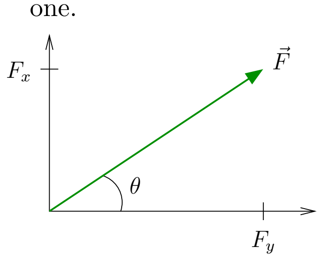
1. Solve for x: $A - Bx = C + D(x + F)$
   (a) $\frac{A-C}{B+D}$
   (b) $\frac{1}{B}(C + DF) - A$
   (c) $\frac{A-C-DF}{B+D}$
   (d) $\frac{A}{B} + C + D(1 + F)$
   (e) 7.13

2. Solve for x: $\frac{x}{a} + x = 8b$
   (a) $4ab$
   (b) $8ab$
   (c) $\frac{8b}{a-1}$
   (d) $\frac{8b}{a+1}$
   (e) $\frac{8ab}{1+a}$

3. If $10x + 10y = 0$ and $4x - 4y = -8$, then
   (a) $x = -1, y = 1$
   (b) $x = -10, y = 10$
   (c) $x = 1, y = -1$
   (d) $x = 0, y = -2$
   (e) $x = -2, y = 0$

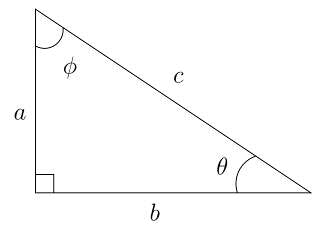
4. Solve for t: $\theta = \omega_\circ t - \frac{1}{2}\alpha t^2$
   (a) $\frac{\omega_\circ \pm \sqrt{\omega_\circ^2 - 4\alpha\theta}}{2\alpha}$
   (b) $\frac{\omega_\circ \pm \sqrt{\omega_\circ^2 - 2\alpha\theta}}{\alpha}$
   (c) $\frac{\omega_\circ \pm \sqrt{\omega_\circ - 2\alpha\theta}}{\alpha}$
   (d) $\frac{\omega_\circ^2 \pm \sqrt{\omega_\circ - 2\alpha\theta}}{\alpha}$
   (e) $\frac{\omega_\circ \pm \sqrt{\omega_\circ^2 \pm 4\alpha\theta}}{\alpha}$

5. In the diagram, which of the following are true? There may be more than one correct answer, but choose only one.



   (a) $F_x = F \tan\theta$
   (b) $F_y = F \tan\theta$
   (c) $F_x = F \sin\theta$
   (d) $F_y = F \sin\theta$
   (e) $F_y = F \cos\theta$

6. In the right-angled triangle shown, which is true?



   (a) $\cot\theta = c/a$
   (b) $\cot\theta = b/c$
   (c) $\cot\theta = a/c$
   (d) $\cot\theta = a/b$
   (e) $\cot\theta = b/a$

7. $\frac{1}{5} + \frac{5}{1} = ?$
   (a) 26
   (b) 1/25
   (c) 26/5
   (d) 5/26
   (e) 1

8. $\frac{1}{5} + \frac{3}{4} = ?$
   (a) 3/9
   (b) 19/20
   (c) 3/20
   (d) 4/9
   (e) 4/20

9. If A is equal to B, and B is equal to C, then we can say that:
   (a) there is not enough information to determine a relationship between A and C
   (b) A is greater than C
   (c) A is smaller than C
   (d) A is necessarily equal to C
   (e) A is not necessarily equal to C

10. Evaluate the following indefinite integral: $\int x\,dx$
   (a) 0
   (b) $\frac{1}{2}x^2 + C$
   (c) $\frac{1}{2}x^2$
   (d) $\frac{1}{2}x + C$
   (e) $x^2 + C$

1. Solve for k: $U = \frac{1}{2}kx^2$

(a) $U - \frac{1}{2}x^2$
(b) $2U - x^2$
(c) $\frac{2x^2}{U}$
(d) $\frac{x^2}{2U}$
(e) $\frac{2U}{x^2}$

