

Relations And Functions

Day 1 Relations and Functions**A relation is a set of ordered pairs.**

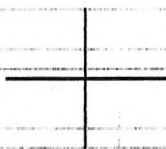
What is an example of an ordered pair?

A Function is a relation in which no two ordered pairs have the same first element.

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Sketch: $y = 2x + 3$

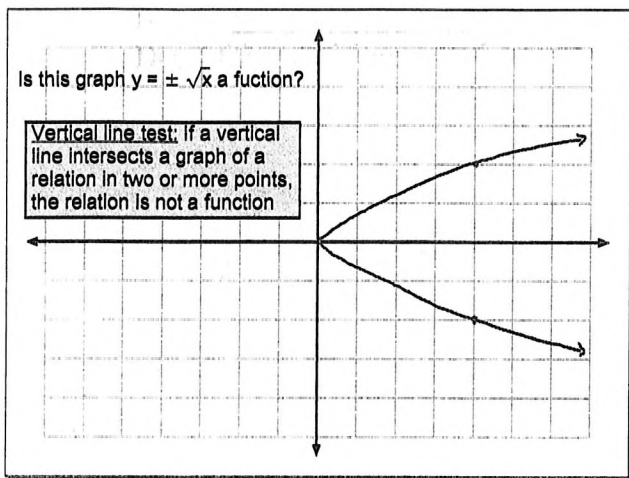
Is this a function?

**Domain: Is the set of all first elements. (x-values)****Range: Is the set of all second elements. (y-values)**

Oct 12-3:47 PM

Are the following functions? Find the domain and range.**a) (2,4) (3,5) (4,6) (5,7)****b) (2,1) (2,2) (2,3) (2,4)****c) (3,2) (4,2) (5,2) (6,2)**

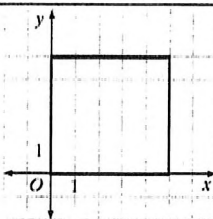
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Oct 12-4:17 PM

The graph of a relation is shown at the right.

- Determine whether or not the graph represents a function.
- Find the domain of the graph.
- Find the range of the graph.



Oct 12-4:11 PM

Find the largest domain of each function:

a. $y = \frac{1}{x+3}$

b. $y = \frac{x+1}{x^2-2x-3}$

c. $y = \frac{x}{5x^2+1}$

Oct 12-4:30 PM

8-3

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

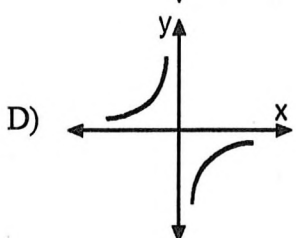
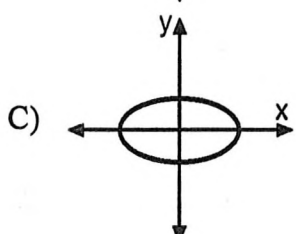
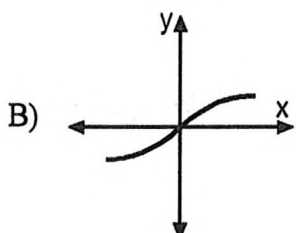
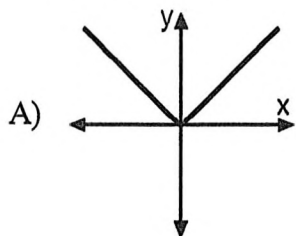
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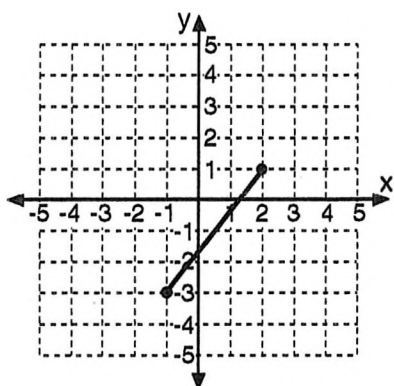
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Day 1 Classwork/Homework

- 1) Which graph of a relation is
- not*
- a function?



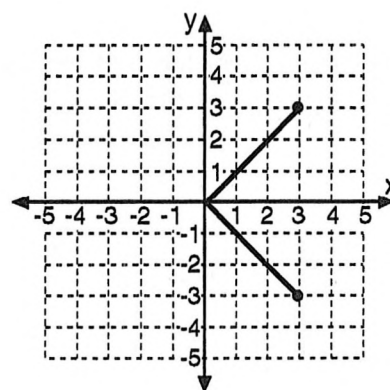
- 2) For the graph of the relation below,
 (a) state the domain.
 (b) state the range.
 (c) state whether or not the relation is a function.
 [Justify your answer.]



- 3) The function $f(x) = \frac{1}{x-3}$ is defined for *all* real numbers except when x is

- A) -3 C) 0
 B) 3 D) $-\frac{1}{3}$

- 4) For the graph of the relation below,
 (a) state the domain.
 (b) state the range.
 (c) state whether or not the relation is a function.
 [Justify your answer.]



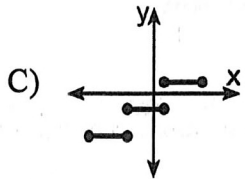
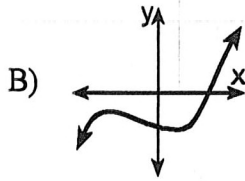
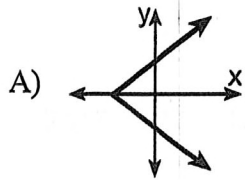
- 5) Given the relation $R = \{(-2,3), (a,4), (1,9), (0,7)\}$, which replacement for a makes this relation a function?

