

1 Arithmetic with Literal Equations Feb 2026 (No Calculators)

3 pts 1. Solve the following for a , as a single fraction in simplest form. No variables equal 0, and no variables equal each other.

$$apr - rcp = tap$$

Ans. _____

4 pts 2. A trapezoid is placed on top of a rectangle to form a hexagon. The area of the hexagon is given by $A = \frac{1}{2}h(B + b) + Bh$. The heights of the rectangle and the trapezoid are the same. Find h in terms of A , B and b as a single fraction in simplest form.

Ans. _____

5 pts 3. A farmer wants to buy a hundred head of cattle, consisting of bulls, cows and calves for \$20,000. For each bull he would pay \$2000, for each cow he would pay \$1000 and he would pay \$200 for each pair of calves. How many bulls, how many cows and how many calves must he buy of each, for him to pay \$20,000 for the 100 head of cattle?

Ans. **Bulls:** _____ **Cows:** _____ **Calves:** _____

2 Logs and Log equations Feb 2026 (No Calculators)

3 pts 1. If $\log_b M = \log_c N = 9$, find the value of $\log_{bc} MN$.

Ans. _____

4 pts 2. Solve for x over the real numbers: $\log_8 (x + 6) + \log_8 (x - 6) = 2$.

Ans. _____

5 pts 3. Solve for x : $\log x = \frac{1}{2}(\frac{1}{2} \log 16 + \log 12) - \frac{1}{3}(\log 25 + \log 40)$.

Ans. _____

3 Linear Coordinate Geometry Feb 2026 (No Calculators)

3 pts 1. The line through $(5, -2)$, that is perpendicular $y = \frac{1}{2}x - 3$, has an x -intercept in the form $(a, 0)$. Find a .

Ans. _____

4 pts 2. Quadrilateral $EFGH$ has vertices $E(-2, -8)$, $F(-5, 15)$, $G(4, 10)$ and $H(2, -6)$. The diagonals $\overline{EG}$ and $\overline{FH}$ intersect at point (a, b) . Find the value of $a + b$.

Ans. _____

5 pts 3. Find all the values of k , such that the point $(3, 10)$ is exactly 14 units from the line $k - 3x = 4y$.

Ans. _____

4 Functions Feb 2026 (No Calculators)

3 pts 1. If $f(x) = 3 + 7x$ and $g(x) = 2 - x$, find the value of

$$f(-2) + g(-2) + f(g(-2)) + g(f(-2)).$$

Ans. _____

4 pts 2. $g(x)$ is defined by $(-2, 4)$, $(-1, 3)$, $(0, 1)$, $(5, 12)$ and

$h(x)$ is defined by $(5, -2)$, $(4, 5)$, $(12, 1)$, $(16, 12)$.

Compute
$$\frac{h(g(h(g(-2))))}{h^{-1}(g^{-1}(h^{-1}(g^{-1}(12))))}.$$

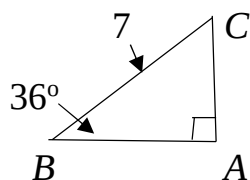
Ans. _____

5 pts 3. Let $f(3 - 2x) = \frac{7 - 10x}{22x + 3}$, where $x \neq \frac{-3}{22}$. Find x such that $f(5 - 2x) = 2$.

Ans. _____

5 Trigonometric Mechanics Feb 2026 (You may use calculators)

3 pts 1. In triangle ABC , $m\angle A = 90^\circ$ and $m\angle B = 36^\circ$. If $BC = 7$, find AC .



Ans. _____

4 pts 2. In $\triangle EFG$, $EG = 19.2$ ft, $GF = 12$ ft and $m\angle EFG = 100^\circ 18'$. Find the measure of the smallest angle of the triangle. Write your answer to the nearest minute.

Ans. _____

5 pts 3. The side lengths of triangle CAR are $AC = 3$, $CR = 4$ and $AR = 6$. Point D is chosen on $\overline{AR}$ such that $AD = 5$ and $DR = 1$. Compute the length of segment CD .

