FIITJEE – JEE (Main)

BATCHES – Class – XI

Physics, Chemistry & Mathematics
Reshuffling Test

QP Code:

Time Allotted: 3 Hours **Maximum Marks: 300**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

Important Instructions

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections.**
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts**: **Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. No candidate is allowed to carry any textual material, printed or written, bits of papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices ext. except the Admit Card inside the examination hall / room.

B. Filling of OMR Sheet:

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with ***Blue/Black Ball Point Pen*** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.
4. **Do not fold or make any stray marks on the Answer Sheet.**

C. Marking Scheme for All Two Parts:

(i) **Part-A (01-20) –** Contains Twenty (20) multiple choice objective questions which have four (4) options each and only one correct option. Each question carries **+4 marks** which will be awarded for every correct answer and **-1 mark** will be deducted for every incorrect answer.

(ii) **Part-B (01-05)** contains five (05) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+4 marks** for correct answer and **there will be no negative marking.**

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

SECTION – I: PHYSICS

Part – A: Single Correct Answer Type

This section contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**

1. A body when projected vertically up covers a total distance D. During the time of its flight t. If there were no gravity, the distance covered by it during the same time is equal to
(A) 0 (B) D (C) 2D (D) 4D

2. The magnitude of the resultant of velocity of two cars moving with equal speed, becomes $\sqrt{3}$ times when the direction of either car is reversed. The angle between the direction of cars is
(A) 30° (B) 60°
(C) 120° (D) None of these

3. A stationary body is accelerated by applying a force of 30N. The momentum of the body after 2 sec is
(A) 7.5 kg-m/s (B) 30 kg-m/s
(C) 120 kg-m/s (D) 60 kg-m/s

4. A body of mass 2kg is acted upon by two forces each of magnitude 1N, making an angle 60° with each other. The net acceleration of the body in m/s^2 is
(A) 0.1 (B) 1.0
(C) $\sqrt{3}/2$ (D) $\sqrt{2}/3$

5. 840 J of heat is required to raise the temperature of 2 moles of an ideal gas from 20°C to 40°C at constant pressure. The amount of heat required to raise the temperature of the same gas from 40°C to 60°C at constant volume is
(take R = 8.4 J $g.mole^{-1} k^{-1}$)
(A) 504 J (B) 420 J
(C) 840 J (D) 630 J

6. A particle is vibrating in SHM with an amplitude of 4 cm. At what displacement from the equilibrium position is its energy half potential and half kinetic
(A) 1 cm (B) $\sqrt{2}$ cm
(C) 2 cm (D) $2\sqrt{2}$ cm

Space for rough work

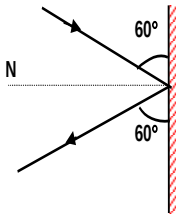
7. A block of mass m is moving with a constant acceleration a on a horizontal frictional plane. If the coefficient of friction between the block and ground is μ, the power delivered by the external agent after a time t from the beginning is equal to:
(A) ma^2t (B) $\mu mgat$
(C) $\mu m(a+\mu g)gt$ (D) $m(a+\mu g)at$

8. A particle moves with a velocity $5\hat{i}-3\hat{j}+6\hat{k}$ m/s under the influence of a constant force $\vec{F}=(10\hat{i}+10\hat{j}+20\hat{k})$N. The instantaneous power applied to the particle is:
(A) 200 J/s (B) 40 J/s
(C) 140 J/s (D) 170 J/s

9. A piano string 1.5m long is made of steel of density 7.7×10^3 kg/m^3 and Young's modulus 2×10^{11} N/m^2. It is maintained at a tension which produces an elastic strain of 1% in the string. The fundamental frequency of transverse vibrations of string is nearly equal to the:
(A) 85Hz (B) 170Hz
(C) 340Hz (D) 310Hz

10. A body of mass 5m initially at rest explodes into 3 fragments with mass ratio 3 : 1 : 1. Two of fragments each of mass m are found to move with a speed 60m/s in mutually perpendicular directions. The velocity of third fragment is
(A) $60\sqrt{2}$ (B) $20\sqrt{3}$
(C) $10\sqrt{2}$ (D) $20\sqrt{2}$

11. A 3kg ball strikes a heavy rigid wall with a speed 10 m/s at an angle of 60° with the wall. It gets reflected with the same speed as shown. If the ball is in contact with the wall for 0.25, what is the average force exerted on the ball by the wall?



