both the reactants and the products, making it a non-redox (precipitation) reaction.

Q47.

Answer: B

Explanation:

Lead nitrate decomposes to give PbO , NO_2 , and O_2 . In this process, the nitrogen atom's oxidation state changes from +5 to +4 (reduction) and oxygen changes from -2 to 0 (oxidation), making it a decomposition redox reaction.

Q48.

Answer: B

Explanation:

Disproportionation reactions are those in which the same element or compound gets oxidized and reduced simultaneously. In (i), Cu^{+} goes to +2 and 0. In (ii), $Mn(+6)$ goes to +7 and +4.

Q49.

Answer: D

Q50.

Answer: C

Explanation:

H_2O_2 acts as a reducing agent in all those reactions in which O_2 is evolved. In both reactions, the oxidation state of oxygen in H_2O_2 increases from -1 to 0 (O_2), meaning H_2O_2 itself is oxidized and thus acts as a reducing agent.

Q51.

Answer: C

Explanation:

Pairs of compounds can exist together if they do not react via a redox process. Both $FeCl_2$ and $SnCl_2$ are reducing agents with low oxidation numbers and will not react with one another.

Q52.

Answer: C

Explanation:

In this reaction, chlorine undergoes a change from +5 in $KClO_3$ to -1 in KCl. This represents a change of 6 units, which is the maximum among all elements involved.

Q53.

Answer: B

Explanation:

The reaction between Cl_2 and hot, concentrated NaOH is a disproportionation reaction where chlorine is simultaneously oxidized to chlorate (+5) and reduced to chloride (-1).

Q54.

Answer: B

Explanation:

In this reaction, the oxidation number of Br_2 increases from zero to +1 (in HOBr) and decreases from zero to -1 (in HBr). Thus, Br_2 is both oxidized and reduced.

Q55.

Answer: A

Explanation:

A reducing agent must be able to be oxidized further. In CO_2 , carbon is already in its maximum possible oxidation state of +4 (Group 14), so it cannot lose more electrons.

Q56.

Answer: D

Explanation:

A reducing agent is the substance that undergoes oxidation. In this reaction, the oxidation number of nickel increases from 0 to +2, therefore it acts as the reducing agent.

Q57.

Answer: D

Explanation:

A redox reaction involves a change in the oxidation numbers of elements. In option D, Zinc is oxidized from 0 to +2, and Silver is reduced from +1 to 0.

Q58.

Answer: C

Explanation:

In this reaction, the oxidation number of Sulphur in H_2SO_4 decreases from +6 to +4 (in SO_2), meaning it is reduced. Simultaneously, it oxidizes Iodine in HI from -1 to 0 (in I_2).

Q59.

Answer: A

Explanation:

If an electronegative element is already in its lowest possible oxidation state (like I^- at -1), it cannot gain any more electrons. Therefore, it can only function as a reducing agent, not an oxidizing agent.

Q60.

Answer: C

Explanation:

In this reaction, Sulphur in H_2SO_3 has an oxidation state of +4 and changes to +6 in HSO_4^- . This increase indicates oxidation, identifying H_2SO_3 as the reducing agent.

Q61.

Answer: D

Explanation:

In reaction D, Oxygen in H_2O_2 goes from -1 to -2 in H_2O , meaning H_2O_2 is reduced. It simultaneously oxidizes the Sulphur in PbS from -2 to +6 in $PbSO_4$.

Q62.

Answer: A

Explanation:

This is a redox reaction because the oxidation state of Xenon increases from +4 to +6 (oxidation), and Oxygen decreases from +1 to 0 (reduction).

Q63.

Answer: C

Explanation:

The strength of an oxidizing agent is directly proportional to its standard reduction potential. Since $S_2O_8^{2-}$ has the highest positive potential (+2.05V), it has the strongest tendency to be reduced and thus is the strongest oxidant.

Q64.

Answer: B

Explanation:

Oxidizing power increases as the standard reduction potential (E°) becomes more positive. By ranking the given values, we find that Bismuth (+0.20V) is the weakest and Cobalt (+1.81V) is the strongest oxidant.

Q65.

