SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC	GT-2	Date: 10-09-20
Time: 02:00 PM to 05:00 PM	2013_P2 Model	Max.Marks:180

KEY SHEET

PHYSICS

1	**CD**	2	**AC**	3	**CD**	4	**AD**	5	**BC**
6	**BC**	7	**AC**	8	**BD**	9	**A**	10	**D**
11	**B**	12	**C**	13	**D**	14	**A**	15	**A**
16	**C**	17	**A**	18	**B**	19	**C**	20	**D**

CHEMISTRY

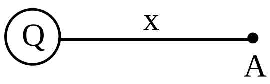
21	**ABC**	22	**AD**	23	**ABD**	24	**ABD**	25	**BD**
26	**ABCD**	27	**BD**	28	**ABCD**	29	**B**	30	**B**
31	**A**	32	**C**	33	**D**	34	**C**	35	**C**
36	**D**	37	**C**	38	**B**	39	**A**	40	**A**

MATHS

41	**BCD**	42	**AC**	43	**CD**	44	**ABC**	45	**BD**
46	**ABD**	47	**ABD**	48	**BC**	49	**B**	50	**C**
51	**D**	52	**B**	53	**C**	54	**B**	55	**C**
56	**B**	57	**C**	58	**B**	59	**A**	60	**B**

SOLUTIONS
PHYSICS

1. C)



$$u_E = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0\left(\frac{k_0 Q}{x^2}\right)^2$$

$$V = \frac{k_0 Q}{x} \text{ and } V^2 = \left(\frac{k_0 Q}{x}\right)^2$$

$$\frac{R_2}{R_1} = \left(\frac{x_1}{x_2}\right)^2 = \frac{1}{4}$$

D) $[\eta] = \frac{\varepsilon_0}{x^2} = \frac{Q^2}{x^2 F x^2} = \frac{A^2T^2}{L^2L^2HLT^{-2}} = M^{-1}L^{-5}T^4A^2$

2. For right limb $P_0V_0 = P_1V_1$ gives $80\times 40 = P_1\ 30 \Rightarrow P_1 = \frac{320}{3}$ (1)

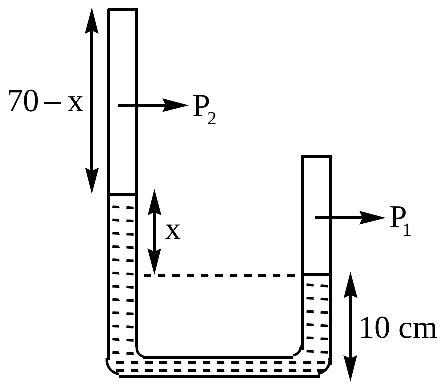
$P_2(70-x) = 80\times 80$ (2)

$P_2 = P_1 - x$ (3)

(1), (2) & (3) $\Rightarrow \left(\frac{320}{3} - x\right)(70-x) = 6400$

$(320-3x)(70-x) = 6400\times 3$

$x = 6.25$ cm



3. From the given information, the switch that was closed is S_1. The resonant frequency is 1000 rad/s. For $\omega_1 = 500;\ x_1 = \frac{1}{\omega_1 C} - \omega_1 L = 15$ (1)

For $\omega_2 = 2000;\ x_2 = \omega_2 L - \frac{1}{\omega_2 C} = 15$ (2)

and $\omega_0 = \frac{1}{\sqrt{LC}}$ (3)

$$\frac{1}{LC} = 10^6$$

$$15 = \frac{1}{\omega_1 C} - \omega_1 L = \frac{1}{500C} - \frac{500\times 1}{10^6 C}$$

$$C\times 15 = \frac{1}{500} - \frac{1}{2000} = 10^{-4}(20-5)$$

$C = 100\ \mu F$

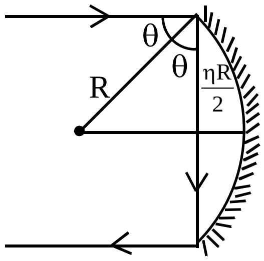
and $L = \frac{1}{10^6 C} = \frac{10^{-6}}{10^{-4}} = 10^{-2} = 10\ mH$

