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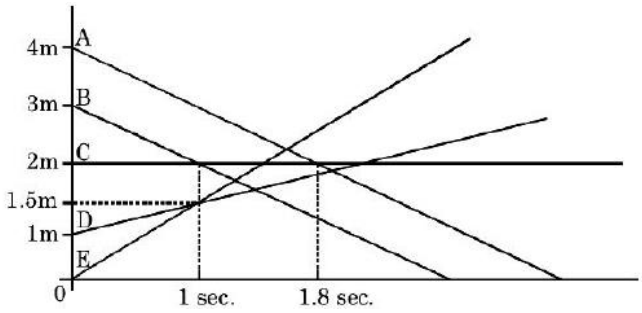
Speed Test–1

Physics **More than One Type Questions:**

01. 5 elastic balls A, B, C, D and E of same mass are moving on a long frictionless horizontal wire. A graph is drawn for their position x against time. Select the possible **CORRECT** statement(s) on basis of graph.



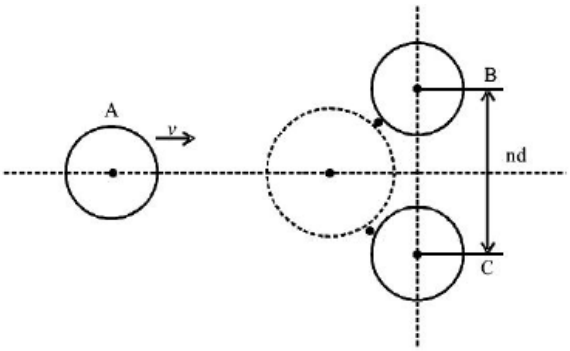
A) There are a total of 10 collisions.

B) Ball A finally moves with a velocity of + 1.5 m/s.

C) Ball C finally moves with a velocity of 0.5 m/s.

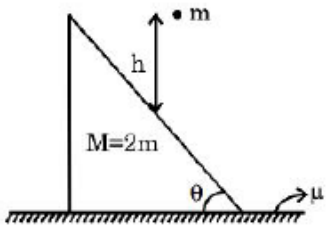
D) Ball D finally moves with a velocity of $\frac{-10}{9}$m/s.

02. Three identical discs A, B and C rest on a smooth horizontal plane as shown in figure. The disc A is set in motion with velocity v along the $\perp^r$ bisector of line BC. The distance between disc B and C is n times the diameter of each disc. For which of the following values of n will the disc A continue moving after elastic collision.



A) $n = \sqrt{2.5}$ B) $n = \sqrt{2}$ C) $n = \sqrt{1.5}$ D) $n = \sqrt{3}$

03. Diagram shows a wedge kept on a rough surface. A ball of mass 'm' is dropped on the slant face of the wedge. If the collision is perfectly elastic, choose the **CORRECT** statement(s) :



A) The ball of mass 'm' may jump to the same maximum height from the point of impact for some values of θ except 0^0.

B) Friction acting between wedge and ground is impulsive in nature.

C) Momentum of the system (M + m) can be conserved in horizontal direction.

D) We can choose some axis such that momentum of system (M + m) is conserved along that axis.

04. 2n identical cubical blocks are kept in a straight line on a horizontal smooth surface. The separation between any two consecutive blocks is same. The odd numbered blocks 1, 3, 5, ... (2n – 1) are given velocity v to the right whereas blocks
2, 4, 6 ..... 2n are given velocity v to the left. All collisions between blocks are perfectly elastic. Choose the **CORRECT** statement(s):-

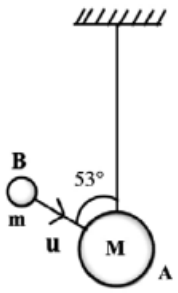
A) The total number of collisions that will take place is $\left(\frac{n(n+1)}{2}\right)$.

B) The total number of collisions that will take place in n(n + 1).

C) The total number of collisions that will take place is 2[n(n + 1)].

D) The velocity of COM of entire system after all the collisions will be zero.

05. A ball 'A' of mass M = 4 kg is suspended by a vertical string. Another ball 'B' of mass m = 1 kg moving with a velocity u = 5.8 m/s at an angle $\theta = 53°$ from vertical collides elastically with the ball 'A' as shown. Then choose the correct option(s).



A) The velocity of ball 'A' just after collision is 2 m/s

B) The velocity of ball 'B' just after collision is 4.2 m/s

C) The velocity of ball 'B' just after collision is 2 m/s

D) The impulse on the ball 'A' due to tension in the string is 6 N-s

06. A ball projected with speed 10 m/s at angle of projection $\theta = 30°$ with horizontal. Coefficient of restitution e=1/3 between ball and ground then $\left(g = 10 m/s^2\right)$

A) Displacement of ball up to third collision is $\left(\frac{65\sqrt{3}}{9}\right)m$

B) Maximum height attain after first collision is 0.14 m

C) Total energy of ball remain conserved

D) Total energy of ball not remain conserved

07. Which of the following is/are correct ?

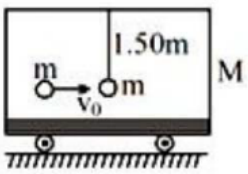
A) If the centre of the mass of three particles is at rest and it is known that two of them are moving along different non-collinear lines, then the third particles must also be moving

B) If the centre of mass of a system remains at rest, then the net work done by all the forces acting on the system must be zero.

C) If the speed of centre of mass of a system remains zero, then the net external force acting on the system must be zero

D) If the speed of centre of mass is changing, then there must be some work being done by the internal forces on the system.

08. A ball of mass m = 1 kg is hung vertically by a thread of length $l = 1.50m$.. Upper end of the thread is attached to the ceiling of a trolley of mass M = 4kg. Initially, trolley is stationary and it is free to move along horizontal rails without friction. A shell of mass m = 1kg, moving horizontally with velocity $v_0 = 6ms^{-1}$, collides with the ball and gets stuck with it. As a result, thread starts to deflect towards right $\left(g = 10\ ms^{-2}\right)$

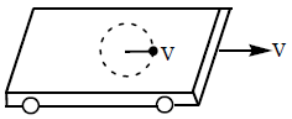


A) The maximum deflection of the thread with the vertical is 37°
B) The maximum deflection of the thread with the vertical is 45°
C) The velocity of the trolley at that instant of maximum inclination of thread is $1ms^{-1}$
D) The velocity of the trolley at that instant of maximum inclination of thread is $2ms^{-1}$

09. Two hydrogen like atoms A and B are of different masses and each atom contains equal no. of protons and neutrons. The energy difference between the radiation corresponding to first balmer lines emitted by A and B is 5.667 eV. When the atoms
A and B moving with the same velocity strikes a heavy target, they rebound back with the same velocity. In this process the atom B imparts twice the momentum to the target than that A imparts. Identify the atoms A and B.

A) ${}^{4}_{2}He, {}^{6}_{3}Li$ B) ${}^{2}_{1}H, {}^{4}_{2}He$ C) ${}^{2}_{1}H, {}^{6}_{3}Li$ D) None of these

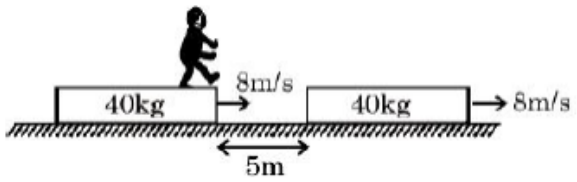
10. On a train moving along east with a constant speed v, a boy revolves a bob with string of length ℓ on smooth surface of the train, with same constant speed v relative to train. Mark the correct option (s).



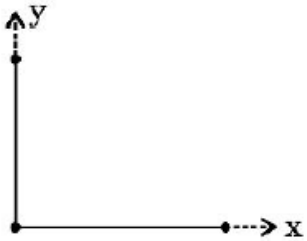
A) Maximum speed of the bob is 2v in ground frame.
B) Tension in the string connecting the bob is $\frac{4mv^2}{\ell}$ at an instant shown
C) Tension in the string is $\frac{mv^2}{\ell}$ at all the moments
D) Minimum speed of bob is zero in ground frame.

INTEGERS

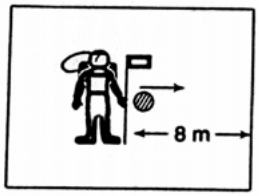
11. A boy of mass 40 kg is on a plank of mass 40 kg moving to right on a smooth floor at 8 m/s. He wants to jump on to an identical plank travelling in the front at the same speed. With what minimum speed (in m/s) relative to the plank on which he is standing, should he jump ? $\left(g = 10m/s^2\right)$



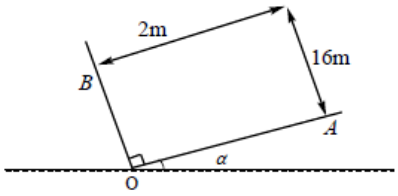
12. Two uniform rods of same length but different density are arranged as shown in the diagram. Centre of mass of this arrangement lies on a line ax + by = ℓ.
(ℓ is the length of rod) find a + b = ?



13. An astronaut has a mass of 50 kg and is at rest inside the satellite. He throws an object of mass 5 kg towards a wall of the satellite. He finds that the object moves away at a velocity of $12ms^{-1}$ relative to him. The object collides with the front wall and rebounds. How long (in s) after throwing the object the astronaut can catch the object ? Assume that collision of the object with the satellite wall is elastic and that the astronaut does not meet a collision till the object is back to him. The object was thrown at a distance of 8m from the wall.

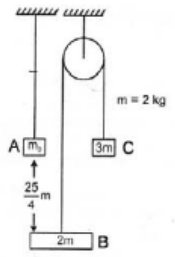


14. Two inclined planes OA and OB intersects at 'O' at 90° as shown in figure. An elastic ball is released at a point at perpendicular distances 16m and 2m from plane OA and OB respectively. All collisions are elastic.

