KEY

MATHEMATICS		PHYSICS		CHEMISTRY	
1.	B	24.	B	47.	D
2.	A	25.	C	48.	C
3.	A	26.	D	49.	A
4.	C	27.	C	50.	C
5.	C	28.	B	51.	B
6.	B	29.	C	52.	B
7.	B,C	30.	A,B	53.	B,D
8.	D	31.	A,B,C,D	54.	D
9.	A,B,C,D	32.	B,C,D	55.	A,B
10.	A,C	33.	A,B,C,D	56.	A,B
11.	D	34.	A	57.	A
12.	A	35.	B	58.	B
13.	C	36.	A	59.	A
14.	D	37.	D	60.	A
15.	B	38.	A	61.	D
16.	A	39.	B	62.	B
17.	B	40.	D	63.	D
18.	B	41.	D	64.	A
19.	C	42.	C	65.	C
20.	A	43.	C	66.	C
21.	A	44.	B	67.	C
22.	B	45.	A	68.	A
23.	A	46.	C	69.	D

SOLUTIONS
MATHEMATICS

1. Put y = vx

Given diff equation is $\frac{dx}{\sqrt{1+v^2}} = \frac{dx}{x}$

$\Rightarrow \left(v + \sqrt{v^2+1}\right)$

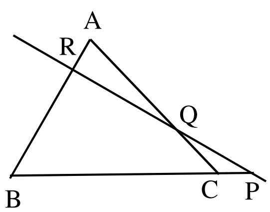
$\Rightarrow y + \sqrt{x^2+y^2} = cx^2$

2. $m = 1 \pm 2i \Rightarrow (m-1)^2 = -4 \Rightarrow m^2 - 2m + 5 = 0$

The req diff equation is $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 5y = 0$

3. Using SA = SB = SC

4. Let PQR has equation lx+my+n = 0



Let A= (x_1,y_1), B= (x_2,y_2) , C = (x_3,y_3)

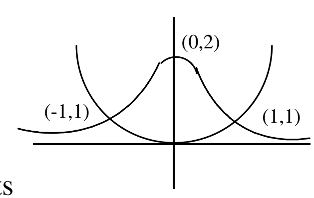
$\frac{BP}{PC} = \frac{-(lx_2+my_2+n)}{lx_3+my_3+n}, \frac{CQ}{QA} = \frac{-(lx_3+my_3+n)}{lx_1+my_1+n}$

$\frac{AR}{RB} = \frac{-(lx_1+my_1+n)}{lx_2+my_2+n}$ and multiplying

5. $\perp$lar bisector of AB is x-y – 2 = 0

Hence circumcentre is $\left(\frac{-4}{5}, \frac{14}{5}\right)$

6. Req area is $2\int_0^1 \frac{2}{1+x^2} - x^2 dx$



$= \pi - \frac{2}{3}$ sq units

7. $\frac{y}{\left(\frac{dy}{dx}\right)} = Kx \Rightarrow K\frac{dy}{y} = \frac{dx}{x} \Rightarrow y^K = cx$ Or $y = cx^K$, where K is not arbitrary constant

Hence it is not given that subtangent is twice the abscissa hence (d) is not correct

8. Given D.E is $(xy+y^4)\, dx = (xy^3-x^2)\, dy$

$$\Rightarrow \frac{-y}{x} d\left(\frac{y}{x}\right) + \frac{d(xy)}{(xy)^2} = 0$$

$$\Rightarrow y^3 + 2x + 2Cx^2y = 0$$

It is passes through (1,2)

$$\therefore C = \frac{-5}{2}$$

Req sol is $y^3 + 2x - 5x^2 y = 0$

9. $$\frac{dy}{dx} = \frac{-2y\cot x \pm \sqrt{4y^2\cot^2 x + 4y^2}}{2}$$

$$= y(-\cot x \pm \operatorname{cosec} x)$$

$$\frac{dy}{y} = \left(\frac{-\cos x \pm 1}{\sin x}\right)dx$$

$$\therefore y = \frac{c}{1+\cos x}, y = \frac{c}{1-\cos x}$$

And $x = 2\cos^{-1}\sqrt{\frac{c}{2y}}, x = 2\sin^{-1}\sqrt{\frac{c}{2y}}$

10. Put $y^{-2} = z$ then given eqn becomes $\frac{dz}{dx} - 2xz = -2x^3$

I.F = $e^{\int -2x dx} = e^{-x^2}$

Solution is $z e^{-x^2} = -\int te^{-t} dt.$ where $t = x^2$

$$\Rightarrow \left(x^2 + 1 + ce^{x^2}\right)y^2 = 1$$

So ans are (a) and (c)

15. Given family of circles is $x^2 + y^2 - Ax = 0$

It's diff equation is $y^2 - x^2 - 2xy\frac{dy}{dx} = 0$

The orthogonal family has diff equation

$y^2 - x^2 + 2xy\frac{dx}{dy} = 0$ which is homogeneous solving we get $x^2 + y^2 - cy = 0$ (C arbitrary)

16. similar to problem 15.