4. For two reflections $\theta \ge 45$

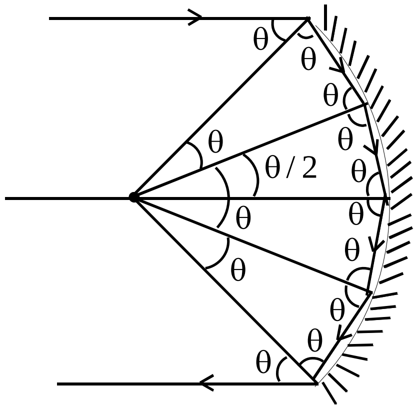
$\sin\theta \ge \frac{1}{\sqrt{2}}$

$\frac{\eta R}{2R} \ge \frac{1}{\sqrt{2}}$

$\eta \ge \sqrt{2}$



For three reflections



$\sin\theta = \frac{\eta R}{2R} = \frac{\sqrt{3}}{2}$

$\eta \ge \sqrt{3}$

$\Rightarrow 90 = \frac{3\theta}{2}$

$\theta = 60°$

5. ${}_2^4He + {}_4^9Be \rightarrow {}_6^{12}C + n$

Energy released = Final binding energy - initial binding energy

$= (12 + 7.6885 - 9 \times 6.4763 - 4 \times 7.6819) = 5.65\,MeV$

6. Just after cutting of string the acceleration of lower block is zero as spring force won't change immediately and the acceleration of upper blocking is $2g \downarrow = \frac{mg + F_S}{m} = \frac{mg + mg}{m}$

7. $u = 3x^2y^2 + 6x$

$\vec{F} = -\hat{i}\frac{\partial u}{\partial x} - \hat{j}\frac{\partial u}{\partial y} = -\hat{i}(6xy^2 + 6) - \hat{j}(6x^2y)$

at (1, 1) $\vec{F} = -12\hat{i} - 6\hat{j}$ and $a = 6\sqrt{5} - 15^2$

work done $= \Delta u = u_f - u_i = 0 - u(1, 1) = -9\ J$

8. Conceptual

9. The final volume of kerosene oil is

$$V = V_0(1+\gamma_S \Delta\tau) - \frac{V_0}{2}(1+\gamma_\omega \Delta\tau) = V_0 + V_0\gamma_S \Delta T - \frac{V_0}{2} - \frac{V_0}{2}\gamma_\omega \Delta T$$

$$= \frac{V_0}{2} + V_0 \Delta T\left(\gamma_S - \frac{\gamma_\omega}{2}\right) = \frac{V_0}{2}\left[1+\Delta T(2\gamma_S - \gamma_\omega)\right]$$

mass of k.oil in the tank is $m = V\rho_2 = \frac{V\rho_1}{(1+\gamma_k \Delta T)}$

mass over flown $\Delta m = m_0 - m = 40\,kg - \frac{\rho_1 V}{(1+\gamma_k 30)}$

10. Height of water column $= \frac{\text{volume of water}}{\text{Area of vessel}}$

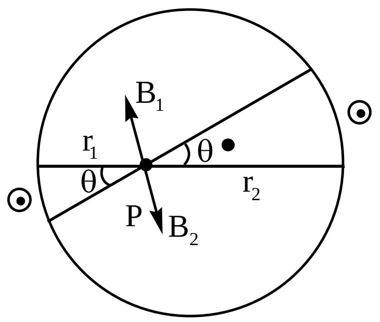
$$H = \frac{\frac{V_0}{2}(1+\gamma_w \Delta T)}{\frac{V_0}{2}\left(1+\frac{2}{3}\gamma_S \Delta T\right)}$$

11. At any internal point 'P'

$B_1 = \frac{\mu_0 n_1 I}{2\pi r_1}$ and $B_2 = \frac{\mu_0 n_2 I}{2\pi r_2}$

$n_1 = \frac{N r_1 \theta}{2\pi R}$; $n_2 = \frac{N r_2 \theta}{2\pi R}$

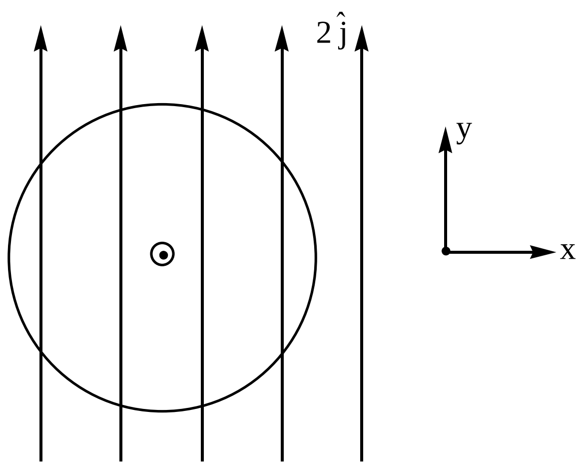
$\frac{n_1}{r_1} = \frac{n_2}{r_2} \Rightarrow B_1 - B_2 = 0$



12. For any external point we can apply ampere's law. Due to symmetry $B\,2\pi x = \mu_0 NI$

$$B = \frac{\mu_0 NI}{2\pi x}$$

13&14.