Ans. _____

6 Team Feb 2026 (You may use Calculators)

3 pts 1. Solve the equation $8ab - 2axy = 10ay - 14xy$ for x . No variables equal 0. If the answer is a fraction, the denominator does not equal 0.

(1) Ans. _____ **3 pts**

3 pts 2. $A(5, -3)$ and $B(-3, 5)$ form segment AB . A bug starts at A and crawls along $\overline{AB}$ until it is $\frac{3}{4}$ of the way to B at W . Find the ordered pair for W .

(2) Ans. _____ **3 pts**

3 pts 3. Given that $f(x) = 6x^4 + 17x^3 - 75x^2 - 26x + 120$, find the value of $\frac{f(4)}{f(0)} + f(3) \cdot f(-5)$.

(3) Ans. _____ **3 pts**

4 pts 4. Let $g(x) = \frac{x+4}{4-3x}$. Find the value of x such that $g^{-1}(x)$ does not exist.

(4) Ans. _____ **4 pts**

4 pts 5. The coordinates of $\triangle ABC$ are $A(0, 0)$, $B(5, 0)$ and $C(0, 10)$. Point A is reflected over side BC and is labeled A' . Find the coordinates of A' .

(5) Ans. _____ **4pts**

4 pts 6. The angle of elevation from point P on level ground to the top of tower C is 42° . From point Q , 75 meters beyond P along the same line as P to the tower, the angle of elevation to C is 27° . Find the height of the tower.

(6) Ans. _____ **4 pts**

5 pts 7. The graph of the function $f(x) = x^2 - 2x - 15$ is translated 20 units down and 19 units to the right. What is the sum of the x -intercepts of the translated graph?

(7) Ans. _____ **5 pts**

5 pts 8. Let $[A]$ denote the greatest integer less than or equal to the real number A . Find all values of x such that $[\log_2 x] + [\log_3 x] = 7$.

(8) Ans. _____ **5pts**

5 pts 9. Find the distance between the vertices of $f(x)$ and $g(x)$, if $f(x) = -x^2 - 7x - 7.25$ and $g(x) = 2x^2 - 10x + 9.5$.

(9) Ans. _____ **5pts**

Solution Sheet Arithmetic with Literal Equations

1. $\text{arp} - \text{rcp} = \text{tap} \rightarrow \text{arp} - \text{tap} = \text{rcp} \rightarrow a(\text{pr} - \text{tp}) = \text{rcp} \rightarrow a = \frac{\text{rcp}}{p(\text{r}-\text{t})} = \frac{\text{rc}}{\text{r}-\text{p}}.$ **Ans. $\frac{\text{rc}}{\text{r}-\text{t}}$**
2. $A = \frac{1}{2}h(B + b) + Bh \rightarrow 2A = Bh + bh + 2BH = 3Bh + bh, h = \frac{2A}{3B+b}.$ **Ans. $\frac{2A}{3B+b}$**
3. Let b = the # of bulls, c = the # of cows and a = the number of calves. Then $b + c + a = 100$ and $2000b + 1000c + 100a = 20,000$. Multiplying the first equation by 100 and subtracting it from the second yields $1900b + 900c = 10,000$ or $19b + 9c = 100$. Since b and c are whole numbers, $1 \leq b \leq 5$. Plugging in 1 for b , $9c = 81$ and $c = 9$. All other possible values for b produce fractional values for c . **Ans. 1 bull, 9 cows, 90 calves**

Logs and Log Equations

1. $\log_b M = 9$, so $b^9 = M$ and $\log_c N = 9$, so $c^9 = N$. $b^9 c^9 = MN$ or $(bc)^9 = MN$. Thus $\log_{bc} MN = 9$. **Ans. 9**
2. $\log_8 (x + 6) + \log_8 (x - 6) = 2 \rightarrow \log_8 (x^2 - 36) = 2 \rightarrow x^2 - 36 = 64, x^2 = 100, x = \pm 10$. But x cannot be -10 . **Ans. 10**
3. $\log x = \frac{1}{2}(\frac{1}{2} \log 16 + \log 12) - \frac{1}{3}(\log 25 + \log 40) \rightarrow \log x = \frac{1}{2}(\log 48) - \frac{1}{3} \log 1000 \rightarrow \log x = \log \frac{\sqrt{48}}{10} \rightarrow x = \frac{4\sqrt{3}}{10} = \frac{2\sqrt{3}}{5}.$ **Ans. $\frac{2\sqrt{3}}{5}$**

