MATHS

BOOKS - RD SHARMA MATHS (ENGLISH)

DERIVATIVES AS A RATE MEASURER

Others

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. Find the rate of change of the volume of a ball with respect to its radius $r.$ How fast is the volume changing with respect to the radius when the radius is 2cm?

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3. Find the rate of change of the area of a circular disc with respect to its circumference when the radius is 3cm.

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4. Find the rate of change of the volume of a cone with respect to the radius of its base.

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5. Find the rate of change of the volume of a sphere with respect to its diameter.

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6. Find the rate of change of the volume of a sphere with respect to its surface area when the radius is 2cm.

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7. Find the rate of change of the total surface area of a cylinder of radius r and h, when the radius varies.

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8. The money to be spend for the welfare of the employees of a firm is proportional to the rate of change of its total revenue (Marginal revenue). If the total revenue (in rupees) received from the sale of x units of a product

is given by $R(x) = 3x^2 + 36x + 5$, find the marginal revenue, when $x = 5$, and write which value does the question indicate.

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9. A balloon in the form of a right circular cone surmounted by a hemisphere, having a diameter equal to the height of the cone, is being inflated. How fast is its volume changing with respect to tis total height h, when $h = 9cm$.

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10. Water is running into an inverted cone at the rate of π cubic metres per minute. The height of the cone is 10 metres, and the radius of its base is 5m. How fast the water level is rising when the water stands 7.5 m below the base.

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11. If $y = 7x - x^3$ and x increases at the rate of 4 units per second, how fast is the slope of the curve changing when $x = 2$?

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12. Find an angle θ (i) Which increases twice as fast as its cosine. (ii) Whose rate of increase twice is twice the rate of decrease of its consine.

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13. The top of a ladder 6 metres long is resting against a vertical wall on a level pavement, when the ladder begins to slide outwards. At the moment when the foot of the ladder is 4 metres from the wall, it is sliding away from the wall at the rate of 0.5 m/sec. How fast is the top-sliding downwards at this instance? How far is the foot from the wall when it and the top are moving at the same rate?

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14. A ladder 13m long leans against a wall. The foot of the ladder is pulled along the ground away from the wall, at the rate of 1.5m/sec. How fast is the angle θ between the ladder and the ground is changing when the foot of the ladder is 12m away from the wall.

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15. A particle moves along the curve $y = x^2 + 2x$. At what point(s) on the curve

are the x and y coordinates of the particle changing at the same rate?

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

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17. A man 2 metres high walks at a uniform speed of 5 km/hr away from a lamp-post 6 metres high. Find the rate at which the length of his shadow increases.

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18. The radius of a spherical soap bubble is increasing at the rate of 0.2 cm/sec. Find the rate of increase of its surface area, when the radius is 7 cm.

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19. The side of a square in increasing at the rate of 0.2 cm/sec. Find the rate of increase of the perimeter of the square.

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20. An edge of a variable cube is increasing at the rate of 3cm per second. How fast is the

volume of the cube increasing when the edge is 10cm long?

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21. The side of a square sheet is increasing at the rate of 4cm per minute. At what rate is the area increasing when the side is 8 cm long?

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22. A kit is 120m high and 130 m of string is out. If the kite is moving away horizontally at the rate of 52 m/sec, find the rate at which the string is being paid out.

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23. Find the point on the curve $y^2 = 8x$ for which the abscissa and ordinate change at the same rate.

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24. A particle moves along the curve $y = \left(\frac{2}{3}\right)x^3 + 1$. Find the points on the curve at which the y-coordinate is changing twice as fast as the x-coordinate

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25. The surface area of a spherical bubble is increasing at the rate of 2 cm^2/s . When the radius of the bubble is 6cm, at what rate is the volume of the bubble increasing?

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26. The volume of metal in a hollow sphere is constant. If the inner radius is increasing at the rate of 1 cm/sec, find the rate of increase of the outer radius when the radii are 4 cm and 8 cm respectively.

