# Master JEE CLASSES

Kukatpally, Hyderabad.

JEE-ADVANCE-2016-P1-Model **Max. Marks:186**

## PAPER-I

**MATHS:** 2-D GEOMETRY: Distance Formula, Section formula, Finding various Centres with given vertices of a triangle, Area of Triangle, Collinearity of Points, Locus(Simple problems), Translation and Rotation of axes (30%); Equation of Straight Line: General form, Slope Form, Intercept Form, Normal form, Two Point Form & Parametric Form, Angle between two lines, Intersection of two lines, Position of Two Points w.r.t a line, Length of perpendicular distance of a point from a line, Distance between parallel lines, Reflection of a point w.r.t a line, Optimization using Triangular Inequality (60%); Cumulative (10%)

**PHYSICS:** Friction: A solid surface relatively at rest on another solid surface, static friction as a force opposing the tendency of relative motion on the other surface. Limiting friction, coefficient of static friction, Difference between fs, max/fs and static friction as a self adjusting force, angle of friction. Direction of static friction, related Numerical problems, Friction as the cause of motion (walking, vehicles etc). Minimum force required to move a block on a fixed horizontal surface on another block with horizontal surface, A solid surface moving relatively on another solid surface. Kinetic friction (Dynamic or sliding friction). Coefficient of kinetic friction. Direction of Kinetic friction, Cause of static friction, cause of kinetic friction, methods to reduce friction, Advantages and disadvantages of friction, Dependence of friction on area of contact, polishing a surface, A block on a fixed rough inclined plane, angle of repose, cases and acceleration down the plane. Body projected up along the inclined plane etc, Miscellaneous problems on Friction (60%)

constraint equations, Problems in NLM without friction (Including spring problems)(30%)

Cumulative syllabus covered till now (10%)

**CHEMISTRY:** Abnormal Colligative Properties, Theory of distillation.

**Chemical Kinetics**::Rates of chemical reactions; Order, Molecularity and Rate constant, Zero and First Order Reactions, First Order Reactions (EXCLUDING ARHENIUS EQUATION) (70%)

Liquid Solutions and Colligative Properties: Henry's law, Vapour pressure, Ideal solution, Determination of molecular weight by relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmtoic pressure(including Vant-hoff factor) (30%)

# JEE-ADVANCE-2016-P1-Model

**Time: 07:30AM to 10:30 AM** **IMPORTANT INSTRUCTIONS** **Max Marks: 186**

## PHYSICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 1 – 5) | Questions with Single Correct Choice | 3 | -1 | 5 | 15 |
| Sec – II(Q.N : 6 – 13) | Questions with Multiple Correct Choice (Partial Marking +1) | 4 | -2 | 8 | 32 |
| Sec – III(Q.N : 14 – 18) | Questions with Integer Answer Type | 3 | 0 | 5 | 15 |
| **Total** | | | | **18** | **62** |

## CHEMISTRY:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 19 – 23) | Questions with Single Correct Choice | 3 | -1 | 5 | 15 |
| Sec – II(Q.N : 24 – 31) | Questions with Multiple Correct Choice (Partial Marking +1) | 4 | -2 | 8 | 32 |
| Sec – III(Q.N : 32 – 36) | Questions with Integer Answer Type | 3 | 0 | 5 | 15 |
| **Total** | | | | **18** | **62** |

## MATHEMATICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 37 – 41) | Questions with Single Correct Choice | 3 | -1 | 5 | 15 |
| Sec – II(Q.N : 42 – 49) | Questions with Multiple Correct Choice (Partial Marking +1) | 4 | -2 | 8 | 32 |
| Sec – III(Q.N : 50 – 54) | Questions with Integer Answer Type | 3 | 0 | 5 | 15 |
| **Total** | | | | **18** | **62** |

***space for rough work***

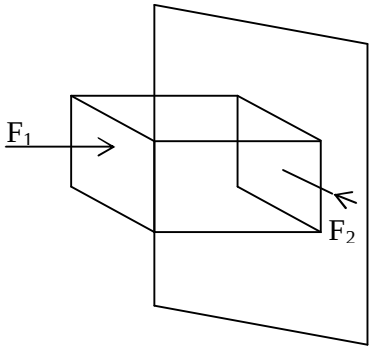
**PHYSICS** **Max Marks: 62**

## SECTION – I
## (SINGLE CORRECT ANSWER TYPE)

This section contains 5 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

**Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.**

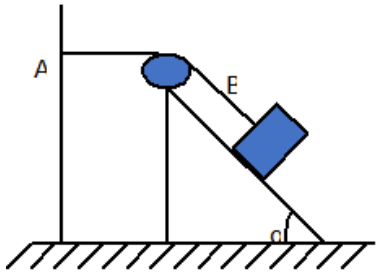
1. A block of mass 4kg is pressed against a wall by two perpendicular horizontal forces as shown in the figure. $F_1$ is perpendicular to the wall and $F_2$ is parallel to the wall. $\mu_s = 0.8$, $\mu_k = 0.5$ and $g = 10ms^{-2}$




For $F_1 = 75N$ and $F_2 = 30N$ then the force of friction is

A) 30 N B) 40N C) 50 N D) 45 N

2. A massless inextensible rope rests on a stationary wedge forming an angle $\theta$ with the horizontal. One end of the rope is fixed to the wall at point A (as shown in figure). A small load is attached to the rope at point B. The wedge starts moving to the right with a constant acceleration 'a'. The magnitude of acceleration of the load is given by




A) a B) $2a\sin\frac{\theta}{2}$ C) $a\sin\theta$ D) $g\sin\theta$

3. A particle of mass 'm' rests on a horizontal floor with which it has a coefficient of static friction μ. For the block to just move

A) A minimum force $F_{\min}=\frac{\mu mg}{\sqrt{1+\mu^2}}$ has to be applied at an angle $\theta=\tan^{-1}\left(\frac{1}{\mu}\right)$ with the horizontal

B) A minimum force $F_{\min}=\mu m$ has to be applied at an angle $\theta=\tan^{-1}(\mu)$ with the horizontal

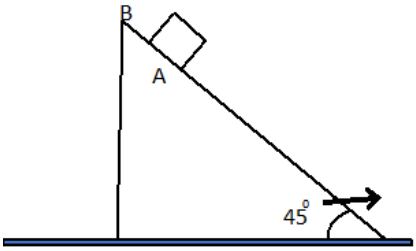
C) A minimum force $F_{\min}=\frac{\mu mg}{\sqrt{1+\mu^2}}$ has to be applied at an angle $\theta=\tan^{-1}(\mu)$ with the horizontal

D) A minimum force $F_{\min}=\mu mg$ has to be applied at an angle $\theta=\tan^{-1}\left(\frac{1}{\mu}\right)$ with the horizontal

04. The force along the incline required to just move a body up an inclined plane is double the force along the incline required to just prevent it from sliding down. If $\phi$ is angle of friction and $\theta$ is the angle which incline makes with the horizontal then