2. The value of y that satisfies $\frac{y}{3.2} = 14$ is

(a) 3.2
(b) -3.8
(c) 44.8
(d) 17.2
(e) 0

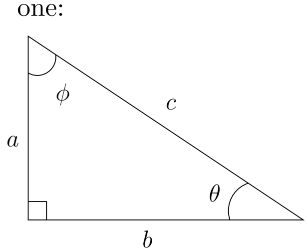
3. If $2x + 2y = 0$ and $2x - 2y = -4$, then

(a) $x = 0, y = -2$
(b) $x = -2, y = 2$
(c) $x = 0, y = 2$
(d) $x = -1, y = 1$
(e) $x = 2, y = -2$

4. Solve for x: $\frac{M_1}{x^2} = \frac{M_2}{(d-x)^2}$

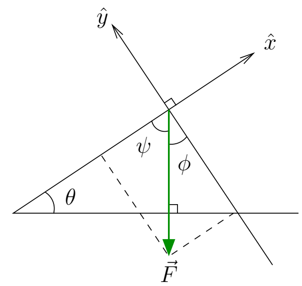
(a) $\frac{-2dM_1 \pm \sqrt{4dM_1^2 + 4(M_1 - M_2)M_1 d^2}}{M_2 - M_1}$
(b) $\frac{-2dM_1 \pm \sqrt{d^2M_1^2 + 4(M_1 - M_2)M_1 d^2}}{M_2 - M_1}$
(c) $\frac{-dM_1 \pm d\sqrt{M_1 M_2}}{M_2 - M_1}$
(d) $\frac{-2dM_1 \pm \sqrt{2d^2M_1^2 + 4(M_1 - M_2)M_1 d^2}}{-2(M_1 + M_2)}$
(e) $\frac{-\left(2dM_1 \pm d\sqrt{M_1 M_2}\right)}{M_1 - M_2}$

5. In the right-angled triangle shown, which is true? There may be more than one correct answer, but choose only one:



(a) $\sin^{-1}(c/a) = \theta$
(b) $\sin^{-1}(a/c) = \theta$
(c) $\sin^{-1}(b/c) = \phi$
(d) $\sin^{-1}(a/c) = \phi$
(e) $\sin^{-1}(b/c) = \theta$

6. In the diagram below, $\theta = 30.0°$ and the vector $\vec{F}$ is 20.0 units long. Given that $\cos 30° = \sqrt{3}/2 \approx 0.866$ and $\sin 30° = 1/2$, this means that (there may be more than one correct answer, but choose only one):



(a) F_x is 10.0 units long
(b) F_y is 34.6 units long
(c) F_x is 8.7 units long
(d) F_y is 17.3 units long
(e) F_y is 11.5 units long

7. $\frac{21(x + y^3)}{7xy}$ reduces to

(a) $3xy^2$
(b) $3(1 + y^2)$
(c) $\frac{3(x + y^2)}{x}$
(d) $3(x + y)$
(e) $\frac{3(x + y^3)}{xy}$

8. $\frac{1}{4} + \frac{3}{5} = ?$

(a) 3/9
(b) 3/20
(c) 5/12
(d) 17/20

9. If A is greater than B, and B is less than C, then we can say that:

(a) A is greater than C
(b) A is necessarily equal to C
(c) A is smaller than C
(d) there is not enough information to determine a relationship between A and C
(e) A is not necessarily equal to C

10. If $F = mg$ and m and g are constants, then the definite integral $\int_0^h F\,dy$ is equal to

(a) $\frac{1}{2}(mgh)^2$
(b) mgy
(c) mgh
(d) $\frac{1}{2}(mg)^2$
(e) $mgh + C$

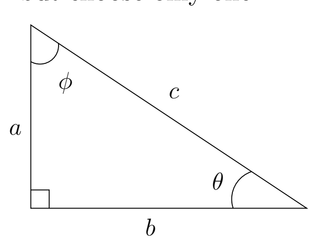
1. Solve for a: $3(2-5a) = 3+2a$
   (a) $3/17$
   (b) $17/3$
   (c) $-17/3$
   (d) $-3/2$
   (e) $2/3$