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27. The radius of a cylinder is increasing at the rate 2cm/sec. and its altitude is decreasing at the rate of 3cm/sec. Find the rate of change of volume when radius is 3 cm and altitude 5 cm.

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28. The volume of a cube is increasing at the rate of 9cm3/sec. How fast is the surface are increasing when the length of an edge is 10 cm?

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29. For the curve $y = 5x - 2x^3$, if x increases at the rate of 2 units/sec, then how fast is the slope of the curve changing when $x = 3$?

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30. A man is walking at the rate of 6.5 km/hr towards the foot of a tower 120m high. At what rate is he approaching the top of the tower when he is 5m away from the tower?

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31. A man 2m tall, walks at the rate of $1\frac{2}{3}m/sec$ towards a street light which is $5\frac{1}{3}$ m above the ground. At what rate is tip of his shadow moving? At what rate is the length of the shadow changing when he is $3\frac{1}{13}m$ from the base of the light?

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32. An airforce plane is ascending vertically at the rate of 100 km/h. If the radius of the earth is $rkm,$ how fast is the area of the earth, visible from the plane, increasing at 3 minutes after it started ascending? Given that the visible area A at height h is given by $A = 2\pi r^2 \frac{h}{r+h}$.

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33. Find an angle $\theta, 0 < \theta < \frac{\pi}{2}$, which increases twice as fast as its sine.

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34. The volume of a cube is increasing at a rate of $7cm^3/sec$ How fast is the surface area increasing when the length of an edge is 12cm?

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35. The volume of a cube is increasing at a constant rate. Prove that the increase in surface area varies inversely as the length of the edge of the cube.

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36. Two men $PandQ$ start with velocity u at the same time from the junction of two roads inclined at 45^0 to each other. If they travel by different roads, find the rate at which they are being separated.

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37. Water is dripping out from a conical funnel of semi-vertical angle $\frac{\pi}{4}$ at the uniform rate of $2cm^3/sec$ in its surface area through a tiny hole at the vertex in the bottom. When the slant height of the water is 4cm, find the rate of decrease of the slant height of the water.

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38. An inverted cone has a depth of 10cm and a base of radius 5cm. Water is poured into it at the rate of 3/2 c.c. per minute. Find the rate at which the level of water in the cone is rising when the depth is 4cm.

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39. A kite is moving horizontally at the height of 151.5 meters. If the speed of kite is 10 m/sec, how fast is the string being let out; when the

kite is 250m away from the boy who is flying the kiet? The height of the boy is 1.5 m.

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40. in a sphere the rate of change of surface area is (A) 8π Times the Rate of Change of Diameter (B) 2π Times the Rate of Change of Diameter (C) 2π Times the Rate of Change of Radius (D) 8π Times the Rate of Change of radius

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41. If the area of circle increases at a uniform rate, then prove that the perimeter varies inversely as the radius.

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

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43. A swimming pool is to be drained by cleaning. If L represents the number of litres of water in the pool t seconds after the pool has been plugged off to drain and $L = 2000(10 - t)^2$. How fast is the water ruining out at the end of 5 seconds? What is the average rate at which the water flows out during the first 5 seconds?

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44. If x and y are the sides of two squares such that $y = x - x^2$. Find the change of the area of second square with respect to the area of the first square.

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45. Find the rate of change of volume of a sphere with respect to its surface area when the radius is 2cm.

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46. The balloon, which always remains spherical, has a variable diameter $\frac{3}{2}(2x+3)$. Determine the rate of change of volume with respect to x.

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47. A balloon, which always, remains spherical, has a variable radius. Find the rate at which its volume is increasing with respect to its radius when the radius is 7cm.

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48. Water is running into a conical vessel, 15cm deep and 5cm in radius, at the rate of 0.1 cm^3/sec. When the water is 6cm deep, find at what rate is the water level rising? the water-surface area increasing? the wetted surface of the vessel increasing?

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49. Water is dripping out from a conical funnel at a uniform rate of $4cm^3/cm$ through a tiny hole at the vertex in the bottom. When the slant height of the water is 3cm, find the rate of decrease of the slant height of the water-cone. Given that the vertical angle of the funnel is 120^0.