13. Induced emf $e = A\frac{dB}{dt} = \pi r^2\, 2t$

Induced current $i = \frac{e}{R_0} = \frac{2\pi 3r}{\pi} = 2r^2 t$

$\left|\vec{\tau}_B\right| = \left|\vec{\mu}\times B\,\hat{j}\right| = i\,\pi r^2(2) = 2\pi r^2\, 2r^2\, t \ge mgr$

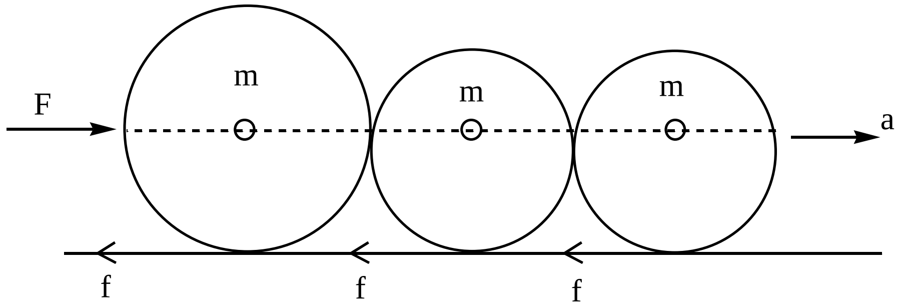
$t \ge \frac{mgr}{4\pi r^4} = \frac{\pi\times 10}{4\times r^3} = 20\text{ sec}$

$E = \frac{e}{2\pi r} = rt = \frac{1}{2}\times 20 = 10\,V/m$

14. Heat $= \int \frac{e^2}{R_0}dt = \int_0^{20} \frac{\pi^2 r^4 4t^2}{\pi}dt$

$= 4\pi r^4 \frac{t^3}{3} = \frac{4}{3}\pi\times\frac{1}{8}\times\frac{1}{2}\times 20\times 20\times 20 = \frac{2\pi}{3}\times 10^3\text{ J}$

15&16.



The linear acceleration of COM of each cylinder is $a = \frac{F-3f}{3m}$ or $F = 3f + 3ma$ (1)

$\tau = fR = \frac{mR^2}{2}\alpha = \frac{ma}{2}R$ or $f = \frac{ma}{2}$ (2)

(1) & (2) $\Rightarrow \Rightarrow F = \frac{a}{2}ma = \mu mgt$ (3)

$a_{max} = 2\mu g$ (4)

$F_0 = \frac{a}{2}m\,2\mu g = \mu mgt$

t = 9 sec

17. From the figure $\lambda_{K\alpha} = \frac{1}{4.34}\overset{0}{A} = 0.23\overset{0}{A}$ and $\lambda_{K\beta} = \frac{1}{5.56}\overset{0}{A} = 0.18\overset{0}{A}$

accelerating potential difference $V = \frac{hc}{e\lambda} = \frac{12414}{\frac{1}{8.06}}$

$\square\, 10^5\,V$

From Mosely's law

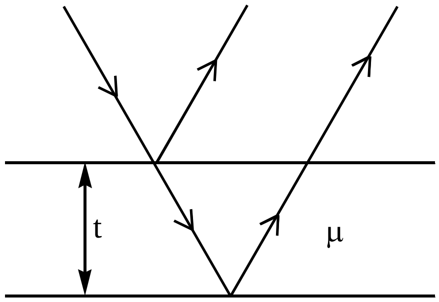
$\frac{1}{\lambda_{K\alpha}} = a^2(z-b)^2 = \left(\frac{3R}{4}\right)(z-1)^2$

$4.34\times 10^{10} = \frac{3}{4}\times 1.1\times 10^7 (z-1)^2$

$(z-1)^2 = \frac{4.34\times 4\times 10^3}{3.3} = \square\ 5260 = a$

$z-1 = 73$ or $z = 74$

18.



