OUTCOME 6 DAY 1 ASSIGNMENT (Section 3.1 & 3.2 in Text)

1. Determine the velocity and acceleration functions for each of the following position functions.

   (a) $s(t)=t^3+4t^2+5t+9$ (b) $s(t)=t^2\sqrt{t+1}$ (c) $s(t)=\dfrac{3t^2}{t+2}$

2. A particle moves along the x-axis so that its position in metres, after t seconds, is given by the function $s(t)=t^3+6t^2+9t$.

   (a) Find the initial position of the particle.
   (b) Find the velocity and the acceleration of the particle at any time, t.
   (c) Find the average velocity between $t=2$ and $t=6$.
   (d) Find the instantaneous velocity at $t=2$, $t=4$, and $t=6$.
   (e) Is the average of the instantaneous velocities at $t=2$ and $t=6$ the same as the average velocity between $t=2$ and $t=6$?
   (f) Is the instantaneous velocity at $t=4$ the same as the average of the instantaneous velocities at $t=2$ and $t=6$?
   (g) Is the instantaneous velocity at $t=4$ the same as the average velocity between $t=2$ and $t=6$?
   (h) Where is the particle when its velocity is 144 m/s?
   (i) Find the acceleration when $t=5$.
   (j) Where is the particle when its acceleration is 30 m/s^2?
   (k) Find the average acceleration between $t=2$ and $t=6$.

3. A particle moves along the x-axis so that its position in metres, after t seconds, is given by the function $s(t)=t^3-9t^2+24t$ where $t\geq 0$.

   (a) Determine the velocity at $t=1$ and $t=3$.
   (b) Determine the time interval(s) in which the particle is moving to the right.
   (c) Determine the time interval(s) in which the particle is moving to the left.
   (d) Determine the total distance travelled between $t=0$ and $t=5$.

4. If a ball is dropped from a height of 72 m above the ground, its height after t seconds is given by the function $h(t)=72-4.9t^2$.

   (a) Find the velocity of the ball after 3 seconds.
   (b) Find the average velocity of the ball between $t=1$ and $t=3$.
   (c) When does the ball hit the ground? Round your answer to the nearest tenth of a second.
   (d) What is the acceleration of the ball?

5. An arrow is shot vertically up into the air from the top of a barn and its height above ground (in metres) after t seconds is approximated by the function $h(t)=-5t^2+100t+8$.

   (a) Find the initial velocity of the arrow.
   (b) What was the velocity of the arrow after 3 seconds?
   (c) When did the arrow reach its maximum height?
   (d) What was the maximum height reached by the arrow?
   (e) When did the arrow hit the ground? Round your answer to two decimal places. (Hint: the quadratic formula will be needed.)
   (f) With what velocity did the arrow hit the ground? Round your answer to one decimal place.

6. A toboggan slides down a uniformly sloped hill and travels a distance $s(t)$ metres after t seconds where $s(t)=3t^2$.

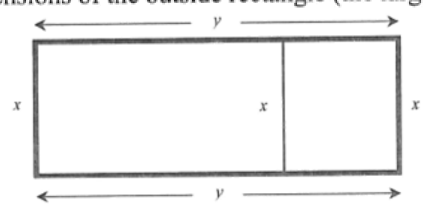
   (a) How far has the toboggan travelled after 10 seconds?
   (b) What is the velocity of the toboggan after 6 seconds?
   (c) What is the velocity of the toboggan after it has travelled 192 m?
   (d) How long does it take for the toboggan to reach a velocity of 60 m/s?

7. A motorcyclist applies the brakes uniformly so that her distance (in metres) from a stop sign, t seconds after applying the brakes, is approximated by the function $s(t)=33-32t+8t^2$.

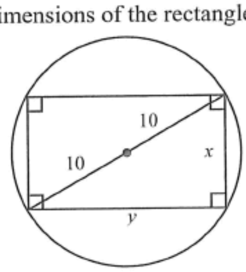
   (a) How far from the stop sign was the cyclist when she applied her brakes?
   (b) What was her velocity at that time?
   (c) When did she stop?
   (d) How far from the stop sign was she when she stopped?