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50. A spherical ball of salt is dissolving in water in such a manner that the rate of decrease of volume at any instant is proportional to the surface. Prove that the radius is decreasing at a constant rate.

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51. A man is moving away from a tower 41.6 m high at the rate of 2 m/sec. Find the rate at which the angle of elevation of the top of

tower is changing, when he is at a distance of 30m from the foot of the tower. Assume that the eye level of the man is 1.6m from the ground.

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52. A balloon, which always remains spherical, has a variable radius. Find the rate at which its volume is increasing with respect to its radius when the radius is 7 cm.

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53. Find the rate of change of the area of a circle with respect to its radius. How fast is the area changing with respect to the radius when the radius is 3 cm?

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54. A balloon, which always remains spherical, has a variable diameter . Determine the rate of change of volume with respect to .

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55. The total cost C(x) in Rupees, associated with the production of x units of an item is given by $C(x) = 0.005x^3 - 0.02x^2 + 30x + 5000$. Find the marginal cost when 3 units are produced, where by marginal cost we mean the instantaneous rate of change

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56. The total revenue in Rupees received from the sale of x units of a product is given by $R(x) = 3x^2 + 36x + 5$. Find the marginal revenue, when $x = 5$, where by marginal revenue we mean the rate of change of total revenue

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57. 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 distance between P and Q.

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58. Find the rate of change of the volume of a sphere with respect to its surface area when the radius is 2cm.

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59. 'y=xcosx` . Find dy/dx

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60. A swimming pool is to be drained by cleaning. If L represents the number of litres of water in the pool t seconds after the pool has been plugged off to drain and $L = 2000(10 - t)^2$. How fast is the water ruining out at the end of 5 seconds? What is the average rate at which the water flows out during the first 5 seconds?

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66. Find the rate of change of the area of a circle with respect to its radius when r =4 cm .

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67. Find the rate of change of the volume of a ball with respect to its radius How fast is the volume changing with respect to the radius when the radius is 2 cm?

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68. 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 17 units are produced.

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69. The money to be spend for the welfare of the employees of a firm is proportional to the rate of change of its total revenue (Marginal revenue). If the total revenue (in rupees) received from the sale of x units of a product is given by $R(x) = 3x^2 + 36x + 5$, find the

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71. An edge of a variable cube is increasing at the rate of 3 cm per second. How fast is the volume of the cube increasing when the edge is 10 cm long?

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72. The radius of a circle is increasing uniformly at the rate of 4 cm/sec. Find the rate at which the area of the circle is increasing when the radius is 8 cm.

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75. The radius of a balloon is increasing at the rate of 10 cm/sec. At what rate is the surface area of the balloon increasing when the radius is 15 cm?

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76. A spherical ball of salt is dissolving in water in such a manner that the rate of decrease of volume at any instant is proportional to the surface. Prove that the radius is decreasing at a constant rate.

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77. Find an angle θ , which increases twice as fast as it sine.

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78. A stone is dropped into a quiet lake and waves move in circles at a speed of 4cm 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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79. differentiate xsinx with respect to x.

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80. The volume of a cube is increasing at a rate of 9 cm^3/sec . How fast is the surface area increasing when the length of an edge is 12 cm?

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81. The volume of a cube is increasing at a constant rate. Prove that the increase in surface area varies inversely as the length of the edge of the cube.

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82. find f ' (x) if f(x) = sinxlogx

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83. For the curve $y = 5x - 2x^3$, if x increases at the rate of 2 units/sec, then how fast is the slope of the curve changing when $x = 3$?

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

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85. find f '(x) if f(x)= log(logx)

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86. find dy/dx if y= sinx.cosx

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87. find dy/dx if y = x tanx

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88. A ladder of length 5 m is leaning against a wall. The bottom of ladder is being pulled along the ground away from wall at rate of $2cm/\sec$. How fast is the top part of ladder sliding on the wall when foot of ladder is 4m away form wall.

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89. The two equal sides of an isosceles triangle with fixed base b are decreasing at the rate of $3cm/s$. How fast is the area decreasing when the two equal sides are equal to the base?

