MATHS

BOOKS - JEEVITH PUBLICATIONS

MATHS (KANNADA ENGLISH)

APPLICATION OF DERIVATIVES

Five Marks Questions With Answers

1. Find the rate of change of the area of a circle with respect to its radius r when

(a) r = 3 cm.

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2. Find the rate of change of the area of a circle with respect to its radius r when

(b) r = 4cm.

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3. The volume of a cube is increasing at the rate of $8cm^3/s$. How fast is the surface area

increasing when the length of an edge is 12 cm?

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4. The radius of a circle is increasing uniformly at the ratio 3 cm/s. Find the rate at which the area of the circle is increasing when the radius is 10 cm.

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5. An edge of a variable cube is increasing at the rate of 3 cm/s. How fast is the volume of the increasing when the edge is 10 cm long?

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6. A stone is dropped into a quiet lake and waves in circles at the speed of 5 cm/s. At the instant when the radius of the circular wave is 8 cm, how fast is the enclosed area increasing?

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7. The radius of a circle is increasing at the rate of 0.7 cm/s. What is the rate of increase of its circumference?

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8. The length x of rectangle is decreasing at the rate of 5cm/minute and width y is increasing at the rate of 4 cm/minute. When x=8 cm and y=6 cm, find the rate of change of

(i) the perimeter and (ii) the Area of the rectangle.

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9. The length x of rectangle is decreasing at the rate of 5cm/minute and width y is increasing at the rate of 4 cm/minute. When x=8 cm and y=6 cm, find the rate of change of (i) the perimeter and (ii) the Area of the rectangle.

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10. A balloon which always remain spherical on inflation, is being inflated by pumping in 900 cubic cm of gas per second. Find the rate at which the radius of the balloon increases when the radius is 15 cm.

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11. A balloon which remains spherical has a vertical radius. Find the rate at which its

volume is increasing with the radius when the radius is 10 cm.

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12. A ladder 5 m long is leaning against a well. The bottom of the ladder is pulled along the ground, away from the well, at the rate of 2 m/s. How fat is its height on the wall decreasing when the foot of the ladder is 4m away from the wall?

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13. A particle move along the curve $6y = x^3 + 2$ .Find the points on the curve at which y-coordinate is changing 8 times as fast as the x-coordinates.

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14. The radius of an air bubble is increasing at the rate of $\frac{1}{2} cm/s$. At what rate is the volume of the bubble increasing when the radius is 1 cm?

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15. A balloon, which always spherical, has a variable diameter $3/2(2x+1)$. Find the rate of change of its volume with respect to x.

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16. Sand is pouring from a pipe at the rate of $12cm^3/s$. The falling sand forms a cone on the ground in such a way that the height of

the cone is always one-sixth of the base. How fast height of the sand cone increasing when the height is 4 cm?

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17. The total cost C(x) in rupees associated with the production of x units of an item is given by $C(x) = 0.007x^3 - 0.003x^2 + 15x + 4000.$ Find the marginal cost when x = 17 units are produced.

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18. The total revenue in rupees received from the sale of x units of a product is given by $R(x) = 13x^2 + 26x + 15$. Find the marginal revenue when x = 7.

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19. A man of height 2 metres walks at a uniform speed of 5 km/h away from a lamp

post which is 6 metres high. Find the rate at which the length of his shadow increases.

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20. A water tank has the shape of an inverted right circular cone with its axis vertical and vertex lowermost. Its semi-vertical angle is $\tan^{-1}(0.5)$. Water is poured into it at a constant rate of 5 cubic metre per hour. Find the rate at which the level of the water is

rising at the instant when the depth of water in the tank is 4 m.

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21. A car starts from a point P at time t = 0 seconds and stops at point Q. The distance x, in metres, covered by it, in t seconds is given by $x = t^2\left(2 - \frac{t}{3}\right)$. Find the time taken by it to reach Q and also find the distance between P and Q.

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22. A circular disc of radius 3 cm is being heated. Due to expansion, its radius increased at the rate of $0.05cm/s$. Find the rate at which its area is increasing when radius is 3.2 cm.

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Three Marks Questions With Answers A Decreasing And Increasing Functions

1. Show that the function given by $f(x) = 3x + 17$ is strictly increasing on R.

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2. Show that the function given by $f(x) = e^{2x}$ is strictly increasing on R.