$\Delta x = 2\mu t = n\lambda$ for distructive interference

$t = \frac{n\lambda}{2\mu} = \frac{n\lambda}{3}$

$t = \frac{n_1 450}{3} = 150 n_1$ (1)

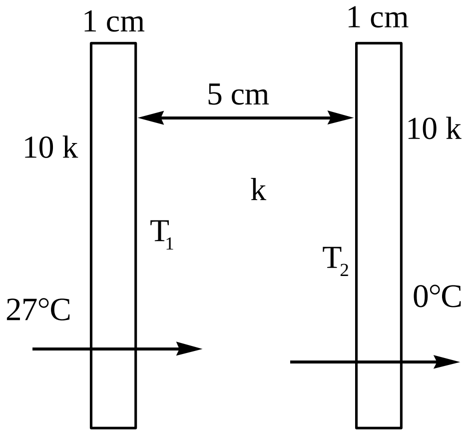
$t = \frac{n_2 540}{3} = 180 n_2$ (2)

(1) & (2) will satisfy for $n_1 = 6$ and $n_2 = 5 \Rightarrow t = 900$ nm.

For constructive interference in reflected light $\Delta x = 2\mu t = (2n-1)\frac{\lambda}{2}$

or $\lambda = \frac{4\mu t}{2n-1} = \frac{6 \times 900\,\text{nm}}{2n-1}$

19.



$\frac{(27-T_1)10k}{1\text{ cm}} = \frac{(T_1 - T_2)k}{5\text{ cm}} = \frac{(T_2 - 0)10k}{1}$

Solving we get $T_1 = 26.5°C$

$T_2 = 0.5°C$

Rate of heat flow $P = \frac{0.5 \times 10 \times 0.08}{10^{-2}}$

$= 40$ J/s

Temperature gradient across stagnant air space is $= \frac{T_1 - T_2}{5\text{ cm}} = \frac{26}{5} \times 10^2 = 520$ k/m

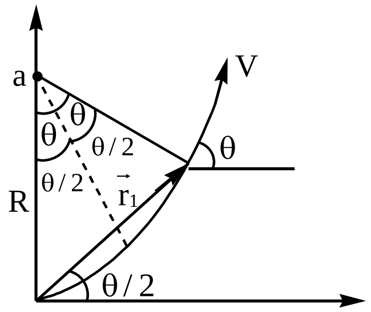
20. Angle between two velocity vectors is always $60°$ as both rotate with same angular velocity $\Rightarrow \vec{V}_1 \cdot \vec{V}_2 = V\cos 60 = \frac{V^2}{2}$

$\vec{r}_1 = 2R\sin(\theta/2)\left(\cos(\theta/2)\hat{i} + \sin(\theta/2)\hat{j}\right)$

similarly $\vec{r}_2 = 2R\sin(\theta/2)\left(\cos(60+\theta/2)\hat{i}+\sin(60+\theta/2)\hat{j}\right)$

$$\vec{r}_1\cdot\vec{r}_2 = 4R^2\sin^2(\theta/2)\left(\cos\left(60+\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)+\sin\left(\frac{\theta}{2}\right)\sin\left(60+\frac{\theta}{2}\right)\right)$$