(A) 300N (B) $120\sqrt{3}$ N
(C) $15\sqrt{3}$ N (D) 150N

12. A body of mass m_1 moving with a uniform velocity 40m/s collides with another mass m_2 a rest and then the two together begin to move with a uniform velocity of 30 m/s. The ratio of their masses (m_1/m_2) is
(A) 0.75 (B) 4.0
(C) 3.0 (D) 1.33

13. Given that the displacement of the body in metre is a function of time as follows, $x = 2t^4 + 5$. The mass of the body is 2 kg. What is the increase in its kinetic energy one second after the start of motion?
(A) 8 J (B) 16 J
(C) 32 J (D) 64 J

Space for rough work

14. Two skaters A and B weigh 40kg wt and 60kg wt respectively stand facing each other 5m apart on a smooth horizontal surface. They then pull a light rope stretched between them. Where they meet?
(A) 2.5 m from A
(B) 2m from A
(C) 3 m from A
(D) 1.5m from A

15. The radius of gyration of a thin spherical shell of radius R about its tangent is
(A) $\sqrt{\frac{2}{3}}R$
(B) $\sqrt{\frac{3}{5}}R$
(C) $\sqrt{\frac{2}{5}}R$
(D) $\sqrt{\frac{5}{3}}R$

16. A uniform rod of length ℓ hangs vertically from a hinge passing through one end. The initial angular velocity ω that must be imparted to the rod so as to rotate it through 90° is
(A) $\sqrt{\frac{g}{\ell}}$
(B) $\sqrt{\frac{2g}{\ell}}$
(C) $\sqrt{\frac{3g}{\ell}}$
(D) $\sqrt{\frac{6g}{\ell}}$

17. An accurate and reliable audio oscillator is used to standardise a tuning fork. When the oscillator reading is 514, two beats are heard per second. When the oscillator reading is 510, the beat frequency is 6 Hz. The frequency of the tuning fork is
(A) 506
(B) 510
(C) 516
(D) 158

18. A satellite is moving round the earth with velocity v. To make the satellite escape, the minimum percentage increase in its velocity is nearly
(A) 41.4%
(B) 82.8%
(C) 100%
(D) None of these

19. What is the value of acceleration at a height equal to the radius of earth from the surface of the earth?
(A) g/2
(B) g/4
(C) 3g/4
(D) 0

20. The excess pressure of first soap bubble is four times than second. Then the ratio of volume of the first bubble to second is
(A) 1 : 64
(B) 1 : 4
(C) 64 : 1
(D) 1 : 2

Space for rough work

Part – B
Numerical based questions

1. A car moving with constant acceleration covers the distance between two points 60 m apart in 6 s. Its speed as it passes the second point is 15 m/s. Find the speed (in m/s) at the first point.

2. A vessel contains a mixture of 1 mole of oxygen and 2 moles of hydrogen at 300K. Find the ratio of average rotational kinetic energy per O_2 molecule to that of per H_2 molecule.

3. Two masses 2kg and 5kg are connected by a light string passing over a frictionless pulley. Find the tension (in N) in the cord connecting the masses. (Take g=9.8 m/s^2)

4. A block of mass 10 kg accelerates uniformly from rest to a speed of 2m/s in 20 second. Find the average power (in W) at in time interval 0 to 20 second.

5. A steel wire of uniform cross-section of 1 mm^2 is heated to 70°C and stretched by tying its two ends rigidly. What is the change in the tension (in N) of the wire when the temperature falls from 70°C to 35°C? Coefficient of linear expansion of steel is (1.1. $\times$ 10^{-5} /°C and Young's modulus is $2.0\times10^{11}N/m^2$).

Space for rough work

SECTION – II: CHEMISTRY

Part – A: Single Correct Answer Type

This section contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**

1. What is the oxidation numbers of nitrogen in the following compounds?
   HNO_3, N_2O_5, $NaNO_3$ and NF_3
   (A) +5, +3, +2, -3
   (B) +5, +5, +5, -3
   (C) +5, +5, +5, +3
   (D) +5, +3, +3, +3

2. Each of the following set of quantum numbers represent an atomic orbital. Which orbital contains the least number of radial nodes?
   (A) n = 3, ℓ = 0, m = 0
   (B) n = 4, ℓ = 1, m = -1
   (C) n = 4, ℓ = 3, m = +2
   (D) n = 5, ℓ = 1, m = 0