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90. An airforce plane is ascending vertically at the rate of 100 km/h. If the radius of the earth is rkm, how fast is the area of the earth, visible from the plane, increasing at 3 minutes

after it started ascending? Given that the visible area A at height h is given by $A = 2\pi r^2 \frac{h}{r+h}$.

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92. Sand is pouring from a pipe at the rate of 12 cm^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 radius of the base. How fast is the height of the sand cone increasing when the height is 4cm ?

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93. An inverted cone has a depth of 10cm and a base of radius 5cm. Water is poured into it at the rate of 3/2 c.c. per minute. Find the rate at which the level of water in the cone is rising when the depth is 4cm.

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94. Water is dripping out from a conical funnel at a uniform rate of $4cm^3/cm$ through a tiny hole at the vertex in the bottom. When the

slant height of the water is 3cm, find the rate of decrease of the slant height of the water-cone. Given that the vertical angle of the funnel is 120^0.

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95. A solid sphere of radius $2.45m$ is rotating with an angular speed of $10rad/s$. When this rotating sphere is placed on a rough horizontal surface then after sometime it

starts pure rolling. Find the linear speed of the sphere after it starts pure rolling.

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97. Water is running into a conical vessel, 15cm deep and 5cm in radius, at the rate of 0.1 cm^3/sec. When the water is 6cm deep, find at what rate it. the water level rising? the water-surface area increasing? the wetted surface of the vessel increasing?

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98. 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

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99. A man is moving away from a tower 41.6 m high at the rate of 2 m/sec. Find the rate at which the angle of elevation of the top of tower is changing, when he is at a distance of 30m from the foot of the tower. Assume that

the eye level of the man is 1.6m from the ground.

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100. A kite is moving horizontally at a height of $151.5m$. If the speed of the kite is $10\frac{m}{s}$, how fast is the string being let out, when the kite is 250 m away from the boy who is flying the kite? The height of the boy is 1.5 m. (A) 8 m/s (B) 12 m/s (C) 16 m/s (D) 19 m/s

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101. The side of a square sheet is increasing at the rate of 4cm per minute. At what rate is the area increasing when the side is 8 cm long?

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103. The side of a square is increasing at the rate of 0.2 cm/sec. Find the rate of increase of the perimeter of the square.

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

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105. The radius of a spherical soap bubble is increasing at the rate of 0.2 cm/sec. Find the rate of increase of its surface area, when the radius is 7 cm.

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106. A balloon which always remains spherical, is being inflated by pumping in 900 cubic centimetres of gas per second. Find the rate at

which the radius of the balloon is increasing when the radius is 15 cm.

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107. The radius of an air bubble is increasing at the rate of 0.5 cm/sec. At what rate is the volume of the bubble increasing when the radius is 1 cm?

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108. A man 2 metres high walks at a uniform speed of 5 km/hr away from a lamp-post 6 metres high. Find the rate at which the length of his shadow increases.

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109. A stone is dropped into a quiet lake and waves move in circles at a speed of 4cm 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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110. A man 160 cm tall, walks away from a source of light situated at the top of a pole 6m high at the rate of 1.1 m/sec. How fast is the length of his shadow increasing when he is 1 metre away from the pole.

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111. A man 180 cm tall walks at a rate of 2m/sec. away, from a source of light that is 9 m above the ground. How fast is the length of his shadow increasing when he is 3 m away from the base of light?

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112. A ladder 13m long leans against a wall. The foot of the ladder is pulled along the ground away from the wall, at the rate of 1.5m/sec. How fast is the angle θ between the ladder

and the ground is changing when the foot of the ladder is 12m away from the wall.

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113. A particle moves along the curve $y = x^2 + 2x$. At what point(s) on the curve are the x and y coordinates of the particle changing at the same rate?

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114. If $y = 7x - x^3$ and x increases at the rate of 4 units per second, how fast is the slope of the curve changing when $x = 2$?

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117. Find an angle θ, whose rate of increase is twice as the rate of decrease of its cosine.