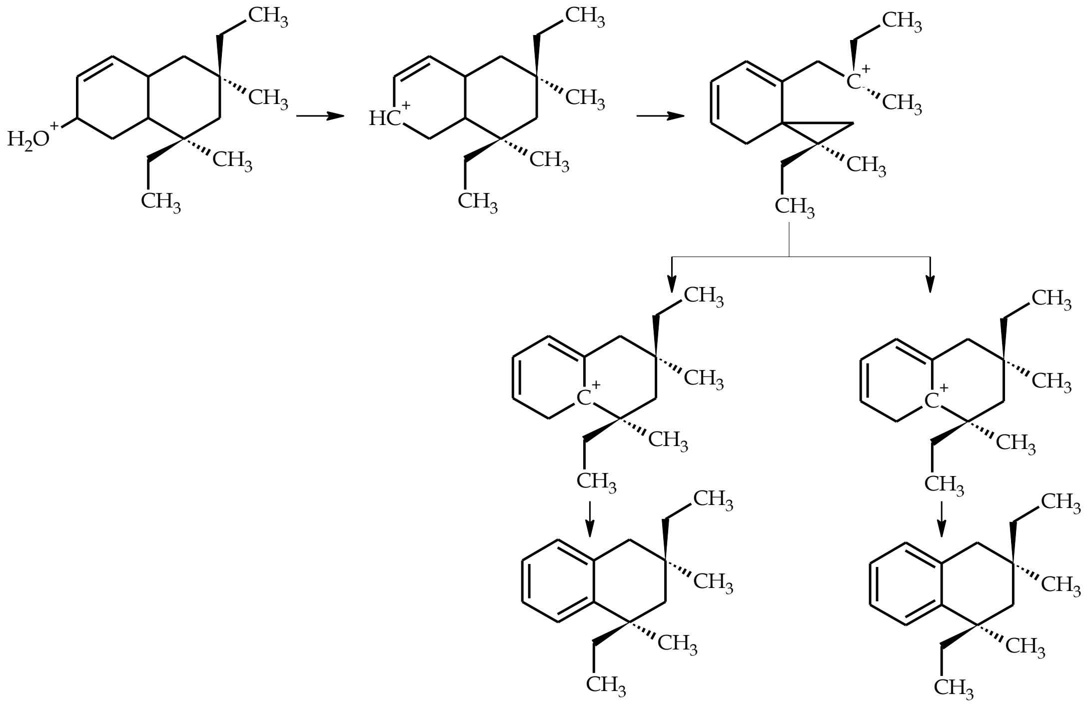
$$\vec{r}_1\cdot\vec{r}_2 = 4R^2\sin\left(\frac{\theta}{2}\right)(\cos 60) = 2R^2\sin^2\left(\frac{\theta}{2}\right)$$



CHEMISTRY

21. α, β–unsaturated carboxylic acids lose CO_2 on simple heating.

22.



23. M_{eq} of hydrogen produced at cathode is same as M_{eq} of oxygen produced at anode. As the solution around electrode A is slightly basic, colour changes to blue.

24. a. $2CuO \text{ ® } Cu_2O+\frac{1}{2}O_2$

oxygen has n–gactor 4

b. C is anhydrous copper sulphate and is white.

About 35% loss in mass corresponds to loss of all five water molecules

$\frac{248.5X37}{100X18} \approx 5$.

25. NCERT

26. The driving force behind these reactions is the formation of LiBr (very large lattice energy and insoluble in organic solvents in which the reaction is performed. Due to

similar reasons the $MgCl_2$ react with LiC_2H_5. Benzene is more acidic than C_2H_6. So the driving force for the reaction is loss of C_2H_6. Li_3N converts into amides and hydrides by reaction with hydrogen.

27. BeO is amphoteric and dissolves in barium hydroxide forming $BaBeO_2$. In this reaction BeO acts as acid and neutralizes $Ba(OH)_2$. So pH decreases.

28. A) Being acidic CO_2 decreases the concentration of OH^-

B) Similar to $BaCO_3, BaCS_3$ gives $BaS + CS_2$

C) O_2, SO and S_2 all three molecules have same number of valence electrons and have same MO electronic configuration

D) Oxygen, sulphur and selenium belong to same group and form similar compounds with carbon.

29. A & B can give the given compound, B is best method because of good leaving nature.

30. Phenol do not react with $NaHCO_3$.t–BuoNa gives alkene as major product.

31. Enantiomers have same molar free energy.

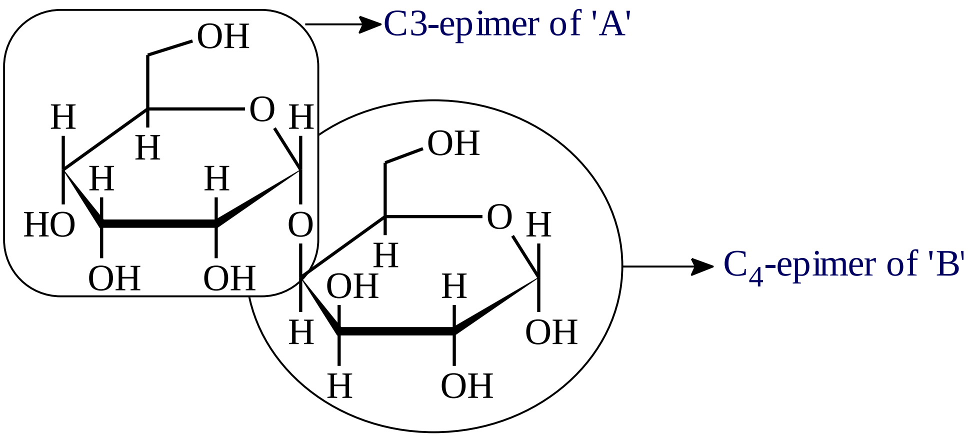
32. $\frac{[C]}{[C]_0} = 0.839$

De = $\frac{0.839 - 0.161}{0.839 + 0.161} X100$ =67.7%.