A) $\tan\theta = \tan\phi$ B) $\tan\theta = 2\tan\phi$ C) $\tan\theta = 3\tan\phi$ D) $\tan\theta = 3\tan\theta$

05. If the coefficient of friction between A and B is μ, the maximum acceleration of the wedge A towards right for which B will remain at rest with respect to the wedge is



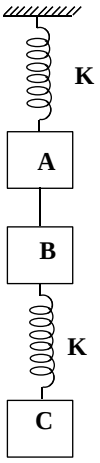

A) $\mu g$ B) $g\left(\frac{1+\mu}{1-\mu}\right)$ C) $g\left(\frac{1-\mu}{1+\mu}\right)$ D) $\frac{g}{\mu}$

## SECTION – II
## (MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

**Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases**

06. The system shown adjacent is in equilibrium. Blocks A, B &C are of equal masses m (Assume springs to be ideal)




Then choose the correct statements

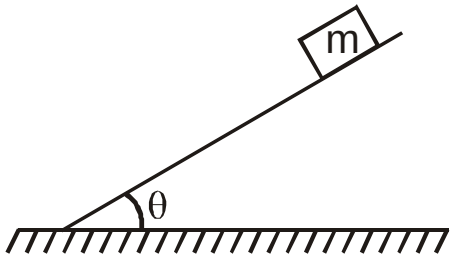
A) Immediately after the string (inextensible) between A & B is cut acceleration of block C is zero

B) Immediately after the spring between B and C is cut tension in the string between A and B is $T = \frac{3mg}{2}$

C) Immediately after the spring between ceiling and A is cut tension in the string between A and B is $T = \frac{3mg}{2}$

D) Immediately after the spring between ceiling and A is cut tension in the string between A and B is $T = 2mg$

07. A block of mass m is placed on a fixed inclined plane making an angle $\theta = 37°$ with horizontal. The block is moving down the incline with constant velocity. The only forces acting on block are mg downwards and net reaction exerted by inclined plane (g is acceleration due to gravity). Then pick up the correct statement(s).




A) The horizontal component of net reaction exerted by plane on block is zero.

B) The magnitude of net reaction exerted by plane on block is not less than mg.

C) The magnitude of net reaction exerted by plane on block is not greater than mg

D) If mass of block is somehow doubled, the net force on block still remains the same

08. A system of masses is shown in the figure with masses & co-efficient of friction indicated. Calculate:

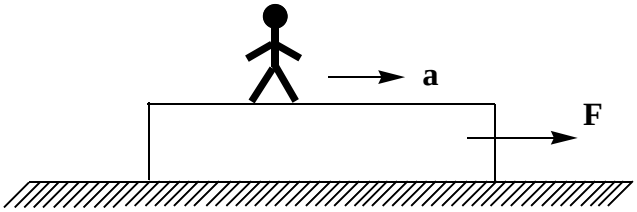

A) the maximum value of F for which there is no slipping anywhere is 90 N

B) the maximum value of F for which B does not slide on C is 100 N

C) the maximum value of F for which A does not slip on B is 150 N

D) the minimum value of F for which A slips on B is 120 N

09. A plank of mass M is placed on a rough horizontal surface. A man of mass m walks on the plank with an acceleration 'a 'while the plank is also acted upon by a horizontal force F whose magnitude and direction can be adjusted to keep the plank at rest. Co-efficient of friction between plank and surface is $\mu$.




**Choose the correct options.**

A) The maximum value of F to keep the plank at rest is ma + $\mu$(M+m)g

B) The minimum value of F to keep the plank at rest is ma - $\mu$(M+m)g

C) direction of friction on the plank due to ground will always be forward

D) if F=ma then friction on man due to plank is also F and friction between plank and ground is zero

10. A block of mass 10 kg is placed on a rough horizontal surface and is acted upon by a variable force F horizontally. The coefficient of friction between block and surface is $\mu$=0.5. The force F starting from a value of zero is increased linearly to 100 N in 4 s and then abruptly decreased to 40 N which is then continued for 3 sec. and then force is removed.

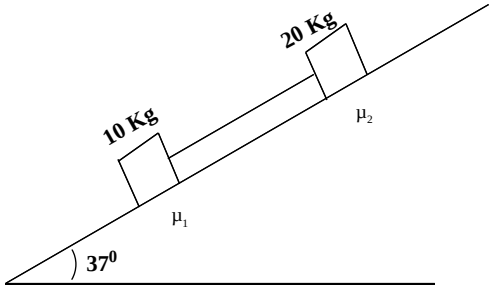
A) The maximum velocity reached by the block is 5 m/s

B) The time during which the block is in motion is 5.4 sec.

C) The maximum velocity reached by the block is at time 2 sec. after the start of motion of the block

D) Friction on block will be 25 N at time 1 s after the force begins to act

11. Two blocks of mass 10 kg and 20 kg are placed on a fixed inclined plane and they are connected by a light string. The inclined plane makes an angle $37^0$ with the horizontal. Both the blocks released from rest simultaneously and string is just straight without any tension: (Take g = 10 m/s$^2$)




Choose the correct options:

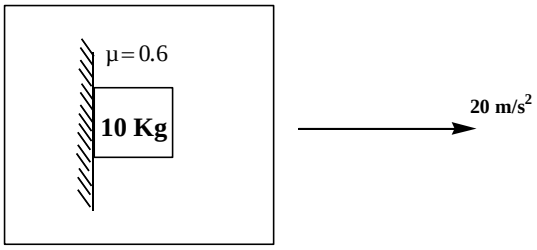
A) Tension in the rope if $\mu_1 = \mu_2 = 0.5$ is 0 N

B) Tension in the rope if $\mu_1 = \mu_2 = 0.5$ is 20 N

C) Tension in the rope if $\mu_1 = \mu_2 = 0.8$ is 0 N

D) Tension in the rope if $\mu_1 = 0.2$ and $\mu_2 = 0.5$ is 16 N

12. A car is accelerating on a horizontal road with acceleration = 20 m/s$^2$. A box that is placed inside the car, of mass m = 10 kg is put in contact with the vertical wall as shown. The friction coefficient between the box and the wall is $\mu = 0.6$.