OUTCOME 6 DAY 2 ASSIGNMENT (Section 3.1 & 3.2 in Text)

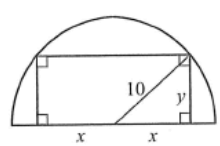
2. One number is 6 larger than another. Find these numbers if their product is to be a minimum. What is the minimum product?
3. One number is 10 larger than another. Find these numbers if the sum of their squares is to be a minimum. What is the minimum sum of squares?
4. Two numbers have a product of 16. Find these numbers if the sum of their squares is to be a minimum. What is the minimum sum of squares?
5. Two numbers have a sum of 50. What is their maximum product?
6. What number exceeds its positive square root by the least possible amount? For example, 100 exceeds its square root of 10 by 90 whereas 9 exceeds its square root of 3 by only 6.
7. Two nonnegative numbers have a sum of 21. Find these numbers if the product of one of the numbers with the square of the other is to be a maximum. What is this maximum product?
8. Two nonnegative numbers have a sum of 20. Find the numbers if the product of the cube of one of them with the square of the other is to be a maximum. What is this maximum product?
9. Two nonnegative numbers have a product of 100. What is their minimum sum?
10. Two nonnegative numbers have a sum of 10. What is the least possible sum of their reciprocals?
11. What is the maximum area a rectangle can enclose if its perimeter is 400 metres?
12. What is the minimum perimeter of a rectangle whose area is 400 m^2?
13. A farmer has 32 metres of fencing with which to make a rectangular enclosure. If he uses his barn for one side of the rectangle, what is the maximum area he can enclose?
14. A farmer has 600 metres of fencing with which he wants to make two adjacent rectangular pens as shown in the figure below. What is the maximum total area that can be enclosed? What are the dimensions of the outside rectangle (the largest rectangle of the three in the figure)?



15. Find the dimensions of the rectangle of largest area that can be inscribed in a circle of radius 10 cm.

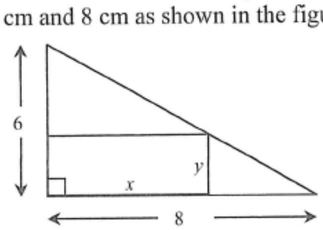


Question 15

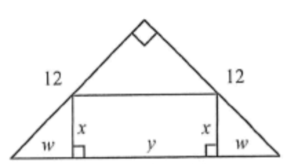


Question 16

16. Find the dimensions of the rectangle of largest area that can be inscribed in a semicircle of radius 10 cm.
17. Find the dimensions of the rectangle of largest area that can be inscribed in a right triangle with legs of length 6 cm and 8 cm as shown in the figure.



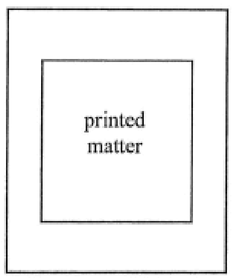
Question 17



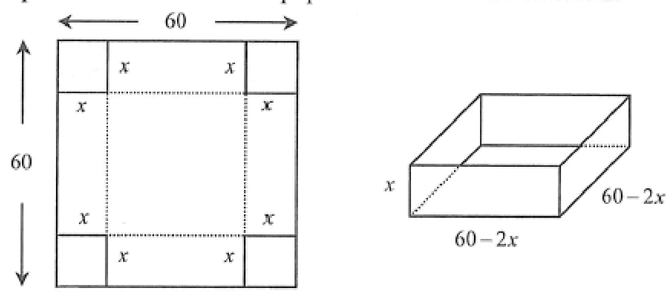
Question 18

18. Find the dimensions of the rectangle of largest area that can be inscribed in an isosceles right triangle with legs of length 12 cm as shown in the figure.
19. Find the maximum area of an isosceles triangle whose legs are 20 cm.

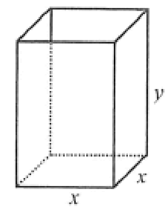
20. A rectangular paper poster must contain 450 cm^2 of printed matter. The printed area is to be surrounded by a border of width 6 cm on the top and bottom and 3 cm on the left and right. Find the outside dimensions of the poster if the area of the paper used is to be a minimum.



Question 20

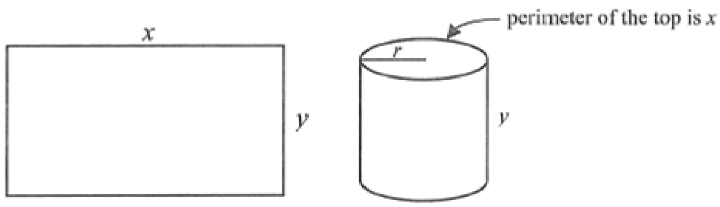


Question 21

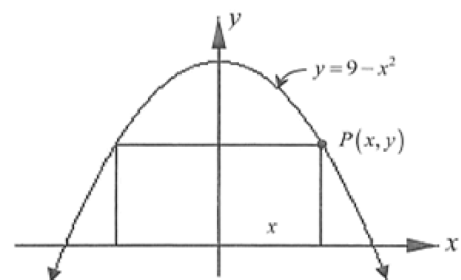


Question 23

21. A piece of cardboard, 60 cm by 60 cm is to be transformed into a box with an open top by cutting squares of the same size from each corner and folding up the flaps. Find the dimensions of the cut-out squares so that the volume of the box can be maximized.
22. Repeat question 21 if the piece of cardboard has dimensions 24 cm by 45 cm.
23. A box-shaped storage bin with an open top and a square base (bottom) is to be built to hold 32 m^3. Find its dimensions in order to minimize the area of the material used in making the box. See the figure above.
24. A rectangle has a perimeter of 216 cm. The rectangle is to be rolled into a cylindrical tube with hollow ends. Find the dimensions of the rectangle in order to maximize the volume of the tube. See the figure below.