33. In the rust iron is present in +3 oxidation state and form blue solution with potassium ferrocyanide.

34. Since Zn and Mg are more electropositive than iron. Iron will rust but copper is less electropositive than iron. So cannot reduce rust.

35.



36. Conceptual

37. Conceptual

38. NCERT

39. $FeCl_3$ + NaOH forms $Fe(OH)_3$: OH^- colloidal particles in the sol.

40. Conceptual

MATHS

41. 41. $(a-2b)^2+(a-c)^2=0 \Rightarrow a=2b=c$

$\therefore \cos A=\frac{1}{4}, \cos B=\frac{7}{8}; \cos C=\frac{1}{4}$

$\frac{r}{r_1}=\frac{s-a}{s}=1-\frac{a}{s}=1-\frac{a}{\frac{5a}{4}}=\frac{1}{5}$

42. $a<0, c>0 \frac{-b}{2a}>0 \Rightarrow b>0$

$abc<0$

$f(-1)=0, f(3)=0 \quad f\left(\frac{1}{3}\right)>0, f\left(\frac{-1}{3}\right)>0$

43. Sum $=\frac{\ln_{10}^5-1}{3\ln_{10}^2}=\frac{\ln_{10}^5-\ln_{10}^{10}}{3\ln_{10}^2}=\frac{-\ln_{10}^2}{3\ln_{10}^2}=-1/3$

Product : $-\frac{2\ln_{10}^2}{3\ln_{10}^2}=\frac{-2}{3}$

Sum of coefficients $=2\ln_{10}^2$

Discriminant $=25\left(\ln_{10}^2\right)^2$

44. $(1,1,4),(1,2,3)(2,2,2)$

$w=90+360+90=540=2^2\times 3^3\times 5^1$

45. a) $\underset{x\to 1^+}{Lt}\ g(f(x))=\underset{x\to 0^-}{Lt}\ g(x)$ does not exists

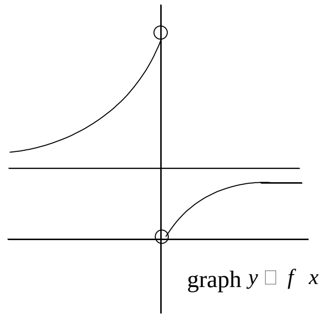
b) $\underset{x\to \frac{\pi}{2}^-}{Lt}\ g(f(g(x)))=\underset{x\to 0^-}{Lt}\ g(f(x))=\underset{x\to 2^-}{Lt}\ g(x)=0$

c) $\underset{x\to 2^+}{Lt}\ \frac{f(g(x))}{f(x)-2}=0$

d) $\underset{x\to 0^+}{Lt}\ \frac{g(2-x)}{(2-x-2)^2}=\underset{x\to O^+}{Lt}\ \frac{1-\cos x}{x^2}=\frac{1}{2}$

46. $y=\frac{1}{1+e^{1/x}}; \quad \frac{dy}{dx}>0\ \forall x\in R-\{0\}$

$\underset{x\to \pm\infty}{Lt}\ y=\frac{1}{2}; \quad \underset{x\to 0^+}{Lt}\ y=0$



47. $|A| = 5 \therefore A, A^2, A^3$ invertible

$$A^2 = \begin{bmatrix} 9 & 8 & 8 \\ 8 & 9 & 8 \\ 8 & 8 & 9 \end{bmatrix} \qquad 4A + 5I_3 = \begin{bmatrix} 9 & 8 & 8 \\ 8 & 9 & 8 \\ 8 & 8 & 9 \end{bmatrix}$$