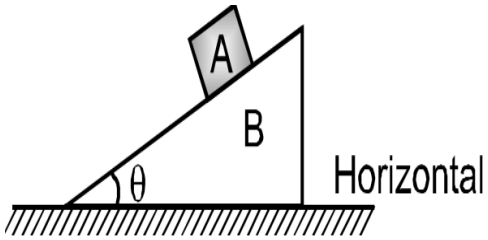

A) The acceleration (with respect to ground) of the box will be 20 $m/s^2$

B) The friction force acting on the box will be 100 N

C) The contact force between the vertical wall and the box will be $100\sqrt{5}$ N

D) The net contact force between the vertical wall and the box is only of electromagnetic in nature

13. In the figure shown A and B are free to move. All the surfaces are smooth. mass of A is m.




Then :

A) Net acceleration of A will be more than g $\sin\theta$

B) Net acceleration of A will be less than g $\sin\theta$

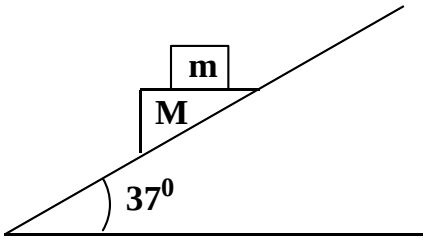
C) Normal reaction between A and B will be more than mg $\cos\theta$

D) Normal reaction between A and B will be less than mg $\cos\theta$

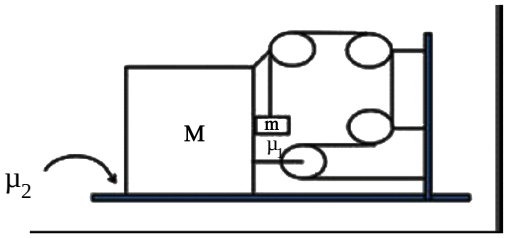
## SECTION – III
## (INTEGER ANSWER TYPE )

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).
**Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases.**

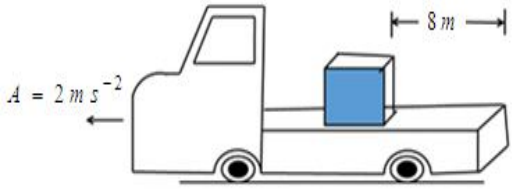
14. Block M slides down on frictionless incline as shown. if the minimum friction coefficient so that m does not slide with respect to M is $\mu$ then find the value of $4\times\mu$



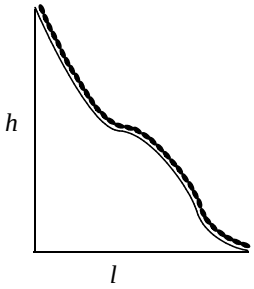

15. Two blocks M and 'm' are arranged as shown in the diagram. The coefficient of friction between the blocks is $\mu_1 = 0.25$ and between the ground and M is $\mu_2 = 1/3$. If M=8kg then find the maximum value of 'm' so that the system will remain at rest.




16. The rear side of a truck is open and a box of 40kg mass is placed 8m away from the open end as shown in figure. The coefficient of friction between the box and the surface below it is $\mu$=0.1. On a straight road, the truck starts from rest and moves with acceleration $2ms^{-2}$. Find the time (in sec) when box falls off the truck. Take $g = 10ms^{-2}$




17. A uniform chain is placed at rest on a rough surface of base length *l* and height *h* on an irregular surface as shown. Then, the minimum coefficient of friction between the chain and the surface must be equal to $n\left(\frac{h}{l}\right)$. Find n = ?




18 A block is lying on the horizontal frictionless surface. One end of a uniform rope is fixed to the block which is pulled in the horizontal direction by applying a force F at the other end. If the mass of the rope is half the mass of the block, the tension in the middle of the rope will be $\frac{nF}{6}$. Find the value of n(Neglect sagging of rope under its own weight)

**CHEMISTRY** **Max Marks : 62**

**SECTION – I**
**(SINGLE CORRECT ANSWER TYPE)**

This section contains 5 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

**Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.**

19. 0.15g of weak polybasic acid $H_xA$ required 20ml of 0.1M $NaOH$ solution for complete neutralization . In a separate experiment 3.88g sodium salt of the same and dissolved in 100g water, solution freezes at $-0.93^0C$ $\left(K_f\ H_2O = 1.86\ k\ kg\ mole^{-1}\right)$ molecular formula of one mole of sodium salt is

A) Na A B) $Na_2A$ C) $Na_4A$ D) $Na_3A$

20. The correct relationship between freezing point of very dilute solution of $AlCl_3$ ($t_1$) and $CaCl_2$($t_2$) having same molar concentration in aqueous medium.

A) $t_1=t_2$ B) $t_1>t_2$

C) $t_2>t_1$ D) Can't predict

21. A solution of glucose is isotonic with 4g of urea/lit. The concentration of glucose is

A) $48g/Lit$ B) $8\ g/Lit$

C) $12\ g/Lit$ D) $14\ g/Lit$

22. For the elementary reaction M$\rightarrow$ N the rate of disappearance of M increases to a factor of 8 upon doubling the concentration of M. Then order of reaction is

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

***space for rough work***

23. For a first order homogeneous gaseous reaction, $A \rightarrow 2B + C$ If the total pressure after time $t$ was $P_t$ and after long time $(t \rightarrow \infty)$ was $P_\infty$ then k in terms of $P_t, P_\infty$ and $t$ is :

A) $k = \frac{2.303}{t}\log\left(\frac{P_\infty}{P_\infty - P_t}\right)$ B) $k = \frac{2.303}{t}\log\left(\frac{2P_\infty}{P_\infty - P_t}\right)$

C) $k = \frac{2.303}{t}\log\left(\frac{2P_\infty}{3(P_\infty - P_t)}\right)$ D) $k = \frac{2.303}{t}\log\left(\frac{P_\infty}{3(P_\infty - P_t)}\right)$

## SECTION – II
## (MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

**Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases**

24. Two first order reaction have half-lives in the ratio $8:1$. Then

A) The ratio of time intervals $t_1 : t_2$. The time $t_1$ and $t_2$ are the time period for $\left(\frac{1}{4}\right)^{th}$ and $\left(\frac{3}{4}\right)^{th}$ completion is 1: 0.301

B) The ratio of time intervals $t_1 : t_2$. The time $t_1$ and $t_2$ are the time period for $\left(\frac{1}{4}\right)^{th}$ and $\left(\frac{3}{4}\right)^{th}$ completion is 1: 0.602

C) Ratio of their rate constants is 1:8

D) Half-life ratio will remain 8:1 even on changing the concentration.

25. In the following gaseous phase first order reaction $A(g) \rightarrow 2B(g) + C(g)$ initial pressure was found to be 400 mm of $Hg$ and it changed to 1000 mm of $Hg$ after 20 min. Then

A) Half life for A is 10 min

B) Rate constant is 0.0693 $\text{min}^{-1}$

C) Partial pressure of C at 30 min is 350mm of $Hg$

D) Total pressure after 30 min is 1150 mm of Hg

26. For a first order reaction identify true statement

A) Degree of dissociation of reactant is $\left(1 - e^{-kt}\right)$

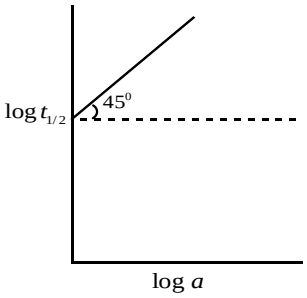
B) Concentration of reaction increases exponentially

C) Concentration of product increases exponentially

D) Graph of rate Vs concentration is not linear

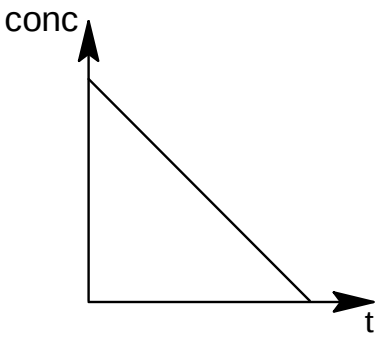
27. For a chemical change having $\log t_{1/2}$ *vs* $\log a$ is given below

(Where a = initial concentration of reaction ; $t_{1/2}$ = half – life)

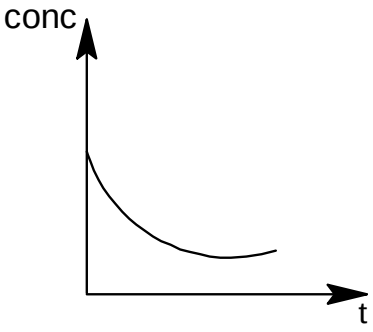



A) The order of reaction Zero order B) The order of reaction First order

C)




D)




28. In a first order reaction, the initial amount of a substance becomes 1/3 in 1028 seconds. Calculate the time taken to reduce the concentration to 1/9 to the initial concentration.