2. Solve for x: $\frac{x}{2} + \frac{x}{3} = 1$
   (a) 3
   (b) 6
   (c) $5/6$
   (d) $6/5$
   (e) $5/2$

3. If $x - y = -10$ and $x - y = -2$, then
   (a) There is insufficient information to solve the system of equations
   (b) There is no solution that satisfies the above system of equations
   (c) $x = 15, y = 5$
   (d) $x = -20, y = 10$
   (e) $x = 0, y = 0$

4. Solve for t given the values of the parameters: $s = u_\circ t + \frac{1}{2}at^2$, where $s = 1, a = 3$ and $u_\circ = 0$
   (a) $\pm\sqrt{3/2}$
   (b) $\pm\sqrt{2/3}$
   (c) 0
   (d) $\sqrt{\pm 3/2}$
   (e) $\sqrt{\pm 2/3}$

5. In the right-angled triangle shown, which of the following is true? There may be more than one correct answer, but choose only one



   (a) $\cos^{-1}(a/c) = \phi$
   (b) $\cos^{-1}(c/a) = \phi$
   (c) $\cos^{-1}(c/a) = 90°$
   (d) $\cos^{-1}(c/a) = \theta$
   (e) $\cos^{-1}(a/c) = \theta$

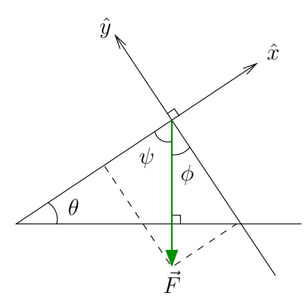
6. If the radius of a circle is found to be $r = 0.30$ cm, then the area of the circle is:
   (a) $1.88\ \text{cm}^2$
   (b) $0.94\ \text{cm}^2$
   (c) 0.94 cm
   (d) 1.88 cm
   (e) $0.28\ \text{cm}^2$

7. Once Alice gives half of her money to Hapless Bob, she is left with \$3 and Bob will have twice as much as he had initially. Before the transaction:
   (a) Alice had \$4 and Bob had \$12
   (b) Alice had \$6 and Bob had \$3
   (c) Alice had \$12 and Bob had \$6
   (d) There is insufficient information
   (e) Alice had \$12 and Bob had \$4

8. Evaluate the following derivative at $x = 2$: $\frac{d}{dx}\left(x^2 - 3x\right)$
   (a) 4
   (b) -1
   (c) 1
   (d) -5

9. The following can be reduced to: $\dfrac{36(y^2 - z^2)}{(6y + 6z)}$
   (a) $6yz$
   (b) $6(y - z)$
   (c) $\dfrac{6(y-z)}{yz}$
   (d) $\dfrac{6y}{z} - \dfrac{6z}{y}$
   (e) $6(y + z)$

10. In the diagram below, $\theta = 30.0°$. This means that



   (a) $\phi = 45°$
   (b) $\phi = 60°$
   (c) $\phi = 30°$
   (d) $\phi = 90°$
   (e) $\phi = 120°$

1. What is $\left(\frac{4}{5}\right)\left(\frac{5}{10}\right)$?

   (a) 4/5
   (b) 14/10
   (c) 9/15
   (d) 2/5
   (e) 40/25

2. Solve for x: $x - y = 5x + 2$

   (a) $-\frac{y}{4} + \frac{1}{2}$
   (b) $\frac{4}{y} + 2$
   (c) $(5x + 2) + y$
   (d) $-\frac{1}{4}(y + 2)$
   (e) $\frac{-y}{5x + 2}$

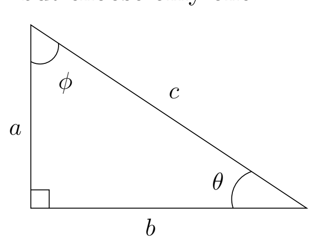
3. If you've traveled at an average speed of 68 mph and gone for 88 miles, how long was your trip?