3. Which of the following property of phosphorus is equal in PF_3 and PF_5?
   (A) Hybridization
   (B) Electronegativity
   (C) Non-bonding electrons
   (D) Mass of nucleus

4. Aqueous solution of which salt has maximum pH?
   (A) NaCl
   (B) CH_3COONa
   (C) $NaNO_3$
   (D) NaBr

5. Which compound of hydrogen contains polar as well as non-polar covalent bonds?
   (A) Heavy water
   (B) Hydrogen peroxide
   (C) Hard water
   (D) Deuterosulphuric acid

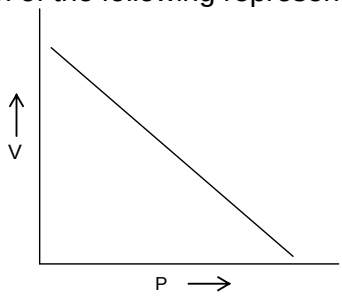
6. $SO_3(g) + CO(g) \rightleftharpoons SO_2(g) + CO_2(g)$
   The correct statement regarding above reaction is
   (A) Le-Chatelier's principle cannot be applied on it
   (B) $K_P = K_C$
   (C) $K_P = \dfrac{p_{CO} \times p_{SO_3}}{p_{SO_2} \times p_{CO_2}}$
   (D) At equilibrium K_C is always equal to one

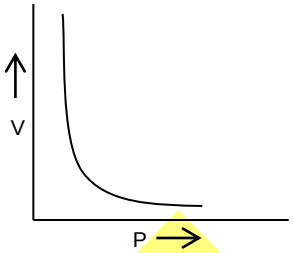
7. A mixture of aqueous solutions of CH_3COONa and HCl in 2 : 1 molar ratio can
   (A) behave as a buffer
   (B) display common ion effect
   (C) produce H^- ions
   (D) can form a diabasic acid

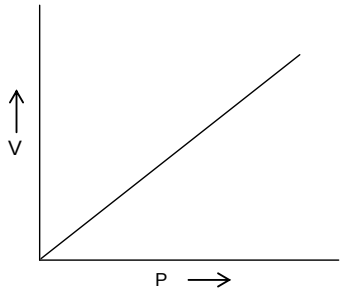
Space for rough work

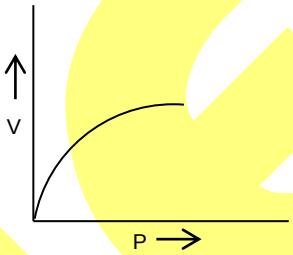
8. Which physical quantity of an ideal gas increases by increasing pressure and decreasing temperature?
(A) vapour density (B) relative density
(C) average kinetic energy (D) root mean square velocity

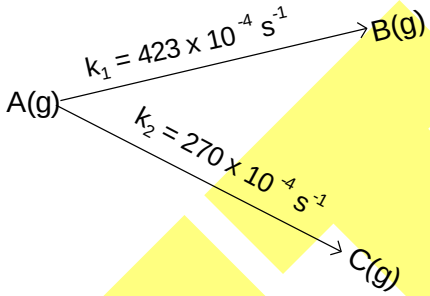
9. Which of the following represents an isothermal thermodynamic process?

(A) 

(B) 

(C) 

(D) 

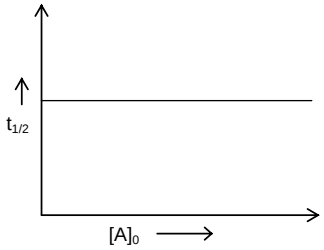
10. 

What is the half-life of (A) in second unit?
(A) 25.6 (B) 10
(C) 12 (D) 18.5

11. How many oxygen atom(s) is/are present in a molecule of unhydrated sodium metaborate?
(A) 1 (B) 2
(C) 3 (D) 4

Space for rough work

12. SiO_2 is dissolved in
(A) HCl (B) HBr
(C) HI (D) HF

13. Which of the following graph is correct for zero order reaction?
(A)


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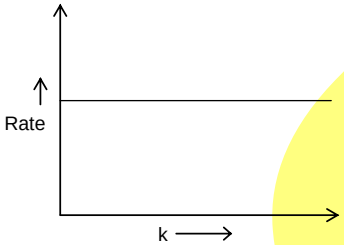