A) 200 sec B) 3.33 min C) 150 sec D) 400 sec

29. Which of the following is/are true for the solution mixture of **benzene** and **tolune**

A) It obeys Raoult's law over entire range of composition.

B) $\Delta H_{mix} = 0$

C) $(\Delta S_{mix})system > 0$

D) $(\Delta S)_{\text{surrounding}} = 0$

30. The rate law of a chemical reaction given below $2NO + O_2 \rightarrow 2NO_2$ is given as rate $= K[NO]^2[O_2]$. If the volume of reaction vessel is reduced to $1/4^{th}$ of its original value then identify true statements?

A) rate of reaction will be come 64 times

B) rate constant of the reaction will be come 64 times

C) rate of the reaction is unaffected

D) Half life of the reaction will not change

31. The gas phase decomposition of dimethyl ether follows first order kinetics, $CH_3OCH_{3(g)} \rightarrow CH_{4(g)} + H_{2(g)} + CO_{(g)}$. The reaction is carried out in a constant volume container at $500^0C$ and has a half-life of 14.5 minute. Initially only dimethyl ether is present at a pressure of 0.40 atmosphere. What is the total pressure (approximately) of the system after 12 minute? Assume ideal gas behavior.(anti log of 0.249 = 1.778)

A) 0.75 atm B) 0.45 atm

C) 0.35 cm of Hg D) 57 cm of Hg

## SECTION – III
## (INTEGER ANSWER TYPE )

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).
**Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases**

32. The weight of glucose dissolved in 100 grm of water produce same lowering of vapor pressure as 1 gm urea dissolved in 50gm of water at same temperature is

33. At 300 k the half-life a sample of a gaseous compound initially at 1 atm is 100 sec. When the pressure is 0.5 atm the half-life is 50 sec. The order of reaction is

34. At $25^0C$ vapor pressure of volatile liquid 'A' in pure state is 60 torr. To 4 mole of 'A' 'X' mole 'B' volatile liquid is added, at $25^0C$. The vapor pressure of resulting solution was found to be 72 torr, and mole fraction of 'A' in vapor phase is $\frac{1}{3}$, the value of 'X' is

35. 0.5 m solution of a non-volatile, non-electrolyte solute in a volatile solvent boils at 332.012K and boiling point of pure solvent is 330K and it's molecular mass is 40. Find its molar enthalpy of vaporisatron

36. A 0.4m aqueous solution of $Na_xA$ has freezing point $-3.72^0C$. If $K_f\,(H_2O)$ is .1.86K kg $mol^{-1}$. The value of 'X' is (salt is 100% ionised)

## SECTION – I
## (SINGLE CORRECT ANSWER TYPE)

This section contains 5 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

**Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.**

37. If $A(x_1, y_1), B(x_2, y_2), C(x_3, y_3)$ are the vertices of a triangle, then the equation

$$\begin{vmatrix} x & y & 1 \\ x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \end{vmatrix} + \begin{vmatrix} x & y & 1 \\ x_1 & y_1 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0$$ represents

A) a line through B B) a line through C

C) altitude through A D) median through A

38. Let d (P, OA) $\leq \min\{d(P, AB), d(P, BC), d(P, OC)\}$ where 'd' denotes the distance from the point to the corresponding line and S be the region consisting of all those points P inside the rectangle OABC with vertices O(0,0), A(3,0), B(3,2) and C(0,2); which satisfy the above relation. Then area of the region S is

A) 2 sq units B) 3 sq units C) 4 sq units D) 5 sq units

***space for rough work***

39. The line $x+2y=4$ is translated by 3-units closer to the origin and then rotated by $30^0$ in the clock wise direction about the point where shifted line cuts the X-axis, then equation of line in new position

A) $y=\frac{-\left(2+\sqrt{3}\right)}{\left(2\sqrt{3}-1\right)}x+3\sqrt{5}$ B) $y=\frac{-\left(2+\sqrt{3}\right)}{\left(2\sqrt{3}-1\right)}x-4$

C) $y=\left(\frac{2+\sqrt{3}}{2\sqrt{3}-1}\right)x+3\sqrt{5}-4$ D) $y=\frac{-\left(2+\sqrt{3}\right)}{2\sqrt{3}-1}(x+3\sqrt{5}-4)$

40. The equations of two adjacent sides of a rhombus are $y=x \text{ and } y=7x$. The diagonals of the rhombus intersect each other at the point (1,2), then area of the rhombus is

A) $\frac{10}{3}$ B) $\frac{20}{3}$ C) $\frac{50}{3}$ D)6

41. The point (2, 6) is translated parallel to y = 3x in the first quadrant through unit distance, then possible coordinates of the point in the new position is

A) $(3,7)$ B) $\left(2+\frac{3}{\sqrt{7}},6+\frac{1}{\sqrt{7}}\right)$

C) $\left(2+\frac{3}{\sqrt{10}},6+\frac{1}{\sqrt{10}}\right)$ D) $\left(2+\frac{1}{\sqrt{10}},6+\frac{3}{\sqrt{10}}\right)$

## SECTION – II
## (MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

**Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases**

42. The point P divides the line segment joining $A(-5,1)$ and $B(3,5)$ in the ratio $\lambda:1$. The co-ordinates of Q and R are $(1,5)$ and $(7,2)$ respectively. The area of $\Delta PQR$ is 2 sq. units. Then $\lambda =$ …….

