Q1. If $\vec{a}$ and $\vec{b}$ makes an angle $\cos^{-1}\left(\frac{5}{9}\right)$ with each other, then $|\vec{a}+\vec{b}| = \sqrt{2}|\vec{a}-\vec{b}|$ for $|\vec{a}| = n|\vec{b}|$ The integer value of n is ____ ***09 Apr 2024 (M)***

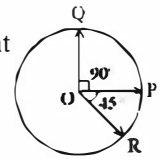
Q2. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is half that of $\vec{B}$. The angle between vectors $\vec{A}$ and $\vec{B}$ is _____ $^{\circ}$. ***09 Apr 2024 (E)***

Q3. Young's modulus is determined by the equation given by $Y = 49000\frac{m}{l}\cdot\frac{dyn}{cm^2}$ where M is the mass and l is the extension of wire used in the experiment. Now error in Young modules (Y) is estimated by taking data from $M-l$ plot in graph paper. The smallest scale divisions are 5 g and 0.02 cm along load axis and extension axis respectively. If the value of M and l are 500 g and 2 cm respectively then percentage error of Y is : ***08 Apr 2024 (M)***

(1) 0.5% (2) 2%

(3) 0.02% (4) 0.2%

Q4. Three vectors $\overrightarrow{OP}, \overrightarrow{OQ}$ and $\overrightarrow{OR}$ each of magnitude A are acting as shown in figure. The resultant of the three vectors is $A\sqrt{x}$. The value of x is _____ .



08 Apr 2024 (M)

Q5. In an expression $a \times 10^b$; ***08 Apr 2024 (M)***

(1) b is order of magnitude for $a \geq 5$ (2) b is order of magnitude for $a \leq 5$

(3) a is order of magnitude for $b \leq 5$ (4) b is order of magnitude for $5 < a \leq 10$

Q6. For three vectors $\vec{A} = (-x\hat{i} - 6\hat{j} - 2\hat{k}), \vec{B} = (-\hat{i} + 4\hat{j} + 3\hat{k})$ and $\vec{C} = (-8\hat{i} - \hat{j} + 3\hat{k})$, if $\vec{A}\cdot(\vec{B}\times\vec{C}) = 0$, then value of x is _____ ***06 Apr 2024 (M)***

Q7. 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 : ***06 Apr 2024 (M)***

(1) 5% (2) 1%

(3) 3% (4) 4%

Q8. The angle between vector $\vec{Q}$ and the resultant of $(2\vec{Q}+2\vec{P})$ and $(2\vec{Q}-2\vec{P})$ is : ***05 Apr 2024 (M)***

(1) $\tan^{-1}\frac{(2\vec{Q}-2\vec{P})}{2\vec{Q}+2\vec{P}}$ (2) 0°

(3) $\tan^{-1}(P/Q)$ (4) $\tan^{-1}(2Q/P)$

Q9. Time periods of oscillation of the same simple pendulum measured using four different measuring clocks were recorded as 4.62 s, 4.632 s, 4.6 s and 4.64 s. The arithmetic mean of these readings in correct significant figure is : ***05 Apr 2024 (M)***

(1) 5 s (2) 4.623 s

(3) 4.6 s (4) 4.62 s

Q10. Two forces $\vec{F}_1$ and $\vec{F}_2$ are acting on a body. One force has magnitude thrice that of the other force and the resultant of the two forces is equal to the force of larger magnitude. The angle between $\vec{F}_1$ and $\vec{F}_2$ is $\cos^{-1}\left(\frac{1}{n}\right)$. The value of $|n|$ is _____. ***04 Apr 2024 (M)***

Q11. In an experiment to measure focal length (f) of convex lens, the least counts of the measuring scales for the position of object (u) and for the position of image (v) are Δu and Δv, respectively. The error in the measurement of the focal length of the convex lens will be: ***04 Apr 2024 (M)***

(1) $2f\left[\frac{\Delta u}{u}+\frac{\Delta v}{v}\right]$ (2) $\frac{\Delta u}{u}+\frac{\Delta v}{v}$

(3) $f^2\left[\frac{\Delta u}{u^2}+\frac{\Delta v}{v^2}\right]$ (4) $f\left[\frac{\Delta u}{u}+\frac{\Delta v}{v}\right]$

Q12. Match List - I with List - II.