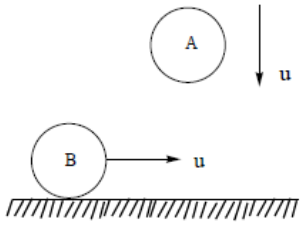


On an average, how many times does the ball bounce on plane OB for each time it bounces on plane OA ?

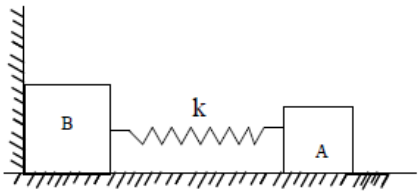
15. Given system is released from rest at the position shown in figure. Later on B collides with A and the collision is head on and elastic. After collision A attains maximum height 1.25 m from its initial position. The value of m_0 is nm Kg, find n. Take $\left(g = 10m/s^2\right)$



16. Two identical balls A and B are moving with same speed u = 9.8 m/s as shown in the fig. Ball A hits a smooth floor head on and at the same instant ball B strikes A head on with a horizontal velocity u $\left(g = 9.8m/s^2\right)$. The collision between A and B is perfectly inelastic whereas the coefficient of restitution for collision between A and the floor is e = 0.5. The time (in sec) after which the two balls will collide again? Assume friction to be absent everywhere.

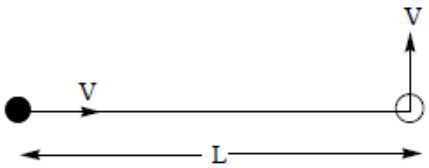


17. Two identical blocks A and B each having mass m are connected with a spring of force constant k. The floor is smooth and A is pushed so as to compress the spring by x_0, and The system is released from this position , acceleration of the centre of mass of the system at the instant when block A acquires half its maximum speed is $\left(\frac{Kx_0}{m}=4\right)$

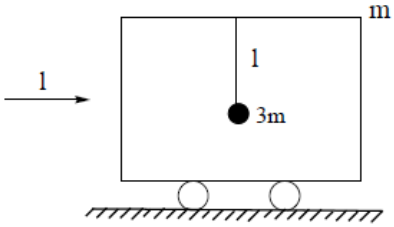


18. Two identical small balls are interconnected with a light and inextensible thread having length L. The system is on a smooth horizontal table with the thread just taut. Each ball is imparted a velocity v, one towards the other ball and the other in a direction that is perpendicular to the velocity given to the first ball as shown in the figure. kinetic energy of the system after the string gets taut is $n\left(\frac{1}{2}mV^2\right)$,

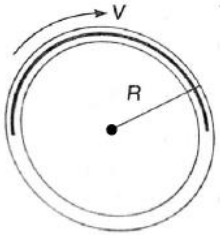
where n =



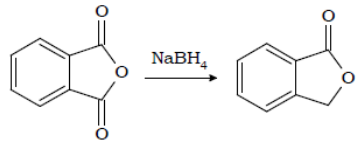
19. A toy car of mass m is placed on a smooth horizontal surface. A particle of mass 3m is suspended inside the car with the help of a string of length l. Initially everything is at rest. A sudden horizontal impulse, I = $2m\sqrt{gl}$ is applied on the car (as shown in figure) and it starts moving. If maximum angle that the string makes with the vertical is θ_0 subsequently, then the value of $\cos\theta_0$

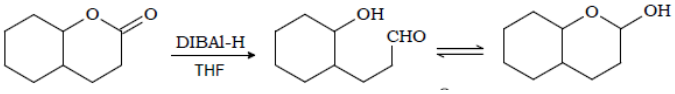


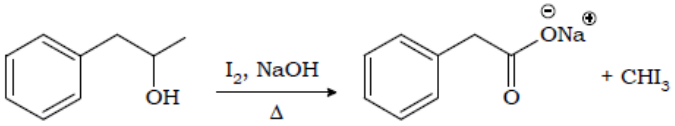
20. A metal wire having mass M is bent in the shape of a semicircle of radius R and is sliding inside a smooth circular grove of radius R present in a horizontal table. The wire just fits into the groove and is moving at a constant speed V. magnitude of net force acting on the wire is $K\left(\frac{MV^2}{R}\right)$, Where k =

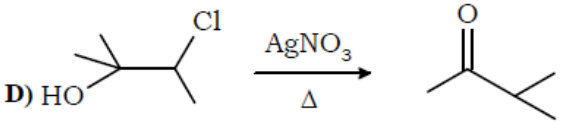


21. Which of the following transformations can be achieved

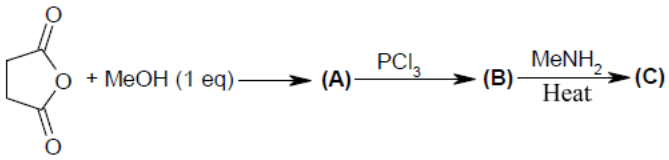
A) 

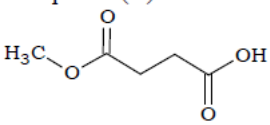
B) 

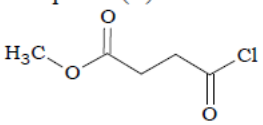
C) 

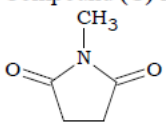
D) 

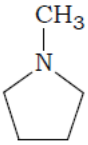
22. Correct statement(s) regarding the following reaction scheme is/are



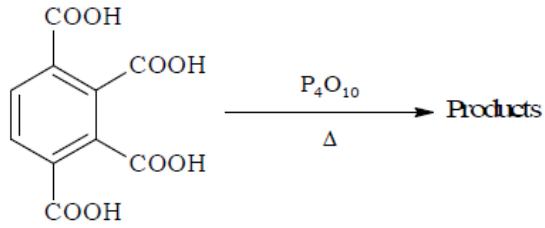
A) Compound (A) is 

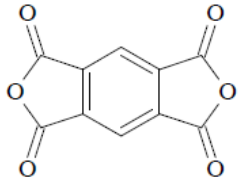
B) Compound (B) is 

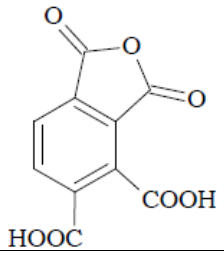
C) Compound (**C**) is 

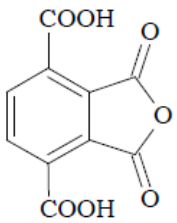
D) Compound (**C**) on reduction with $LiAlH_4$ gives 

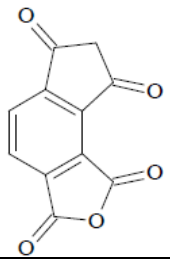
23. The probable product(s) of the following reaction is/are



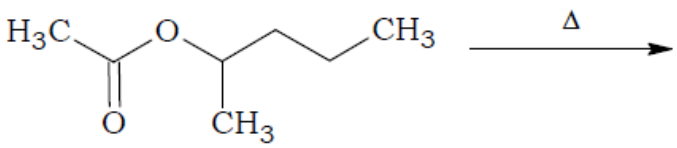
A) 

B) 

C) 

D) 

24. Correct statement(s) regarding the following reaction is/are



A) Acetic acid is one of the products. **C)** It proceeds through a cyclic transition state.

B) Cis and trans pent-2-ene are formed. **D)** Pent-1-ene is the major product.

25. Which of the following compounds could be converted to pentanal as major product in one or two steps?

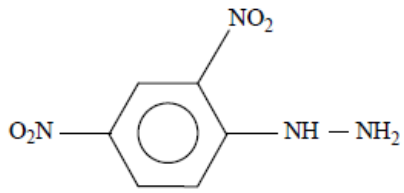
A) 1-pentyne **B)** trans-5-decene **C)** 2-pentanone **D)** 1-pentanol

26. Which of the following reagent/s give/s yellow precipitate with compound 'T'?

T =

A) Fehling solution

B) I_2/NaOH

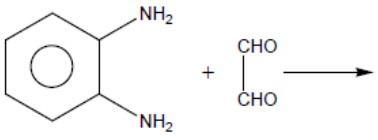


C)

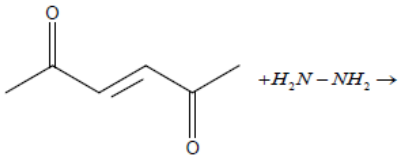
D) $AgNO_3+NH_4OH$

27. Which of the following will produce aromatic product?

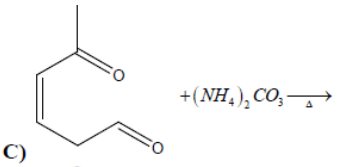
A)



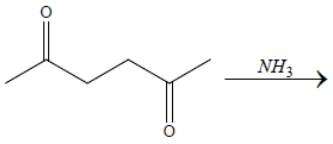
B)



C)

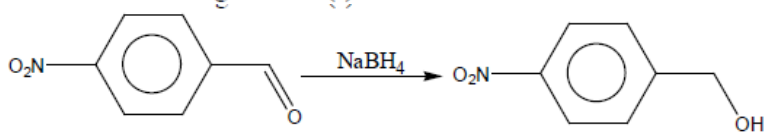


D)

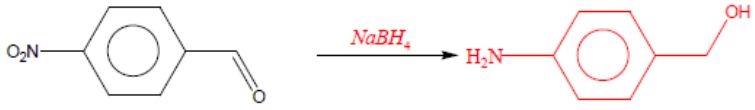


28. Which of the following reaction(s) is / are correct ?

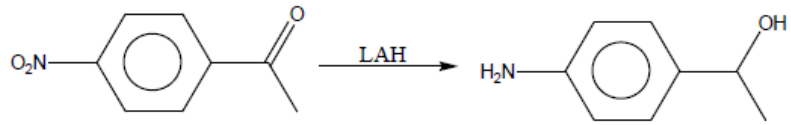
A)



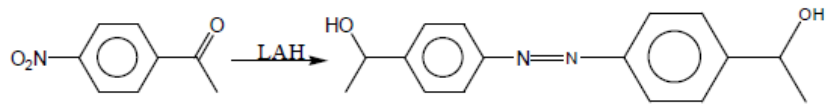
B)



C)



D)



29. Which of the following statements are **incorrect** about a carbonyl group?

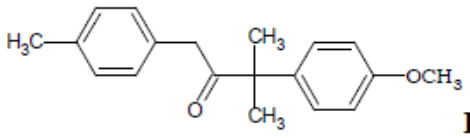
A) The carbonyl carbon has one π - bond and two sigma bonds.