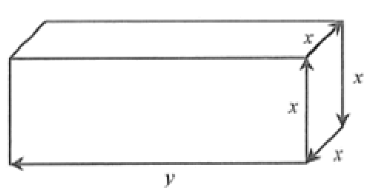


Question 24



Question 25

25. Find the area of the largest rectangle bounded by the curve $y = 9 - x^2$ above and the x-axis below. See the figure above.
26. There are size and weight restrictions on packages that can be mailed to many overseas countries. One size restriction that applies to box-shaped packages is that the combined girth and length must not exceed 300 cm. What is the volume of the largest package that can be sent to such a country if the cross section of the package is a square? See the figure below.



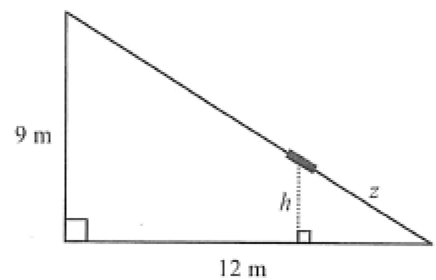
$\text{Girth} + \text{Length} = 4x + y$

27. A hockey club charges $20 for fans to see a game. At that price, only 3000 fans come to the games. The owner estimates that for every $1 drop in ticket price another 500 fans will attend. What should the ticket price be in order to maximize revenue? What is the maximum revenue? How many fans will attend at that price?

OUTCOME 6 DAY 3 ASSIGNMENT (Section 3.5 in Text)

Round each answer to two decimal places where necessary. Where referred to, assume that buildings are vertical and the ground is horizontal.

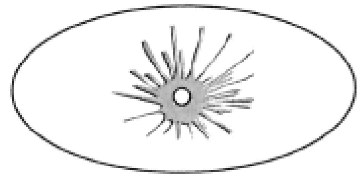
1. A pedestrian is walking at a rate of 60 m/minute towards an apartment building that is 36 m high. At what rate is the distance between the pedestrian and the top of the building changing when the pedestrian is 27 m from the base of the apartment?
2. A cyclist, travelling east at 30 km/h, has passed through an intersection. An observer, 56 m south of the intersection, watches the cyclist. How is the distance between the cyclist and pedestrian changing when the cyclist is 33 m from the intersection?
3. A skateboard ramp is in the shape of a right triangle with legs of length 9 m and 12 m. If the boarder is coming down the ramp at a speed of 20 km/h, how is the boarder's distance from the ground changing at any time, *t*? Hint: Find the hypotenuse of the ramp. Then, using similar triangles, find a linear relationship between *z* and *h*. Differentiate this relationship relative to *t* and substitute in the known information.



4. A lifeguard, standing on the edge of a swimming pool, threw a lifeline to a struggling swimmer. The lifeguard gathered in the rope at a rate of 1 m/s, advancing the swimmer directly towards the edge of the pool. At what speed did the swimmer approach the edge when the swimmer was 4 m from the edge? Assume that the lifeguard's hands are 1.5 m higher than the swimmer.
5. A child is flying a kite in a stiff breeze so that the kite string is always straight. Even though the child lets out more string, the kite refuses to gain altitude and flies at a height of 200 m, being blown away horizontally at a speed of 15 km/h. At what rate is the string lengthening when 400 m of string have been let out?
6. A football fan is watching a game from the sideline. A receiver catches a pass directly opposite the fan but 15 m inbounds and runs at a rate of 8m/s towards the end zone on a path parallel to the sideline. How is the distance between the player and fan changing when the player has run 20 m?
7. A hot air balloon rises vertically at a uniform rate of 2.4 m/s. An observer, standing 50 m from a point directly below the balloon, watches the event. How is the distance between the observer and the balloon changing when the balloon is 125 m above the ground?
8. The base of a 5 m ladder slides along the ground away from a building at a speed of 12 cm/s. At what rate is the top of the ladder coming down the wall when the base of the ladder is 4 m from the wall?
9. Two cars, one travelling west at 80 km/h and the other travelling north at 100 km/h, approach the same intersection. How is the distance between them changing when the car travelling west is 154 m from the intersection and the car travelling north is 72 m from the intersection?
10. A car, travelling south at a speed of 50 km/h, and a truck, travelling east at a speed of 55 km/h, are driving away from the same intersection. How is the distance between them changing when the car is 156 m from the intersection and the truck is 133 m from the intersection?
11. A motorcyclist, travelling west at a speed of 75 km/h, is approaching an intersection. A cyclist, travelling south at a speed of 45 km/h, is moving away from the same intersection. How is the distance between them changing when the motorcyclist is 56 m from the intersection and the cyclist is 90 m from the intersection?
12. A car, travelling north at a speed of 80 km/h, is approaching an intersection. A truck, travelling east at a speed of 60 km/h, is leaving the same intersection. How is the distance between them changing when the car is 39 m from the intersection and the truck is 52 m from the intersection?