17. $r = a\sin 3\theta \Rightarrow \frac{dr}{d\theta} = 3a\cos 3\theta$ Eliminating a we get $\frac{dr}{d\theta} = 3r\cot 3\theta$ we get

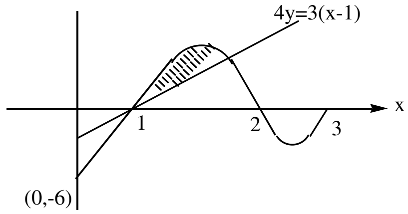
For orthogonal trajectories $\frac{dr}{d\theta}$ should be replaced by $-r^2\frac{d\theta}{dr}$ hence the trajectories are

$$\frac{3}{r}dr + \tan 3\theta d\theta = 0$$

$$\Rightarrow r^9 \sec 3\theta = c$$

18. AB makes 45^0 with x-axis .

$\therefore$ New position of B is $\left(2+2\sqrt{2}\cos 90^0, o+2\sqrt{2}\sin 90^0\right) = \left(2, 2\sqrt{2}\right)$

23. 

PHYSICS

24. Conserve energy and angular momentum for the initial maximum distance positions
25. Calculate g for r>R and equate to a constant such that r is eliminated
26. Power supplied is equal to frictional torque multiplied by angular velocity
27. Centre of mass remains at rest while the each particle will rotate about centre of mass due to attractive force because of remaining seven particles.
28. Tension in string is same use viscous force in free body diagram. Maximum possible velocity is terminal velocity.
29. Conserve linear momentum to get common velocity when the separation becomes very large. Use energy conservation also
32. For equal volumes effective density is arithmetic mean .For equal masses effective density is harmonic mean.

38 to 40

Due to gravitational force spheres will accelerate. Work for the acceleration considering rolling and slipping to get the limiting values.

Normal reaction is equal to F for each sphere

41 to 43

Forces acting on the rod R tension in string, buoyant forces on immersed portion of rod and sphere and gravitational forces

Maximum power dissipation occurs when terminal velocity is reach

44 to 46

Use principle of superposition and equate g to zero

Use energy conservation to calculate speed of the particle

CHEMISTRY

47. $r = K(c)^m$

$$\left(\frac{r_1}{r_2}\right)=\left(\frac{c_1}{c_2}\right)^m$$

$$m=\log\frac{\left(\frac{r_1}{r_2}\right)}{\left(\frac{c_1}{c_2}\right)}$$

$$\frac{r_1}{r_2}=15 \qquad \frac{c_1}{c_2}=5$$

48. Linearity is possible only with 2 terminal atoms

49. $NH_4HS(s) \rightleftharpoons NH_3(g)+H_2S(g)$

1	0	0
0.5	0.5	0.5

Total no.of moles at equilibrium = 1

$$K_p = P_{NH_3}LP_{H_2} = \frac{1}{2}x\frac{1}{2}=\frac{1}{4}$$

50. $\left[NH_4^+\right]\left[NH_2^-\right]=10^{-18}$

$$\left[NH_2^-\right]=10^{-9}$$

$$P^{NH_2}=9$$

51. Due to greater inter -molecular atractions

52. t_{75} = 2x t_{50}

58. H_3BO_3 is a Lewi's acid .Not a proton donating Bronstead acid

61. K_w depends on temp only

62. $K_w = [H^+] [OH^-]$ for pure water

64. $pH=p^{ka}+\log\frac{0.2}{1}$

$= 4.76 + \log(2x10^{-1}) = 4.76 -1+0.3010$

66. $pH=p^{ka}+\log\frac{0.5x}{10} \Rightarrow \log\left(\frac{0.5x}{10}\right)=0$

0.5 x = 10

$$x=\frac{10}{0.5}$$