   (a) 0.77 hrs
   (b) 1.2 hrs
   (c) 1.3 hrs
   (d) 5.9 hrs
   (e) 20 hrs

4. Solve for k: $3k + 17 = \frac{1}{2}(k + 2) - 8$

   (a) -9.60
   (b) -6.67
   (c) -6.57
   (d) 6.57
   (e) 9.60

5. In the right-angled triangle shown, which of the following is true? There may be more than one correct answer, but choose only one



   (a) $\tan^{-1}(b/c) = \phi$
   (b) $\tan^{-1}(b/a) = \theta$
   (c) $\tan^{-1}(a/b) = \theta$
   (d) $\tan^{-1}(a/b) = \phi$
   (e) $\tan^{-1}(a/c) = \theta$

6. If a sphere has a radius of 0.50 m, then the surface area of the sphere is

   (a) 6.28 m^2
   (b) 0.32 m^2
   (c) 12.6 m^2
   (d) 3.14 m^2
   (e) 0.16 m^2

7. $z^3 z^{-4}$ is the same as

   (a) $1/z$
   (b) z
   (c) $z^{3/4}$
   (d) z^{-12}
   (e) z^{12}

8. Solve for t: $4t^2 - 8t = 2$

   (a) $\frac{2 \pm \sqrt{-6}}{2}$
   (b) $\frac{\sqrt{2 \pm 6}}{2}$
   (c) $1 \pm \frac{\sqrt{6}}{2}$
   (d) $\sqrt{\frac{2 \pm \sqrt{6}}{2}}$
   (e) $3 \pm \frac{\sqrt{6}}{2}$

9. If Alice is half as heavy as Bob, and Bob is three times heavier than his dog, we can conclude that:

   (a) Alice is 0.67 times the weight of the dog
   (b) Alice is 1.5 times the weight of the dog
   (c) Alice is 6 times the weight of the dog
   (d) Alice is 0.16 times the weight of the dog
   (e) There is not enough information to determine a relationship between Alice's weight and the dog's.

10. Solve the indefinite integral $\int u(t)\,dt$, where $u(t) = u_\circ + at$ given $u_\circ$, a and $x_\circ$ are all constants:

   (a) at
   (b) $u_\circ t + \frac{1}{2}at^2$
   (c) a
   (d) $x_\circ$
   (e) $x_\circ + u_\circ t + \frac{1}{2}at^2$

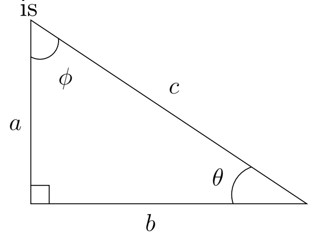
1. Solve for x: $\dfrac{x}{3}+\dfrac{x}{a}=\dfrac{8}{b}$
   (a) $\dfrac{b}{8(3+a)}$
   (b) $\dfrac{b(3+a)}{8}$
   (c) $\dfrac{8(3+a)}{b}$
   (d) $\dfrac{24a}{b(3+a)}$
   (e) $\dfrac{24a}{b}$

2. Solve for x: $U=\frac{1}{2}k(x-x_\circ)^2$
   (a) $\dfrac{2U}{k}+x_\circ$
   (b) $\sqrt{\dfrac{2U}{k}}+x_\circ$
   (c) $\dfrac{2U}{k}-x_\circ$
   (d) $\sqrt{\dfrac{2U}{k}}-x_\circ$
   (e) $\sqrt{\dfrac{2U}{k}+x_\circ}$

3. If $x+2y=10$ and $x-2y=-2$, then
   (a) There is insufficient information to solve the system of equations
   (b) There is no solution that satisfies the above system of equations
   (c) $x=4, y=2$
   (d) $x=3, y=4$
   (e) $x=4, y=3$

4. Which of the following is another way of saying $(x-7)^2$?
   (a) $x^2-14x+49$
   (b) $x^2+14x-49$
   (c) $x^2+14x+49$
   (d) x^2+49
   (e) x^2-49

5. In the right-angled triangle shown, the "hypoteneuse" is



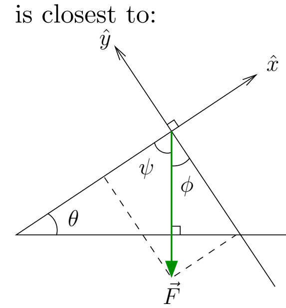
   (a) ϕ
   (b) b
   (c) c
   (d) θ
   (e) a