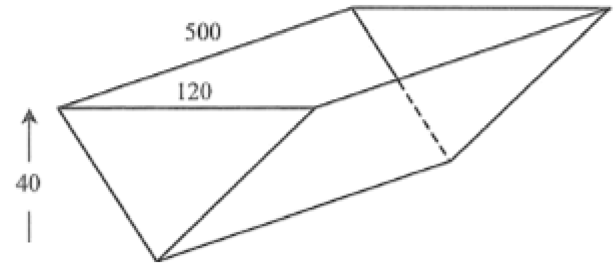
OUTCOME 6 DAY 4 ASSIGNMENT (Section in Text 3.5)

Leave your answers in exact form and/or round your answers to two decimal places.

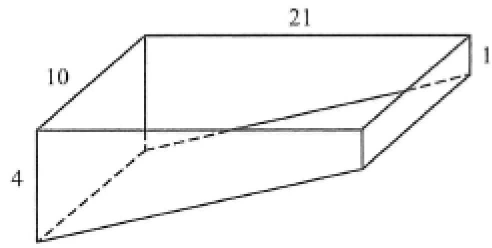


1. On the seventh hole, Steve's golf ball landed in the water hazard. The radius of the circular outer ripple created by the splash grew at a rate of 25 cm/s. At what rate was the area of the circle increasing when the radius of the circle was 200 cm?
2. Marina was pulling an air seeder with her tractor at a speed of 80m/minute in a straight-line path. If the seeder is 13 m wide, what is the rate of change in the area of the rectangle being seeded?
3. The radius of a healing circular skin burn is shrinking at a rate of 2 mm/day. At what rate is the circumference of the burn decreasing when the radius of the burn is 2.5 cm? Give your answer in mm/day.
4. The length of a rectangle is increasing at a rate of 10 cm/s while its width is decreasing at a rate of 15 cm/s. How is the area changing when the length is 30 cm and the width is 22 cm?
5. The legs of an isosceles triangle are increasing at a rate of 16 cm/s while the base of the triangle remains constant at 60 cm. At what rate is the area of the triangle increasing when each leg is 50 cm?
6. An ice-cube is melting at a rate of 15 mm^3/s. If each dimension is melting uniformly, at what rate is an edge of the ice-cube shrinking when it is 30 mm long? Give your answer in mm/s.
7. A spherical snowball rolls down a hill causing the radius to increase at a rate of 3 cm/s. When the radius is 20 cm, find the rate at which:
   (a) the surface area of the snowball is increasing.
   (b) the volume of the snowball is increasing.
8. At what rate must air be forced into a spherical balloon in order for the radius to be growing at a rate of 2 cm/s when the radius of the balloon is 8 cm?
9. At what rate is water being poured into a cylindrical glass of diameter 10 cm if the depth of the water is increasing at a rate of 0.4 cm/s?
10. The surface area of a soap bubble is increasing at a rate of $128\pi\ \text{cm}^2/\text{s}$. At what rate is the volume of the soap bubble increasing when the radius is 4 cm?
11. Water is being poured into a conical flower vase at a rate of $50\ \text{cm}^3/\text{s}$. If the cone has a radius of 6 cm and a height of 30 cm, at what rate is the depth of the water increasing when the depth of the water above the vertex of the cone is 10 cm?
12. Wheat is being augured into a conical pile so that the radius of the pile is always three times its height. At what rate is the wheat being poured onto the pile if the radius of the pile is growing at a rate of 0.8 m/minute when the radius is 3 m? Give your answer in m^3/min.
13. Water is filling a conical storage tank (vertex down) at a rate of 20 L/s. The tank has a diameter of 200 cm and a height of 300 cm. At what rate is the depth of the water rising when the water is 150 cm above the vertex? Note that $1\ \text{L} = 1000\ \text{cm}^3$.
14. Gasoline is draining from a conical storage tank (vertex down) with radius 2 m and height 4 m. At the moment that the gasoline is 3 m deep, the depth is decreasing at a rate of 0.05 cm/s. At what rate is the

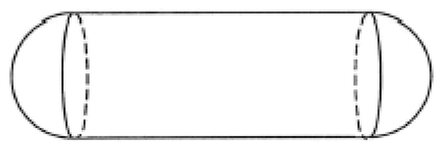
15. A water trough of length 500 cm has a cross section in the shape of a triangle whose base is 120 cm and whose height is 40 cm. If water pours into the trough at a rate of $6500\text{ cm}^3/\text{s}$, at what rate is the height of the water above the vertex of the triangle increasing when that height is 5 cm?



