



# MATHS

## BOOKS - OBJECTIVE RD SHARMA

### MATHS VOL I (HINGLISH)

#### DERIVATIVE AS A RATE MEASURER

##### Illustration

1. The distance travelled by a motor car in  $t$  second after the brakes are applied is a feet,

where  $s = 22t - 12t^2$ .

A. 10.08 ft

B. 10 ft

C. 11 ft

D. 11.5 ft

**Answer: A**



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2. A particle moves in a straight line so that  $s = \sqrt{t}$ , then its acceleration is proportional to

A.  $(\text{velocity})^3$

B. velocity

C.  $(\text{velocity})^2$

D.  $(\text{velocity})^{3/2}$

**Answer: A**



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## Section I Solved Mcqs

1. If  $V = \frac{4}{3}\pi r^3$ , at what rate in cubic units is  $V$  increasing when  $r = 10$  and  $\frac{dr}{dt} = 0.01$ ?

A.  $\pi$

B.  $4\pi$

C.  $40\pi$

D.  $4\pi / 3$

**Answer: B**



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2. Side 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 (a)  $\text{cm}^2/\text{sec}$  (b)  $\text{cm}^2/\text{sec}$  (c)  $10 \text{ cm}^2/\text{sec}$  (d)  $5 \text{ cm}^2/\text{sec}$

A.  $10\sqrt{2}\text{cm}^2 / \text{sec}$

B.  $10\sqrt{3}\text{cm}^2 / \text{sec}$

C.  $10\text{cm}^2 / \text{sec}$

D.  $5\text{cm}^2 / \text{sec}$

**Answer: B**



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3. The radius of a sphere is changing at the rate of  $0.1 \text{ cm/sec}$ . The rate of change of its surface area when the radius is  $200 \text{ cm}$  is (a)  $\text{cm}^2/\text{sec}$  (b)  $\text{cm}^2/\text{sec}$  (c)  $\text{cm}^2/\text{sec}$  (d)  $\text{cm}^2/\text{sec}$

A.  $8\pi \text{cm}^2 / \text{sec}$

B.  $12\pi \text{cm}^2 / \text{sec}$

C.  $160\pi \text{cm}^2 / \text{sec}$

D.  $200\text{cm}^2 / \text{sec}$

**Answer: C**



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4. A cone whose height always equal to its diameter is increasing in volume at the rate  $40 \frac{cm^3}{sec}$ . 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

A. 1 mm/sec

B. 0.001 cm/sec

C. 2 mm/sec

D. 0.002 cm/sec

**Answer: D**



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5. A cylindrical vessel of radius 0.5 m is filled with oil at the rate of  $0.25 \frac{m^3}{min}$ . The rate at which the surface of the oil is rising, is

A. 1 m / minute



B. 2 m / minute

C. 5 m / minute

D. 1.25 m / minute

**Answer: A**



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**6.** The distance moved by the particle in time  $t$  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.  $-48$

**Answer: B**



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7. The altitude of a cone is 20 cm and its semi-vertical angle is  $30^\circ$ . If the semi-vertical angle is increasing at the rate of  $2^\circ$  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

**Answer: B**



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

A.  $-3, -\frac{1}{3}$

B.  $-3, \frac{1}{3}$

C.  $3, -\frac{1}{3}$

D.  $3, \frac{1}{3}$

**Answer: D**



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9. The points of the ellipse  $16x^2 + 9y^2 = 400$  at which the ordinate decreases at the same rate at which the abscissa increases is

A.  $(3, 16/3)$

B.  $(-3, 16/3)$

C.  $(3, 16/3)$

D.  $(3, -3)$

**Answer: A**



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10. 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 24 cm is

A.  $54 \pi \text{ cm}^2 / \text{ min}$

B.  $7 \pi \text{ cm}^2 / \text{ min}$

C.  $27 \text{ cm}^2 / \text{ min}$

D. none of these

**Answer: A**



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11. The rate of change of surface area of a sphere of radius  $r$  when the radius is increasing at the rate of 2 cm/sec is proportional to

A.  $\frac{1}{r^2}$

B.  $\frac{1}{r}$

C.  $r^2$

D.  $r$

**Answer: D**



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**12.** A particle's velocity  $v$  at time  $t$  is given by

$$v = 2e^{2t} \cos\left(\frac{\pi t}{3}\right).$$

the least value of  $t$  for

which the acceleration becomes zero is

A. 0

B.  $\frac{3}{2}$

C.  $\frac{3}{\pi} \tan^{-1}\left(\frac{6}{\pi}\right)$



D.  $\frac{3}{\pi} \cot^{-1} \left( \frac{6}{\pi} \right)$

**Answer: C**



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**13.** If  $s = 4t + \frac{1}{t}$  is the equation of motion of a particle, then the acceleration when velocity vanishes, is