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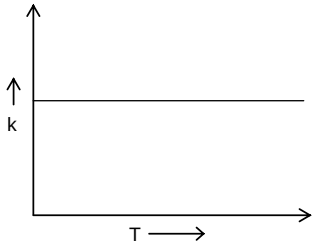
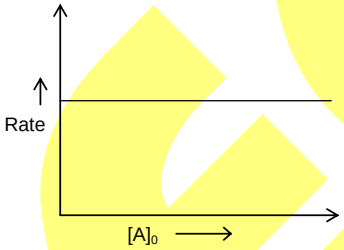
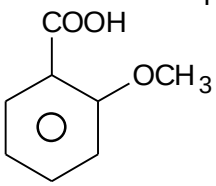
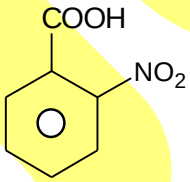
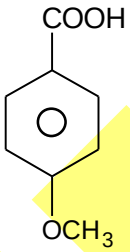
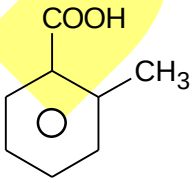


(D)


14. The most acidic compound out of the following is:
(A)


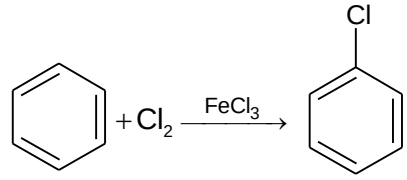
(B)


(C)


(D)


15. 2-chlorobutane and 1-chlorobutane are called
(A) functional isomers (B) metamers
(C) chain isomers (D) position isomers

Space for rough work

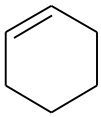
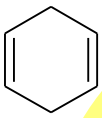
16. 

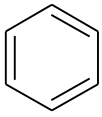
In above reaction, the reacting species is

(A) Cl^- (B) $:\dot{\underset{\cdot\cdot}{Cl}}:$

(C) Cl^+ (D) Cl^{2+}

17. Which of the following compound forms maximum number of different products in reductive ozonolysis reaction?

(A)  (B) 

(C)  (D) 

18. Which of the following is a sink of NO_2?

(A) Air (B) Ocean

(C) Earth crust (D) Soil

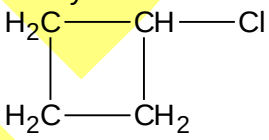
19. Which of the following electronic transition in hydrogen atom results in it's ionization?

(A) $n_1 = 1 \rightarrow n_2 = 4$ (B) $n_1 = 1 \rightarrow n_2 =$ infinity

(C) $n_1 = 1 \rightarrow n_2 = 0$ (D) $n_1 = 1 \rightarrow n_2 = 2$

20. Which of the following compound can react with maximum quantity of $NaNH_2$?

(A) 2-butene (B) 2-butyne

(C) $CH_3CH_2CH_2Cl$ (D) 

Space for rough work

Part – B
Numerical based questions

1. The solubility product constant of a salt XY_2 is 0.0625. What is the molarity of the saturated aqueous solution of XY_2?

2. $X_2Y(s) \longrightarrow X_2(g) + Y(g);\ \Delta H = 12.574\ kJ\ mol^{-1}$
What is the internal energy change of the above reaction in kJ mol^{-1} unit at 500 K?

3. $Ni(CO)_4(s) \rightleftharpoons Ni(s) + 4CO(g)$
The equilibrium constant K_p of above reaction is 506.25×10^{-2} atm^4 at a certain tempreaure. What is the equilibrium pressure of the reaction in atm unit?

4. An alkyl chloride(X) forms compound(Y) when it is heated with alcoholic KOH. Acidified permanganate oxidation of (Y) forms two moles of carboxylic acid(Z). Heating of the sodium salt of (Z) with sodalime results in the formation of CH_4. What is the molar mass of (X) in g mol^{-1} unit?

5. $Ca \xrightarrow{N_2+O_2} (P) \xrightarrow{H_2O} (Q) + (R)\uparrow$
$(P) \xrightarrow{HCl} (S) + (R)\uparrow$
$(S) \xrightarrow{Na_2CO_3} (T)\downarrow + (U)$
In above reaction, (P) is a mixture of two compounds. If the molar masses of (S) and (T) respectively are x and y g mol^{-1}. What is the value of $\left(\frac{x+y}{2}\right)$?