List - I (Number)		List - II (Signficant figure)	
(A)	1001	(I)	3
(B)	010.1	(II)	4
(C)	100.100	(III)	5
(D)	0.0010010	(IV)	6

Choose the correct answer from the options given below:

01 Feb 2024 (E)

(1) (A)-(III), (B)-(IV), (C)-(II), (D)-(I) (2) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

(3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III) (4) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

Q13. The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as $r=(0.35\pm0.05)$ cm, $R=(100\pm10)$ ohm, $l=(15\pm0.2)$ cm

The percentage error in resistivity of the material of the wire is :

01 Feb 2024 (M)

(1) 25.6% (2) 39.9 %

(3) 37.3% (4) 35.6 %

Q14. If two vectors $\vec{A}$ and $\vec{B}$ having equal magnitude R are inclined at an angle θ, then ***31 Jan 2024 (E)***

(1) $\left|\vec{A}-\vec{B}\right|=\sqrt{2}R\sin\left(\frac{\theta}{2}\right)$ (2) $\left|\vec{A}+\vec{B}\right|=2R\sin\left(\frac{\theta}{2}\right)$

(3) $\left|\vec{A}+\vec{B}\right|=2R\cos\left(\frac{\theta}{2}\right)$ (4) $\left|\vec{A}-\vec{B}\right|=2R\cos\left(\frac{\theta}{2}\right)$

Q15. 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: ***31 Jan 2024 (M)***

(1) 0.2% (2) 0.3%

(3) 0.1% (4) 0.144%

Q16. A vector has magnitude same as that of $\vec{A}=3\hat{j}+4\hat{j}$ and is parallel to $\vec{B}=4\hat{i}+3\hat{j}$. The x and y components of this vector in first quadrant are x and 3 respectivcly where x =____. ***30 Jan 2024 (E)***

Q17. The resistance $R=\frac{V}{I}$, where $V=(200\pm5)$ V and $I=(20\pm0.2)$ A, the percentage error in the measurement of R is : ***29 Jan 2024 (M)***

(1) 3.5% (2) 7%

(3) 3% (4) 5.5%

Q18. 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: ***29 Jan 2024 (E)***

(1) 66%
(2) 43%
(3) 34%
(4) 14%

Q19. A vector in $x-y$ plane makes an angle of 30° with y-axis. The magnitude of y-component of vector is $2\sqrt{3}$. The magnitude of x-component of the vector will be : ***15 Apr 2023 (M)***

(1) $\frac{1}{\sqrt{3}}$
(2) 6
(3) 2
(4) $\sqrt{3}$

Q20. A body of mass (5 ± 0.5) kg is moving with a velocity of (20 ± 0.4) m s^{-1}. Its kinetic energy will be ***13 Apr 2023 (M)***

(1) (1000 ± 0.14) J
(2) (500 ± 0.14) J
(3) (500 ± 140) J
(4) (1000 ± 140) J

Q21. When vector $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ is subtracted from vector $\vec{B}$, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector $\vec{B}$ will be: ***11 Apr 2023 (E)***

(1) $\sqrt{5}$
(2) 3
(3) $\sqrt{6}$
(4) $\sqrt{33}$

Q22. A physical quantity P is given as $P = \frac{a^2b^3}{c\sqrt{d}}$. The percentage error in the measurement of a, b, c and d are 1%, 2%, 3% and 4% respectively. The percentage error in the measurement of quantity P will be ***10 Apr 2023 (M)***

(1) 13%
(2) 16%
(3) 12%
(4) 14%

Q23. Two forces having magnitude A and $\frac{A}{2}$ are perpendicular to each other. The magnitude of their resultant is: ***08 Apr 2023 (M)***

(1) $\frac{\sqrt{5}A}{4}$
(2) $\frac{\sqrt{5}A}{2}$
(3) $\frac{5A}{2}$
(4) $\frac{\sqrt{5}A^2}{2}$

Q24. A cylindrical wire of mass (0.4 ± 0.01) g has length (8 ± 0.04) cm and radius (6 ± 0.03) mm. The maximum error in its density will be ***08 Apr 2023 (M)***

(1) 3.5%
(2) 5%
(3) 1%
(4) 4%

Q25. Two resistance are given as $R_1 = (10 \pm 0.5)\,\Omega$ and $R_2 = (15 \pm 0.5)\,\Omega$. The percentage error in the measurement of equivalent resistance when they are connected in parallel is ***06 Apr 2023 (M)***

(1) 6.33
(2) 2.33
(3) 5.33
(4) 4.33

Q26. The length of a metallic wire is increased by 20% and its area of cross-section is reduced by 4%. The percentage change in resistance of the metallic wire is _____. ***06 Apr 2023 (M)***

Q27. A body is moving with constant speed, in a circle of radius 10 m. The body completes one revolution in 4 s. At the end of $3rd$ second, the displacement of body (in m) from its starting point is: ***31 Jan 2023 (E)***

(1) 30 (2) $15\ \pi$
(3) $5\ \pi$ (4) $10\sqrt{2}$

Q28. In an experiment of measuring the refractive index of a glass slab using travelling microscope in physics lab, a student measures real thickness of the glass slab as 5.25 mm and apparent thickness of the glass slab at 5.00 mm. Travelling microscope has 20 divisions in one cm on main scale and 50 divisions on Vernier scale is equal to 49 divisions on main scale. The estimated uncertainty in the measurement of refractive index of the slab is $\frac{x}{10} \times 10^{-3}$, where x is _____ ***29 Jan 2023 (E)***