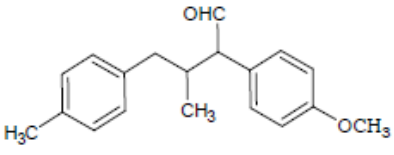
B) The carbonyl carbon has three hybrid orbitals and two pure p – orbitals.

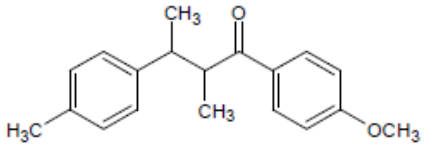
C) The three groups attached to carbonyl carbon lie in the same plane.

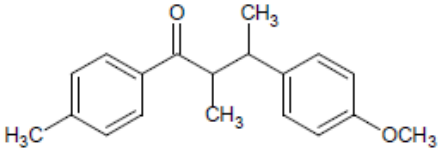
D) The three groups attached to carbonyl carbon lie in different planes.

30. Which of the following carbonyl compounds on reduction with Zn-Hg/Con. HCl give the same product?

A) 

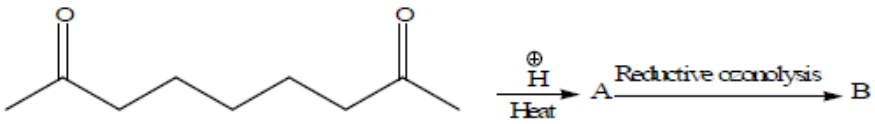
B) 

C) 

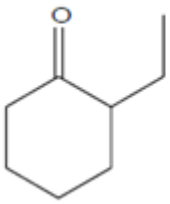
D) 

INTEGERS

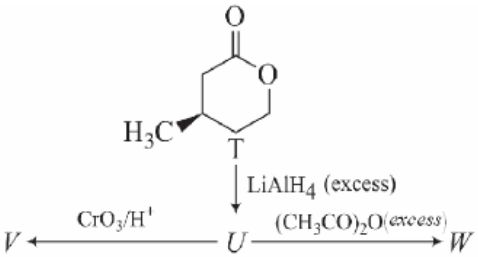
31. Find the molecular weight of the compound B in the following reaction sequence.



[Atomic weights: H = 1, C = 12, O = 16]

32. The number of β – Keto monocarboxylic acids (including stereoisomers) which on heating give 

33. The total number of non bonding electrons in the products U, V, W in the following sequence of reactions.

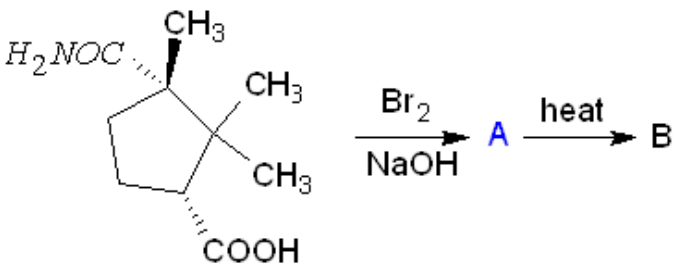


34. Acetone on heating with concentrated Sulphuric acid produces compound Z. Find the molecular weight of Z.

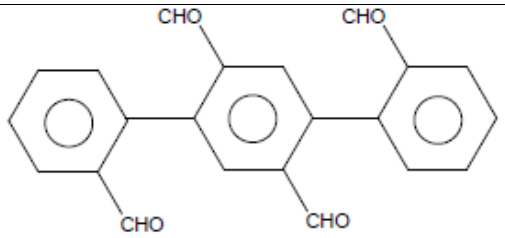
[Atomic weights: H = 1, C = 12, O = 16]

35. Find the molecular weight of **B** in grams in the following reaction sequence

[Atomic weights: H = 1, C = 12, N = 14, O = 16]

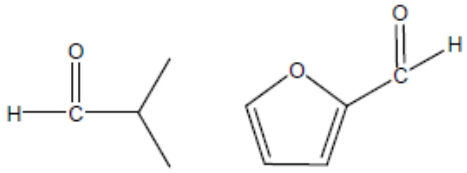


36.

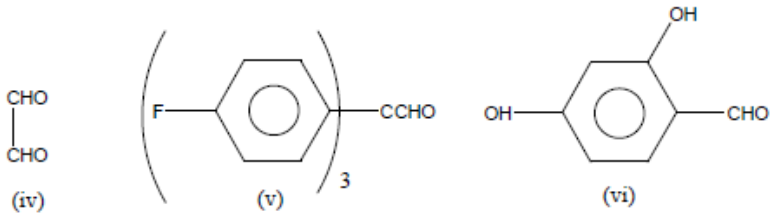


$\xrightarrow[\Delta]{OH^-}(Y)$ [No. of isomeric product obtained].

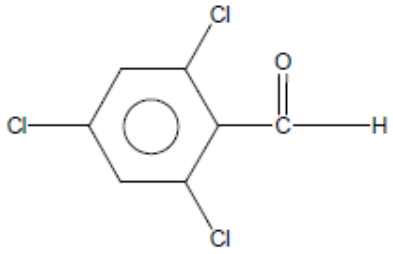
37. Identify the total no of compounds that will give cannizaro reaction

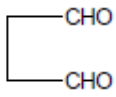


(i) (ii) (iii)



(iv) (v) (vi)

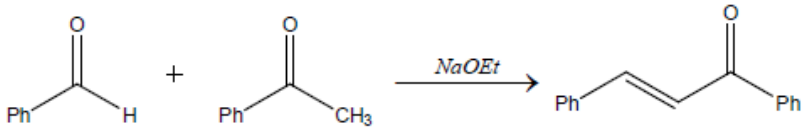




(vii) (viii)

38. 5.3g of Benzaldehyde was reacted with an excess of Acetophenone to produce 5.2g of the enone product as per the reaction shown below. The yield of the reaction is _____%.

(Round off to the nearest integer).

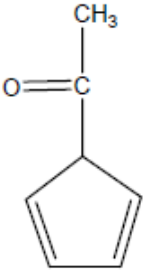


MW = 106 MW = 120 MW = 208

(MW = Molecular weight)

39. The number of dienals possible in the aldol condensation of a mixture of $H_3C—CHO$ and H_3C—CHO is (including stereomers):

40.



$\xrightarrow[\text{Long time}]{D_2O/O\bar{D}}$ A

How many no of hydrogens are replaced by Deuterium in the above reaction

41. Let $y'(x).g(x)-y(x).g'(x)+y^2(x)=0,\ y(-1)=1,\ x\in R$ where $f'(x)$ *denotes* $\frac{df(x)}{dx}$ and $g(x)$ is a given non-constant differentiable function on R

with $g(-1)=0$ then value of $\int_1^2\left(\frac{g(x)}{y(x)}.\frac{1}{x^2\sqrt{x^2+\left(\frac{g(x)}{y(x)}\right)^2}}\right)dx=$

A) $2\sqrt{5}-\sqrt{13}$ **B)** $\frac{7}{2\left(2\sqrt{5}+\sqrt{13}\right)}$ **C)** $\sqrt{13}-\sqrt{5}$ **D)** $\frac{7}{2\left(2\sqrt{5}-\sqrt{13}\right)}$

42. The curve C touches the line L defined below at x = 1, 2, 3

$C: a_6x^6+a_5x^5+a_4x^4+a_3x^3+a_2x^2+a_1x+a_0;\ L: y=mx+c$

if $a_6=1$, m, c, $a_i\in\mathbb{R}$, $i=0, 1, 2, 3, 4, 5$ then the area bounded by C and L is equal to

A) $\frac{3}{34}$ **B)** $\frac{5}{34}$ **C)** $\frac{16}{105}$ **D)** $\frac{11}{105}$

43. The solution of the differential equation $\frac{dy}{dx}+x(x+y)=x^3(x+y)^3-1$ is (where 'c' is arbitrary constant)

A) $\frac{1}{x+y}=x^2+1+ce^x$ **B)** $\frac{1}{(x+y)^2}=x^2+1+ce^{x^2}$

C) $\frac{1}{(x+y)^2}=x+1+ce^x$ **D)** $\frac{1}{x+y}=x+1+ce^{x^2}$

44. Let A(m) denotes the area of the region bounded by the curve $y=2^{2^x+x-2}(\ln 2)^2$ and x-axis between the lines x = 1 and x = m $(m\in N,\ m>2)$, then A(m) + 2 is

A) A prime number for all 'm' **B)** A composite number for all 'm'

C) A prime number for some 'm' **D)** An irrational number for some 'm'

45. A curve is given by $f(x)=x\sin\pi x$ then which of the following is/are **CORRECT**.

A) $\int_0^2 f(x)dx=-\frac{2}{\pi}$

B) $\int_0^2 f(x)dx=\frac{2}{\pi}$

C) Area between $y=x\sin\pi x$, x-axis, x = 0 and x = 2 is $\frac{4}{\pi}$.

D) Area between $y=x\sin\pi x$, x-axis, x = 0 and x = 2 is $\frac{2}{\pi}$.

46. If $y=f(x)$ defined in $(0,\pi)$ satisfies the differential equation $\frac{dy}{dx}=\sin 2x+3y\cot x$ and $y\left(\frac{\pi}{2}\right)=2$, then which of the following statement(s) is(are) **CORRECT** ?