Space for rough work

SECTION – III: MATHEMATICS

Part – A: Single Correct Answer Type

This section contains **20 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**

1. If x_1 and x_2 are the solution of the equation $\sec x = 1+\cos x+\cos^2 x+\cos^3 x+.....\infty$ where $x_1, x_2 \in (0,2\pi)$. The value of $|x_1 - x_2|$, is

(A) $\frac{4\pi}{3}$ (B) $\frac{2\pi}{3}$

(C) $\frac{\pi}{3}$ (D) π

2. If product of the roots of the equation $x^2 - 2kx + 3e^{2\ln k} - 1 = 0$ is 11 (k > 0), then the sum of the roots is equal to

(A) 4 (B) 5

(C) 6 (D) 1

3. The number of four-digit numbers strictly greater than 4321 which can be formed using the digits 0, 1, 2, 3, 4, 5 (repetition of digits is allowed) is

(A) 306 (B) 310

(C) 360 (D) 288

4. If the fourth term in the binomial expansion of $\left(\frac{2}{x}+x^{\log_8 x}\right)^6$, $x>0$ is 20×8^7, then the value of x is

(A) 8^{-2} (B) 8^3

(C) 8 (D) 8^2

5. A straight line touches the rectangular hyperbola $9x^2 - 9y^2 = 8$ and the parabola $y^2 = 32x$. An equation of the line is

(A) $9x + 3y - 8 = 0$ (B) $9x - 3y + 8 = 0$

(C) $3x + 9y + 8 = 0$ (D) $9x - 3y - 8 = 0$

Space for rough work

6. If $\frac{z_2}{z_1}$ is pure imaginary, then $\left|\frac{6z_1+8z_2}{4z_2+3z_1}\right| =$

(A) 1 (B) $\sqrt{2}$
(C) 2 (D) 4

7. If roots of the cubic equation $x^3-7x^2+cx-8=0$ are in G.P., then the value of 'c' is
(A) 10 (B) 12
(C) 14 (D) 16

8. $\lim\limits_{x\to\infty}\frac{2x^2-5x+1}{x^2-x+2} =$

(A) $\frac{1}{2}$ (B) 2
(C) 0 (D) None of these

9. If α,β be the roots of $x^2+x+2=0$ and γ,δ be the roots of $x^2+3x+4=0$ then $(\alpha+\gamma)(\alpha+\delta)(\beta+\gamma)(\beta+\delta)$ is equal to
(A) –18 (B) 18
(C) 24 (D) 44

10. The coefficient of x^{18} in the product $(1+x)(1-x)^{10}(1+x+x^2)^9$ is
(A) 84 (B) -126
(C) -84 (D) 126

11. 2 circles of radii r_1 and r_2 both touching the coordinate axes, intersecting each other orthogonally. The ratio $\frac{r_1}{r_2}$ equals $(r_1>r_2)$ is
(A) $2+\sqrt{3}$ (B) $(\sqrt{3}+1)$
(C) $\sqrt{5}+1$ (D) $2+\sqrt{5}$

12. In an increasing geometric series of positive terms, the difference between the fifth and fourth terms is 576 and the difference between the second and first term is 9. The sum of the first five terms of this series, is
(A) 1061 (B) 1023
(C) 1024 (D) 768

Space for rough work

13. Let $x, y \in R$, $i = \sqrt{-1}$. If $\frac{(1+i)x - 2i}{3+i} + \frac{(2-3i)y + i}{3-i} = i$, then $x + y =$

(A) 1 (B) 2
(C) –1 (D) –3

14. Let the major axis of a standard ellipse equal the transverse axis of a standard hyperbola and their director circles have radii equal to 2R and R respectively: If e_1 and e_2 are the eccentricities of the ellipse and hyperbola then the correct relation is:

(A) $4e_1^2 - e_2^2 = 6$ (B) $e_1^2 - 4e_2^2 = 2$
(C) $4e_2^2 - e_1^2 = 6$ (D) $2e_1^3 - e_2^2 = 4$

15. A point on the straight line $3x + 5y = 15$, which is equidistant from the coordinate axes, will lie only in

(A) IV Quadrant (B) I Quadrant
(C) I and II Quadrants (D) I, II and IV Quadrants

16. Number of zeroes at the end in product of $5^6 \times 6^6 \times 7^6 \ldots\ldots 31^6$ is $8k^2 + 2k + 1$, then k equals