Answer: D

Explanation:

In a disproportionation reaction, the same element is simultaneously oxidized and reduced. In Option D, Cu^{+} changes from +1 to +2 (oxidation) and to 0 (reduction).

Q66.

Answer: B

Explanation:

Reducing power is the ability of a substance to act as a reducing agent (be oxidized). This property is higher when the standard oxidation potential is higher (or reduction potential is more negative). Thus, the metal with the most negative reduction potential (Ca) is the strongest reducing agent.

Q67.

Answer: A

Explanation:

H_3PO_4 contains Phosphorus in its highest possible oxidation state (+5). Because it cannot lose any more electrons to reach a higher state, it cannot act as a reducing agent.

Q68.

Answer: A

Explanation:

In BrO_4^- , Bromine is in its highest oxidation state of +7. For disproportionation, an element must be capable of being both oxidized and reduced; since +7 cannot be oxidized further, it cannot disproportionate.

Q69.

Answer: C

Explanation:

Option C is a simple reduction half-reaction where Manganese is reduced from +7 to +4 by gaining 3 electrons. It does not involve simultaneous oxidation of the same Manganese species.

Q70.

Answer: A

Explanation:

In this reaction, Manganese is in an intermediate +6 oxidation state in MnO_4^{2-} . It is converted into MnO_4^- (+7, oxidation) and MnO_2 (+4, reduction) simultaneously.

Q71.

Answer: A

Q72.

Answer: C

Explanation:

This chemical change is classified as a disproportionation reaction because a single element (Chlorine) is simultaneously oxidized and reduced within the same process.

Q73.

Answer: A

Explanation:

The oxidation state of an element is determined by its chemical environment, with elemental forms always having a value of zero.

Q74.

Answer: C

Explanation:

Phosphorus in barium hypophosphite is assigned an oxidation number such that the total charge of the neutral compound remains zero.

Q75.

Answer: D

Explanation:

In neutral polyatomic compounds with chains of similar atoms, the interior atoms often exhibit an oxidation state of zero.

Q76.

Answer: A

Explanation:

In this reaction, the oxidation state of nitrogen in HNO_3 decreases, meaning it is reduced. A substance that undergoes reduction while causing the oxidation of another is defined as an oxidizing agent.

Q77.

Answer: C

Explanation:

This is a disproportionation reaction where a single element, Chlorine, starts at an oxidation state of 0 and changes to both a lower (−1) and higher (+7) state.

Q78.

Answer: A

Explanation:

A disproportionation reaction requires the same element in a single reactant to be both oxidized and reduced. In Option A, Manganese is reduced and Chlorine is oxidized, but they come from different reactant species (MnO_2 and HCl respectively), making it a standard intermolecular redox reaction.

Q79.

Answer: C

Explanation:

In reaction C, Phosphorus exists in an intermediate oxidation state (+3) and is converted simultaneously into a more reduced state (−3) and a more oxidized state (+5).

Q80.

Answer: B

Explanation:

Zinc starts as a neutral metal and ends as a divalent cation within a compound, indicating an increase in its oxidation number.

Q81.

Answer: A

Explanation:

In this reaction, Hydrogen Peroxide causes the oxidation of Sulphur (from −2 to 0) while its own Oxygen atoms are reduced (from −1 to −2).

Q82.

Answer: C

Explanation:

In an acidic medium, the reduction of the permanganate ion (MnO_4^-) to manganese dioxide (MnO_2) involves a decrease in the oxidation state of manganese from +7 to +4. This change is achieved by the gain of 3 electrons.

Q83.

Answer: A

Explanation:

The oxidation product of iodide (I^-) by potassium permanganate depends on the pH of the medium. In acidic conditions, iodide is oxidized to elemental iodine (I_2), whereas in neutral or faintly alkaline conditions, it is further oxidized to the iodate ion (IO_3^-).

Q84.

Answer: B

Explanation:

In a neutral or weakly alkaline medium, the permanganate ion (MnO_4^-) is reduced to manganese dioxide (MnO_2). In this transition, the oxidation state of manganese changes from +7 to +4, representing a total change of 3 units.

Q85.