A) $\frac{19}{5}$ B) $\frac{31}{9}$ C) 23 D) 19

43. $A(1,2)$ and $B(7,10)$ are two fixed points. If $P(x,y)$ is such that a point where $\underline{|APB} = 60^0$ and the area of $\Delta APB$ is maximum, then the point P

A) is on the line $3x+4y=36$

B) is on any line perpendicular to AB

C) is on perpendicular bisector of AB

D) is on the circle passing through $(1,2)$ and $(7,10)$ having radius 10

44. If $A=\left[a_{ij}\right]$ is a square matrix of even order, such that $a_{ij}=i^2-j^2$, then

A) A is a skew- symmetric matrix

B) A is a symmetric matrix and $|A|$ is a square

C) A is a symmetric matrix and $|A|=0$

D) $|A|$ is the square of a real number if $a_{ij}\forall(i,j)$ are real

***space for rough work***

45. If A and B are square matrices such that $B = -A^{-1}BA$, then which of the following is true

A) $AB + BA = O$ B) $(A+B)^2 = A^2 + B^2$

C) $(A+B)^2 = A^2 + 2AB + B^2$ D) $(A+B)^2 = A + B$

46. A straight line L passing through the point $A(-2,-3)$ cuts the lines $x + 3y = 9$ and $x + y + 1 = 0$ at B and C respectively. If $(AB)(AC) = 20$, then equation of L can be

A) $x - y = 1$ B) $x - y + 1 = 0$ C) $3x - y + 3 = 0$ D) $3x - y = 3$

47. Two equal sides of an isosceles triangle are $7x - y + 3 = 0$ *and* $x + y - 3 = 0$ and its third side passes through (2, -10), then equation of 3rd side

A) $3x + y + 4 = 0$ B) $x - 3y - 31 = 0$

C) $x + y + 8 = 0$ D) $x - 3y - 32 = 0$

48. Orthocenter of a triangle ABC is H(2,3) and altitude AH meets the circum circle of triangle ABC at D(4,7), then which of the following is true

A) Equation of side BC is $x + 2y = 13$

B) If triangle ABC is equilateral then vertex A=(0,-1)

C) If triangle ABC is equilateral then its inradius $= \sqrt{5}$

D) If triangle ABC is equilateral then its area $= 15\sqrt{3}$ *sq.cm*

***space for rough work***

49. If D(3,4), E(5,7), F(1,5) divides the sides BC,CA,AB respectively in the same ratio 3:1, then which of the following is true

A) Area of triangle ABC is 64/7 sq.units

B) Centroid of triangle ABC is $\left(3,\frac{16}{3}\right)$

C) Triangle DEF is isosceles

D) Area of triangle DEF is 4 sq.units

## SECTION – III
## (INTEGER ANSWER TYPE )

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).
**Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases**

50. Consider the triangle formed by the lines $y+3x+2=0, 3y-2x-5=0, 4y+x-14=0$. The point $(\alpha, 2)$ lies inside the triangle. The number of possible integral values of $\alpha$ is

51. For $a>0$ the area of the quadrilateral formed by the lines $3x-2y+3a=0$, $x+3y-a=0, x+3y+4a=0, 3x-2y+7a=0$ is 220 sq. units, then sum of digits of $a$ is

52. The line $\sin\theta(x+2y-1)+\cos\theta(3x-y+2)=0$ is equally inclined with the co-ordinate axes for two values of $\theta$ says $\theta_1$ and $\theta_2$. If the value of $\tan(\theta_1+\theta_2)$ is equal to $\frac{m}{n}\left(0\le\theta\le\pi\right)$, (G.C.D of (m, n) = 1), then $|m-n|$ equals to

53. Vertices of a parallelogram ABCD are $A(3,1); B(13,6); C(13,21)$ and $D(3,16)$. If a line passing through the origin divides the parallelogram into two congruent parts, then the slope of the line is $\frac{m}{n}$, (G.C.D of (m, n) = 1), then $|m-n|$ is equals to

54. The light ray is incident from the point $P(3,10)$ on the line mirror $2x+y-6=0$ at A and reflected ray is passing through $Q(7,2)$. If the coordinates of A is $(\alpha,\beta)$, then $\alpha+\beta$ is equal to

# Master JEE CLASSES

## Kukatpally, Hyderabad.

**JEE-ADVANCE-2016-P1-Model** **Max.Marks: 186**

**KEY SHEET**

## PHYSICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **C** | 2 | **B** | 3 | **C** | 4 | **C** | 5 | **B** |
| 6 | **AB** | 7 | **ABCD** | 8 | **AC** | 9 | **ABD** | 10 | **ABCD** |
| 11 | **ACD** | 12 | **ABCD** | 13 | **AD** | 14 | **3** | 15 | **1** |
| 16 | **4** | 17 | **1** | 18 | **5** | | | | |

## CHEMISTRY

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19 | **C** | 20 | **C** | 21 | **C** | 22 | **B** | 23 | **C** |
| 24 | **BCD** | 25 | **ABCD** | 26 | **AC** | 27 | **AC** | 28 | **B** |
| 29 | **ABCD** | 30 | **A** | 31 | **AD** | 32 | **6** | 33 | **0** |
| 34 | **6** | 35 | **9** | 36 | **4** | | | | |

## MATHS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 37 | **D** | 38 | **A** | 39 | **D** | 40 | **A** | 41 | **D** |
| 42 | **AC** | 43 | **AC** | 44 | **AD** | 45 | **AB** | 46 | **AC** |
| 47 | **AD** | 48 | **ABCD** | 49 | **BD** | 50 | **2** | 51 | **2** |
| 52 | **1** | 53 | **3** | 54 | **5** | | | | |

# SOLUTIONS
## PHYSICS

01. Ans: (C)

Normal force $N = 75\,Newton$.

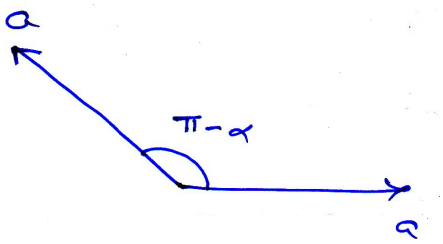
Hence $f_{limiting} = 0.8 \times 75N = 60N$.

Resultant of Mg and $F_2$ is 50N.

So frictional force = 50N.

02. Ans: (B)

$\vec{a}_{load} = \vec{a}_{load\ w.r.t\ wedge} + \vec{a}_{wedge}$




03. Ans: (C)

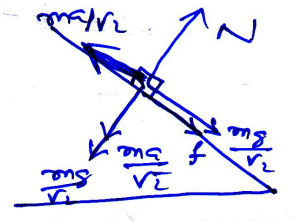
04. Ans: (C)

$(mg\sin\theta + \mu mg\cos\theta) = 2(mg\sin\theta - \mu\, mg\cos\theta)$

$\Rightarrow \mu = \dfrac{\tan\theta}{3} = \tan\phi$

05. Ans : (B)

F.B.D of block w.r.t. wedge is as shown




So $\dfrac{mg}{\sqrt{2}} = f + \dfrac{mg}{\sqrt{2}}$

and $f_L = \mu\left(\dfrac{mg}{\sqrt{2}} + \dfrac{ma}{\sqrt{2}}\right)$

so $a = g\left(\dfrac{1+\mu}{1-\mu}\right)$

06. Ans : A, B

In equilibrium

$kx_1 = 3mg$

T=2mg

$kx_2 = mg$

If string is cut T= 0 only.

If upper string is cut $kx_1 = 0$

$kx_2$ is same

Tension becomes $T^1$ to ensure same acceleration of A and B.