A) $y\left(\frac{\pi}{6}\right)=0$

B) $y'\left(\frac{\pi}{3}\right)=\frac{9-3\sqrt{2}}{2}$

C) $y(x)$ increases in interval $\left(\frac{\pi}{6},\frac{\pi}{3}\right)$

D) The value of definite integral $\int_0^{\pi/2} y(x)dx$ equals π.

47. $f:\left(-\frac{\pi}{2},\frac{\pi}{2}\right)\to R$, $y=f(x)$ has primitive F(x) such that

$f(x)+\cos x.F(x)=\frac{\sin 2x}{(1+\sin x)^2}$, then which of the following is/are **TRUE**.

A) $f(x)=\frac{-2\cos x}{(1+\sin x)^2}-C\cos x e^{-\sin x}$

B) If $F(0)=2$ then $F(x)=\frac{2}{1+\sin x}$

C) If $F(0)=2$ then $F\left(\frac{\pi}{2}\right)=1$.

D) If $F(0)=2$ then $f(0)=-2$.

48. Let function $f(x)$ satisfy $x^2f'(x)+2xf(x)=e^x$ and $f(2)=\frac{e^2}{4}$. Which of the following is/are **CORRECT**?

A) $f(x)=1$ has exactly one real solution.

B) $f(x)=3$ has exactly three real solutions.

C) $f(x)$ has local maxima but no local minima.

D) $f(x)$ has local minima but no local maxima.

49. Let y(x) be a solution of the differential equation $(1+e^x)y'+ye^x=1$. If $y(0)=2$, then which of the following statements is(are) true?

(A) $y(-4)=0$

(B) $y(-2)=0$

(C) y(x) has a critical point in the interval $(-1,0)$

(D) y(x) has no critical point in the interval $(-1,0)$.

50. Let $y=f(x)$ be differentiable function and satisfy $f(0)=2$, $f'(0)=3$ and $f''(x)=f(x)$. Which of the following is/are **TRUE** ?

A) Range of the function y = f(x) is R

B) $f(\ell n2)=\frac{19}{4}$

C) Area enclosed by $y=f(x)$ with co-ordinate axes in 2nd quadrant is $3+\sqrt{2}$

D) Area enclosed by $y=f(x)$ with co-ordinate axes in 3rd quadrant is $3-\sqrt{5}$.

INTEGERS

51. Let $f(x)=\frac{\sin x}{x}$, $x\in(0,\pi)$ and $g(x)$ be its inverse. If A denotes area bounded by curve $y=g(x)$, x-axis, between $x=\frac{2}{\pi}$, $x=\frac{3}{\pi}$ and 'm' denotes slope of tangent to curve y = g(x) at the point where it meets the curve xy = 1, then which of the following options is/are correct?

A) $A\in\left(0,\frac{1}{6}\right)$ **B)** $A\in\left(\frac{1}{6},\frac{3}{2}\right)$ **C)** $m=-\frac{\pi^2}{4}$ **D)** $m=-\frac{4}{\pi^2}$

52. Let the curve y = f(x) passes through (4, -2) satisfying the differential equation $y(x+y^3)dx=x(y^3-x)dy$ and let

$y=g(x)=\int_{\frac{1}{8}}^{\sin^2 x}\sin^{-1}\sqrt{t}dt+\int_{\frac{1}{8}}^{\cos^2 x}\cos^{-1}\sqrt{t}\,dt,\ 0\le x\le\frac{\pi}{2}$ be second curve

then, which of the following options is/are correct?

	A) The equation of the curve $y=f(x)$ satisfies $ay^3+bx=0$ then a= b, a and b are positive integers **B)** The equation of the curve $y=f(x)$ satisfies $ay^3+bx=0$ then $a+b=3$, a and b are positive integers and co-prime **C)** The area of the region bounded by $y=f(x)$, $y=g(x)$ and $x=0$ is $\frac{1}{8}\left(\frac{3\pi}{8}\right)^4$ square units **D)** The area of the region bounded by $y=f(x)$, $y=g(x)$ and $x=0$ is $\frac{1}{8}\left(\frac{3\pi}{16}\right)^4$ square units
53.	Let A_n represents the area formed by the elements of set A, defined below. $A=\left\{(x,y)\in\mathbb{R}\times\mathbb{R};\ y\le[x]+\sqrt{\{x\}},\ y\ge0,\ 0\le x\le n,\ n\in\mathbb{N}\right\}$ If [.] denotes the greatest integer function and {.} denotes the fractional part function, then find the value of A_3+A_6
54.	Let f(x) and g(x) be two differentiable functions satisfying the following conditions: $f(0)=2,\ g(0)=1,\ f(x)+g'(x)=1=f'(x)+g(x),\ x\ge0$ The value of 2f(ln 2) + 3g(ln 3) is equal to :
55.	The functions f(x) and g(x) are defined as $f(x)=\begin{cases}-2, & -3\le x\le0\\ x-2, & 0<x\le3\end{cases}$, *and* $g(x)=\min\left(f(\lvert x\rvert)+\lvert f(x)\rvert,\ f(\lvert x\rvert)-\lvert f(x)\rvert\right)$ The area bounded by y =g(x), y = 0, x = 3, x = -3, is equal to
56.	If the family of straight lines in the x-y plane satisfying the property that the sum of x and y intercepts on co-ordinates axes is 2020 has differential equation $\left(x\frac{dy}{dx}-y\right)\left(\frac{dy}{dx}-1\right)+k\frac{dy}{dx}=0$ then the sum of digits of 'k' equals.
57.	A curve passing through (1, 1) and (0, k) satisfies the differential equation $\left(y+ye^{x/y}\right)dx+e^{x/y}(y-x)dy=0$, then [k] is equal to (where [.] denotes greatest integer function)
58.	Let 'C' be the curve passing through the point (1, 1) has the property that the perpendicular distance of the normal from origin at any point P of the curve is equal to distance of P from x-axis. If area bounded by curve 'C' and x-axis in first quadrant is $k\pi$ square units then 4k is equal to
59.	If $x\frac{dy}{dx}+2y=\log_e x$ then $\left[\frac{e^2y(e)-y(1)}{e^2+1}\right]=$_____ (Where [.] is G.I.F)
60.	The area enclosed by the curves $y=\sin x+\cos x$ and $y=\lvert\cos x-\sin x\rvert$ over the interval $\left[0,\frac{\pi}{2}\right]$ is A, value of $\left[A^2\right]$ is _____ . [.] is GIF

Physics Key sheet:–

1) ABD	**2) ACD**	**3) BD**	**4) AD**	**5) ABD**	**6) ABD**	**7) AC**	**8) AC**	**9) B**	**10) ACD**
11) 10	**12) 4**	**13) 1.6**	**14) 1**	**15) 5**	**16) 1**	**17) 1.73**	**18) 1.5**	**19) 0.5**	**20) 0.62 to 0.64**

Chemistry Key sheet:–

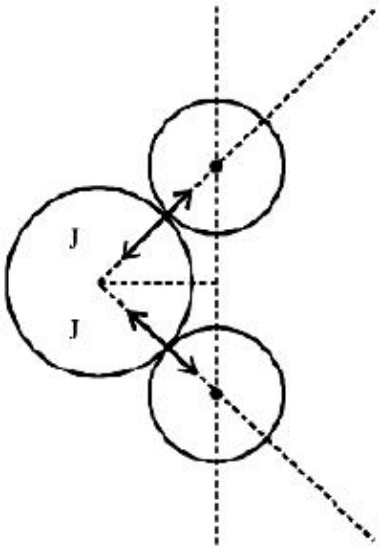
21) ABCD	**22) ABCD**	**23) BC**	**24) ABCD**	**25) ABD**	**26) BC**	**27) ACD**	**28) AD**	**29) ABD**	**30) BD**
31) 170	**32) 6**	**33) 40**	**34) 120**	**35) 153**	**36) 3**	**37) 4**	**38) 50**	**39) 4**	**40) 8**

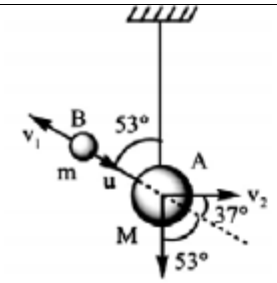
Mathematics Key sheet:–

41) B	**42) C**	**43) B**	**44) B**	**45) AC**	**46) AC**	**47) ABCD**	**48) ABD**	**49) AC**	**50) AB**
51) BC	**52) BD**	**53) 24**	**54) 3.50**	**55) 4**	**56) 4**	**57) 3**	**58) 2**	**59) 0**	**60) 1**

SOLUTIONS

PHYSICS

01.	From graph clearly there are 10 intersection points including the intersection of lines of A and B also ; So there are total 10 collisions. Now by exchanging the slope of line at each intersection we can easily find that final velocity of A, C and D are $V_A = +1.5$ m/s $V_C = 0$ $V_D = -\frac{10}{9}$ m/s
02.	(1) $2mv_1\cos\theta = mv$ (2) $\frac{1}{2}m\Omega = 2.\frac{1}{2}mv_1^2$ (3) $\sin\theta = \frac{nd/2}{d}$ (4) $mv = 2m.v_1\cos\theta$ $\theta = 45$ and $n = \sqrt{2}$ (for A to stop) 
03.	Friction at the horizontal surface will be impulsive in nature $\Rightarrow$ momentum of the system will not be conserved in horizontal direction. Momentum of the system (M + m) will be conserved in the direction $\perp$ to the net impulsive (normal + friction) force.
04.	Initially there will be n collisions. Exchange of velocity takes place between two colliding blocks. The two extreme blocks will move out and never encounter any other collision. Remaining (2n–2) blocks will further have (n–1) collisions and so on. This way total no. of collisions = $n+(n-1)+(n-2)+(n-3)+.....+3+2+1=\frac{n(n+1)}{2}$.
05.	Using conservation of momentum along horizontal directior



$mu\sin 53° = -mv_1\sin 53° + Mv_2 \quad \frac{4}{5}u = -v_1\frac{4}{5} + 4v_2 \quad 5v_2 - v_1 = u.....(1)$

$\frac{v_2\cos 37° + v_1}{u} = e = 1 \qquad 0.8v_2 + v_1 = u.....(2)$

Solving (1) and (2), we get $\quad 5.8v_2 = 2u \quad \Rightarrow v_2 = \frac{2u}{5.8} = 2m/s$

$v_1 = 5v_2 - u = 5\times 2 - 5.8 = 4.2m/s \qquad \int Ndt = m(v_1 + u) = 10N - s$

06.

$$x = u\cos\theta(t_0 + t_1 + t_2) = u\cos\theta\left(\frac{2u\sin\theta}{g} + \frac{e2u\sin\theta}{g} + \frac{e^2 2u\sin\theta}{g}\right)$$

$$h_1 = \frac{e^2u^2\sin^2\theta}{2g}$$

07. Conceptual

08. When shell strikes the ball and gets stuck with it. combined body of mass 2m starts to move to the right. Let velocity of combined body (just after collision) be v_1.