(A) 8 (B) 11
(C) 4 (D) 44

17. If $\log_{10}\left(ab^3\right) = \log_{10}\left(a^2b\right) = 1$, then the value of $\log_{10}(ab)$ is equal to

(A) $\frac{5}{3}$ (B) $\frac{3}{5}$
(C) $\frac{2}{5}$ (D) $\frac{1}{5}$

18. In an ellipse, with center at the origin, if the difference of the lengths of major axis and minor axis is 10 and one of the foci is at $(0, 5\sqrt{3})$, then the length of its latus rectum is:

(A) 6 (B) 5
(C) 8 (D) 10

19. Axis of a parabola lies along the x-axis. If its vertex and focus are at distances 2 units and 4 units respectively from the origin, on the positive x-axis, then which of the following points does not lie on the parabola?

(A) $(4, -4)$ (B) $\left(6, 4\sqrt{2}\right)$
(C) $(8, 6)$ (D) $\left(5, 2\sqrt{6}\right)$

Space for rough work

20. If $\cos(\alpha+\beta)=\frac{3}{5}$, $\sin(\alpha-\beta)=\frac{5}{13}$ and $0<\alpha,\beta<\frac{\pi}{4}$, then $\tan(2\alpha)$ is equal to

(A) $\frac{63}{52}$ (B) $\frac{63}{16}$

(C) $\frac{21}{16}$ (D) $\frac{33}{52}$

Part – B
Numerical based questions

1. Suppose that the points (h, k), $(1, 2)$ and $(-3, 4)$ lie on the line L_1. If a line L_2 passing through the points (h, k) and $(4, 3)$ is perpendicular to L_1, then $\frac{k}{h}$ is equal to

2. If the foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{b^2}=1$ and the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$ coincide then the value of b^2 is equal to

3. A rectangle is inscribed in a circle with a diameter lying along the line $3y=x+7$. If the two adjacent vertices of the rectangle are $(-8, 5)$ and $(6, 5)$, then the area of the rectangle (in square units) is

4. If one end of a focal chord of the parabola $y^2=16x$ is at $(1, 4)$, then the length of this focal chord is

5. The minimum value of $\sec^2\theta+4\operatorname{cosec}^2\theta$ is

Space for rough work

Answers – A

Answers

Physics

1.	C	2.	C	3.	D	4.	C
5.	A	6.	D	7.	D	8.	C
9.	B	10.	D	11.	B	12.	C
13.	D	14.	C	15.	D	16.	C
17.	C	18.	A	19.	B	20.	A

1.	5	2.	1	3.	28	4.	1
5.	77						

Chemistry

1.	C	2.	C	3.	D	4.	B
5.	B	6.	B	7.	A	8.	B
9.	B	10.	B	11.	B	12.	D
13.	D	14.	B	15.	D	16.	C
17.	D	18.	B	19.	B	20.	B

1.	0.25	2.	4.26	3.	1.5	4.	92.5
5.	105.5						

Mathematics

1.	A	2.	A	3.	B	4.	D
5.	B	6.	C	7.	C	8.	B
9.	D	10.	A	11.	A	12.	B
13.	B	14.	C	15.	C	16.	C
17.	B	18.	B	19.	C	20.	B

1.	3	2.	**7**	3.	84	4.	25
5.	9						

Hints & Solutions

Physics

Part-A

1. **C**

Sol. The displacement of the body during the time t as it comes back to the point of projection

$\Rightarrow$ $S = 0$

$\Rightarrow$ $v_0 t - \frac{1}{2} g t^2 = 0$

$\Rightarrow$ $t = \frac{2v_0}{g}$

During the same time t, the body moves in absence of gravity through a distance D′ = v.t, because in absence of gravity g = 0

$\Rightarrow$ $D' = v_0 = \left(\frac{2v_0}{g}\right) = \frac{2v_0^2}{g}$ …(A)

In presence of gravity the total distance covered is

$= D = 2H = 2 \frac{v_{02}^2}{2g} = \frac{v_0^2}{g}$ …(B)

(A) ÷ (B) $\Rightarrow$ D′ = 2D

Hence, (C) is correct

2. **C**

Sol. Let the vectors be

$\vec{A}$ & $\vec{B}$

$|\vec{A}| = |\vec{B}|$ (given)

$\frac{R_2}{R_1} = \sqrt{3}$ (given)

$\Rightarrow$ $\frac{R_2}{R_1} = \frac{\sqrt{A^2 + B^2 - 2AB\cos\theta}}{\sqrt{A^2 + B^2 + 2AB\cos\theta}} = \sqrt{3}$

Putting A = B we obtain $\theta = 120°$.