16. A swimming pool is 21 m long, 10 m wide, 4 m deep at the deep end and 1 m deep at the shallow end (see figure). If water is poured into the pool at a rate of $1.5\text{ m}^3/\text{min}$, at what rate is the depth of the water at the deep end increasing when the depth of the water is 2.5 m? Give your answer in cm/min. Assume that the pool was initially empty.



17. A computer draftsperson creates a solid in the shape of a cylinder capped on each end by a hemisphere. By animating the diagram, the radius of the cylinder increases at a rate of 3 cm/s while the height of the cylinder decreases at a rate of 2 cm/s. How is the volume of the solid changing when the radius is 9 cm and the height is 14 cm?



18. The length of a rectangular box is increasing at a rate of 6 cm/s, the width of the box is decreasing at a rate of 5 cm/s, and the height of the box is increasing at a rate of 3 cm/s. How is the volume of the box changing when the length is 14 cm, the width is 12 cm and the height is 10 cm?

19. If in a hemispherical bowl of radius r the water is h units deep, then its volume is given by the formula $V=\dfrac{1}{3}\pi h^2(3r-h)$. Water is leaking out of a hemispherical punch bowl with radius 20 cm at a rate of $36\text{ cm}^3/\text{s}$. At what rate is the depth of the water decreasing when the water is 4 cm deep?

20. Water leaks out of an inverted conical reservoir (vertex up) at a rate of $200\text{ cm}^3/\text{s}$. The cone has a height of 45 cm and a radius of 21 cm. Find the rate at which the water level is falling when the depth of the water is 24 cm.

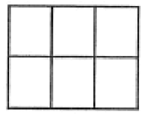
OUTCOME 6 REVIEW

Day 1 -2 Review Questions:

1. The population of a bacteria culture after t hours is given by the function $P(t)=600+100t+8t^3$.
   Answer each of the following questions, providing appropriate units.
   (a) What was the initial size of the population?
   (b) What was the size of the population after 6 hours?
   (c) What was the average rate of growth of the population between $t=3$ and $t=7$?
   (d) What was the instantaneous rate of growth of the population when $t=5$?
2. The value, V, of a new automobile t years after it has been purchased is given by the function
   $V(t)=\dfrac{30000}{1+0.1t+0.05t^2}$. Round your answer to each question to the nearest cent.
   (a) Find the purchase price.
   (b) Find the value of the car after 3 years.
   (c) What was the average rate of depreciation during those three years?
   (d) Find the instantaneous rate of depreciation when $t=3$.
3. A particle moves along the x-axis so that after t seconds its position is given by the function
   $s(t)=2t^3-21t^2+72t$.
   (a) Find the velocity and acceleration of the particle at any time, t.
   (b) Find the position, velocity, and acceleration of the particle when $t=8$.
   (c) Find the time intervals during which the particle is moving to the right.
   (d) Find the time intervals during which the particle is moving to the left.
   (e) How far has the particle moved during between $t=0$ and $t=5$?
   (f) Find the average velocity of the particle between $t=6$ and $t=10$.
4. The height of a ball above ground level, measured in metres, is given by the function
   $s(t)=-5t^2+60t+8$, where t is time in seconds.
   (a) What was the initial height of the ball?
   (b) When did the ball reach its maximum height?
   (c) What was the maximum height reached by the ball?
   (d) When did the ball hit the ground? Round your answer to two decimal places.
   (e) With what velocity did the ball hit the ground? Round your answer to two decimal places.
5. A snowmobile operator, travelling along a narrow bush trail, came over a hill and saw another machine stalled 18 metres ahead. The operator immediately cut the throttle and travelled a distance of $s(t)=12t-t^3$ metres thereafter, where t was the time in seconds. Was there a collision? Explain.
6. The height (in metres) of a bullet above ground level, t seconds after being fired from a gun, is given by the function $h(t)=400t-5t^2$.
   (a) Find the maximum height reached by the bullet.
   (b) If the fuselage of an airplane can withstand bullets travelling at a rate of 50m/s, what is the lowest height at which the plane can safely fly?
7. Two nonnegative numbers have a sum of 180. Find these numbers if the product of one of the numbers with the square of the other is to be a maximum. Find that maximum product.
8. Two nonnegative numbers have a product of 72. Find these numbers if the sum of one of them and twice the other is to be a minimum.
9. Two nonnegative numbers have a sum of 4. Find these numbers if the sum of the cube of one of them and the square of the other is to be a minimum. What is that minimum sum?

10. An open-topped box is to be made from a square piece of tin that is 54 cm by 54 cm by cutting out squares of equal size from each of the corners and folding up the flaps. Find the size of the square if the volume of the box is to be a maximum.

