MATHS

BOOKS - OBJECTIVE RD SHARMA ENGLISH

DERIVATIVE AS A RATE MEASURER

Illustration

1. If the rate of change of area of a circle is equal to the rate of change of its diameter,

then its radius is equal to (a) unit (b) unit (c) units (d) units

A. $\dfrac{2}{\pi}$ unit

B. $\dfrac{1}{\pi}$ unit

C. $\dfrac{\pi}{2}$ units

D. π units

Answer: A

2. 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. $\dfrac{1}{\sqrt{2\pi}}$ unit

D. $\dfrac{1}{2\sqrt{\pi}}$ unit

Answer: D

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

A. 1

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

C. 4π

D. $4\pi/3$

Answer: A

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4. If the area of an expanding circular region increases at a constant rate with respect to time, then the rate of increase of the perimeter with respect to the time

A. Varies inversely as radius

B. Varies directly as radius

C. Remains constant

D. Varies directly as square of the radius

Answer: A

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5. The speed v of a particle moving along a straight line is given by $a + bv^2 = x^2$ where x is its distance from the origin. The acceleration of the particle is

A. $\dfrac{x}{b}$

B. $\dfrac{x}{ab}$

C. abx

D. ax

Answer: A

6. A particle is moving along the curve $x = at^2 + bt + c$. If $ac = b^2$, then particle would be moving with uniform

A. rotation

B. velocity

C. acceleration

D. retardation

Answer: C

7. The distance travelled by a motor car in t second after the brakes are applied is s feet, where s = $22t - 12t^2$. The distance travelled by the car before it stops, is

    A. 10.08 ft

    B. 10 ft

    C. 11 ft

D. 11.5 ft

Answer: A

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

A. π

B. 4π

C. 40π

D. $4\pi/3$

Answer: B

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2. 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

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

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

C. $10cm^2/\sec$

D. $5cm^2/\sec$

Answer: B

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3. 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

A. $8\pi cm^2/\sec$

B. $12\pi cm^2/\sec$

C. $160\pi cm^2/\sec$

D. $200 cm^2/\sec$

Answer: C

4. A cone whose height is always equal to its diameter is increasing in volume at the rate of 40 cm3/sec. At what rate is the radius

increasing when its circular base area is 1 m2?

(a) 1 mm/sec (b) 0.001 cm/sec (c) 2 mm/sec (d) 0.002 cm/sec

A. 1 mm/sec

B. 0.001 cm/sec

C. 2 mm/sec

D. 0.002 cm/sec

Answer: D

5. 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.

    A. 1 m / minute

    B. 2 m / minute

    C. 5 m / minute

    D. 1.25 m / minute

Answer: A

6. 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

A. 42

B. -42

C. 48

D. -48

Answer: B

7. 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

A. 30 cm/sec

B. $\dfrac{160}{3} cm/\sec$

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. $-3, \; -\dfrac{1}{3}$

B. $-3, \; \dfrac{1}{3}$

C. $3, \; -\dfrac{1}{3}$

D. $3, \; \dfrac{1}{3}$

Answer: D

9. The coordinates of the point on the ellipse

$$16x^2 + 9y^2 = 400 \quad \text{where} \quad \text{the} \quad \text{ordinate}$$

decreases at the same rate at which abscissa

increases are :

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/minute and the altitude is decreasing at the rate of 4 cm/minute. At what rate, lateral surface is changing when the radius in 7 cm and altitude is 24 cm?

A. $54\pi cm^2 / \min$

B. $7\pi cm^2 / \min$

C. $27 cm^2 / \min$

D. none of these

Answer: A

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. $\dfrac{1}{r^2}$

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

C. r^2

D. r

Answer: D

12. A particle's velocity v at time t is given by $v = 2e^{2t} \cos \dfrac{\pi t}{3}$. The least value of t at which the acceleration becomes zero, is :

A. 0

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

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

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

Answer: C

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13. If $s = 4t + \dfrac{1}{t}$ is the equation o 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. $\dfrac{1}{2\sqrt{\pi}}$

C. 4π

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

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

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 2m/sec, is

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

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

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

D. $5m/\sec$

Answer: A

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 cm/sec, then the rate of increase of its area when its side is $30/\sqrt{2}$ cm, is

A. $3 cm^2/\sec$

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

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

D. $6 cm^2 / \sec$

Answer: D

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

A. $1620 cm^3 / \sec$

B. $810 cm^3 / \sec$

C. $405 cm^3 / \sec$

D. $45 cm^3 / \sec$

Answer: D

21. A particle is moving in a straight line such that its distance s at any time t is given by $s = \dfrac{t^4}{4} - 2t^3 + 4t^2 - 7$. Find when its velocity is maximum

A. 1

B. 2

C. 3

D. 4

Answer: B

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. 2/3 metres/min

C. -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. $\propto \dfrac{1}{s^2}$

D. $\propto s$

Answer: A

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

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

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

C. $\dfrac{1}{20} ft / \min$

D. $\dfrac{1}{25} ft / \min$

Answer: A

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

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

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

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

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

Answer: C

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
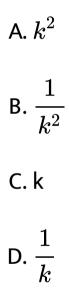
    A. as

    B. s

    C. s^2

    D. 2s

Answer: B

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

A. k^2

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

C. k

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

Answer: B

4. If a particle moves according to the law $s = 6t^2 - \dfrac{t^3}{2}$, 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 $8cm/\sec^2$, 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 $45°$.

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: C

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: A

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

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. $30\pi m^2/\sec$

B. $30 m^2/\sec$

C. $3\pi m^2/\sec$

D. none of these

Answer: D

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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

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 $\dfrac{x}{2}$ 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

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

16. The diameter of a circle is increasing at the rate of 1 cm/sec. When its radius is π, 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

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

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

A. $\dfrac{30}{\sqrt{2}}cm$

B. $30\sqrt{2}$ cm

C. 30 cm

D. 15 cm

Answer: A

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. 10π mm^2/minute

B. 100π mm^2/minute

C. π mm^2/minute

D. $-\pi$ mm^2/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

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 ists volume increases uniformal at the rate of $40 \ cm^3 / \ min$.

At $r = 8,$ its surface area increase at the rate

A. $10cm^2$ minute

B. $20cm^2$ minute

C. $40cm^2$ minute

D. none of these

Answer: A

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

25. The edge of a cube is equal to the radius o

the sphere. If the rate at which the volume of

the cube is increasing is equal to λ, then the

rate of increase of volume of the sphere, is

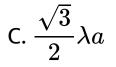A. $\dfrac{4\pi\lambda}{3}$

B. $4\pi\lambda$

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

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 λ units/sec. The rate of increase of its area, is

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

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

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

D. none of these

Answer: C

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