07. Ans: A, B, C, D

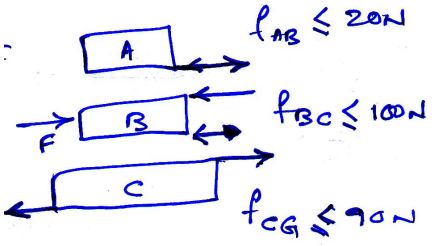
As the block moves with constant velocity, $\mu = \tan\theta$ and net reaction force on the block by the inclined plane is $mg$ upwards.

08. Ans: A, C

So maximum value of F

So that all blocks

Remain at rest is 90N




Maximum acceleration of C = 0.25 m/s?

Taking (A+B) system

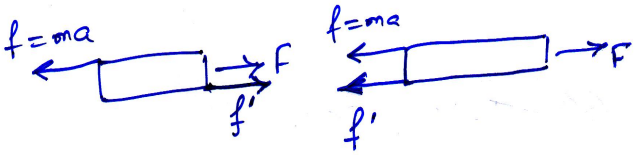
$\frac{F-100}{50} = 0.25 \Rightarrow F = 112.5\ N$.

So maximum value of F for which B does not slide on C is 112.5N.

Maximum acceleration of $A = 1m/s^2$

So $\frac{F-100}{50} = 1 \Rightarrow F = 150N$

09. Ans : A, B, D




10. Ans: A, B, C, D

$F = 25t$

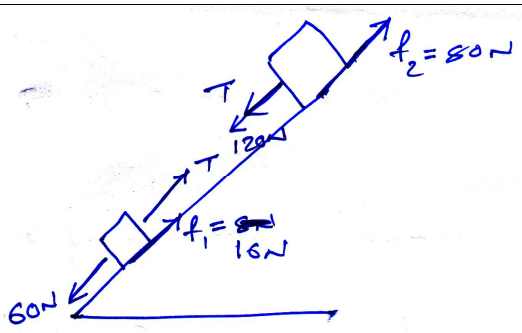
$V = \int_2^4 \frac{F}{m} \times dt = 5m/s$

Up to 2 seconds block remains at rest.

From t = 2s to t = 4s, it accelerated.

Again from t = 4s to t = 7s it deaccerates at $1m/s^2$ and then from t = 7s, it deaccelerates at $5m/s^2$.

11. A, C, D.




In case D

$$a = \frac{60+120-16-80}{30} m/s^2$$

$$= 2.8\ m/s^2$$

$$60 - T - 16 = 28$$

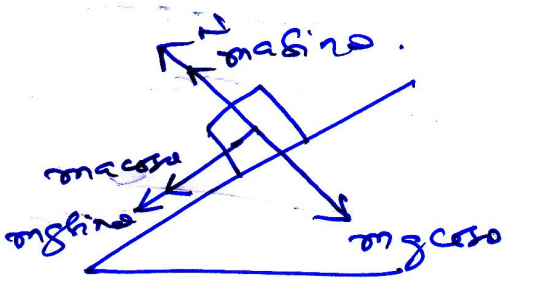
$$\Rightarrow T = 16N$$

12. Ans: A, B, C, D.

13. Ans: A, D.

Let wedge is moving toward right with acceleration $\vec{a}$.

Then, FBD of block w.r.t wedge is as shown.




So $\vec{a}_r = g\sin\theta + a\cos\theta$

Not acceleration of block is $\vec{a}_{block} = \vec{a}_r + \vec{a}$

$$= \sqrt{(g\sin\theta)^2 + (a\sin\theta)^2}$$

$$> g\sin\theta$$

$$N = mg\cos\theta - ma\sin\theta$$

So $N < mg\cos\theta$.

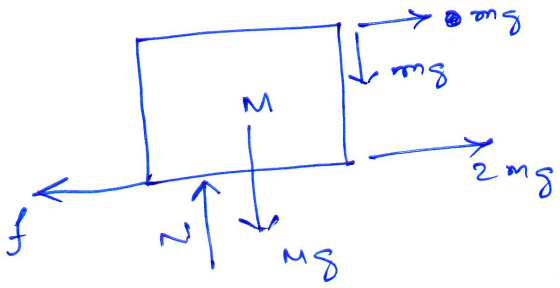
14. (3)

$$\mu = \frac{3}{4}$$

15. (1)

When system in equilibrium, and value of 'm' is maximum, friction between 'm' and M is zero, and T =mg.

F.B. D of M is




$f = 3mg = \frac{1}{3}(8+m)g$

$\Rightarrow\ m = 1\ kg.$

16. (4)

w.r.t truck

(40)(2)-(0.1)(40)(10) = (40)(w)

w=1 m/s$^2$

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

$t = 4$ sec

17. (1)

Take small length *dl* of the chain(inclined at angle $\theta$ to horizontal)

$dF_{pull} = (dm)\, g \sin\theta$

$= (\lambda dl)\, g \sin\theta$

$= \lambda g\, dy$

$F_{pull} = \lambda g \int dy$

$= \lambda g h$

Stopping force maximum

$df_{max} = \mu dN$

$= \mu(dmg\cos\theta)$

$\mu(\lambda dl)\, g\cos\theta$

$= \mu g\, dx$

$f_{max} = \mu g l$

18. (5)

## CHEMISTRY

19. $E\ q\ wt\ of\ Acid = \frac{0.15\times 1000}{20\times 0.1} = 75$

$Eqwt\ of\ A^{-x} = 75 - 1 = 74$

$E\ q\ wt\ of\ Na_xA = 23 + 74 \Rightarrow 97$

$\therefore$ mol wt = $97\ x$

$i = x+1\ \ \Delta Tf = i.Kf.m$

$0.93 = (x+1)1.86 \times \frac{3.88}{97x} \times \frac{1000}{100}$

$\therefore x = 4$

20. Conceptual

21. Conceptual

22. Conceptual

23. $A \rightarrow 2B + C$

$t = 0 \quad P_i \quad 0 \quad 0$

$t \quad P_i - x \quad 2x \quad x$

$t \rightarrow \infty \quad 0 \quad 2P_i \quad P_i$

$P_\infty = 3P_i \text{ or } P_i = \frac{P_\infty}{3}; P_i + 2x = P_t$

$x = \frac{P_t - P_i}{2}$

24. $t_1 = \frac{(t_{1/2})_1}{0.693} \ln\left(\frac{1}{(1-(1/4))}\right)$

$t_2 = \frac{(t_{1/2})_2}{0.693} \ln\left(\frac{1}{1-3/4}\right)$

$\frac{t_1}{t_2} = \frac{8}{1} \times \frac{\ln(4/3)}{\ln(4)}$

$= \frac{8 \times 0.125}{0.602} = 1:602$

25. Conceptual

26. Conceptual

27. $t_{1/2} = \frac{a}{2k} = k'.a; \log(t_{1/2}) = \log k' + \log a$

28. For the first order reaction, $K = \frac{2.303}{t} \log_{10} \frac{a}{(a-x)}$ Let the initial amount is a mol $L^{-1}$, then after $t = 100$ seconds, $(a-x) = \frac{a}{3} mol\ L^{-1}$