6. One "cubic metre" (m^3) has
   (a) 100 cm^3
   (b) 1 000 cm^3
   (c) 10 000 cm^3
   (d) 100 000 cm^3
   (e) 1 000 000 cm^3

7. $\dfrac{7}{5}+\dfrac{2}{5}$ is equal to
   (a) 10/14
   (b) 9/5
   (c) 9/25
   (d) 35/10
   (e) 14/25

8. Evaluate the following derivative at $x=2$: $\frac{d}{dx}\left(x^3-5x\right)$
   (a) −2
   (b) 2
   (c) 3
   (d) 7
   (e) 12

9. In the diagram below, $\theta=30°$ and the vector $\vec{F}$ is 15.0 units long. Given that $\cos 30° = \sqrt{3}/2 \approx 0.866$ and $\sin 30° = 1/2$, the component of $\vec{F}$ parallel to the $\hat{y}$ axis is closest to:



   (a) 0 units long
   (b) 7.5 units long
   (c) 8.7 units long
   (d) 13.0 units long
   (e) 15.0 units long

10. Solve for R: $\dfrac{Q_2}{(d-R)^2}=\dfrac{Q_1}{R^2}$
    (a) $\dfrac{dQ_1 \pm d\sqrt{Q_1Q_2}}{Q_1-Q_2}$
    (b) $\dfrac{-2dQ_1 \mp 2\sqrt{d^2Q_1^2+(Q_1-Q_2)Q_1d^2}}{-(Q_1+Q_2)}$
    (c) $\dfrac{-dQ_1 \pm d\sqrt{Q_1Q_2}}{Q_2-Q_1}$
    (d) $\dfrac{-2dQ_1 \pm \sqrt{4dQ_1^2+4(Q_1-Q_2)Q_1d^2}}{Q_2-Q_1}$
    (e) $\dfrac{-2dQ_1 \pm \sqrt{4dQ_1^2-4(Q_1-Q_2)Q_1d^2}}{Q_2-Q_1}$

The derivative can be defined in terms of a limit. For a function $f(t)$ that depends on the variable t, the derivative is $f'(t) = \frac{df}{dt} = \lim_{\Delta t \to 0} \frac{\Delta f}{\Delta t}$. This corresponds to finding the tangent to the curve at the point t. In practice, for a polynomial, the derivative can be found using the following formula: if $f(t) = a_{-2}t^{-2} + a_{-1}t^{-1} + a_0t^0 + a_1t^1 + a_2t^2 + a_3t^3 + \ldots + a_nt^n$ where the a_i and n are constants, then $f'(t) = \frac{-2a_{-2}}{t^3} - \frac{a_{-1}}{t^2} + 0 + a_1 + 2a_2t + 3a_3t^2 + \ldots + na_nt^{n-1}$. Recall that $1/t^n = t^{-n}, t^0 = 1$ and $t^1 = t$.

The "chain rule" says that if a function f depends on g which itself depends on the variable x, *i.e.* $f(g(x))$, then the derivative of f with respect to x is $\frac{df}{dx} = \left(\frac{df}{dg}\right)\left(\frac{dg}{dx}\right)$. For example, if $f = 2g^2$ and $g = x + 3x^2$, then $df/dx = (4g)\frac{dg}{dx} = (4[x + 3x^2])(1 + 6x)$.