A. 0

B. 16

C. 8

D. 1

**Answer: B**



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

A. 1

B.  $\frac{1}{2\sqrt{\pi}}$

C.  $4\pi$

D.  $\frac{4\pi}{3}$

**Answer: A**



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**15.** A variable trisriable triangle is inscribed in a circle ofus R. If the rate of change of a side is R times the rate of change of the opposite angle, then the opposite angle is

A.  $\pi / 6$

B.  $\pi / 4$

C.  $\pi / 3$

D.  $\pi / 2$

**Answer: C**



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**16.** Two measurements of a cylinder are varying in such a way that the volume is kept constant. If the rates of change of the radius ( $r$ ) and

height ( $h$ ) are equal in magnitude but opposite in sign, then

A.  $r=2h$

B.  $h=2r$

C.  $h=r$

D.  $h=2r$

**Answer: A**



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17. The rate of increase of length of the shadow of a man 2 metres height, due to a lamp at 10 metres height, when he is moving away from it at the rate of  $2\text{m/sec}$ , is

A.  $\frac{1}{2}m / \text{sec}$

B.  $\frac{2}{5}m / \text{sec}$

C.  $\frac{1}{3}m / \text{sec}$

D.  $5m / \text{sec}$

**Answer: A**



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18. If the velocity of a body moving in a straight line is proportional to the square root of the distance traversed, then it moves with

- A. variable force
- B. constant force
- C. zero force
- D. zero acceleration

**Answer: B**





19. If the length of the diagonal of a square is increasing at the rate of  $0.2 \text{ cm/sec}$ , then the rate of increase of its area when its side is  $30 / \sqrt{2} \text{ cm}$ , is

A.  $3\text{cm}^2 / \text{sec}$

B.  $\frac{6}{\sqrt{2}}\text{cm}^2 / \text{sec}$

C.  $3\sqrt{2}\text{cm}^2 / \text{sec}$

D.  $6\text{cm}^2 / \text{sec}$



**Answer: D**



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**20.** The surface area of a cube is increasing at the rate of  $2\text{cm}^2 / \text{sec}$ . When its edge is 90 cm, the volume is increasing at the rate of

A.  $1620\text{cm}^3 / \text{sec}$

B.  $810\text{cm}^3 / \text{sec}$

C.  $405\text{cm}^3 / \text{sec}$

D.  $45\text{cm}^3 / \text{sec}$

**Answer: D**



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21. A particle is moving in a straight line such that its distance  $s$  at any time  $t$  is given by

$$s = \frac{t^4}{4} - 2t^3 + 4t^2 - 7. \quad \text{Find when its}$$

velocity is maximum and acceleration minimum.

A. 1

B. 2

C. 3

D. 4

**Answer: B**



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**22.** A ladder 10 metres long rests with one end against a vertical wall, the other on the floor. The lower end moves away from the wall at the rate of 2 metres/minute. The rate at which

the upper end falls when its base is 6 metres  
away from the wall

- A. 3 metres/min
- B.  $\frac{2}{3}$  metres/min
- C.  $\frac{3}{2}$  metres/min
- D. none of these

**Answer: C**



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23. If a particle moves along a line by

$S = \sqrt{1+t}$  then its acceleration is

proportional to

A. square of the velocity

B. cube of the displacement

C. cube of the velocity

D. square of the displacement

**Answer: C**



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24. If a particle is moving such that the velocity acquired is proportional to the square root of the distance covered, then its acceleration is

A. a constant

B.  $\propto s^2$

C.  $\propto \frac{1}{s^2}$

D.  $\propto s$

**Answer: A**



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25. Gas is being pumped into a spherical balloon at the rate of  $30 \text{ ft}^3 / \text{min}$ . Then the rate at which the radius increases when it reaches the value 15 ft, is

A.  $\frac{1}{30\pi} \text{ ft} / \text{min}$

B.  $\frac{1}{15\pi} \text{ ft} / \text{min}$

C.  $\frac{1}{20} \text{ ft} / \text{min}$

D.  $\frac{1}{25} \text{ ft} / \text{min}$

**Answer: A**



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26. A spherical iron ball 10cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of  $50\text{cm}^3 / \text{m} \in$  . When the thickness of ice is 5cm, then find the rate at which the thickness of ice decreases.