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3. Find the intervals in which the function f given by $f(x) = x^2 - 4x + 6$ is (a) strictly increasing (b) strictly decreasing.

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4. Find the intervals in which the function f given by $f(x) = 2x^2 - 3x$ is

(a) strictly increasing (b) strictly decreasing.

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5. Find the intervals in which the function f given by $f(x) = 2x^3 - 3x^2 - 36x + 7$ is

(a) strictly increasing (b) strictly decreasing?

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6. Find the intervals in which the functions f given by $f(x) = 4x^3 - 6x^2 - 72x + 30$ is

(a) strictly increasing (b) strictly decreasing.

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7. Show that the function given by $f(x) = \sin x$ is

(a) strictly increasing in $\left(0, \frac{\pi}{2}\right)$.

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8. Show that the function given by $f(x) = \sin x$ is

(b) strictly decreasing in $\left(\frac{\pi}{2}, \pi\right)$.

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9. Show that the function given by $f(x) = \sin x$ is

(c) neither increasing nor decreasing in $(0, \pi)$.

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10. Prove that the function given by $f(x) = \cos x$ is

(a) strictly decreasing in $(0, \pi)$.

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11. Prove that the function given by $f(x) = \cos x$ is

(b) strictly increasing in $(\pi, 2\pi)$.

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12. Prove that the function given by $f(x) = \cos x$ is

(c) neither increasing nor decreasing in $(0, 2\pi)$.

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13. Find the intervals in the function f is given by $f(x) = \sin x + \cos x, 0 \leq x \leq 2\pi$ is strictly increasing or strictly decreasing.

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14. Find the interval in which the following functions are strictly increasing or decreasing.

(a) $x^2 + 2x = 5$

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15. Find the interval in which the following functions are strictly increasing or decreasing.

(b) $10 - 6x - 2x^2$

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16. Find the interval in which the following functions are strictly increasing or decreasing.

$-2x^3 - 9x^2 - 12x + 1$

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17. Find the interval in which the following functions are strictly increasing or decreasing.

(d) $6 - 9x - x^2$

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18. Find the interval in which the following functions are strictly increasing or decreasing.

(e) $(x+1)^3(x-3)^3$.

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19. Show that $y = \log(1+x) - \frac{2x}{2+2x}, x > -1,$ is an increasing function of x throughout its domain.

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20. Find the values of x for which y = $[x(x-2)]^2$ is an increasing function.

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21. Prove that $y = \dfrac{4\sin\theta}{(2+\cos\theta)} - \theta$ is an increasing on θ in $\left[0, \dfrac{\pi}{2}\right]$.

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22. Prove that the logarithmic function is strictly increasing on $(0, \infty)$.

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23. Prove that the function f given by $f(x) = x^2 - x + 1$ is neither increasing nor decreasing strictly on (-1,1).

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Three Marks Questions With Answers B Tangents And Normals

1. Find the slope of the tangent to the curve $y = 3x^4 - 4x$ at $x = 4$.

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2. Find the slope of the tangent to the curve $y = \frac{x-1}{x-2}, x \neq 2$ at $x = 10.$

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3. Find the slope of the tangent to curve $y = x^3 - x + 1$ at the point whose x-coordinate is 2.

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4. Find the slope of the tangent to the curve $y = x^3 - 3x + 2$ at the point whose x-coordinate is 3.

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5. Find the slope of the normal to the curve $x = a\cos^3\theta, y = a\sin^3\theta$ at $\theta = \frac{\pi}{3}$.

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6. Find the slope of the normal to the curve $x = 1 - a\sin\theta, y = b\cos^2\theta$ at $\theta = \frac{\pi}{2}$.

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7. Find points at which the tangent to the curve $y = x^3 - 3x^2 - 9x + 7$ is parallel to the x-axis.

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8. Find the point on the curve $y = (x - 2)^2$ at which the tangent is parallel to the chord joining the points (2,0) and (4,4).

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9. Find the equations of the tangent and normal to the given curve at the given points.

(i) $y = x^4 - 6x^3 - 10x + 5$ at $(0, 5)$

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10. Find the equations of the tangent and normal to the given curve at the given points.