$\therefore K = \frac{2.303}{100} \log_{10} \frac{a}{a/3} = \frac{2.303}{100} \log_{10} 3$

$= 10.988 \times 10^{-3} \sec^{-1}$

Let the time required to reduce the concentration to $a/9$ is $t_1$ then

$t_1 = \frac{2.303}{10.988 \times 10^{-3}} \log_{10} \frac{a}{a/9} = 200 \sec = 3.33 \min$

30. The reaction is $2NO + O_2 \rightarrow 2NO_2$ Rate $= K[NO]^2[O_2]$

Suppose a mole NO and b mole $O_2$ are present initially in a vessel of V liter

$r_1 = K\left[\frac{a}{V}\right]^2\left[\frac{b}{V}\right] \quad .....(1)$

If volume of vessel is reduced to $V/4$, then for same mole of NO and $O_2$

$$r_2 = K\left[\frac{a}{V/4}\right]^2\left[\frac{b}{V/4}\right] = 64K\left[\frac{a}{V}\right]^2\left[\frac{b}{V}\right] \quad .....(2)$$

By eqs. (1) and (2) , $\frac{r_2}{r_2} = 64$

i.e., rate will increase by 64 times

31. $CH_3.OCH_{3(g)} \rightarrow CH_{4(g)} + H_{2(g)} + CO_{(g)}$

Initial P 0.40 atm P P P

For a I order reaction $K = \frac{2.303}{t}\log_{10}\frac{a}{a-x}$

For ideal gas behavior Mole $\alpha$ Pressure ( at constant V and T)

$\therefore a\ \alpha\ 0.40;\ (a-x)\alpha(0.40-P)$

$$\frac{0.693}{14.5} = \frac{2.303}{12}\log_{10}\frac{0.40}{(0.40-P)}$$

$P = 0.175\ atm$

Pressure of ether decomposed = 0.175

Total pressure = $0.40 - P + P + P + P$

$= 0.40 + 2P = 0.40 + 2\times 0.175$

$= 0.75\ atm = 57\ cm$

32. $\frac{p^0 - p^0}{p^0} = x_1$

34. $y_A = \frac{p_A}{p} \quad \therefore p_A = \frac{1}{3}\times 72 = 24$

$X_A = \frac{n_1}{n_1 + n_2}0.4 = \frac{4}{4\times x}$

$p_A = p^0{}_A \times X_A$

$24 = 60\times X_A$

$X_A = 0.4$

$n_2 = 6$

35. $\Delta T_b = i\ Kb\ m$

$2.01 = 1\times Kb\times 0.5$

$Kb = 4$

$Kb = \frac{M\ KT^2}{\Delta HVap\times 1000}$

$\Delta HVap = 9$

36. $\Delta Tf = i\ Kf\ m$

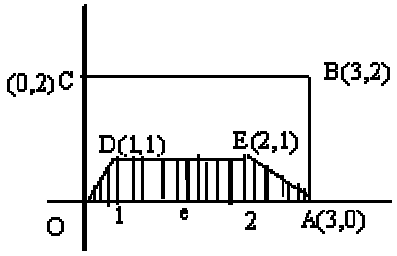
$3.72 = i\times 1.86\times 0.4$

$i = 5 \quad \therefore n = 4$

37. (D)

$$\Rightarrow \begin{vmatrix} x & y & 1 \\ x_1 & y_1 & 1 \\ \frac{x_2+x_3}{2} & \frac{y_2+y_3}{2} & 1 \end{vmatrix} = 0 \text{ represents median through A}$$

38. (B)




i) $0 \le x \le 1 \text{ and } 0 \le y \le 1$

$\therefore d(P,OA) \le d(P,OC) \Rightarrow y \le x$

$1 \le x \le 2$

ii) $d(P,OA) \le d(P,BC)$

$\Rightarrow y \le 2-y \Rightarrow y \le 1$

$2 \le x \le 3 \text{ and } 0 \le y \le 1$

iii) $d(P,OA) \le d(P,AB)$

$\Rightarrow y \le 3-x$

$\Rightarrow x+y \le 3$

Area of Trapezium OAED is required region $\therefore$ Area =

39. (D)

Let the equation of line by $L_2 = x+2y+c=0$

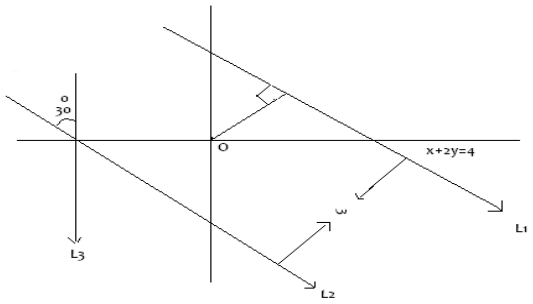
Given line is $L_1 = x+2y-4=0$

Distance between

$L_1$ *and* $L_2$ *is* 3

$$\left|\frac{c+4}{\sqrt{5}}\right| = 3$$

$$c = 3\sqrt{5}-4$$



$(-3\sqrt{5}-4$ value of c should be neglected since $L_2$ lies below the origin)

Shifted line $L_2$ is

$x+2y+3\sqrt{5}-4=0$ if cuts the x-axis at $\left(-\left(3\sqrt{5}-4\right),0\right)=\left(4-3\sqrt{5},0\right)=A$

When $L_2$ is rotated about A through an angle $30^0$ in clock since.

Let this new line be $L_3$ and let m be the slope of $L_3$ and slope of $L_2=-\frac{1}{2}$

$$\tan 30^0=\frac{\frac{-1}{2}-m}{1-\frac{m}{2}}\Rightarrow\frac{1}{\sqrt{3}}=\frac{-1-2m}{2-m}$$

$$2-m=-\sqrt{3}-2\sqrt{3}m$$

$$m\left(1-2\sqrt{3}\right)=2+\sqrt{3}$$

$$m=\frac{2+\sqrt{3}}{1-2\sqrt{3}}$$

Required line $L_3$ *is* $y-0=\frac{2+\sqrt{3}}{1-2\sqrt{3}}\left(x-\left(4-3\sqrt{5}\right)\right)$

40. (A)

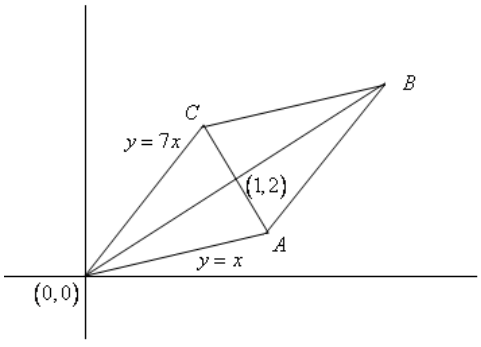
Equation of diagonal AC is $y-2=\frac{-1}{2}(x-1)\Rightarrow x+2y=5$