According to law of conservation of momentum, $(m+m)v_1 = mv_0 \; or \; v_1 = \frac{v_0}{2} = 3ms^{-1}.$

As soon as the combined body starts to move rightwards, thread becomes inclined to the vertical. Horizontal component of its tension retards the combined body while trolley accelerates rightwards due to the same component of tension.

Inclination of thread with the vertical continues to increase till velocities of both (combined body and trolley) become identical or combined body comes to rest relative to trolley. Let velocity at that instant of maximum inclination of thread be v. According to law of conservation of momentum. $(2m+M)v = 2mv_1 \; or \; v = 1ms^{-1}$

During collision of ball and shell, a part of energy is lost. But after that, there is no loss of energy. Hence, after collision, kinetic energy lost is used up in increasing gravitational potential energy of the combined body.

If maximum inclination of thread with the vertical be θ then according to law of conservation of energy, $\frac{1}{2}(2m)v_1^2 - \frac{1}{2}(2m+M)v^2 = 2mg(l - l\cos\theta) \quad \therefore \cos\theta = 0.8 \; or \; \theta = 37°$

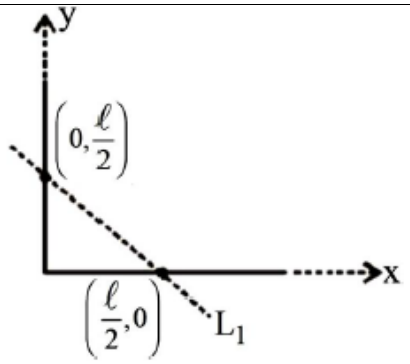
09.

$$(1)\ \Delta E = (\Delta E)_B - (\Delta E)_A = 13.6\times\frac{5}{36}\left(Z_A^2 - Z_B^2\right)$$

$(2)\ Z_A = 2Z_B$

$\Rightarrow Z_B = 1.Z_A = 2$

10. When particle passes through point 2 shown speed is zero and speed is maximum when particle passes through point 4. Frame of trolly in identical and continuously in trolly frame particle is performing uniform circular motion. $T = \frac{mv^2}{l}$; at all the position

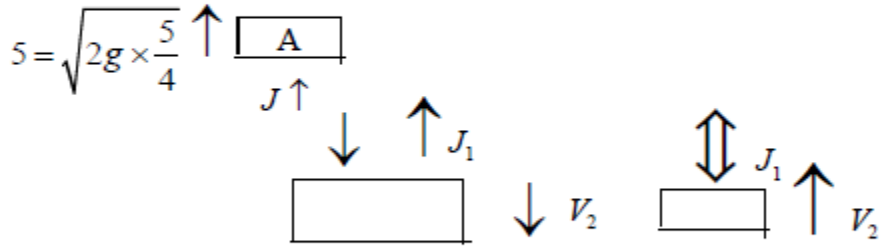
11.	$K = 8$ $S_{rel} = 5$ m $T = \frac{2u_y}{g} = \frac{u_y}{5}$ $40 \times v_1 + 40v_2 = 80 \times 8$ $v_1 + v_2 = 16 m/s \Rightarrow v_2 = 16 - v_1$ $v_1 - 8 = \frac{5}{T} = \frac{25}{u_y} \Rightarrow v_1 = 8 + \frac{25}{u_y}$ $v_1 - v_2 = v_{rel}x = 2v_1 - 16 = 16 + \frac{50}{u_y} - 16$ $v_{rel}y = u_y$ $v_{rel} = \sqrt{\frac{50^2}{u_y^2} + u_y^2}$ $v_{rel_{min}} xy_y - \frac{50^2}{u_y^3} \times 2 = 0$ $u_y^4 = 50^2$ $u_y = \sqrt{50} = 5\sqrt{2}$ $v_{rel} = \sqrt{50 + 50} = 10$ m/s
12.	 Centre of mass must lie on line L_1 $\frac{x}{\frac{\ell}{2}} + \frac{y}{\frac{\ell}{2}} = 1$ $2x + 2y = \ell$ $a + b = 4$
13.	Let the astronaut recoil with speed v_1 and speed of the object by v_2 Given $v_2 + v_1 = 12 \Rightarrow v_2 = 12 - v_1$, Momentum conservation gives : $5v_2 = 50v_1 \Rightarrow 12 - v_1 = 10v_1 \Rightarrow v_1 = \frac{12}{11} ms^{-1}$ And $v_2 = 12 - \frac{12}{11} = \frac{120}{11} ms^{-1}$ Let the object and astronaut meet after time t.Displacement of astronaut $x_1 = v_1 t = \frac{12t}{11}$ In this time the object travels a distance = $8 + 8 + x_1$ with a constant speed v_2. $\therefore 16 + x_1 = v_2 t \quad \Rightarrow 16 + \frac{12t}{11} = \frac{120}{11} t \Rightarrow 16 = \frac{108}{11} t \Rightarrow t = \frac{16 \times 11}{108} = 1.6s.$
14.	Let time taken to hit OB are $t_1 \& t_2$ respectively $a = \frac{1}{2} g \cos\theta t_1^2 b = \frac{1}{2} g \tan\theta t_1^2 \frac{t_1}{t_2} = 4.$

15.

$5=\frac{1}{2}(2)(t^2)\quad t=\frac{5}{2}S\qquad V_0=5m/s$

Before collision

After collision



$J-J_1=2m(V_2+5)\quad J_1=3m(V_2+5)$

$J=M_0 5$

C= 1 $\Rightarrow$ $V_2+5=5$

$V_2=0\qquad m_0=5M=10$

16.

Applying momentum conservation in horizontal direction, it is easy to see that the two balls will have horizontal component of velocity $V_x=\frac{u}{2}$

(Collision between the balls is perfectly inelastic).

Due to collision with the floor, ball A acquires a vertical velocity = 0.5u
Both balls are traveling in horizontal direction with same velocity after collision
Hence, they collide next where A falls back on to the floor

$t=\frac{2(0.5u)}{g}=\frac{u}{g}$

17.

(a) The normal force of wall on B is the reason for acceleration of the COM. Just when B is about to leave the wall (i.e. when the spring is relaxed) let the speed of A be v.

$\frac{1}{2}mv^2=\frac{1}{2}kx_0^2\Rightarrow v=\sqrt{\frac{k}{m}}x_0$

Speed of COM is $v_0=\frac{v}{2}=\frac{1}{2}\sqrt{\frac{k}{m}}x_0$

This is the final maximum speed.

(b) Let compression in the spring be x when speed of A is $\frac{v}{2}$

$\frac{1}{2}kx^2+\frac{1}{2}m\left(\frac{v}{2}\right)^2=\frac{1}{2}kx_0^2$

$kx^2+\frac{1}{4}kx_0^2=kx_0^2$

$x^2=\frac{3x_0^2}{4};x=\frac{\sqrt{3}x_0}{2}$

$\therefore$ Normal force by the wall $=\frac{\sqrt{3}kx_0}{2}$

$a_{cm}=\frac{\sqrt{3}kx_0}{2(2m)}=\frac{\sqrt{3}kx_0}{4m}$

18. (a) We will study the motion of second particle the reference frame attached to the first particle. The velocity of second particle makes an angle of 45° with the initial line joining the two particles (see fig 2) The thread is loose before the distance between particles again becomes L. Fig3 shows the situation just before the string gets taut

Required time is $t = \dfrac{L\sqrt{2}}{v\sqrt{2}} = \dfrac{L}{v}$

b) In the reference frame of ground, velocities just before the string gets taut, has been shown in fig. 4. The velocity component for the two particles along the string will be same for both particles after the string is taut. Fig.5 shows the situation immediately after the string gets taut.

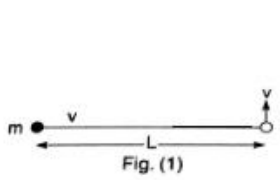


Fig. (1)

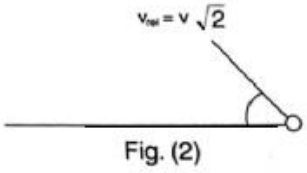


Fig. (2)

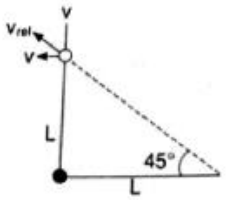


Fig. (3)

Fig. (4)

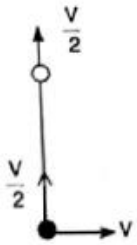


Fig. (5)

$t > \frac{L}{v}$

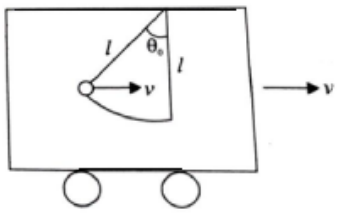
Now , total K.E. $= \dfrac{1}{2}\dfrac{mv^2}{4} + \dfrac{1}{2}mv^2\left(1^2 + \dfrac{1}{2^2}\right) = \dfrac{3}{4}mv^2$

19. (a) Immediately after the impulse, velocity of the car is $v_0 = \dfrac{I}{m} = 2\sqrt{gl}$

The sing will make maximum angle with the vertical when there is no relative motion between the particle and the car and both move horizontally with common velocity v.