Linear Coordinate Geometry

1. $y = -2x + c$ is the form of the perpendicular line. Plug $(5, -2)$ into $2(5) + (-2) = c$ and you get $2x + y = 8$. Plug in 0 for y and we get $x = 4$. **Ans. 4**
2. The slope for $\overline{EG} = \frac{-8-10}{-2-4} = 3$, so $y = 3x - 2$, or $3x - y = 2$. For $\overline{FH}$, $\frac{15+6}{-5-2} = -3$, so $y = -3x$, or $3x + y = 0$. Adding the equations: $6x = 2, x = 1/3$. Plug in: $3(\frac{1}{3}) + y = 0, y = -1$. Thus $a = 1/3$ and $b = -1$, and $a + b = -2/3$. **Ans. $-2/3$**
3. $0 = 3x + 4y - k$. Plugging in to the distance formula from a point to a line $\frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$, we get $\frac{|3(3) + 4(10) - k|}{\sqrt{3^2 + 4^2}} = 14 \rightarrow \frac{|49 - k|}{5} = 14 \rightarrow 49 - k = 70$ or $49 - k = -70$. $k = -21$ or 119 . **Ans. -21 or 119**

Functions

1. $f(x) = 3 + 7x$ and $g(x) = 2 - x$. $f(-2) = -11, g(-2) = 4$. $f(g(-2)) + g(f(-2)) = f(4) + g(-11) = 31 + 13$. $-11 + 4 + 31 + 13 = 37$. **Ans. 37**

2. $h(g(h(g(-2)))) = h(g(h(4))) = h(g(5)) = h(12) = 1$. $h^{-1}(g^{-1}(h^{-1}(g^{-1}(12)))) = h^{-1}(g^{-1}(h^{-1}(5))) = h^{-1}(g^{-1}(4)) = h^{-1}(-2) = 5$. Thus answer is $1/5$. **Ans. 1/5**

3. We can start by finding $f(x)$: the numerator of $f(3 - 2x)$ is $7 - 10x$, so $(3 - 2x)$ must have been multiplied by 5, which makes $15 - 10x$. If we add -8 to this get we $7 - 10x$. So the numerator of $f(x)$ is $5x - 8$. The denominator of $f(3 - 2x)$ is $22x + 3$, so $3 - 2x$ must have been multiplied by -11, which makes $-33 + 22x$. If we add 36 to this we get $22x + 3$. So the denominator of $f(x) = -11x + 36$. We now have $f(x) = \frac{5x-8}{-11x+36}$ and $f(5 - 2x) = \frac{5(5-2x)-8}{-11(5-2x)+36} = \frac{25-10x-8}{-55+22x+36} = \frac{17-10x}{22x-19} = f(x)$. If $(17-10x)/(22x-19) = 2$, then $17 - 10x = 44x - 38 \rightarrow 55 = 54x$, $x = 55/54$.

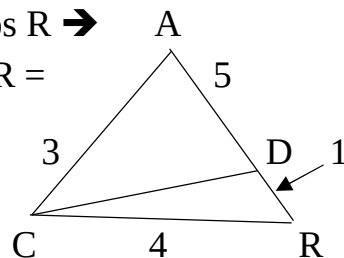
Alt. Sol.: Let y = the input we want, to produce $f(5 - 2x)$. Thus $3 - 2y = 5 - 2x \rightarrow -2y = 2 - 2x$ or $y = x - 1$. Plugging in: $\frac{7-10(x-1)}{22(x-1)-19} = \frac{17-10x}{22x+3}$. **Ans. 55/54**

Trigonometric Mechanics

1. $\sin 36^\circ = AC/7 \rightarrow 7 \sin 36^\circ = AC = 4.11449$. **Ans. 4.1145**