Q29. If $\vec{P} = 3\hat{i} + \sqrt{3}\hat{j} + 2\hat{k}$ and $\vec{Q} = 4\hat{i} + \sqrt{3}\hat{j} + 2.5\hat{k}$ then, the unit vector in the direction of $\vec{P} \times \vec{Q}$ is $\frac{1}{x}\left(\sqrt{3}\hat{i} + \hat{j} - 2\sqrt{3}\hat{k}\right)$. The value of x is ***25 Jan 2023 (M)***

Q30. If two vectors $\vec{P} = \hat{i} + 2m\hat{j} + m\hat{k}$ and $\vec{Q} = 4\hat{i} - 2\hat{j} + m\hat{k}$ are perpendicular to each other. Then, the value of m will be ***24 Jan 2023 (E)***

(1) -1 (2) 2
(3) 3 (4) 1

Q31. Vectors $a\hat{i} + b\hat{j} + \hat{k}$ and $2\hat{i} - 3\hat{j} + 4\hat{k}$ are perpendicular to each other when $3a + 2b = 7$, the ratio of a to b is $\frac{x}{2}$. The value of x is _____. ***24 Jan 2023 (M)***

Q32. If the projection of $2\hat{i} + 4\hat{j} - 2\hat{k}$ on $\hat{i} + 2\hat{j} + \alpha\hat{k}$ is zero. Then, the value of α will be ***28 Jul 2022 (M)***

Q33. 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 ***28 Jul 2022 (E)***

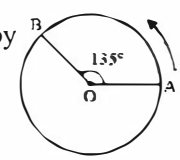
Q34. A torque meter is calibrated to reference standards of mass, length and time each with 5% accuracy. After calibration, the measured torque with this torque meter will have net accuracy of ***27 Jul 2022 (M)***

(1) 15% (2) 25%
(3) 75% (4) 5%

Q35. If $\vec{A} = \left(2\hat{i} + 3\hat{j} - \hat{k}\right)$ m and $\vec{B} = \left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$ m. The magnitude of component of vector $\vec{A}$ along vector $\vec{B}$ will be _____ m. ***26 Jul 2022 (E)***

Q36. In an experiment of determine the Young's modulus of wire of a length exactly 1 m, the extension in the length of the wire is measured as 0.4 mm with an uncertainty of ± 0.02 mm when a load of 1 kg is applied. The diameter of the wire is measured as 0.4 mm with an uncertainty of ± 0.01 mm. The error in the measurement of Young's modulus (ΔY) is found to be $x \times 10^{10}$ N m^{-2}. The value of x is _____. ***26 Jul 2022 (M)***

Q37. A person moved from A to B on a circular path as shown in figure. If the distance travelled by him is 60 m, then the magnitude of displacement would be: (Given $\cos 135^\circ = -0.7$)



25 Jul 2022 (M)

(1) 42 m (2) 47 m
(3) 19 m (4) 40 m

Q38. 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: ***25 Jul 2022 (E)***

(1) 2 (2) 4

(3) 6 (4) 8

Q39. Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitudes. If magnitude of $\vec{A}+\vec{B}$ is equal to two times the magnitude of $\vec{A}-\vec{B}$, then the angle between $\vec{A}$ and $\vec{B}$ will be ***29 Jun 2022 (M)***

(1) $\cos^{-1}\left(\frac{3}{5}\right)$ (2) $\cos^{-1}\left(\frac{1}{3}\right)$

(3) $\sin^{-1}\left(\frac{1}{3}\right)$ (4) $\sin^{-1}\left(\frac{3}{5}\right)$

Q40. A silver wire has a mass (0.6 ± 0.006)g, radius (0.5 ± 0.005) mm and length (4 ± 0.04) cm. The maximum percentage error in the measurement of its density will be ***27 Jun 2022 (M)***

(1) 7% (2) 3%

(3) 4% (4) 6%

Q41. $\vec{A}$ is a vector quantity such that $\left|\vec{A}\right|$ = non-zero constant. Which of the following expression is true for $\vec{A}$?

25 Jun 2022 (M)

(1) $\vec{A}\cdot\vec{A}=0$ (2) $\vec{A}\times\vec{A}<0$

(3) $\vec{A}\times\vec{A}=0$ (4) $\vec{A}\times\vec{A}>0$

Q42. If $Z=\frac{A^2B^3}{C^4}$, then the relative error in Z will be ***25 Jun 2022 (M)***

(1) $\left(\frac{2\Delta A}{A}+\frac{3\Delta B}{B}+\frac{4\Delta C}{C}\right)$ (2) $\left(\frac{\Delta A}{A}+\frac{\Delta B}{B}+\frac{\Delta C}{C}\right)$

(3) $\left(\frac{2\Delta A}{A}+\frac{3\Delta B}{B}-\frac{4\Delta C}{C}\right)$ (4) $\left(\frac{\Delta A}{A}+\frac{\Delta B}{B}-\frac{\Delta C}{C}\right)$

Q43. Which of the following relations is true for two unit vector $\hat{A}$ and $\hat{B}$ making an angle θ to each other?