A.  $\frac{5}{6\pi} \text{cm} / \text{min}$

B.  $\frac{1}{54\pi} \text{cm} / \text{min}$

C.  $\frac{1}{18\pi} \text{cm} / \text{min}$

D.  $\frac{1}{36\pi} \text{cm} / \text{min}$



**Answer: C**



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27. The weight  $W$  of a certain stock of fish is given by  $W = nw$ , where  $n$  is the size of stock and  $w$  is the average weight of a fish. If  $n$  and  $w$  change with time  $t$  as  $n = 2t^2 + 3$  and  $w = t^2 - t + 2$ , then the rate of change of  $W$  with respect to  $t$  at  $t = 1$ , is

A. 1

B. 13

C. 5

D. 8

**Answer: B**



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## Exercise

1. The edge of a cube is equal to the radius of a sphere. If the edge and the radius increase

at the same rate, then the ratio of the increases in surface areas of the cube and sphere is

A.  $2\pi : 3$

B.  $3 : 2\pi$

C.  $6 : \pi$

D. none of these

**Answer: B**



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2. If the velocity  $v$  of a particle moving along a straight line and its distance  $s$  from a fixed point on the line are related by  $v^2 = a^2 + s^2$ , then its acceleration equals

A.  $as$

B.  $s$

C.  $s^2$

D.  $2s$

**Answer: B**



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3. If the rate of change of sine of an angle  $\theta$  is  $k$ , then the rate of change of its tangent is

A.  $k^2$

B.  $\frac{1}{k^2}$

C.  $k$

D.  $\frac{1}{k}$

**Answer: B**



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4. If a particle moves according to the law

$$s = 6t^2 - \frac{t^3}{2},$$
 then the time at which it is

momentarily at rest is

A.  $t=0$  only

B.  $t=8$  only

C.  $t=0,8$

D. none of these

**Answer: C**



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5. A particle moves on a line according to the law  $s = at^2 + bt + c$ . If the displacement after 1 sec is 16 cm, the velocity after 2 sec is 24 cm/sec and acceleration is  $8\text{cm} / \text{sec}^2$ , then

A.  $a=4, b=8, c=4$

B.  $a=4, b=4, c=8$

C.  $a=8, b=4, c=4$

D. none of these

**Answer: A**



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6. If a particle moving along a line follows the law  $t = as^2 + bs + c$ , then the retardation of the particle is proportional to

- A. square of the velocity
- B. cube of the displacement
- C. cube of the velocity
- D. square of the displacement

**Answer: C**





7. If the semivertical angle of a cone is  $45^\circ$ .

Then the rate of change of its volume is

- A. curved surface area times the rate of change of  $r$
- B. base area times the rate of change of  $l$
- C. base area times the rate of change of  $r$
- D. none of these

**Answer: B**



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8. On the curve  $x^3 = 12y$ , find the interval of values of  $x$  for which the abscissa changes at a faster rate than the ordinate?

A.  $(-2, 2)$

B.  $(-\infty, -2) \cup (2, \infty)$

C.  $[-2, 2]$

D. none of these

**Answer: B**



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9. If the rate of change of area of a square plate is equal to that of the rate of change of its perimeter, then length of the side, is

A. 1 unit

B. 2 units

C. 3 units

D. 4 units

**Answer: B**



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10. A stone dropped into a quiet lake. If the waves moves in circles at the rate of 30 cm/sec when the radius is 50 cm, the rate o increase of enclosed area, is

A.  $30\pi m^2 / \text{sec}$

B.  $30m^2 / \text{sec}$

C.  $3\pi m^2 / \text{sec}$

D. none of these

**Answer: A**



**Watch Video Solution**

**11.** The side of a square is equal to the diameter of a circle. If the side and radius change at the same rate, then the ratio of the change of their areas, is

A.  $1 : \pi$

B.  $\pi : 1$

C.  $2 : \pi$

D. 1 : 2

**Answer: C**



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12. A variable  $\triangle ABC$  is inscribed in a circle of diameter  $x$  units. At a particular instant the rate of change of side  $a$ , is  $\frac{x}{2}$  times the rate of change of the opposite angle  $A$  then  $A =$

A.  $\pi / 6$

B.  $\pi / 3$

C.  $\pi / 4$

D.  $\pi / 2$

**Answer: B**



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**13.** The radius and height of a cylinder are equal. If the radius of the sphere is equal to the height of the cylinder, then the ratio of the

rates of increase of the volume of the sphere  
and the volume of the cylinder, is

