Part B

*Answer **all** the questions.

09 .(a) α and β are the roots of the quadratic equation $10x^2+4x+1=2\lambda x(2-x)$,where λ s a real constant.

(i) Find the quadratic equation whose roots are $\frac{\alpha^3}{\beta}$ and $\frac{\beta^3}{\alpha}$

(ii) Find the range of the values of λ such that α and β are real.

Deduce the values of λ for $\alpha=\beta$

(b) When $k\in\Re$,Let $f(x)=2(5+k)x^2+4(1-k)x+1$.

It is given that $g(x)=\frac{1}{f(x)}$, roots of $f(x)=0$ are real and the minimum value of $g(x)$ is $f(x_1)$

Find the set of values of k .

Find x_1 .Hence ,find the minimum value of $g(x)$ in terms of k .

(c) When the cubic polynomial $f(x)$ with leading coefficient 1 is divided by $(x-1)$ and $(x-2)$ the remainders are 7 and 15 respectively,

Find the remainder when $f(x)$ is divided by $(x-1)(x-2)$

If $f(3)=5$, find the quotient when $f(x)$ is divided by $(x-1)(x-2)$.

Hence ,obtain $f(x)$

10. Find the equations of the bisectors of the angles between the non-parallel straight lines $l_1: a_1x+b_1y+c_1=0$ and $l_2: a_2x+b_2y+c_2=0$.

$A\equiv(-1,-1)$ and $C\equiv(7,15)$ are two opposite vertices of a parallelogram $ABCD$ .It has a diagonal of length $2\sqrt{17}$ which makes an angle $\tan^{-1}(4)$ with the positive direction of the x-axis .Find the coordinates of the vertices B and D .Find the equations of the bisectors of the internal angles of $A\hat{B}C$ and $A\hat{D}C$ of the parallelogram.

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Grade 13 First Term Test – 2023 April

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Part B

*Answer **all** questions.

9.(a) A particle P is projected vertically upwards under gravity from a horizontal floor with a velocity of $8.4ms^{-1}$ .Another particle Q is projected vertically upwards under gravity from a point $2m$ above from the point of projection with a velocity of u, for collision when it reaches its maximum point. If the height from the horizontal floor to the point of collision is $3.6\ m$, find the value of u. $\left(g = 9.8ms^{-2}\right)$

Assuming that both particles P and Q are projected at the same instant, sketch the velocity time graphs for the motions of both particles in the same diagram.

Hence, find the velocities of both particles, when they are at the same height from the horizontal floor.

(b) A car A leaves towards East with a constant velocity of $15\sqrt{3}kmh^{-1}$ passes a fixed point O at 12.00 noon. A car B, leaves towards North with a constant velocity of $15kmh^{-1}$ passes the point O at 2.00 p.m. Sketch a velocity triangle and find the path of B relative to A. Hence, find the shortest distance between A and B and the time at that moment. If the signals can be emitted $30km$ distance between the two cars, find the period of time which the signals can be exchanged between the two cars.

10.(a) A particle is projected with a velocity u from a point O at an angle θ to the horizontal in a vertical plane under gravity .Consider a rectangular Cartesian coordinates system with horizontal and vertical axes are OX and OY respectively through O on the plane of projection. If the position of the particle at time t is $P=(x, y)$,obtain the expressions for x and y in terms of u, θ and t.

At the moment, when a particle is projected under gravity in a vertical plane with a velocity u from a point O at an angle θ to the horizontal ,another particle is projected under gravity in a vertical plane towards it with a velocity u from a point $A=(h, k)$ at an angle θ to the horizontal.

Using the above results, find the shortest distance between the two particles and the time taken for it.

(b) A smooth sphere A of mass $2m$ moving with a velocity u collides with a smooth sphere B of mass m moving in the opposite direction with a velocity of $2u$.Both spheres are on a smooth floor such that the line joining the centers is perpendicular to a vertical wall.The coefficient of restitution between the two spheres is e. The sphere A moves towards the wall. The sphere B is in between the sphere A and the wall where a distance away from the wall. Show that the velocities of the spheres are in opposite direction after the impact. After the sphere B collides with the vertical wall, it collides with the sphere A again. The impact between the sphere B and the vertical wall is perfectly elastic .If the second impact occurs $\frac{3a}{2u}$ time after the first impact, find the value of e.

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