25 Jun 2022 (M)

(1) $\left|\hat{A}+\hat{B}\right|=\left|\hat{A}-\hat{B}\right|\frac{\tan\theta}{2}$ (2) $\left|\hat{A}-\hat{B}\right|=\left|\hat{A}+\hat{B}\right|\frac{\tan\theta}{2}$

(3) $\left|\hat{A}+\hat{B}\right|=\left|\hat{A}-\hat{B}\right|\frac{\cos\theta}{2}$ (4) $\left|\hat{A}-\hat{B}\right|=\left|\hat{A}+\hat{B}\right|\frac{\cos\theta}{2}$

Q44. 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 _____%. ***25 Jun 2022 (E)***

Q45. 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 observations 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 :

01 Sep 2021 (E)

(1) 0.155 (2) 0.0083
(3) 0.083 (4) 0.0155

Q46. Statement I: If three forces $\vec{F_1}$, $\vec{F_2}$ and $\vec{F_3}$ are represented by three sides of a triangle and $\vec{F_1} + \vec{F_2} = -\vec{F_3}$, then these three forces are concurrent forces and satisfy the condition for equilibrium.

Statement II: A triangle made up of three forces $\vec{F_1}$, $\vec{F_2}$ and $\vec{F_3}$ as its sides were taken in the same order, satisfies the condition for translatory equilibrium.

In the light of the above statements, choose the most appropriate answer from the options given below:

31 Aug 2021 (E)

(1) Both Statement I and Statement II are true. (2) Statement I is true but Statement II is false.
(3) Both Statement I and Statement II are false. (4) Statement I is false but Statement II is true.

Q47. Statement-I : Two forces $\left(\vec{P} + \vec{Q}\right)$ and $\left(\vec{P} - \vec{Q}\right)$ where $\vec{P} \perp \vec{Q}$, when act at an angle θ_1 each other, the magnitude of their resultant is $\sqrt{3(P^2 + Q^2)}$, when they act at an angle θ_2, the magnitude of their resultant becomes $\sqrt{2(P^2 + Q^2)}$. This is possible only when $\theta_1 < \theta_2$.

Statement-II : In the situation given above.

$\theta_1 = 60^\circ$ and $\theta_2 = 90^\circ$

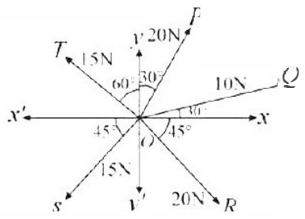
In the light of the above statement, choose the most appropriate answer from the options given below :

31 Aug 2021 (E)

(1) Statement I is false but Statement II is true. (2) Both Statement I and Statement II are true.
(3) Both Statement I and Statement II are false. (4) Statement I is true but Statement II is false.

Q48. The resultant of these forces $\overrightarrow{OP}, \overrightarrow{OQ}, \overrightarrow{OR}, \overrightarrow{OS}$ and $\overrightarrow{OT}$ is approximately _____ N.

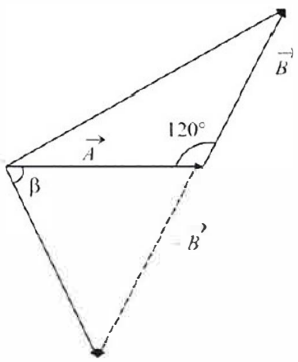
[Take $\sqrt{3} = 1.7, \sqrt{2} = 1.4$ Given $\hat{i}$ and $\hat{j}$ unit vectors along x, y axis]



27 Aug 2021 (M)

(1) $-1.5\hat{i} - 15.5\hat{j}$ (2) $9.25\hat{i} + 5\hat{j}$
(3) $3\hat{i} + 15\hat{j}$ (4) $2.5\hat{i} - 14.5\hat{j}$

Q49. The angle between vector $\left(\vec{A}\right)$ and $\left(\vec{A} - \vec{B}\right)$ is:



26 Aug 2021 (E)

(1) $\tan^{-1}\left(\frac{B\cos\theta}{A-B\sin\theta}\right)$ (2) $\tan^{-1}\left(\frac{\sqrt{3}B}{2A-B}\right)$

(3) $\tan^{-1}\left(\frac{-\frac{B}{2}}{A-B\frac{\sqrt{3}}{2}}\right)$ (4) $\tan^{-1}\left(\frac{A}{0.7B}\right)$

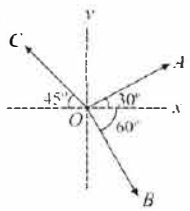
Q50. If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is:

26 Aug 2021 (E)

(1) 43.2 s (2) 8.64 s

(3) 86.4 s (4) 4.32 s

Q51. The magnitude of vectors $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$ in the given figure are equal. The direction of $\overrightarrow{OA}+\overrightarrow{OB}-\overrightarrow{OC}$ with $x-$axis will be:



26 Aug 2021 (M)

(1) $\tan^{-1}\frac{\left(\sqrt{3}-1+\sqrt{2}\right)}{\left(1+\sqrt{3}-\sqrt{2}\right)}$ (2) $\tan^{-1}\frac{\left(1-\sqrt{3}-\sqrt{2}\right)}{\left(1+\sqrt{3}+\sqrt{2}\right)}$

(3) $\tan^{-1}\frac{\left(\sqrt{3}-1+\sqrt{2}\right)}{\left(1-\sqrt{3}+\sqrt{2}\right)}$ (4) $\tan^{-1}\frac{\left(1+\sqrt{3}-\sqrt{2}\right)}{\left(1-\sqrt{3}-\sqrt{2}\right)}$

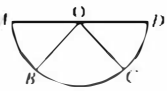
Q52. The acceleration due to gravity is found up to an accuracy of 4% on a planet. The energy supplied to a simple pendulum of known mass m to undertake oscillations of time period T is being estimated. If time period is measured to an accuracy of 3%, the accuracy to which E is known as _____$\%$ ***26 Aug 2021 (E)***

Q53. A physical quantity y is represented by the formula $y=m^2r^{-4}g^xl^{-\frac{3}{2}}$ 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. ***27 Jul 2021 (E)***

(1) 5 and ±2 (2) 4 and ±3

(3) $\frac{16}{3}$ and $\pm\frac{3}{2}$ (4) 8 and ±2

Q54. Assertion A : If $A,\ B,\ C,\ D$ are four points on a semi-circular arc with a centre at O such that $\left|\overrightarrow{AB}\right|=\left|\overrightarrow{BC}\right|=\left|\overrightarrow{CD}\right|$. Then, $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}=4\overrightarrow{AO}+\overrightarrow{OB}+\overrightarrow{OC}$



Reason R : Polygon law of vector addition yields $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CD}+\overrightarrow{AD}=2\overrightarrow{AO}$. In the light of the above statements, choose the most appropriate answer from the options given below.

27 Jul 2021 (M)

(1) A is correct but R is not correct.

(2) A is not correct but R is correct.

(3) Both A and R are correct and R is the correct explanation of A.

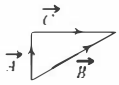
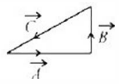
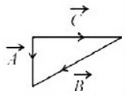
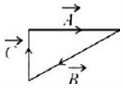
(4) Both A and R are correct but R is not the correct explanation of A.

Q55. Two vectors $\vec{X}$ and $\vec{Y}$ have equal magnitude. The magnitude of $\left(\vec{X}-\vec{Y}\right)$ is n times the magnitude of $\left(\vec{X}+\vec{Y}\right)$. The angle between $\vec{X}$ and $\vec{Y}$ is : ***25 Jul 2021 (E)***

(1) $\cos^{-1}\left(\frac{-n^2-1}{n^2-1}\right)$ (2) $\cos^{-1}\left(\frac{n^2-1}{-n^2-1}\right)$

(3) $\cos^{-1}\left(\frac{n^2+1}{-n^2-1}\right)$ (4) $\cos^{-1}\left(\frac{n^2+1}{n^2-1}\right)$

Q56. Match List I with List II.

List I		List II	
(a)	$\vec{C}-\vec{A}-\vec{B}=0$	(i)	
(b)	$\vec{A}-\vec{C}-\vec{B}=0$	(ii)	
(c)	$\vec{B}-\vec{A}-\vec{C}=0$	(iii)	
(d)	$\vec{A}+\vec{B}=-\vec{C}$	(iv)	

Choose the correct answer from the options given below:

25 Jul 2021 (M)

(1) (a) → (iv), (b) → (i), (c) → (iii), (d) → (ii) (2) (a) → (iv), (b) → (iii), (c) → (i), (d) → (ii)

(3) (a) → (iii), (b) → (ii), (c) → (iv), (d) → (i) (4) (a) → (i), (b) → (iv), (c) → (ii), (d) → (iii)

Q57. What will be the projection of vector $\vec{A}=\hat{i}+\hat{j}+\hat{k}$ on vector $\vec{B}=\hat{i}+\hat{j}$? ***22 Jul 2021 (M)***

(1) $\sqrt{2}\left(\hat{i}+\hat{j}+\hat{k}\right)$ (2) $2\left(\hat{i}+\hat{j}+\hat{k}\right)$

(3) $\sqrt{2}\left(\hat{i}+\hat{j}\right)$ (4) $\left(\hat{i}+\hat{j}\right)$

Q58. Three students S_1, S_2 and S_3 perform an experiment for determining the acceleration due to gravity (g) using a simple pendulum. They use different lengths of pendulum and record time for different number of oscillations. The observations are as shown in the table.