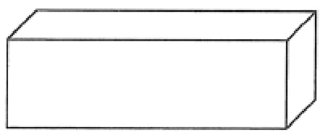
11. A dog kennel operator has 72 m of fencing and wants to enclose six congruent rectangular pens as shown below. What dimensions should be used for each pen in order to maximize the total area enclosed?



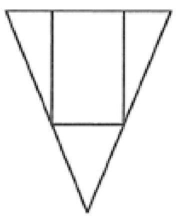
12. The sum of the lengths of two legs in a right triangle is 20 cm. Find the length of each leg if the length of the hypotenuse is to be minimized.

13. What is the shortest vertical distance between the graphs of the functions $f(x) = x^2 + 2$ and $g(x) = -(x-2)^2 - 1$?

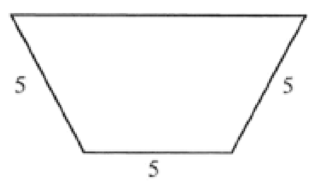
14. A storage box with square ends and no open sides is to be built to have a volume of 50 m^3. If the material for the square ends costs \$80/m^2 while the material for the rectangular sides costs \$200/m^2, find the dimensions of the box in order to minimize its cost.



15. Find the dimensions of the cylinder of greatest volume that can be inscribed in a cone of height 12 cm and radius 4 cm.

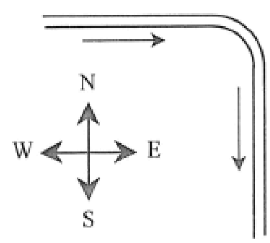


16. The shorter base and the legs of an isosceles trapezoid are each 5 cm in length. Find the length of the longer base if the area of the trapezoid is to be maximized.



Day 3 - 4 Review Questions:

17. The base of a ladder 13 m long is pushed towards the wall at a rate of 10 cm/s. At what rate is the top of the ladder moving up the wall when the base is 5 m from the wall?
18. A right triangle has a hypotenuse of constant length 25 cm. One leg of the right triangle increases at a rate of 1.4 cm/s. When that leg is 24 cm long, find:
(a) the rate at which the other leg is decreasing in length.
(b) how the area is changing when the increasing leg is 24 cm.
19. A truck is parked 100 m directly south of an intersection. A car is travelling east at a rate of 20 m/s. At what rate is the distance between the car and the truck increasing 12 seconds after the car has passed through the intersection?
20. A bicyclist is approaching an intersection travelling south at a rate of 20 km/h. A motorcyclist is leaving the same intersection travelling west at a rate of 60 km/h. How is the distance between them changing when the cyclist is 42 m from the intersection and the motorcyclist is 40 m from the intersection?
21. A train of length 700 m maintains a constant speed of 100 km/h as it travels through a right-angled turn as shown. Let z denote the distance between the front and rear of the train at any time.



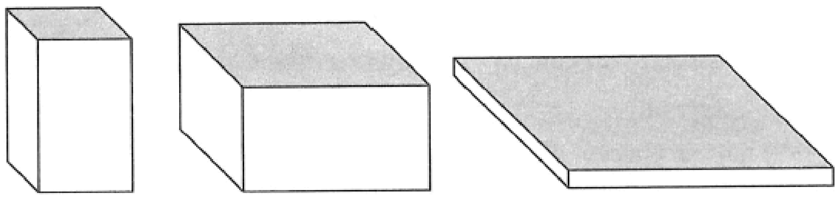
(a) Why is $\frac{dz}{dt} = 0$ before the engine reaches the corner?

(b) Find $\frac{dz}{dt}$ at the moment when the engine is 300 m past the corner and is travelling south.

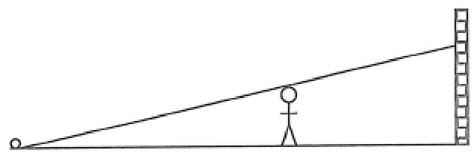
(c) When, if ever, is $\frac{dz}{dt}$ positive?

22. A fictitious piece of pie is in the shape of a sector with radius r and arc length s. If the radius is increasing at a rate of 4 cm/s while the arc length is decreasing at a rate of 3 cm/s, what is happening to the area of the piece of pie when the radius is 8 cm and the arc length is 7 cm? Recall that the area of such a sector is $\frac{1}{2}rs$.
23. A metal ball bearing is heating which causes the radius to grow at a rate of 2 mm/min. At what rate is the volume of the ball increasing when the radius of the ball is 1.5 cm? Give your answer in mm^3/min.
24. A spherical balloon is being inflated at a rate of $20\pi\ \text{m}^3/\text{h}$. At what rate is the radius increasing when the radius is 5 m?
25. A conical paper cup has a radius of 4 cm and a height of 12 cm. If water is leaking from the cup at a rate of $6\ \text{cm}^3/\text{s}$, at what rate is the water level falling when the height of the water is 8 cm?