1. Find the derivative of $y = 5 + 6x$
2. Find the derivative of $f(t) = 10t^{10}$
3. Find the derivative of $f(x) = 3x^3 - 9x + 1$
4. Find the derivative of $y = 3t^3 - 12t^2 + 23t$
5. Find the derivative of $f(t) = 2t^9 - 5t^{-9} + 9t$
6. Find the derivative of $z = 2y^{-6} - 4y^{-4} + 6y^{-2} + 8$
7. Find the derivative of $y = 2\sqrt{x} + 3\sqrt[3]{x} - 4\sqrt[4]{x}$
8. Find the derivative of $f(x) = 2x^{3/5} - 4x^{7/4} + 3x^{8/3} - 8$
9. Find the derivative of $f(t) = \dfrac{1}{t} - \dfrac{1}{t^3} + \dfrac{1}{t^5}$
10. Find the derivative of $g(z) = \dfrac{2}{z^3}\left(1 + \dfrac{1}{2z^2} - \dfrac{3}{z^4}\right)$
11. Find the derivative of $y = x^2(5x^2 - 2)$
12. Find the derivative of $y = (2t - 3)(3t + 2t^2)$
13. Find the derivative of $f(x) = \dfrac{4 - 7x + 8x^3}{x}$
14. Find the derivative of $r(t) = \dfrac{5t^5 - t^3 + 4t}{t^3}$
15. Find where (if anywhere) the function $v(t) = \frac{1}{3}t^3 + t^2 - 15t + 2200$ isn't instantaneously changing
16. Find where (if anywhere) the function $a(t) = t^5 - 2t^4 - 5t^3$ isn't instantaneously changing
17. Determine where the function $f(x) = 600 - 40x^3 - 5x^4 + 4x^5$ is increasing and decreasing.
18. Determine where the function $f(x) = (x + 3)(x - 1)^2$ is increasing and decreasing.
19. Determine where, if anywhere, the tangent line to $f(x) = \frac{1}{3}x^3 - x^2 + 3x$ is parallel to the line $y = 2x + \frac{1}{2}$.
20. Determine where, if anywhere, the tangent line to $v(t) = 3/t - t/3$ is parallel to the line $\omega(t) = 9/t - t/9$

Integrals are the opposite of derivatives; if we integrate something and then differentiate the result, we should get back to where we started. It corresponds to the area under a curve and is defined as $\int_a^b f(x)dx = \lim_{\Delta x \to 0} \sum_{i=a}^{b} f(x_i)\Delta x$. In practice, one evaluates the integral of a polynomial by $\int ax^n dx = \frac{a}{n+1}x^{n+1} + C$, where C is a constant of integration, a is any constant and n is a constant that is not equal to -1. This is an indefinite integral; a definite integral is over a specified range: $\int_{t_1}^{t_2} at^n dt = \frac{a}{n+1}(t_2^{n+1} - t_1^{n+1})$. In this case, the constant of integration cancels, so you can ignore it.

1. Evaluate $\int 3dy$
2. Evaluate $\int (4x^4 - 2x^2 + 7)dx$
3. Evaluate $\int (7z^6 - 55z^{10} - 3z^{14})dz$
4. Evaluate $\int (8t^{-2} + 16t^{-4} + 3t^2)dt$
5. Evaluate $\int (3x^{-3} + 5x^{-5} - 1)dx$
6. Evaluate $\int (2\sqrt[3]{t} + 4\sqrt[5]{t^3})dt$
7. Evaluate $\int (\sqrt{x^7} - \sqrt[7]{x^2} + 2\sqrt[3]{x^7})dx$
8. Evaluate $\int (2t^2 - 1)(1 + 5t)dt$
9. Determine $f(x)$ given that $f'(x) = 3x^5 - 4x^3 - 2x^2 + 7$
10. Determine $h(t)$ given $h'(t) = 3t^{-4} - t^{-3} + t^{-2} - 1$

11. Evaluate $\int_1^3 3dy$
12. Evaluate $\int_1^4 (16x^3 - 6x^2 + 2)dx$
13. Evaluate $\int_{-2}^1 (3t^2 - 5t + 7)dt$
14. Evaluate $\int_3^0 (5x^4 - 3x^2 + x)dx$
15. Evaluate $\int_1^4 \left(\frac{2}{\sqrt{t}} - 3\sqrt{t^3}\right) dt$
16. Evaluate $\int_{-4}^{-1} z^2(5 - 7z)dz$
17. Evaluate $\int_2^1 \frac{3y^5 - 6y^4}{y^4} dy$
18. Evaluate $\int_1^2 (zt^{-2} - tz^{-2})dt$
19. Evaluate $\int_1^2 (zt^{-2} - tz^{-2})dz$
20. Determine the area under the curve $v(t) = 50\,\mathrm{m/s} + (9.8\,\mathrm{m/s^2})t - (0.15\,\mathrm{m/s^3})t^2$ from $t = 0$ to $t = 5$