3. **D**

Sol. $\Delta P = F\Delta t = 30 \times 2 = 60$ kg m/s

4. **C**

Sol. Net force $F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 60°}$

$= \sqrt{1^2 + 1^2 + 2 \times 1 \times \frac{1}{2}} = \sqrt{3}N$

$a = \frac{F}{M} = \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{2} m/s^2$

5. **A**

Sol. $840 = 2.C_P(40 - 20)$

$\Rightarrow C_P = 21$

$\therefore C_v = C_P - R = 12.6$

$\therefore$ Q = $nC_v dt = 2\times12.6\times(60-40) = 504J$

Here A is correct.

6. **D**

Sol. According to the question given

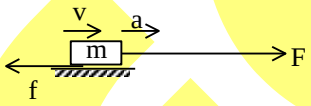
$$\frac{1}{2}m\omega^2y^2 = \frac{1}{2}\omega^2\left(a^2-y^2\right)$$

or $2y^2 = a^2$

or $y = \frac{a}{\sqrt{2}} = 2\sqrt{2}$ cm

7. **D**

Sol. Instantaneous power delivered = $P = \vec{F}.\vec{v} = Fv$



where, F – f = ma

$\Rightarrow$ F = f + ma

$\Rightarrow$ P = (f + ma) v

Put $f = \mu mg$

$\therefore$ $P = (\mu mg + ma)v = m(a + \mu g).at$

8. **C**

Sol. $P = \vec{F}.\vec{v}$

$= (5i - 3j + 6k).(10\,i + 10\,j + 20\,k)$

$= 50 - 30 + 120$

$= 140$ J/s

9. **B**

Sol. $Y = \frac{F.\ell}{A.\Delta\ell} \Rightarrow F = YA.\frac{\Delta\ell}{\ell}$

$=2\times10^{11}\times\frac{1}{100}\times A$

$n = \frac{1}{2\times1.5}\sqrt{\frac{F}{Ad}} = \frac{1}{3}\sqrt{\frac{2\times10^9 A}{A\times7.7\times10^3}}$

n = 170Hz

10. **D**

Sol. $3mv = \sqrt{(m\times60)^2+(m\times60)^2} = m\,60\sqrt{2}$

$v = 20\sqrt{2}$

11. **B**

Sol. $F = \frac{2\times3\times10\sqrt{3}}{0.25\times2}$

12. **C**

Sol. $40m_1 = (m_1 + m_2)\,30$

$\Rightarrow \frac{m_2}{m_1} = \frac{40}{30} - 1 \Rightarrow \frac{m_1}{m_2} = 3$

13. **D**

Sol. $V = \frac{dx}{dt} = 8t^3$

increase in kinetic energy = $\frac{1}{2}mv^2$

= $\frac{1}{2}\times 2\times(8)^2 = 64$

14. **C**

Sol. $X_{cm} = \frac{60\times 5}{40+60} = 3$ m

15. **D**

Sol. $I_{tangent} = I_{cm} + MR^2$

$= \frac{2}{3}MR^2 + MR^2 = \frac{5}{3}MR^2$

$\Rightarrow \quad Mk^2 = \frac{5}{3}MR^2 \quad \Rightarrow \quad k = \sqrt{\frac{5}{3}}R$

16. **C**

Sol. Initial K.E. of rotation = $\frac{1}{2}I\omega^2 = \frac{1}{2}.\frac{M\ell^2}{3}.\omega^2$

Initially, the total energy is P.E. = $Mg\frac{\ell}{2}$

where $\frac{\ell}{2}$ is the height through which c.m. of the rod is raised.

$\Rightarrow \quad \frac{1}{6}M\ell^2\omega^2 = \frac{1}{2}Mg\ell \quad \Rightarrow \quad \omega = \sqrt{3g/\ell}$

17. **C**

Sol. When the oscillator reading is 514, two beats are heard. Hence the frequency f the tuning fork is $514 \pm 2 = 516$ or 512. When the oscillator reading is 510, the frequency of the tuning fork is $510 \pm 6 = 516$ or 504. The common value is 516. Hence the frequency is 516 Hz.