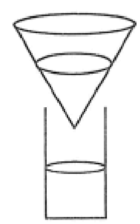
26. Sand leaves a conveyor belt at a rate of $0.72 \text{ m}^3/\text{min}$, forming a conical pile whose radius is the same as its height. At what rate is the height of the pile rising when the height of the pile is 6 m?
27. A conical wading pool has a diameter of 12 m and a depth of 1 m. Water is draining from the pool at a rate of $2 \text{ m}^3/\text{minute}$. At what rate is the height of the water decreasing when it is 25 cm deep above the vertex of the cone? Give your answer in cm/min.
28. Each side of the square top of a box is growing at a rate of 8 cm/s while the height of the box is shrinking at a rate of 5 cm/s. What is happening to the volume of the box when it measures 60 cm by 60 cm by 10 cm?



29. A spotlight on the ground shines towards a wall 12 m away. A man 2 m tall walks directly towards the wall at a rate of 1.6 m/s. At what rate is his shadow length against the wall decreasing when he is 4 m from the wall?



30. Water is leaking from a cone with radius 6 cm and height 12 cm into a cylindrical glass jar with radius 5 cm. It is observed that the height of the water in the jar is increasing at a rate of 3 cm/min. At what rate is the height of the water in the cone decreasing when the height of the water in the cone is 5 cm?



CALCULUS 30: SOLUTIONS TO WORKBOOK ASSIGNMENTS

SOLUTIONS TO: OUTCOME 6 DAY 1 ASSIGNMENT

1. (a) $v(t)=3t^2+8t+5$; $a(t)=6t+8$ **(b)** $v(t)=\frac{1}{2}t(t+1)^{-1/2}(5t+4)$; $a(t)=\frac{1}{4}(t+1)^{-3/2}(15t^2+24t+8)$ **(c)** $v(t)=\frac{3t(t+4)}{(t+2)^2}$; $a(t)=\frac{24}{(t+2)^3}$ **2. (a)** 0 m **(b)** $v(t)=3t^2+12t+9$; $a(t)=6t+12$ **(c)** 109 m/s **(d)** 45 m/s, 105 m/s, 189 m/s **(e)** No, $\frac{45+189}{2}\neq 109$ **(f)** No, $105\neq\frac{45+189}{2}$ **(g)** No, $105\neq 109$ **(h)** 320 m **(i)** 42 m/s^2 **(j)** 108 m **(k)** 36 m/s^2 **3. (a)** 9 m/s; -3 m/s **(b)** $t\in[0,2)\cup(4,\infty)$ **(c)** $t\in(2,4)$ **(d)** 28 m **4. (a)** -29.4 m/s **(b)** -19.6 m/s **(c)** 3.8 s **(d)** -9.8 m/s^2 **5. (a)** 100 m/s **(b)** 70 m/s **(c)** 10 s **(d)** 508 m **(e)** 20.08 s **(f)** -100.8 m/s **6. (a)** 300 m **(b)** 36 m/s **(c)** 48 m/s **(d)** 10 s **7. (a)** 33 m **(b)** -32 m/s **(c)** 2 s **(d)** 1 m **8.** 98 m/s

SOLUTIONS TO: OUTCOME 6 DAY 2 ASSIGNMENT

1. **(a)** 7 and 8 **(b)** 7.5 and 7.5 **(c)** 56.25 **(d)** part (a) considers only integer possibilities, whereas part (b) broadens the search to include real number possibilities. **2.** -3 and 3; -9 **3.** -5 and 5; 50 **4.** 4 and 4; 32 **5.** 625 **6.** 1/4 **7.** 14 and 7 (14 is the number to be squared) **8.** 12 and 8 (12 is the number to be cubed) **9.** 20 **10.** 2/5 **11.** 10 000 m^2 **12.** 80 m **13.** 128 m^2 **14.** 15 000 m^2; 100 m by 150 m **15.** $10\sqrt{2}$ cm by $10\sqrt{2}$ cm **16.** $10\sqrt{2}$ cm by $5\sqrt{2}$ cm **17.** 3 cm by 4 cm **18.** $6\sqrt{2}$ cm by $3\sqrt{2}$ cm **19.** 200 cm^2 **20.** 21 cm by 42 cm **21.** 10 cm by 10 cm **22.** 5 cm by 5 cm **23.** 4 m by 4m by 2 m **24.** 72 cm by 36 cm **25.** $12\sqrt{3}$ u^2 **26.** 250 000 cm^2 **27.** \$13; \$84 500; 6500 fans **28.** $\sqrt{3}$ cm^2 **29.** the rectangle has dimensions $\dfrac{480}{4+\pi}$ cm by $\dfrac{240}{4+\pi}$ cm **30.** $r = h = \sqrt[3]{\dfrac{400}{\pi}}$ **31.** $\dfrac{10\sqrt{39}}{13}$ or 4.80 km **32.** C is $4\frac{2}{7}$ km from D **33.** $r = h = \dfrac{10}{3}$ **34.** $\dfrac{k^2}{16}$ cm^2 **35.** $\dfrac{k}{6}$ cm by $\dfrac{k}{6}$ cm