2. $m\angle F = 100^\circ 18' = 100.3^\circ$. By Sin Law: $\frac{19.2}{\sin 100.3^\circ} = \frac{12}{\sin G} \rightarrow \sin G = \frac{12 \sin 100.3^\circ}{29.2} = 0.61492 \rightarrow G = \sin^{-1}(0.61492) = 37.94611 = 37^\circ 57'$. $m\angle E = 180^\circ - 100.3^\circ - 37.9^\circ = 41.8^\circ$. So $\angle G$ is the smallest angle. **Ans. 37°57'**

3. Use $\triangle CAR$ to find $\cos R$: using Cos Law, $3^2 = 6^2 + 4^2 - 2 \cdot 6 \cdot 4 \cos R \rightarrow \cos R = 43/48$. In $\triangle CDR$, using Cos Law: $CD^2 = 4^2 + 1^2 - 2(4) \cos R = 17 - \frac{43}{6}$. $CD = \sqrt{17 - \frac{43}{6}} = \sqrt{\frac{59}{6}} = \frac{\sqrt{354}}{6} = 3.13581$.



Ans. 3.1358

Team

1. $8ab - 2axy = 10ay - 14xy \rightarrow 8ab - 10ay = 2axy - 14xy \rightarrow 8ab - 10ay = x(2ay - 14y) \rightarrow x = \frac{8ab-10ay}{2ay-14y} = \frac{4ab-5ay}{ay-7y}$. **Ans. $\frac{4ab-5ay}{ay-7y}$**

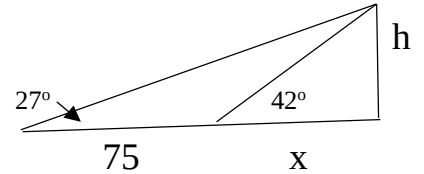
2. A(5, -3) and B(-3, 5) has a rise of 8 and run of -8. $\frac{3}{4}$ of 8 is 6. So $(5 - 6, -3 + 6) = (-1, 3)$ **Ans. (-1, 3)**

3. $f(x) = 6x^4 + 17x^3 - 75x^2 - 26x + 120$. $f(4) = 6(4)^4 + 17(4)^3 - 75(4)^2 - 26(4) + 120 = 1536 + 1088 - 1200 - 104 + 120 = 1440$; $f(0) = 120$; $f(3) = 6(3)^4 + 17(3)^3 - 75(3)^2 - 26(3) + 120 = 486 + 459 - 675 - 78 + 120 = 312$; $f(-5) = 6(-5)^4 + 17(-5)^3 - 75(-5)^2 - 26(-5) + 120 = 3750 - 2125 - 1875 + 130 + 120 = 0$. $\frac{f(4)}{f(0)} + f(3) \cdot f(-5) = \frac{1440}{120} + 312(0) = 12$. **Ans. 12**

4. Letting y equal $g^{-1}(x)$ and switching x for y and $g(x)$ for x in $g(x) = \frac{x+4}{4-3x}$ we find $g^{-1}(x)$.
 $x = \frac{y+4}{4-3y} \rightarrow x(4-3y) = y+4 \rightarrow 4x - 3xy = y+4 \rightarrow 4x - 4 = y(1+3x) \rightarrow y = \frac{4x-4}{1+3x} = g^{-1}(x)$.
 Thus the value for x which makes $\frac{4x-4}{1+3x}$ not exist is $-1/3$. **Ans. $-1/3$**

5. The equation for line BC is $y = -2x + 10$. Since $\overleftrightarrow{AA'} \perp \overleftrightarrow{BC}$, then $\overleftrightarrow{AA'}$ has the equation $y = \frac{1}{2}x$.
 Solving these two equations simultaneously: $\frac{1}{2}x = -2x + 10 \rightarrow x = -4x + 20, 5x = 20$, so $x = 4$, and $y = 2$. This is the midpoint of $\overline{AA'}$. Thus A' must be $(8, 4)$. **Ans. $(8, 4)$**