18. **A**

Sol. $V_f = \sqrt{2}\,v$

19. **B**

Sol. Acceleration = $\frac{Gm}{(2r)^2} = \frac{g}{4}$

20. **A**

Sol. $\frac{P_1}{P_2} = 4$ or $P_1 = 4P_2$

or $\frac{r_1}{r_2} = \frac{1}{4}$

$\frac{v_1}{v_2} = \frac{r_1^3}{r_2^3} = \left(\frac{1}{4}\right)^3 = \frac{1}{64}$

Part-B

1. **5.00**

Sol. We have 15 $= v_0 + 6a$ Where v_0 = velocity at the first point

Also $60 = 6v_0 + \frac{1}{2}a.6^2$, a = acceleration in the direction from first to second point $= 6v_0 + 18a$

solving these two equations for v_0 & a

$a = 5/3\ m/s^2$ & $v_0 = 5$ m/s.

2. **1.00**

Sol. Rotational kinetic energy depends only on degree of freedom associated with which is same for both the diatomic molecules. i.e. 1 : 1 rotation.

3. **28.00**

Sol. $T = \frac{2m_1m_2}{m_1+m_2}g = \frac{2\times5\times2}{5+2}\times9.8 = 28N$

4. **1.00**

Sol. Average power

$$P_{av} = \frac{\text{Net work done}}{\text{Total time taken}}$$

Net work done = change in kinetic energy

= Final energy – initial energy

$= \frac{1}{2}\times10\times2^2 = 20J$

Time taken $= \frac{20}{20} = 1$Watt

5. **77.00**

Sol. The tension produced in a stretched wire due to fall in temperature by Δt is.

$F = YA\,\alpha\Delta t$

Where Y and α are the Young's modulus and coefficient of linear expansion of the material of the wire and A is the cross-sectional area.

Here $Y = 2.0 \times 10^{11} N/m^2$

$A = 1.0\ mm^2 = 1.0\times10^{-6}m^2$

$\alpha = 1.1 \times 10^{-5}/°C$

$\Delta t = (70 - 35) = 35°C$

$\therefore\quad F = 2.0 \times 10^{11} \times (1.0 \times 10^{-6}) \times (1.1 \times 10^{-6}) \times 35$

$= 77N$

Chemistry

1. C

Sol. The electronegativity order of the elements in the compounds follow the order:

F > O > N

$\therefore$ The oxidation states of N are +5, +5, +5 and +3.

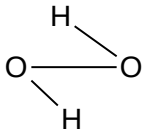
2. C

Sol. Number of radial nodes = (n - ℓ - 1)

3. D

4. B

5. B

Sol. Structure of H_2O_2 is 

Polar covalent bond is O – H

Non polar covalent bond is O – O

6. B

7. A

8. B

Sol. $d = \frac{PM}{RT}$ or $d \alpha \frac{P}{T}$

9. B

10. B

Sol. $t_{½}$ of A = $\frac{0.693}{k_1 + k_2} = \frac{0.693}{(423 + 270)10^{-4}} = \frac{0.693}{0.0693} = 10$

11. B

Sol. Sodium metaborate is $NaBO_2$.

12. D

Sol. $SiO_2 + 4HF \longrightarrow SiF_4 + 2H_2O$

Other halides of silicon undergo hydrolysis.

13. D

Sol. For zero order reaction.

Rate = k

14. B

15. D

16. C

17. D

18. B

19. B

20. B

Part – B

1. 0.25

Sol. $K_{sp} = 4s^3 = 0.0625$

On solving s = 0.25

2. 4.26

Sol. $\Delta E = \Delta H - \Delta nRT = 12.574 - 2 \times 8.314 \times 500 = 4.26 \text{ kJ mol}^{-1}$

3. 1.5

Sol. $K_p = p_{CO}^4 = 506.25 \times 10^{-2} \text{ atm}^4$

$p^{CO} = P_{equ^m} = (506.25 \times 10^{-2})^{1/4} = 1.5 \text{ atm}$

4. 92.5

Sol. $X = CH_3CH_2CH_2CH_2Cl$

$Y = CH_3CH = CHCH_3$

$Z = CH_3COOH$

5. 105.5

Sol. $P = CaO + Ca_3N_2$

$Q = Ca(OH)_2$, $R = NH_3$, $S = CaCl_2$, $T = CaCO_3$

$\therefore \frac{S+T}{2} = \frac{111+100}{2} = 105.5$