Student No.	Length of pendulum (cm)	Number of oscillations (n)	Total time for n oscillations	Time period (s)
1.	64.0	8	128.0	16.0
2.	64.0	4	64.0	16.0
3.	20.0	4	36.0	9.0

(Least count of length = 0.1 m, least count for time = 0.1 s)

If E_1, E_2 and E_3 are the percentage errors in g for students 1, 2 and 3, respectively, then the minimum percentage error is obtained by student no ____ .

22 Jul 2021 (M)

Q59. Three particles P, Q and R are moving along the vectors $\vec{A}=\hat{i}+\hat{j}$, $\vec{B}=\hat{j}+\hat{k}$ and $\vec{C}=-\hat{i}+\hat{j}$, respectively. They strike on a point and start to move in different directions. Now particle P is moving normal to the plane

which contains vector $\vec{A}$ and $\vec{B}$. Similarly particle Q is moving normal to the plane which contains vector $\vec{A}$ and $\vec{C}$. The angle between the dirction of motion of P and Q is $\cos^{-1}\left(\frac{1}{\sqrt{x}}\right)$. Then the value of x is ___ .

22 Jul 2021 (M)

Q60. If $\vec{A}$ and $\vec{B}$ are two vectors satisfying the relation $\vec{A}\cdot\vec{B}=\left|\vec{A}\times\vec{B}\right|$. Then the value of $\left|\vec{A}-\vec{B}\right|$ will be:

20 Jul 2021 (M)

(1) $\sqrt{A^2+B^2}$ (2) $\sqrt{A^2+B^2+\sqrt{2}AB}$

(3) $\sqrt{A^2+B^2+2AB}$ (4) $\sqrt{A^2+B^2-\sqrt{2}AB}$

Q61. Two vectors $\vec{P}$ and $\vec{Q}$ have equal magnitudes. If the magnitude of $\vec{P}+\vec{Q}$ is n times the magnitude of $\vec{P}-\vec{Q}$, then angle between $\vec{P}$ and $\vec{Q}$ is

20 Jul 2021 (E)

(1) $\sin^{-1}\left(\frac{n-1}{n+1}\right)$ (2) $\cos^{-1}\left(\frac{n-1}{n+1}\right)$

(3) $\sin^{-1}\left(\frac{n^2-1}{n^2+1}\right)$ (4) $\cos^{-1}\left(\frac{n^2-1}{n^2+1}\right)$

Q62. The time period of a simple pendulum is given by $T=2\pi\sqrt{\frac{l}{g}}$. The measured value of the length of the pendulum is 10 cm known to a 1 mm accuracy. The time for 200 oscillations of the pendulum is found to be 100 second using a clock of 1s resolution. The percentage accuracy in the determination of g using this pendulum is x. The value of x to the nearest integer is:-

18 Mar 2021 (M)

(1) 2% (2) 3%

(3) 5% (4) 4%

Q63. The radius of a sphere is measured to be (7.50 ± 0.85) cm. Suppose the percentage error in its volume is x. The value of x, to the nearest x, is ___ .

18 Mar 2021 (E)

Q64. The resistance $R=\frac{V}{I}$, where $V=(50\pm2)$ V and $I=(20\pm0.2)$ A. The percentage error in R is x %. The value of x to the nearest integer is _____.

16 Mar 2021 (M)

Q65. In order to determine the Young's Modulus of a wire of radius 0.2 cm (measured using a scale of least count $=0.001$ cm) and length 1 m (measured using a scale of least count $=1$ mm), a weight of mass 1 kg (measured using a scale of least count $=1$ g) was hanged to get the elongation of 0.5 cm (measured using a scale of least count 0.001 cm). What will be the fractional error in the value of Young's Modulus determined by this experiment?

16 Mar 2021 (E)

(1) 0.14% (2) 0.9%

(3) 9% (4) 1.4%

Q66. A wire of 1 Ω has a length of 1 m. It is stretched till its length increases by 25%. The percentage change in resistance to the nearest integer is :

26 Feb 2021 (E)

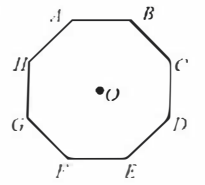
(1) 12.5% (2) 76%

(3) 25% (4) 56%

Q67. If $\vec{P}\times\vec{Q}=\vec{Q}\times\vec{P}$, the angle between $\vec{P}$ and $\vec{Q}$ is $\theta(0^\circ<\theta<360^\circ)$. The value of θ will be ___$^\circ$.