On solving with y=x we get

$A=\left(\frac{5}{3},\frac{7}{3}\right)$

On solving with $y=7x$ *we get* $C=\left(\frac{1}{3},\frac{7}{3}\right)$

Clearly B=(24) required area=$=\frac{1}{2}\begin{vmatrix}2 & 4\\ \frac{4}{3} & \frac{-2}{3}\end{vmatrix}=\left|\frac{1}{2}\times\frac{-20}{3}\right|=\frac{10}{3}$ *sq.units*




41. (D)

$Q=\left(2+\cos\theta,\ 6+\sin\theta\right)$

Where

$\tan\theta=3$

$\sin\theta = \frac{3}{\sqrt{10}}$

$\cos\theta = \frac{1}{\sqrt{10}}$

$\left(2+\frac{1}{\sqrt{10}}, 6+\frac{3}{\sqrt{10}}\right)$ Required ans is $\left(2+\frac{1}{\sqrt{10}}, 6+\frac{3}{\sqrt{10}}\right)$

42. (AC)

$P = \left(\frac{3\lambda-5}{\lambda+1}, \frac{5\lambda+1}{\lambda+1}\right)$; $Q = (1, 5)$, $R = (7, 2)$

$$\Delta PQR = 2 \Rightarrow \begin{vmatrix} \frac{3\lambda-5}{\lambda+1} & \frac{5\lambda+1}{\lambda+1} & 1 \\ 1 & 5 & 1 \\ 7 & 2 & 1 \end{vmatrix} = 4$$

Solving, we get $\lambda = \frac{19}{5}, 23$

43. (AC)

$\Delta$ APB must be isosceles for maximum area and P lies on perpendicular bisector of AB

44. (AD)

Given that, $a_{ij} = i^2 - j^2$

$\therefore \quad a_{ij} = j^2 - i^2 \Rightarrow a_{ij} = -a_{ji}$

Thus, A is a skew-symmetric matrix of even order.

We know that the determinant of every skew symmetric matrix of even order is a perfect square and that of the odd order is zero.

Hence, options a) and d) are correct.

45. (AB)

Given that, $B = -A^{-1}BA$

$\Rightarrow \quad AB = -A\left(A^{-1}BA\right)$

$\Rightarrow \quad AB = -A\left(\left(AA^{-1}\right)(BA)\right)$

$\Rightarrow \quad AB = -\left(I\left(BA\right)\right)$

$\Rightarrow \quad AB = -BA$

$\Rightarrow \quad AB + BA = 0$

$\Rightarrow \quad (A+B)^2 = A^2 + AB + BA + B^2$

$\Rightarrow \quad (A+B)^2 = A^2 + O + B^2$

$\Rightarrow \quad (A+B)^2 = A^2 + B^2.$

46. (AC)

Any point on the line L is $(-2+r\cos\theta,-3+r\sin\theta)$

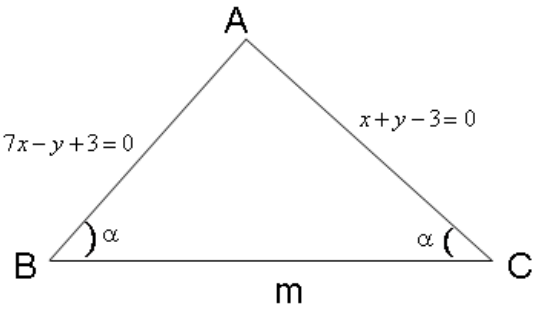
$AB=\dfrac{20}{\cos\theta+3\sin\theta}, AC=\dfrac{4}{\cos\theta+\sin\theta}$

$Now\ (AB)(AC)=20\Rightarrow Tan^2\theta-4Tan\theta+3=0\Rightarrow \tan\theta=1\ or\ 3$

Required lines x-y=1,3x-y+3=0

47. (AB)

$\tan\alpha=\left|\dfrac{7-m}{1+7m}\right|$




$\tan\alpha=\left|\dfrac{-1-m}{1-m}\right|$

$\dfrac{7-m}{1+7m}=\dfrac{1+m}{1-m}$

$7-7m-m+m^2=1+m+7m+7m^2$

$6m^2+16m-6=0$

$3m^2+8m-3=0$

$3m^2+9m-m-3=0$

$3m(m+3)-1(m+3)=0$

$m=\dfrac{1}{3},-3$

$\dfrac{7-m}{1+7m}=-\dfrac{1+m}{1-m}$

$7-7m-m+m^2=-1-m-7m-7m^2$

$8m^2=-8\rightarrow no\ roots$

Required lines

$y+10=\dfrac{1}{3}(x-1)$

$3y+30=x-1\Rightarrow x-3y-31=0$

$y+10=-3(x-1)$

$3x+y+7=0$

48. (ABCD)

$\rightarrow$Slope of $BC=\dfrac{-1}{slope\ HD}=\dfrac{-1}{2}$

Equation of BC is

$y-5=\frac{-1}{2}(x-3)$

$2y-10=-x+3$

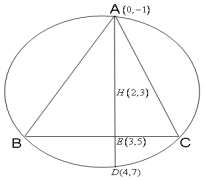
$x+2y=13$

$\rightarrow$If triangle ABC is equilateral H=centroid

If $A=(h,k)$ then H divides AE in the ratio 2:1

$\left(\frac{6+h}{3},\frac{10+k}{3}\right)=(2,3)\Rightarrow h=0,k=-1$

$A=(0,-1)$




E=mid HD=(35)

$\rightarrow$In radius $r=\frac{R}{2}=\frac{AH}{2}=\frac{\sqrt{4+16}}{2}=\sqrt{5}$

$\rightarrow$Area of equilateral triangle ABC is $=\frac{L^2}{\sqrt{3}}$

49. (BD)

$\rightarrow$Area triangle ABC=

$\frac{3^2-3+1}{(3+1)^2}$ *area of triangle DEF*

$=\frac{7}{16}\times(4)=7/4$

$\rightarrow$Centroid of triangle ABC = centroid of triangle DEF=$(3,16/3)$

$\rightarrow$Triangle DEF is scaline

$\rightarrow$Area of triangle DEF=4 sq.units

50. (2)

No. of integral values of $\alpha$ are 2

51. (2)

$\left|\frac{4a\times 5a}{9+2}\right|=220$

$a^2=\frac{220\times 11}{20}\Rightarrow a=11$

52. (1)

$\text{Slope}=1\text{ or }(-1)\Rightarrow -\frac{(\sin\theta+3\cos\theta)}{(2\sin\theta-\cos\theta)}=1\text{or}-1$

$\Rightarrow \tan\theta=-\frac{2}{3}\text{ or }\tan\theta=4$

$\therefore \tan(\theta_1+\theta_2)=\dfrac{-2/3+4}{1-(-2/3)4}=\dfrac{10}{3}\times\dfrac{3}{11}=\dfrac{10}{11}$

53. (1) It passes through (8, 11)

54. (5)

Image of P in the line $2x+y-6=0$ *say* $p^1, A, Q$ should be collinear

Clearly $p^1=(-5,6)\Rightarrow A=(1,4)$