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118. The top of a ladder 6 metres long is resting against a vertical wall on a level pavement, when the ladder begins to slide outwards. At the moment when the foot of the ladder is 4 metres from the wall, it is sliding away from the wall at the rate of 0.5 m/sec. How fast is the top-sliding downwards at this instance? How far is the foot from the wall when it and the top are moving at the same rate?

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119. find f ' (2) If f(x) = 3x +7

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120. Water is running into an inverted cone at the rate of π cubic metres per minute. The height of the cone is 10 metres, and the radius of its base is 5m. How fast the water level is rising when the water stands 7.5 m below the base.

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121. A man 2 metres high walks at a uniform speed of 5 km/hr away from a lamp-post 6 metres high. Find the rate at which the length of his shadow increases.

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122. The surface area of a spherical bubble is increasing at the rate of 2 cm^2/s . When the radius of the bubble is 6cm, at what rate is the volume of the bubble increasing?

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123. The radius of a cylinder is increasing at the rate 2cm/sec. and its altitude is decreasing at the rate of 3cm/sec. Find the rate of change of volume when radius is 3 cm and altitude 5 cm.

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124. The volume of metal in a hollow sphere is constant. If the inner radius is increasing at the rate of 1 cm/sec, find the rate of increase of the outer radius when the radii are 4 cm and 8 cm respectively.

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125. Sand is being poured onto a conical pile at the constant rate of 50 cm^3 per minute such that the height of the cone is always

ontee half of the radius of its base. How fast is the height of the pile increasing when the sand is 5 cm deep.

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126. A kite is 120m high and 130 m of string is out. If the kite is moving away horizontally at the rate of 52 m/sec, find the rate at which the string is being paid out.

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127. A particle moves along the curve $y = \left(\frac{2}{3}\right)x^3 + 1$. Find the points on the curve at which the y-coordinate is changing twice as fast as the x-coordinate.

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128. Find the point on the curve $y^2 = 8x$. for which the abscissa and ordinate change at the same rate.

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129. The volume of a cube is increasing at the rate of $9cm^3/\text{sec}$. How fast is the surface area increasing when the length of an edge is 10 cm?

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130. The volume of a spherical balloon is increasing at the rate of 20 cm^3/sec . Find the rate of change of its surface area at the instant when radius is 5 cm.

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131. The length of a rectangle is decreasing at the rate of 5 cm/minute and the width is increasing at the rate of 4cm/minute. When length is 3 cm and width is 2 cm , find the rates of change of the perimeter and the area of the rectangle.

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132. A circular disc of radius 3 cm is being heated. Due to expansion, its radius increases at the rate of 0.05 cm/sec. Find the rate at which its area is increasing when radius is 3.2 cm.

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133. A particle moves in a straight line and its speed depends on time as $v = |2t - 3|$ $\int v dt$ representsthe distance travelled of the

particle then find the displacement of the particle in 5 s

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134. The volume of a sphere is increasing at the rate of 3 cubic centimeter per second. Find the rate of increase of its surface area, when the radius is 2 cm.

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135. The sides of an equilateral triangle are increasing at the rate of 2 cm/sec. How fast is the area increasing when the side is 10 cm ?

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136. The side of a square is increasing at the rate of 0.1cm/sec. Find the rate of increase of its perimeter.

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137. The radius of a circle is increasing at the rate of 0.5cm/sec. Find the rate of increase of its circumference.

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138. The side of an equilateral triangle is increasing at the rate of 10cm/sec . Find the rate of increase of its perimeter.

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139. Find the surface area of a sphere when its volume is changing at the same rate as its radius.

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140. The rate of change of volume of a sphere is equal to the rate of change of its radius, then its radius is equal to (a) 1 unit (b) $\sqrt{2}\pi$ units (c) $1/\sqrt{2}\pi$unit (d) $1/2\sqrt{\pi}$unit

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141. The amount of pollution content added in air in a city due to x-diesel vehicles is given by $P(x) = 0.005x^3 + 0.02x^2 + 30x$. Find the marginal increase in pollution content when 3 diesel vehicles are added and write which value is indicated in the above question.