$\therefore A^2 = 4A + 5I_3$

$\Rightarrow 5A^{-1} + 4I = A$

$A^{-1} = \frac{1}{5}(A - 4I)$

48. $\bar{v}_1 = \bar{v}_2$

$\Rightarrow (\bar{a}.\bar{b})\bar{c} = (\bar{b}.\bar{c})\bar{a} \Rightarrow$ either $\bar{c}$ and $\bar{a}$ collinear or $\bar{b} \perp$ to $\bar{a}, \bar{c} \Rightarrow \bar{b} = 1\ (\bar{a} \times \bar{c})$

49.50. $(y-2)^2 = 8(x-3)$ focus is $(5,2)$ and $P(5,6)Q(5,-2)$ ends of latusrectum

$\therefore$ Normal at P, Q intersect on axis of parabola

$\Rightarrow$ Circumcentre of ΔPQR is focus of parabola

Area of quadrilateral $TRPQ = \left(\frac{8}{\sqrt{2}}\right)\left(\frac{8}{\sqrt{2}}\right) = 32$

51.52. $Y - y = \frac{-1}{m}(X - x)$; given $y + \frac{x}{m} = \sqrt{x^2 + y^2}$

$\Rightarrow \int \frac{ydy + xdx}{\sqrt{x^2 + y^2}} = \int dy$

$\sqrt{x^2 + y^2} = y + c$

as curve passing through $(-\sqrt{3}, 1)$ the curve is

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

$\left|\int_0^1 \frac{x^2 - 1}{2} dx\right| = \frac{1}{3}$ and shortest distance between the given circle and parabola is $\sqrt{2} - 1$

53.54. $A(z_1)$ is the point of intersection of $\arg(z-2+i)=\frac{3\pi}{4}$ and

$\arg\left(z+i\sqrt{3}\right)=\frac{\pi}{3} \Rightarrow z_1=1$

z_2 is foot from $(5,0)$ to line $y=\sqrt{3}(x-1)$ is $\left(2,\sqrt{3}\right)$

$z_2=2+i\sqrt{3}$ C is centre $(5,0)$

$\therefore A(1,0)B\left(2,\sqrt{3}\right)C(5,0)$ $\therefore$ Area of $\Delta ABC=2\sqrt{3}$

Now the line perpendicular to AB will be at the form

$z=\pm 1\, i(z_2-z_1)$

$=\pm 1\, i\left(2+i\sqrt{3}-1\right)$

$z=\pm 1\, i\left(1+i\sqrt{3}\right)=\pm 1\left(-\sqrt{3}+i\right)$

55.56. $P(7)=\frac{6}{36}, P(10)=\frac{3}{36}$

P(Nobody wins) $\frac{6}{36}\times\frac{3}{36}+\frac{30}{36}\times\frac{33}{36}=\frac{7}{9}$

In any trail, $P(7)=2P(10)$,

If $P(B)=p$

Then $P(A)=2p$, and when equal throws, not considered $p+2p=1$

$\Rightarrow P=\frac{1}{3}$

57. A) $\left[\bar{a}\times\bar{b} \quad \bar{b}\times\bar{c} \quad \bar{c}\times\bar{a}\right]=\left[\bar{a}\ \bar{b}\ \bar{c}\right]^2$

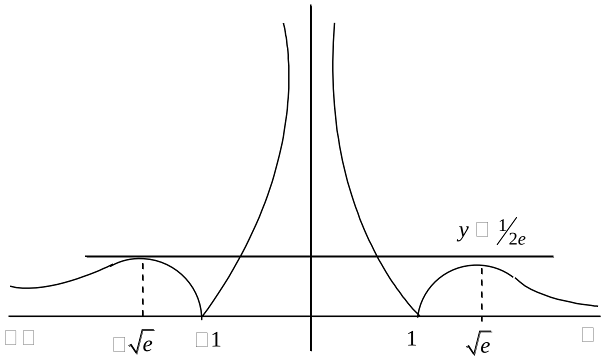
B) $\left[\bar{a}+\bar{b} \quad \bar{b}+\bar{c} \quad \bar{c}+\bar{a}\right]=2\left[\bar{a}\ \bar{b}\ \bar{c}\right]$

C) $2\Delta=\left|\bar{a}\times\bar{b}\right|$

D) Area of parallelogram $=\left|\bar{a}\times\bar{b}\right|$

58. $\frac{\left|\ln|x|\right|}{x^2}=K$

$h(x)=\frac{\ln x}{x^2}$ $h(x)\uparrow$ in $\left(0,\sqrt{e}\right)\downarrow$ in $\left(\sqrt{e},\infty\right)$



59. Conceptual
60. Conceptual