$mv + 3mv = mv_0 \Rightarrow v = \dfrac{v_0}{4}$

Energy Conservation



$\dfrac{1}{2}(3m)v^2 + \dfrac{1}{2}mv^2 = mgl(1-\cos\theta)$

$\Rightarrow 1 - \cos\theta_0 = \dfrac{v_0^2}{8gl}$

$\Rightarrow \cos\theta_0 = 1 - \dfrac{4gl}{8gl}$

$\Rightarrow \theta_0 = 60^\circ$

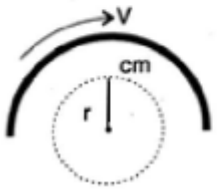
20.

The COM moves in a circle of radius $r = \frac{2R}{\pi}$

Angular speed of COM = angular speed of the wire $\omega = \frac{V}{R}$

$\therefore$ Net force $F = Ma_{cm} = M.\omega^2 r$

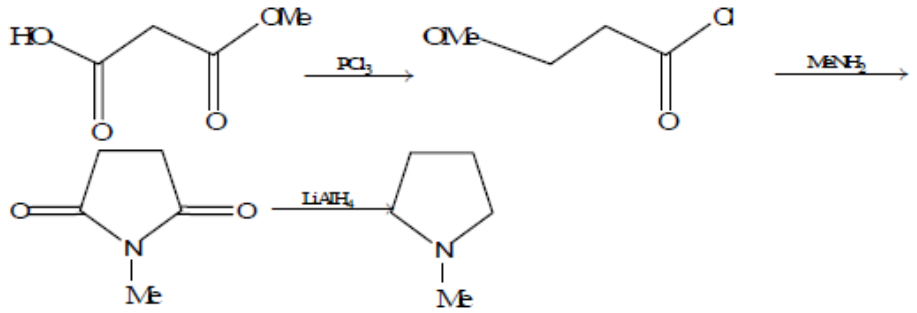
$= M\left(\frac{V}{R}\right)^2 .\left(\frac{2R}{\pi}\right) = \frac{2}{\pi}\frac{MV^2}{R}$



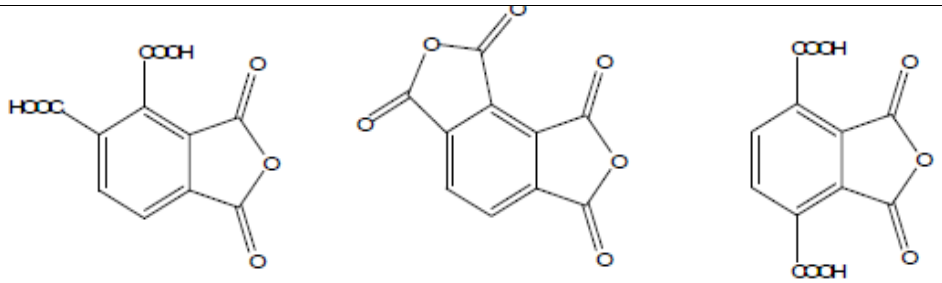
CHEMISTRY

21. All are correct transformations

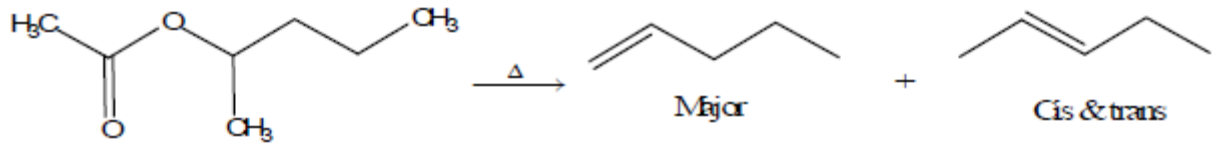
22.



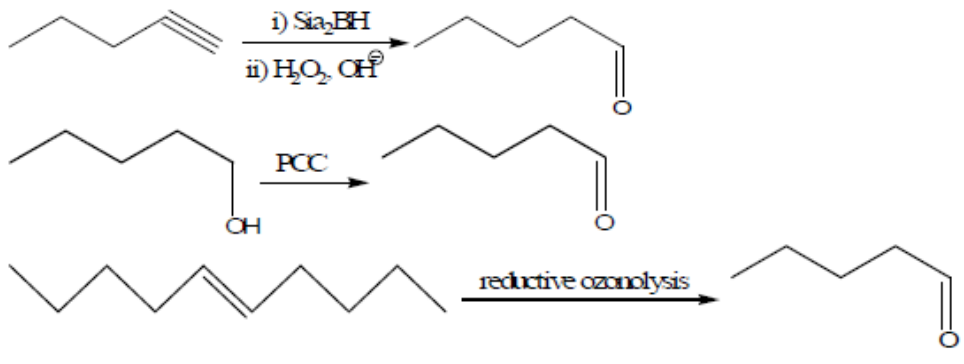
23.

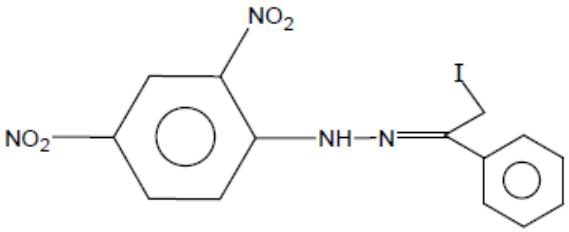
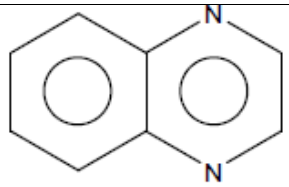
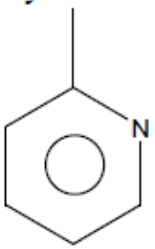
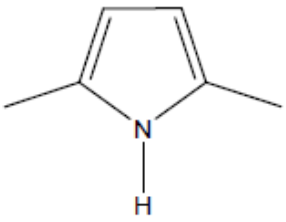
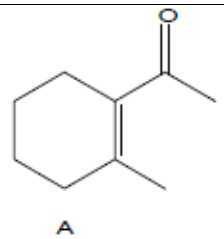
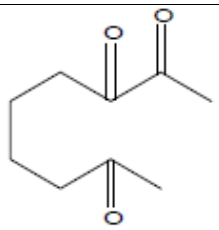
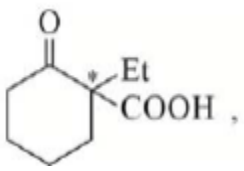
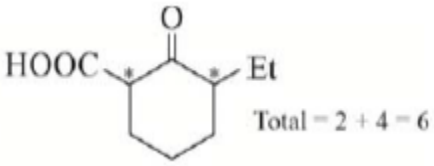
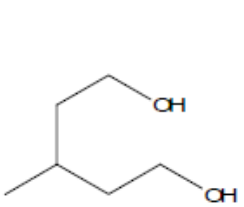
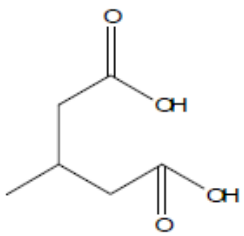
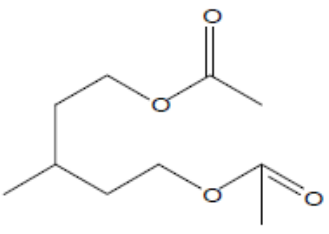


24.

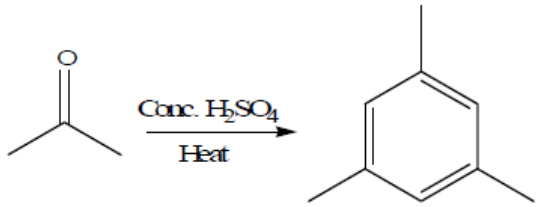


25.



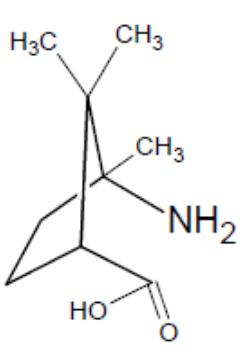
26.	In (B) and (C) → The corresponding yellow precipitates are CHI_3 and 
27.	 aromatic A) B) Cyclization is not possible with trans reactant.  C)  D)
28.	SBH cannot reduce $-NO_2$ group LAH with $-NO_2$ gives azobenzenes
29.	Carbonyl carbon is sp^2 hybridised.
30.	Clemenson reduction
31.	 A  nonane-2,3,8-trione B
32.	 ,  Total = 2 + 4 = 6
33.	 U  V  W

34.

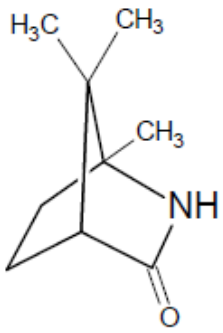


35.