25 Feb 2021 (E)

Q68. In an octagon $ABCDEFGH$ of equal side, what is the sum of $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}+\overrightarrow{AG}+\overrightarrow{AH}$, if, $\overrightarrow{AO}=2\hat{i}+3\hat{j}-4\hat{k}$



25 Feb 2021 (M)

(1) $16\hat{i}+24\hat{j}-32\hat{k}$ (2) $16\hat{i}-24\hat{j}+32\hat{k}$

(3) $16\hat{i}+24\hat{j}+32\hat{k}$ (4) $-16\hat{i}-24\hat{j}+32\hat{k}$

Q69. The period of oscillation of a simple pendulum is $T=2\pi\sqrt{\frac{L}{g}}$. Measured value of L is 1.0 m from meter scale having a minimum division of 1 mm and time of one complete oscillation is 1.95 s measured from stopwatch of 0.01 s resolution. The percentage error in the determination of g will be: ***24 Feb 2021 (E)***

(1) 1.03% (2) 1.33%

(3) 1.30% (4) 1.13%

Q70. A particle moving in the xy-plane experiences a velocity dependent force $\vec{F}=k\left(v_y\hat{i}+v_x\hat{j}\right)$, where v_x and v_y are the x and y components of its velocity $\vec{v}$. If $\vec{a}$ is the acceleration of the particle, then which of the following statements is true for the particle ? ***06 Sep 2020 (E)***

(1) quantity $\vec{v}\times\vec{a}$ is constant in time (2) $\vec{F}$ arises due to a magnetic field

(3) kinetic energy of particle is constant in time (4) quantity $\vec{v}.\vec{a}$ is constant in time

Q71. The density of a solid metal sphere is 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 − ***06 Sep 2020 (M)***

Q72. A physical quantity z depends on four observables a, b, c and d, as $z=\frac{a^2b^{2/3}}{\sqrt{c}d^3}$. The percentage 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 : ***05 Sep 2020 (M)***

(1) 12.25% (2) 16.5%

(3) 13.5% (4) 14.5%

Q73. For the four sets of three measured physical quantities as given below. Which of the following options is correct?

(i) $A_1=24.36, B_1=0.0724, C_1=256.2$; (ii) $A_2=24.44, B_2=16.082, C_2=240.2$; (iii) $A_3=25.2, B_3=19.2812, C_3=236.183$

(iv) $A_4=25, B_4=236.191, C_4=19.5$ ***09 Jan 2020 (E)***

(1) $A_4+B_4+C_4<A_1+B_1+C_1<A_3+B_3+C_3<A_2+B_2+C_2$

(2) $A_1+B_1+C_1=A_2+B_2+C_2=A_3+B_3+C_3=A_4+B_4+C_4$

(3) $A_1+B_1+C_1<A_2+B_2+C_2=A_3+B_3+C_3<A_4+B_4+C_4$

(4) $A_1+B_1+C_1<A_3+B_3+C_3<A_2+B_2+C_2<A_4+B_4+C_4$

Q74. A simple pendulum is being used to determine the value of gravitational acceleration g at a certain place. The length of the pendulum is 25.0 cm and a stopwatch with 1 s resolution measures the time taken for 40

oscillations to be 50 s. The accuracy in g is: ***08 Jan 2020 (E)***

(1) 5.40%
(2) 3.40%
(3) 4.40%
(4) 2.40%

Q75. The sum of two forces $\vec{P}$ and $\vec{Q}$ is $\vec{R}$ such that $\left|\vec{R}\right| = \left|\vec{P}\right|$. Find the angle between resultant of $2\vec{P}$ and $\vec{Q}$ and $\vec{Q}$

_____ ***07 Jan 2020 (E)***

Q76. The area of a square is 5.29 cm^2. The area of 7 such squares taking into account the significant figures is: ***09 Apr 2019 (E)***

(1) 37.03 cm^2
(2) 37.030 cm^2
(3) 37.0 cm^2
(4) 37 cm^2

Q77. In the density measurement of a cube, the mass and edge length are measured as (10.00 ± 0.10) kg and (0.10 ± 0.01) m, respectively. The error in the measurement of density is: ***09 Apr 2019 (M)***

(1) 0.31
(2) 0.10
(3) 0.07
(4) 0.01

Q78. Let $\left|\vec{A_1}\right| = 3$, $\left|\vec{A_2}\right| = 5$ and $\left|\vec{A_1} + \vec{A_2}\right| = 5$. The value of $\left(2\vec{A_1} + 3\vec{A_2}\right) \bullet \left(3\vec{A_1} - 2\vec{A_2}\right)$ is: ***08 Apr 2019 (E)***

(1) -112.5
(2) -118.5
(3) -106.5
(4) -99.5

Q79. Ship A is sailing towards north-east with velocity $\vec{v} = 30\hat{i} + 50\hat{j}$ km h^{-1} where $\hat{i}$ points east and $\hat{j}$, north. The ship B is at a distance of 80 km east and 150 km north of Ship A and is sailing towards the west at 10 km h^{-1}. A will be at the minimum distance from B in: ***08 Apr 2019 (M)***

(1) 4.2 h
(2) 3.2 h
(3) 2.6 h
(4) 2.2 h

Q80. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measures by using a watch of 1 second least count. The mean value of time taken comes out to be 30 s. The length of the pendulum is measured by using a meter scale of least count 1 mm and the value obtained is 55.0 cm. The percentage error in the determination of g is close to ***08 Apr 2019 (E)***