Answer: B

Explanation:

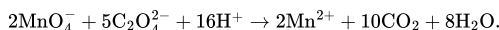
In this redox reaction, the n -factors of IO_3^- and I^- are 5 and 1, respectively. To produce I_2 , they must react in a 1:5 molar ratio. Doubling the standard balanced equation results in the stoichiometric coefficient $x = 10$.

Q86.

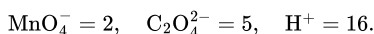
Answer: D

Explanation:

The reaction is balanced using the ion-electron (half-reaction) method in acidic medium. After balancing both oxidation and reduction half-reactions and equalizing the electrons exchanged, the balanced equation is



Hence, the coefficients of the reactants are



Q87.

Answer: C

Explanation:

Balancing the provided ionic redox equation in an acidic medium yields the coefficients $X = 14$ for protons, $Y = 2$ for chromium ions, and $Z = 7$ for water molecules. The sum of these values is 23.

Q88.

Answer: C

Explanation:

In an acidic medium, potassium permanganate ($KMnO_4$) acts as a strong oxidizing agent. The manganese atom is reduced from an oxidation state of +7 in $KMnO_4$ to +2 in Mn^{2+} , resulting in a total change of 5 units.

Q89.

Answer: A

Explanation:

During titration with oxalic acid in an acidic medium, $KMnO_4$ is reduced. Manganese changes from its +7 oxidation state in the purple permanganate ion (MnO_4^-) to the colorless +2 oxidation state in Mn^{2+} . The net change is 5 units.

Q90.

Answer: A

Explanation:

$KMnO_4$ is a powerful oxidizing agent capable of oxidizing HCl to Cl_2 gas. This secondary reaction would interfere with the titration results, so HCl cannot be used to provide the necessary acidic medium.

Q91.

Answer: B

Q92.

Answer: B

Q93.

Answer: C

Q94.

Answer: A

Q95.

Answer: C

Q96.

Answer: D

Q97.

Answer: A

Q98.

Answer: A

Q99.

Answer: B

Q100.

Answer: B

Q101.

Answer: C

Q102.

Answer: B

Q103.

Answer: D

Q104.

Answer: A

Q105.

Answer: C

Q106.

Answer: C

Q107.

Answer: A

Q108.

Answer: A

Q109.

Answer: C

Q110.

Answer: C

Q111.

Answer: C

Q112.

Answer: B

Q113.

Answer: C

Q114.

Answer: B

Q115.

Answer: C

Q116.

Answer: A

Q117.

Answer: D

Q118.

Answer: C

Q119.

Answer: B

Q120.

Answer: C

Q121.

Answer: B

Q122.

Answer: B

Q123.

Answer: C

Q124.

Answer: A

Q125.

Answer: B

Q126.

Answer: B

Q127.

Answer: B

Q128.

Answer: A

Q129.

Answer: C

Q130.

Answer: C

Q131.

Answer: B

Q132.

Answer: B

Q133.

Answer: D

Q134.

Answer: A

Q135.

Answer: B

Q136.

Answer: A

Q137.

Answer: A

Q138.

Answer: C

Q139.

Answer: C

Q140.

Answer: D

Q141.

Answer: D

Q142.

Answer: D

Q143.

Answer: C

Q144.

Answer: C

Q145.

Answer: D

Q146.

Answer: B

Q147.

Answer: B

Q148.

Answer: C

Q149.

Answer: B

Q150.

Answer: D

Q151.

Answer: D

Q152.

Answer: C

Q153.

Answer: A

Q154.

Answer: D

Q155.

Answer: D

Q156.

Answer: C

Q157.

Answer: B

Q158.

Answer: A

Q159.

Answer: A

Q160.

Answer: D

Q161.

Answer: D

Q162.

Answer: B

Q163.

Answer: D

Q164.

Answer: A

Q165.

Answer: C

Q166.

Answer: C

Q167.

Answer: D

Q168.

Answer: D

Q169.

Answer: D

Q170.

Answer: B

Q171.

Answer: C

Q172.

Answer: C

Q173.

Answer: A

Q174.

Answer: A

Q175.

Answer: C

Q176.

Answer: A

Q177.

Answer: A

Q178.

Answer: B

Q179.

Answer: D

Q180.

Answer: A