B is $C_9H_{15}NO$

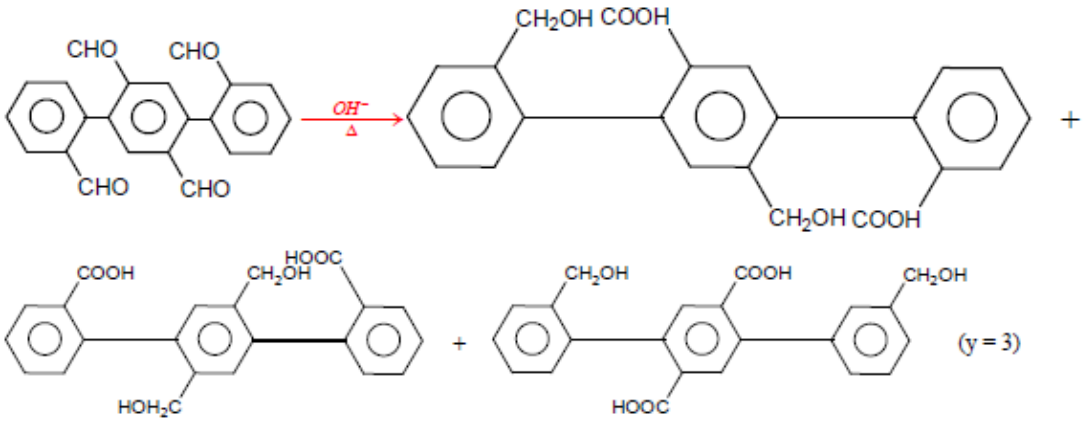


A

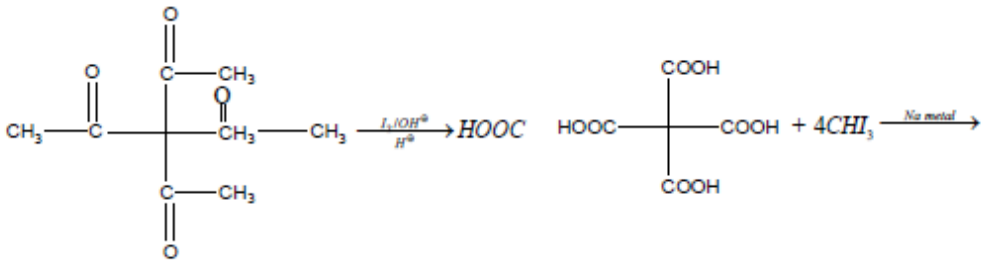


B

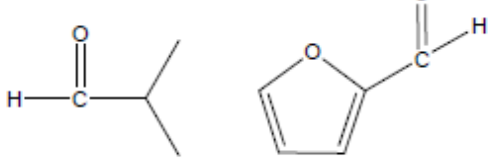
36.



37.



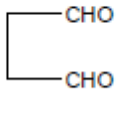
$2H_2\uparrow + C(COONa)_4$



(i)

(ii)

(iv)



(viii)

38. 1mole of Benzaldehyde forms 1 mole of Enone.

$$\frac{5.3}{106}=\frac{1}{20}\Rightarrow 0.05$$

$\Rightarrow 0.05$ mole of Benzaldehyde form 0.05 mole of Enone

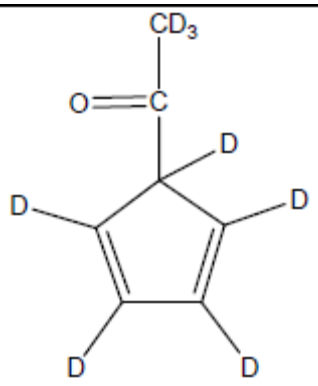
$$0.05\times 208=\frac{1040}{100}$$

$$=10.4$$

$$\boxed{\%yield=\frac{Actual\ yield}{Theortical\ yield}\times 100}$$

$$=\frac{5.2}{10.4}\times 100=50\%$$

39. $CH_3\ CH = CH - CH=CH - CHO$, it exhibits geometrical isomerism at both the double bonds.

40. 

MATHEMATICS

41.

$$y'(x).\,g(x)-y(x).\,g'(x)+y^2(x)=0 \qquad \Rightarrow \frac{g(x)}{y(x)}=x+c$$

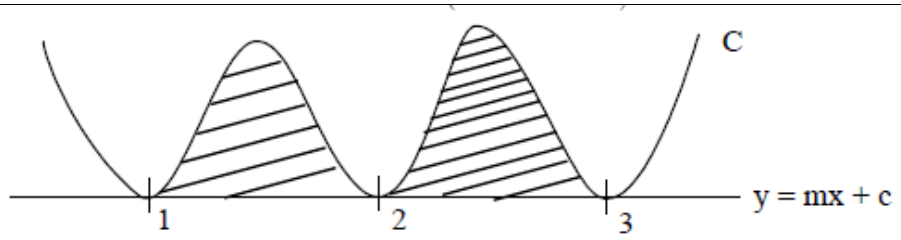
$$=-d\left(\frac{g(x)}{y(x)}\right)+1=0 \quad y(-1)=1\ and\ g(-1)=0$$

$$=\int_1^2 \frac{(1+x)dx}{x^2\sqrt{x^2+(1+x)^2}} \quad \left(-\frac{2}{x^2}-\frac{2}{x^3}\right)dx=2t\ dt$$

$$=\int_1^2 \frac{(1+x)dx}{x^2\sqrt{2+\frac{2}{x}+\frac{1}{x^2}}} \quad put\ 2+\frac{2}{x}+\frac{1}{x^2}=t^2$$

$$=\sqrt{5}-\frac{\sqrt{13}}{2}=\frac{2\sqrt{5}-\sqrt{13}}{2}=\frac{7}{2\left(2\sqrt{5}+\sqrt{13}\right)}$$

42.



Required area

$$= \int_1^3 \left(x^6 + a_5x^5 + ... + a_0\right) - (mx + c)\,dx = \int_1^3 (x-1)^2(x-2)^2(x-3)^2\,dx$$

$$= \int_{-1}^1 \left[(x+1)x(x-1)\right]^2 dx = \int_{-1}^1 \left(x^3 - x\right)^2 dx = \int_{-1}^1 x^6 + x^2 - 2x^4 dx$$

$$= 2\left[\frac{1}{7} + \frac{1}{3} - \frac{2}{5}\right] = \frac{2[15 + 35 - 42]}{105} = \frac{16}{105}$$

43.

$$Let\ t = \frac{1}{(x+y)^2} \qquad \frac{dt}{dx} = -\frac{2}{(x+y)^3}\left(1 + \frac{dy}{dx}\right)$$

$$so\ \frac{1}{(x+y)^3}\frac{dy}{dx} + \frac{x}{(x+y)^2} - x^3 = \frac{-1}{(x+y)^3}$$

44.

$$A(m) = \int_1^m 2^{2^n + x - 2}(\ln 2)^2\,dx$$

$$Let\ 2^{2^n} = t \Rightarrow \left(2^{2^n}.\ln 2.2^x.\ln 2\right)dx = dt$$

$$\therefore A(m) = \frac{1}{4}\int_{t=4}^{2^{2^m}} dt = \frac{1}{2}\left[2^{2^m} - 4\right] = 2^{2m-2} - 1 \quad let\ 2^{2^{m-2}} - \frac{1}{2} = k$$

$$A(m) + 2 = k^4 + 1 = \left(k^2 - \sqrt{2}k + 1\right)\left(k^2 + \sqrt{2}k + 1\right)$$

$k^2.\sqrt{2}k$ are integers for $m \in N,\ m > 2$

45.

$$\int_0^2 (x\sin\pi x)\,dx$$

Use by parts

$$\int_0^1 (x\sin\pi x)\,dx + \left|\int_1^2 x\sin\pi x\,dx\right|.$$

46.

Given, $\frac{dy}{dx} - 3y\cot x = \sin 2x$, $y\left(\frac{\pi}{2}\right) = 2$ (Linear differential equation)

$\therefore$ I.F. $= e^{-\int 3\cot x dx} = e^{-3\ln(\sin x)} = \frac{1}{\sin^3 x}$

$\therefore$ General solution is $y\left(\frac{1}{\sin^3 x}\right) = \int \frac{2\sin x \cdot \cos x}{\sin^3 x} dx + C = 2\int \operatorname{cosec} x \cot x \, dx + C$

$\Rightarrow \frac{y}{\sin^3 x} = -2\operatorname{cosec} x + C$

As, $y\left(x = \frac{\pi}{2}\right) = 2 \Rightarrow \frac{2}{1^3} = -2 + C \Rightarrow C = 4$.

$\therefore y = \left(4\sin^3 x - 2\sin^2 x\right)$

(A) $y\left(\frac{\pi}{6}\right) = 4\left(\frac{1}{2}\right)^3 - 2\left(\frac{1}{2}\right)^2 = \frac{1}{2} - \frac{1}{2} = 0$

(B) $y'(x) = \left(12\sin^2 x \cos x - 4\sin x \cos x\right)$

So, $y'\left(\frac{\pi}{3}\right) = \left(\frac{12\times 3}{4} \times \frac{1}{2} - 4 \times \frac{\sqrt{3}}{2} \times \frac{1}{2}\right) = \frac{9}{2} - \frac{2\sqrt{3}}{2} = \left(\frac{9 - 2\sqrt{3}}{2}\right)$

(C) As, $y'(x) = 4\sin x \cos x\left(3\sin x - 1\right) = 2\sin 2x\left(3\sin x - 1\right)$

$\therefore y(x)$ increases in $\left(\frac{\pi}{6}, \frac{\pi}{3}\right)$

47.