(1) 0.2%
(2) 6.8%
(3) 3.5%
(4) 0.7%

Q81. A particle moves from the point $(2.0\hat{i} + 4.0\hat{j})$m, at t = 0, with an initial velocity $(5.0\hat{i} + 4.0\hat{j})ms^{-1}$. It is acted upon by a constant force which produces a constant acceleration $(4.0\hat{i} + 4.0\hat{j})ms^{-2}$. What is the distance of the particle from the origin at time 2 s? ***11 Jan 2019 (E)***

(1) 15 m
(2) $20\sqrt{2}$ m
(3) 5 m
(4) $10\sqrt{2}$ m

Q82. Two forces P and Q, of magnitude $2F$ and $3F$, respectively, are at an angle θ with each other. If the force Q is doubled, then their resultant also gets doubled. Then, the angle θ is: ***10 Jan 2019 (E)***

(1) 120° (2) 60°

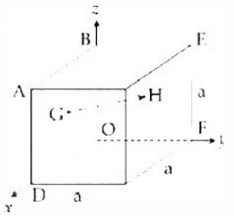
(3) 30° (4) 90°

Q83. The diameter and height of a cylinder are measured by a meter scale to be $12.6 \pm 0.1\ cm$ and $34.2 \pm 0.1\ cm$, respectively. What will be the value of its volume in appropriate significant figures? ***10 Jan 2019 (E)***

(1) $4264 \pm 81 cm^3$ (2) $4264.4 \pm 81.0\ cm^3$

(3) $4260 \pm 80\ cm^3$ (4) $4300 \pm 80\ cm^3$

Q84. In the cube of side 'a' shown in the figure, the vector from the central point of the face $ABOD$ to the central point of the face $BEFO$ will be:



10 Jan 2019 (M)

(1) $\frac{1}{2}a\left(\hat{k}-\hat{i}\right)$ (2) $\frac{1}{2}a\left(\hat{i}-\hat{k}\right)$

(3) $\frac{1}{2}a\left(\hat{j}-\hat{i}\right)$ (4) $\frac{1}{2}a\left(\hat{j}-\hat{k}\right)$

Q85. Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitudes. The magnitude of $\left(\vec{A}+\vec{B}\right)$ is ' n ' times the magnitude of $\left(\vec{A}-\vec{B}\right)$. The angle between $\vec{A}$ and $\vec{B}$ is: ***10 Jan 2019 (E)***

(1) $\cos^{-1}\left[\frac{n^2-1}{n^2+1}\right]$ (2) $\sin^{-1}\left[\frac{n-1}{n+1}\right]$

(3) $\cos^{-1}\left[\frac{n-1}{n+1}\right]$ (4) $\sin^{-1}\left[\frac{n^2-1}{n^2+1}\right]$

Q86. A particle is moving with a velocity $\vec{v}=K\left(y\hat{i}+x\hat{j}\right)$, where K is a constant.

The general equation for its path is: ***09 Jan 2019 (M)***

(1) $y^2 = x + \text{constant}$ (2) $xy = \text{constant}$

(3) $y = x^2 + \text{constant}$ (4) $y^2 = x^2 + \text{constant}$

Q87. A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is: ***09 Jan 2019 (M)***

(1) 2.5% (2) 1.0%

(3) 2.0% (4) 0.5%

ANSWER KEYS

1. (3)	**2.** (150)	**3.** (2)	**4.** (3)	**5.** (2)	**6.** (4)	**7.** (1)	**8.** (2)
9. (3)	**10.** (6)	**11.** (3)	**12.** (3)	**13.** (2)	**14.** (3)	**15.** (2)	**16.** (4)
17. (1)	**18.** (3)	**19.** (3)	**20.** (4)	**21.** (4)	**22.** (1)	**23.** (2)	**24.** (4)
25. (4)	**26.** (25)	**27.** (4)	**28.** (41)	**29.** (4)	**30.** (2)	**31.** (1)	**32.** (5)
33. (5)	**34.** (2)	**35.** (2)	**36.** (2)	**37.** (2)	**38.** (4)	**39.** (1)	**40.** (3)
41. (3)	**42.** (1)	**43.** (2)	**44.** (18)	**45.** (4)	**46.** (1)	**47.** (2)	**48.** (2)
49. (2)	**50.** (1)	**51.** (2)	**52.** (14)	**53.** (3)	**54.** (4)	**55.** (2)	**56.** (2)
57. (4)	**58.** (1)	**59.** (3)	**60.** (4)	**61.** (4)	**62.** (2)	**63.** (34)	**64.** (5)
65. (4)	**66.** (4)	**67.** (180)	**68.** (1)	**69.** (4)	**70.** (1)	**71.** (1050)	**72.** (4)
73. (3)	**74.** (3)	**75.** (90)	**76.** (1)	**77.** (1)	**78.** (2)	**79.** (3)	**80.** (2)
81. (2)	**82.** (1)	**83.** (3)	**84.** (3)	**85.** (1)	**86.** (4)	**87.** (2)	