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142. find dy/dx If ytany = sinx

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143. Differentiate ylogy = sinlogx with respect to x

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144. The Sides of an equilateral triangle expands at the rate of 2 cm/sec. The rate of increase of its area when each side is 10 cm,is

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145. The radius of a sphere is changing at the rate of 0.1 cm/sec. The rate of change of its surface area when the radius is 200 cm is

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146. A cone whose height always equal to its diameter is increasing in volume at the ran $40\frac{cm^3}{\sec}$ .At what rate is the radius increasing when its circular base area is $1m^2$? (A) 1 (B) 0.001 (C) 2 (D) 0.002

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147. A cylindrical vessel of radius 0.5 m is filled with oil at the rate of $0.25\pi m^3/$minute. The rate at which the surface of the oil is rising, is

(a) 1 m/min. (b) 2 m/min. (c) 5 m/min. (d) 1.25 m/min.

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148. The distance moved by the particle in time is given by $x = t^3 - 12t^2 + 6t + 8$. At the

instant when its acceleration is zero, the velocity is (a) 42 (b) -42 (c) 48 (d) -48

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149. The altitude of a cone is 20 cm and its semi-vertical angle is 30^0 . If the semi-vertical angle is increasing at the rate of 2^0 per second, then the radius of the base is increasing at the rate of (a) 30 cm/sec (b) $\frac{160}{3}$ cm/sec (c) 10 cm/sec (d) 160 cm/sec

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150. For what values of x is the rate of increase of $x^3 - 5x^2 + 5x + 8$ is twice the rate of increase of x ?

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151. The coordinates of the point on the ellipse $16x^2 + 9y^2 = 400$ where the ordinate decreases at the same rate at which the abscissa increases, are (a) $\left(3, \frac{3}{16}\right)$ and

$\left(-3, -\frac{3}{16}\right)$ (b) $\left(3, -\frac{16}{3}\right)$ and $\left(-3, \frac{16}{3}\right)$ (c) $\left(\frac{1}{16}, \frac{1}{9}\right)$ and $\left(-\frac{1}{16}, -\frac{1}{9}\right)$ (d) $\left(\frac{1}{16}, -\frac{1}{9}\right)$ and $\left(-\frac{1}{16}, \frac{1}{9}\right)$

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152. The radius of the base of a cone is increasing at the rate of 3 cm/min and the altitude is decreasing at the rate of 4 cm/min. The rate of change of lateral surface when the radius is 7 cm and altitude is 24cm is (a)

$108\pi cm^2 per \text{ min}$ (b) $7\pi cm^2 per \text{ min}$ (c) $27\pi cm^2 per \text{ min}$ (d) none of these

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153. The radius of a sphere is increasing at the rate of 0.2 cm/sec. The rate at which the volume of the sphere increases when radius is 15 cm, is

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154. If y=xsecx then find the value of dy/dx

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155. If xy = tany then find the value of dy/dx

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156. If xy= tanx then find the value of dy/dx

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157. Differentiate xsiny = cosy with respect to x

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158. Find second order derivative of xcosx

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159. find second order derivative of logsinx with respect to x

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160. Find the second order derivative of $\log(\log x)$

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161. Find the second order derivative of $\tan x$ with respect to x

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162. find the second order derivative of sinx with respect to x

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163. Find dy/dx If ysiny = xy

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164. Find the derivative of xy = tany

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165. A man of height 6 ft walks at a uniform speed of 9 ft/sec from a lamp fixed at 15 ft height. The length of his shadow is increasing at the rate of (a) 15 ft/sec (b) 9 ft/sec (c) 6 ft/sec (d) none of these

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166. Find dy/dx If xy= sinx

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167. Find the second order derivative of xtanx with respect to x

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168. A cylindrical tank of radius 10m is being filled with wheat at the rate of 314 cubic metre per hour. Then the depth of the wheat is increasing at the rate of (a) 1 m/hr (b) 0.1 m/hr (c) 1.1 m/h (d) 0.5 m/hr

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