Let $y = F(x) \Rightarrow \frac{dy}{dx} + \cos x . y = \frac{2\sin x \cos x}{(1+\sin x)^2}$

I.F $= e^{\int \cos x dx} = e^{\sin x}$

Sol: $ye^{\sin x} = \underbrace{\int \frac{2\sin x \cos x . e^{\sin x} dx}{(1+\sin x)^2}}_{I} + C$ _____(1)

$I = \int \frac{2te^t}{(1+t)^2} dt = 2\int \frac{\left[(1+t)-1\right]e^t dt}{(1+t)^2}$

$I = 2\int e^t \left(\frac{1}{1+t} - \frac{1}{(1+t)^2}\right) dt = \frac{2e^t}{1+t}$

From (1)

$ye^{\sin x} = \frac{2e^{\sin x}}{1+\sin x} + c; \ \therefore 2 = 2 + c$

$c = 0$

$y = \frac{2}{1+\sin x} + c.e^{-\sin x}$

$\frac{dy}{dx} = \frac{-2\cos x}{(1+\sin x)^2} - c\cos x e^{-\sin x} = f(x)$

48. $f(x)=\frac{e^x}{x^2}$

49. $y'+e^x y'+ye^x=1$

$\Rightarrow dy+d\left(e^x y\right)=dx$

$\Rightarrow y+e^x y=x+c$

$\because\ y(0)=2\ \Rightarrow\ c=4$

50. $\frac{dy}{\sqrt{y^2+5}}=\pm dx\Rightarrow \ell n\left(y+\sqrt{y^2+5}\right)=\pm x+c$

Put $x=0,\ y=2.$

$\ell n(5)=c$

$\ell n\left(\sqrt{y^2+5}+y\right)=\pm x+\ell n5$

$\sqrt{y^2+5}+y=5e^x$ --------(1)

$\frac{1}{\sqrt{y^2+5}+y}=\frac{1}{5e^x}$

$\sqrt{y^2+5}-y=\frac{1}{e^x}$ _____(2)

(1) – (2)

$2y=5e^x-\frac{1}{e^x}$

$y=\frac{1}{2}\left[5e^x-\frac{1}{e^x}\right]$

$y(\ln 2)=\frac{1}{2}\left[10-\frac{1}{2}\right]=\frac{1}{2}\left[\frac{19}{2}\right]$

$y(\ell n2)=\frac{19}{4}$

$f''(x)=f(x)\Rightarrow f'(x)f''(x)=f'(x)f(x)\ \frac{(f'(x))^2}{2}=\frac{f^2(x)}{2}+c$

$\frac{9}{2}=2+c\ \Rightarrow \frac{9}{2}-2=c\Rightarrow c=\frac{5}{2}.$

$\left(\frac{dy}{dx}\right)^2=y^2+5\Rightarrow \frac{dy}{dx}=\pm\sqrt{y^2+5}.$

INTEGERS

51. $A=-\frac{1}{2}+\int_{\frac{\pi}{6}}^{\frac{\pi}{2}}\frac{\sin t}{t}\,dt \qquad and\ m=\frac{1}{f'\left(\frac{\pi}{2}\right)}$

52.	Given D.E $x^2y^3\left(\frac{ydx-xdy}{x^2}\right)+x.(xdy+ydx)=0$ $or\ \frac{y}{x}.d\left(\frac{y}{x}\right)-\frac{d(xy)}{x^2y^2}=0\Rightarrow\frac{1}{2}\left(\frac{y}{x}\right)^2+\frac{1}{xy}=C$ (On integrating) $use\ (4.-2)\Rightarrow C=0\Rightarrow y^3=-2x\ for\ g(x)$ $g'(x)=0\Rightarrow g(x)=C\ at\ x=\frac{\pi}{4};g\left(\frac{\pi}{4}\right)=\frac{3\pi}{16}$ $so\ g(x)=\frac{3\pi}{16}$
53.	$A_n=\int_0^n[x]+\sqrt{x-[x]}\,dx=\sum_{r=0}^{n-1}\int_r^{r+1}[x]+\sqrt{\{x\}}\,dx=$ $=\sum_{r=0}^{n-1}\int_0^1[x]+r+\sqrt{\{x\}}\,dx=\sum_{r=0}^{n-1}\int_0^1 0+r+\sqrt{x}\,dx=\sum_{r=0}^{n-1}\left(r+\frac{2}{3}\right)=\frac{n(n-1)}{2}+\frac{2n}{3}$
54.	$f(x)+g'(x)=1\ and\ f'(x)+g(x)=1\therefore f(x)+g(x)+f'(x)+g'(x)=2\ and$ $f(x)-g(x)=f'(x)-g'(x)$ $\Rightarrow f(x)+g(x)=2+e^{-x}\ and\ f(x)-g(x)=e^x$ $\Rightarrow f(\ln 2)=\frac{1}{2}\left(2+2+\frac{1}{2}\right)=\left(\frac{9}{4}\right)\ and\ g(\ln 3)=\frac{1}{2}\left(2+3-\frac{1}{3}\right)$
55.	$g(x)=-4-x;-3<x<0$ $2x-4;0<x<2$ $0;2<x<3$
56.	$\frac{x}{a}+\frac{y}{b}=1$ and $a+b=2020$ $\therefore\frac{x}{2020-b}+\frac{y}{b}=1$ forming the D.E by eliminating 'b' we get $\left(x\frac{dy}{dx}-y\right)\left(\frac{dy}{dx}-1\right)+2020\frac{dy}{dx}=0\ \Rightarrow k=2020\Rightarrow sum=4$

57.

$$\left(1+e^{\frac{x}{y}}\right)dx+e^{\frac{x}{y}}\left(1-\frac{x}{y}\right)dy=0$$

$$\Rightarrow dx+e^{\frac{x}{y}}dy+y\left(-\frac{x}{y^2}\right)e^{\frac{x}{y}}dy+e^{\frac{x}{y}}dx=0$$

$$\Rightarrow dx+e^{\frac{x}{y}}dy+y.d\left(e^{\frac{x}{y}}\right)=0$$

$$\Rightarrow dx+d\left(y.e^{x/y}\right)=0$$

$$\Rightarrow x+y.e^{\frac{x}{y}}=c$$

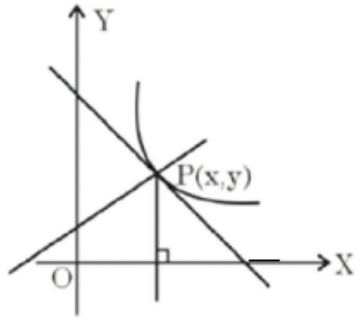
Passes through (1, 1), so c = 1 +e

Putting x = 0; y = c = 1 +e

i.e; k = 1 +e

$\therefore [k]=[1+e]=3$.

58.



Equation of normal is $Y-y=\frac{-1}{m}(X-x)$

$X+mY-(x+my)=0 \qquad .....(1)$

Perpendicular distance from (0, 0) to equation (1) is $\left|\frac{x+my}{\sqrt{1+m^2}}\right|=|y|$

$$\Rightarrow 2xy\frac{dy}{dx}=y^2-x^2$$

Put $y^2=t\Rightarrow 2y\frac{dy}{dx}=\frac{dt}{dx}$

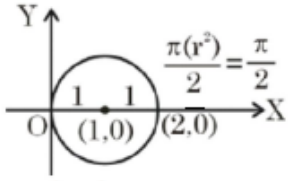
$$x\frac{dt}{dx}=t-x^2$$

$$\Rightarrow \frac{dt}{dx}-\frac{t}{x}=-x$$

$I.F=e^{-\int\frac{1}{x}dx}=\frac{1}{x}$

$$\frac{t}{x}=-x+c\Rightarrow\frac{y^2}{x}=-x+c$$

(1,1) lies on it so c = 2



$C: x^2+y^2-2x=0$

Area $=\frac{\pi}{2}$

$\therefore k=\frac{1}{2}=0.50$

59.

$$\frac{dy}{dx}+\frac{2}{x}y=\frac{\log_e x}{x}$$

$$y.x^2\int x^2\cdot\frac{\log x}{x}dx=\int x\log_e x dx$$

$$yx^2=\frac{x^2}{2}\log x-\frac{x^2}{4}+c$$

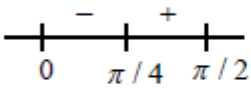
$$\therefore e^2y(e)-y(1)=\frac{e^2+1}{4}$$

$$\frac{e^2y(e)-y(1)}{e^2+1}=\frac{1}{4}\Rightarrow\left[\frac{e^2y(e)-y(1)}{e^2+1}\right]=0$$

60.

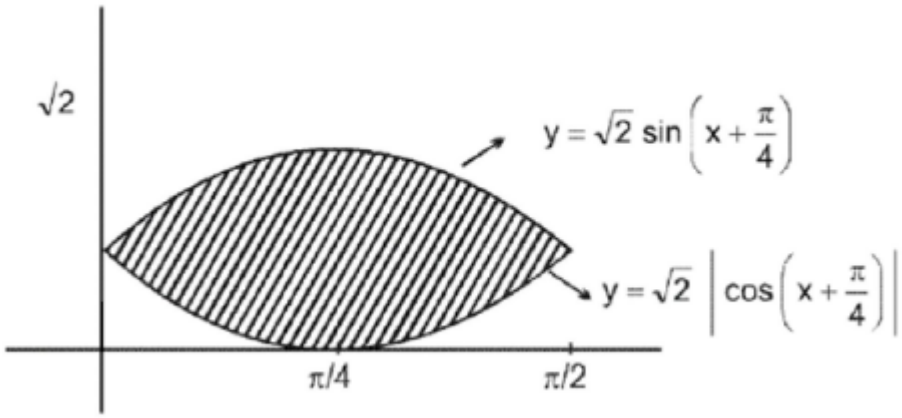
Given $y=\sin x+\cos x \qquad x\in[0,\pi/2]$

$$\frac{dy}{dx}=\cos x-\sin x$$



$$y=|\cos x-\sin x|=\begin{cases}\cos x-\sin x & x\in[0,\pi/4]\\ \sin x-\cos x & x\in[\pi/4,\pi/2]\end{cases}$$

$$\text{required area}=\int_0^{\pi/4}|(\sin x+\cos x)-(\cos x-\sin x)|dx+\int_{\pi/4}^{\pi/2}|2\cos x|dx$$



$$=\int_0^{\pi/4}|2\sin x|dx+\int_{\pi/4}^{\pi/2}|2\cos x|dx$$

$$=2(-\cos x)_0^{\pi/4}+2(\sin x)_{\pi/4}^{\pi/2}$$

$$=2\left[-\frac{1}{\sqrt{2}}+1+1-\frac{1}{\sqrt{2}}\right]$$

$$=2\left(2-\frac{2}{\sqrt{2}}\right)$$

$$=2\left(2-\sqrt{2}\right)=4-2\sqrt{2}=2\sqrt{2}\left(\sqrt{2}-1\right).$$