(ii) $y = x^4 - 6x^3 + 13x^2 - 10x + 5$ at $(1, 3)$

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11. Find the equations of the tangent and normal to the given curve at the given points.

(iii) $y = x^3$ at $(1, 1)$

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12. Find the equations of the tangent and normal to the given curve at the given points.

(iv) $y = x^2$ at (0,0).

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13. Find the equations of the tangent and normal to the given curve at the given points.

(v) $x = \cos t, y = \sin t$ at $t = \frac{\pi}{4}$

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14. Find the slope of the tangent to the curve $y = x^3 - x$ at $x = 2$.

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15. Find the point at which the tangent to the curve $y = \sqrt{4x - 3} - 1$ has its slope $\frac{2}{3}$.

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16. Find the point on the curve $y = x^3 - 11x + 5$ at which the tangent is $y = x - 11$.

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17. Find the equation of all lines having slope -1 that are tangent to the curve $y = \frac{1}{x+1}, x \neq -1$.

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18. Find the equation of all lines having slope -2 that are tangent to the curve $y = \frac{1}{x-3}, x \neq 3.$

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19. Find the equation of all lines having slope 0 which are tangents to the curve $y = \frac{1}{x^2 - 2x + 3}.$

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20. Find points on the curve $\frac{x^2}{9} + \frac{y^2}{16} = 1$ at which the tangents are

(a) parallel X-axis.

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21. Find points on the curve $\frac{x^2}{9} + \frac{y^2}{16} = 1$ at which the tangents are

(b) parallel to Y-axis.

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22. Find the equation of the tangent line to the curve $y = x^2 - 2x + 7$ which is

(a) parallel to the line $2x - y + 9 = 0$

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23. Find the equation of the tangent line to the curve $y = x^2 - 2x + 7$ which is

(b) perpendicular to the line $5y - 15x = 13.$

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24. Show that the tangents to the curve $y = 7x^3 + 11$ at the points where x = 2 and x = -2 are parallel.

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25. Find the points on the curve $y = x^3$ at which the slope of the tangent is equal to the y-coordinate of the point.

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26. For the curve $y = 4x^3 - 2x^5$, find all the points at which the tangent passes through the origin.

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Three Marks Questions With Answers C Approximations

1. Using differentials, find the approximate value of each of the following upto 3 place of

decimal.

(i) $\sqrt{25.3}$

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2. Using differentials, find the approximate value of each of the following upto 3 place of decimal.

(ii) $\sqrt{49.5}$

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3. Using differentials, find the approximate value of each of the following upto 3 place of decimal.

(iii) $\sqrt{0.6}$

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4. Using differentials, find the approximate value of each of the following upto 3 place of decimal.

(iv) $(0.009)^{1/3}$

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5. Find the approximate value of $f(2.01)$, where $f(x) = 4x^2 + 5x + 2$.

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6. Find the approximate value of $f(5.001)$, where $f(x)j = x^3 - 7x^2 + 15$.

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7. Find the approximate change in the volume V of a cube of side x metre caused by increasing the side by 1%.

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8. Find the approximate change in the surface area of a cube of side x metre caused by decreasing the side by 1%.

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9. If the radius of a sphere is measured as 7m with an error of 0.02 m, then find the approximate error in calculating its volume.

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Exercise

1. Find the local maxima and local minima. If any of the following function. Also, find the local maximum and the local minimum values,

as the case may be as follows:

(i) $f\left(x = x^2\right)$

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2. Find the local maxima and local minima. If any of the following function. Also, find the local maximum and the local minimum values, as the case may be as follows:

(ii) $g(x) = x^3 - 3x$

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3. Find the local maxima and local minima. If any of the following function. Also, find the local maximum and the local minimum values, as the case may be as follows:

(iii) $h(x) = \sin x + \cos x, 0 < x < \frac{\pi}{2}$

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4. Find the local maxima and local minima. If any of the following function. Also, find the local maximum and the local minimum values,

as the case may be as follows:

(iv) $f(x) = \sin x - \cos x, 0 < x < 2\pi$

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5. Find the local maxima and local minima. If any of the following function. Also, find the local maximum and the local minimum values, as the case may be as follows:

(v) $f(x) = x^3 - 6x^2 + 9x + 15$

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6. Find the local maxima and local minima. If any of the following function. Also, find the local maximum and the local minimum values, as the case may be as follows:

(vi) $g(x) = \frac{x}{2} + \frac{2}{x}, x > 0$

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7. Prove that the following functions do not have maxima or minima:

(a) $f(x) = e^x$

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8. Prove that the following functions do not have maxima or minima:

(b) $g(x) = \log x$

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9. Prove that the following functions do not have maxima or minima:

(c) $h(x) = x^3 + x^2 + x + 1$

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10. Find the absolute maximum value and the absolute minimum value of the following functions in the given interval.