6. Using the figure, $\tan 27^\circ = \frac{h}{x+75}$ and $\tan 42^\circ = \frac{h}{x}$. Thus
 $\tan 27^\circ(x+75) = x \tan 42^\circ \rightarrow x \tan 27^\circ + 75 \tan 27^\circ = x \tan 42^\circ \rightarrow$
 $x(\tan 27^\circ - \tan 42^\circ) = -75 \tan 27^\circ$, so $x = \frac{75 \tan 27^\circ}{\tan 42^\circ - \tan 27^\circ}$. If
 $\tan 42^\circ = \frac{h}{x}$, then $h = x \tan 42^\circ = \frac{75 \tan 27^\circ \tan 42^\circ}{\tan 42^\circ - \tan 27^\circ} = 88.02838$. **Ans. 88.0284**



7. Translating $f(x) = x^2 - 2x - 15$ to 20 units down and 19 units to the right:
 $f(x) = (x-19)^2 - 2(x-19) - 15 - 20 = x^2 - 38x + 361 - 2x + 38 - 35 = x^2 - 40x + 364 =$
 $(x-26)(x-14)$. $x = 26$ or 14 or the sum of the roots is $-\frac{b}{a} = -\frac{-40}{1} = 40$. **Ans. 40**

8. This is a step function. If we let x be a power for either 2 or 3 that will produce a whole number and then go from there: let $x = 4$, $\lceil \log_2 4 \rceil = 2$, $\lceil \log_3 4 \rceil = 1$, too small. $\lceil \log_2 8 \rceil = 3$, $\lceil \log_3 8 \rceil = 2$, too small. $\lceil \log_2 16 \rceil = 4$, $\lceil \log_3 16 \rceil = 2$, too small. $\lceil \log_2 27 \rceil = 5$, $\lceil \log_3 27 \rceil = 3$, this is where it starts. $\lceil \log_2 32 \rceil = 5$, $\lceil \log_3 32 \rceil = 3$, too big. This is where it stops. So $27 \leq x < 32$. **Ans. $27 \leq x < 32$**

9. The vertex of $f(x)$: $f(x) = -x^2 - 7x - 7.25$ is: $f(x) = -(x^2 + 7x + \frac{49}{4}) - 7.25 + 12.25 =$
 $-(x + \frac{7}{2})^2 + 5$ or $(-\frac{7}{2}, 5)$; vertex for $g(x)$: $g(x) = 2x^2 - 10x + 9.5 = 2(x^2 - 5x + \frac{25}{4}) + 9.5 - 12.5$
 or $(\frac{5}{2}, -3)$. The distance between them is $\sqrt{(-\frac{7}{2} - \frac{5}{2})^2 + (5 + 3)^2} = \sqrt{6^2 + 8^2} = 10$. **Ans. 10**

Answer Sheet Feb 2026

Arithmetic with Literal Equations

1. $\frac{rc}{r-t}$

2. $\frac{2A}{3B+b}$

3. 1 bull, 9 cows, 90 calves

Logs and Log Equations

1. 9

2. 10

3. $\frac{2\sqrt{3}}{5}$

Linear Coordinate Geometry

1. 4

2. $-2/3$

3. 119 or -21

Functions

1. 37

2. $1/5$

3. $55/54 \quad \left(1 \frac{1}{54}\right)$

Trigonometric Mechanics

1. 4.1145

2. $37^{\circ}57'$

3. $3.1358 \quad \left(\frac{\sqrt{354}}{6}\right)$

Team

1. $\frac{4ab-5ay}{ay-7y} \quad \left(\frac{5ay-4ab}{7y-ay}\right)$

2. (-1, 3)

3. 12

4. $-1/3 \quad (-0.3333)$

5. (8, 4)

6. 88.0284

7. 40

8. $27 \leq x < 32 \quad ([27, 32))$

9. 10

Answers Accepted on Appeal

Round 5 #1: $7\sin(36)$ or $7\sin(36^{\circ})$

Team #1: Answers where numerator and denominator are fully factored is acceptable.