A.  $4:3$

B.  $3:4$

C.  $4:3\pi$

D.  $3\pi:4$

**Answer: A**



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14. The points on the curve  $12y = x^3$  whose ordinate and abscissa change at the same rate, are

A.  $(-2, -2/3), (2, 2/3)$

B.  $(-2/3, -2), (2/3, 2)$

C.  $(-2, -2/3)$  only

D.  $(2/3, 2)$  only

**Answer: A**



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15. A particle moves along the parabola  $y^2 = 2ax$  in such a way that its projection on y-axis has a constant velocity. Show that its projection on the x-axis moves with constant acceleration

- A. constant velocity
- B. constant acceleration
- C. variable velocity
- D. variable acceleration

**Answer: B**



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16. The diameter of a circle is increasing at the rate of 1 cm/sec. When its radius is  $\pi$ , the rate of increase of its area, is

A.  $\pi cm^2 / sec$

B.  $2\pi cm^2 / sec$

C.  $\pi^2 cm^2 / sec$

D.  $2\pi^2 cm^2 / sec$

**Answer: C**



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17. A man 2 metres tall walks away from a lamp post 5 metres height at the rate of 4.8 km/hr. The rate of increase of the length of his shadow, is

A. 1.6 km/hr

B. 6.3 km/hr

C. 5 km/hr

D. 3.2 km/hr

**Answer: D**



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**18.** At an instant the diagonal of a square is increasing at the rate of  $0.2 \text{ cm/sec}$  and the area is increasing at the rate of  $6 \text{ cm}^2 / \text{sec}$ . At the moment its side, is

A.  $\frac{30}{\sqrt{2}} \text{ cm}$

B.  $30\sqrt{2} \text{ cm}$

C.  $30 \text{ cm}$

D. 15 cm

**Answer: A**



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**19.** If  $s = ae^t + be^{-t}$  is the equation of motion of a particle, then its acceleration is equal to

A.  $s$

B.  $2s$

C. 3s

D. 4s

**Answer: A**



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**20.** A circular metal plate is heated so that its radius increases at a rate of 0.1 mm per minute. Then the rate at which the plate's area is increasing when the radius is 50 cm, is

A.  $10\pi$  mm/minute

B.  $100\pi$  mm/minute

C.  $\pi$  mm/minute

D.  $-\pi$  mm/minute

**Answer: B**



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**21.** The distances moved by a particle in time  $t$  seconds is given by  $s = t^3 - 6t^2 - 15t + 12$ .



The velocity of the particle when acceleration becomes zero, is

A. 15

B.  $-27$

C.  $6/5$

D. none of these

**Answer: B**



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22. If  $s = e^t (\sin t - \cos t)$  is the equation of motion of a moving particle, then acceleration at time  $t$  is given by

A.  $2e^t (\cos t + \sin t)$

B.  $2e^t (\cos t - \sin t)$

C.  $e^t (\cos t - \sin t)$

D.  $e^t (\cos t + \sin t)$

**Answer: A**



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23. A spherical balloon is being inflated so that its volume increase uniformly at the rate of  $40\text{cm}^3 / \text{minute}$ . The rate of increase in its surface area when the radius is 8 cm, is

A.  $10\text{cm}^2 / \text{minute}$

B.  $20\text{cm}^2 / \text{minute}$

C.  $40\text{cm}^2 / \text{minute}$

D. none of these

**Answer: A**



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24. If a point is moving in a line so that its velocity at time  $t$  is proportional to the square of the distance covered, then its acceleration at time  $t$  varies as

A. cube of the distance

B. the distance

C. square of the distance

D. none of these

**Answer: A**



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**25.** The edge of a cube is equal to the radius of the sphere. If the rate at which the volume of the cube is increasing is equal to  $\lambda$ , then the rate of increase of volume of the sphere, is

A.  $\frac{4\pi\lambda}{3}$

B.  $4\pi\lambda$

C.  $\frac{\lambda}{3}$

D. none of these

**Answer: A**



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**26.** The side of an equilateral triangle is  $a$  units and is increasing at the rate of  $\lambda$  units/sec.

The rate of increase of its area is

A.  $\frac{2}{\sqrt{3}}\lambda a$

B.  $\sqrt{3}\lambda a$

C.  $\frac{\sqrt{3}}{2} \lambda a$

D. none of these

**Answer: C**



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