(a) $f(x) = x^3, x \in [-2, 2]$

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11. Find the absolute maximum value and the absolute minimum value of the following functions in the given interval .

(b) $f(x) = \sin x + \cos x, x \in [0, \pi]$

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12. Find the absolute maximum value and the absolute minimum value of the following functions in the given interval.

(c) $f(x) = 4x - \frac{1}{2}x^2, x \in \left[-2, \frac{9}{2}\right]$

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13. Find the absolute maximum value and the absolute minimum value of the following

functions in the given interval .

(d) $f(x) = (x-1)^2 + 3x, x \in [-3, 1]$

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14. Find both the maximum value and the minimum value $3x^4 - 8x^3 + 12x^2 - 48x + 25$ on the interval [0,3].

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15. Find the maximum value of $2x^3 - 24x + 107$ in the interval [1,3]. Find the maximum value of the same function in [-3, -1].

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16. It is given that at $x = 1$, the function $x^4 - 62x^2 + ax + 9$ attains its maximum value, on the interval [0,2]. Find the value of a.

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17. Find two number whose sum is 24 and whose product is larger as possible.

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18. Find two positive numbers x and y such that $x + y = 60$ and xy^3 is maximum.

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19. Find two positive numbers x and y such that their sum is 35 and the product is x^3y^5 is maximum.

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20. Find two positive numbers whose sum is 16 and the sum of whose cubes is minimum.

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21. A square piece of tin of side 18 cm is to be made into a box without top, by cutting off square from each corner and foling up the flaps of the box. What should be the side of the square to be cut off so that the volume of the box is maximum possible.

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22. A rectangular sheet of tin 45 cm by 24 cm is to made into a box without top, by cutting-

off square from each other corner and folding up the flaps. What should be the side of the square to be cut-off so that the volume of the box is maximum?

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Try Yourself

1. Find the rate of change of the area of a circle with respect to its radius r when r = 5cm.

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2. The volume of a cube is increasing at the rate of 9 cubic cm/sec. How fast is the surface area increasing when the length of an edge is 10 cm?

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3. The volume of a cube is increasing at a rate of 9 cubic centimetres per second. How fast is the surface area increasing when the length of an edge is 10 centimetres per second. How fast

is the surface area increasing when the length of an edge is 10 centimetres?

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4. A stone is dropped into a quiet lake and waves in circles at a speed of 4 cm per second. At the instant, when the radius of the circular wave is 10 cm, how fast is the enclosed area increasing?

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5. The length x of a rectangle is decreasing at the rate of 3 cm/min and the width y is increasing at the rate of 2cm/min. When x=10cm and y=6cm, find the ration of change (i) the perimeter and (ii) the area of the reactangle.

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6. The length x of a rectangle is decreasing at the rate of 3 cm/min and the width y is increasing at the rate of 2cm/min. When

x=10cm and y=6cm, find the ration of change (i) the perimeter and (ii) the area of the reactangle.

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7. Find the intervals in the function f is given by $f(x) = \sin x + \cos x, 0 \leq x \leq 2\pi$ is strictly increasing or strictly decreasing.

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8. Find the slope of the tangent to the curve $y = x^3 - x$ at $x = 2$.

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9. Find the point at which the tangent to the curve $y = \sqrt{4x - 3} - 1$ has its slope $\frac{2}{3}$.

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10. Use differential to approximate $\sqrt{36.6}$

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11. Find the approximate value of $f(3.02)$, where $f(x) = 3x^2 + 5x + 3$.

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12. If the length of three sides of a trapezium other than base are equal to 10 cm then find the area of the trapezium when it is maximum.

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13. Prove that the radius of the right circular cylinder of greatest curved surface area which can be inscribed in a given cone is half of that of the cone.

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