SOLUTIONS TO: OUTCOME 6 DAY 3 ASSIGNMENT

1. decreasing at a rate of 36 m/min **2.** increasing at a rate of 15.23 km/h **3.** decreasing at a rate of 12 km/h **4.** approaching at a rate of 1.07 m/s **5.** 12.99 km/h **6.** increasing at a rate of 6.4 m/s **7.** increasing at a rate of 2.23 m/s **8.** coming down at a rate of 16 cm/s **9.** decreasing at a rate of 114.82 km/h **10.** increasing at a rate of 73.73 km/h **11.** decreasing at a rate of 1.42 km/h **12.** At that moment the distance, z, between them is neither increasing nor decreasing since $\dfrac{dz}{dt} = 0$. They are at the point of closest approach. **13.** 0.6 m/s **14.** 0.46 m/s

SOLUTIONS TO: OUTCOME 6 DAY 4 ASSIGNMENT

1. $10\,000\pi$ or 31 415.93 cm^2/s **2.** 1040 m^2/min **3.** 4π or 12.57 mm/day **4.** shrinking at a rate of 230 cm^2/s **5.** 600 cm^2/s **6.** shrinking at a rate of 1/180 or $0.00\overline{5}$ mm/s **7.** **(a)** 480π or 1507.96 cm^2/s **(b)** 4800π or 15079.64 cm^2/s **8.** 512π or 1608.50 cm^3/s **9.** 10π or 31.42 cm^3/s **10.** 256π or 804.25 cm^3/s **11.** $25/2\pi$ or 3.98 cm/s **12.** $12\pi/5$ or 7.54 m^3/min **13.** $8/\pi$ or 2.55 cm/s **14.** 1125π or 3534.29 cm^3/s **15.** 13/15 or 0.87 cm/s **16.** 6/7 or 0.86 cm/min **17.** increasing at a rate of 1566π or 4919.73 cm^3/s **18.** increasing at a rate of 524 cm^3/s **19.** $1/4\pi$ or 0.08 cm/s **20.** $5000/2401\pi$ or 0.66 cm/s

SOLUTIONS TO OUTCOME 6 REVIEW

1. **(a)** 600 **(b)** 2100 **(c)** 732 bacteria/h **(d)** 700 bacteria/h **2.** **(a)** \$30 000 **(b)** \$17 142.86 **(c)** \$4285.71/yr **(d)** \$3918.37/yr **3.** **(a)** $v(t)=6t^2-42t+72$; $a(t)=12t-42$ **(b)** $s(8)=256$ u; $v(8)=120$ u/s; $a(8)=54$ u/s^2 **(c)** $t\in(0,3)\cup(4,\infty)$ **(d)** $t\in(3,4)$ **(e)** 87 u **(f)** 128 u/s **4.** **(a)** 8 m **(b)** 6 s **(c)** 188 m **(d)** 12.13 s **(e)** −61.32 m/s **5.** No. The operator's velocity was 0 in 2 seconds. During that time the snowmobile travelled 16 m, thus stopping 2 m before the stalled machine. **6.** **(a)** 8000 m **(b)** 7875 m **7.** 120 (the number to square) and 60; 864 000 **8.** 6 (the number to double) and 12 **9.** $4/3$ (the number to cube) and $8/3$ (the number to square); the minimum sum is $256/27$ **10.** 9 cm by 9 cm **11.** 4m by 4.5 m **12.** each leg is 10 cm **13.** 5 u **14.** 5 m by 5 m by 2 m **15.** $r=8/3$ cm, $h=4$ cm **16.** 10 cm **17.** $25/6$ cm/s **18.** **(a)** 4.8 cm/s **(b)** decreasing at 52.7 cm^2/s **19.** 240/13 or 18.46 m/s **20.** increasing at $780/29$ or 26.90 km/h **21.** **(a)** the distance between the front of the train and the back of the train is constant at that time **(b)** decreasing at 20 km/h **(c)** when the engine is more than 350 m south of the corner **22.** increasing at 2 cm^2/s **23.** 1800π or 5654.87 mm^3/min **24.** $1/5$ m/h **25.** $27/32\pi$ or 0.27 cm/s **26.** $1/50\pi$ or 0.0064 m/min **27.** $800/9\pi$ cm/min **28.** decreasing at 8400 cm^3/s **29.** $3/5$ m/s **30.** 12 cm/min