- A) 1 C) 0
 B) -2 D) 4

- 6) Which relation is *not* a function?

- A) $\{(1,4), (3,8), (5,16)\}$
 B) $\{(1,1), (1,2), (1,3)\}$
 C) $\{(1,1), (2,2), (3,3)\}$
 D) $\{(1,1), (2,1), (3,1)\}$

7) Which graph of a relation is also a function?



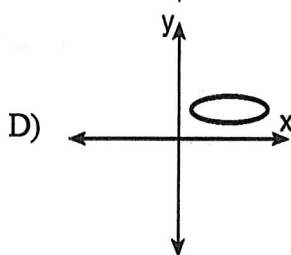
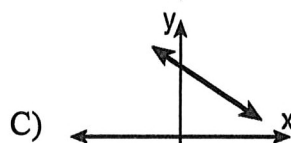
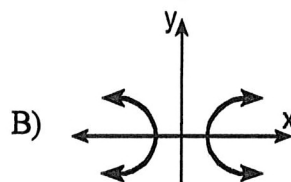
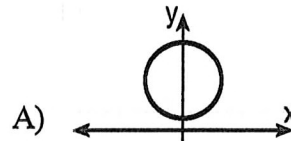
D) all of the above

8) What values of x which would cause the relation $\{(2,7), (4,8), (x,3), (5,6)\}$ *not* to be a function?

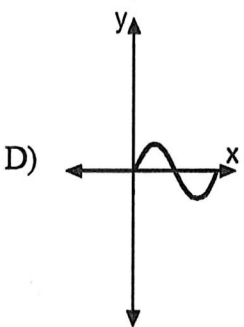
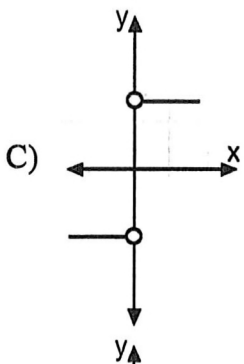
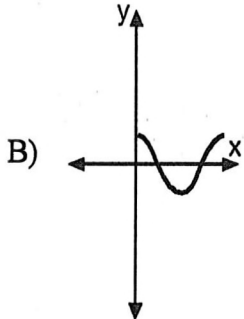
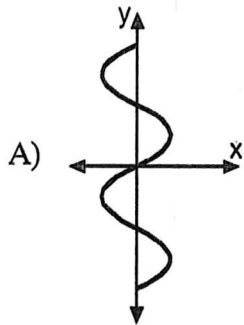
9) Is this relation a function? [*Justify your answer.*]

$$\{(1,2), (5,8), (3,4), (6,3)\}$$

10) Which graph of a relation is also a function?



- 11) Which graph of a relation is *not* a function?



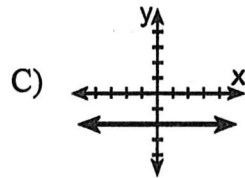
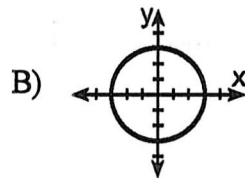
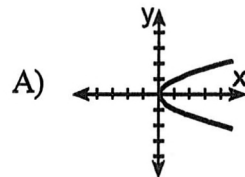
- 12) The relation defined by the set of ordered pairs $\{(0,2), (-2,2), (1,4), (0,-1)\}$ is *not* a function. Which of the ordered pairs listed below, if omitted from this relation, will make the resulting set a function.

A) $(1,4)$ C) $(0,-1)$
 B) $(-2,2)$ D) $(4,1)$

- 13) Is this relation a function? [Justify your answer.]

$\{(-4,2), (-4,1), (-4,0), (-4,-1)\}$

- 14) Which graph of a relation is also a function?



D) all of the above

Day 2
Function Notation

$f(x) = 2x + 3$ The function value paired with x is $2x + 3$.

$f(x)$ replaces $y =$

Oct 13-2:16 PM

If $f(x) = 2x + 3$, evaluate the following:

a) $f(-4)$ b) $f(a + 1)$

c) $f(2x)$ d) $f(x^2)$

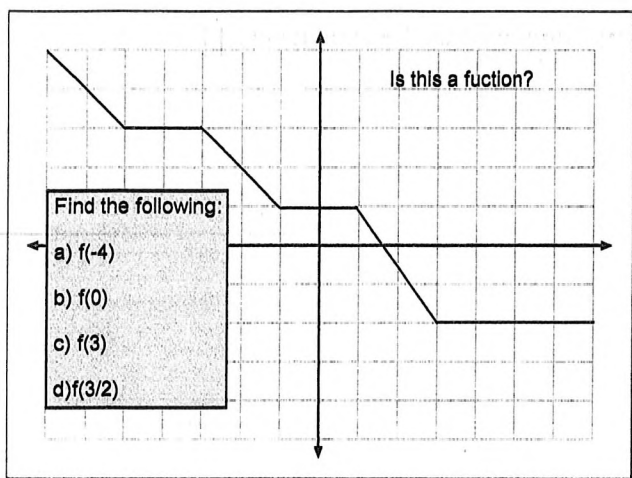
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Let f be the set of ordered pairs such that the second element of each pair is 1 more than twice the first.

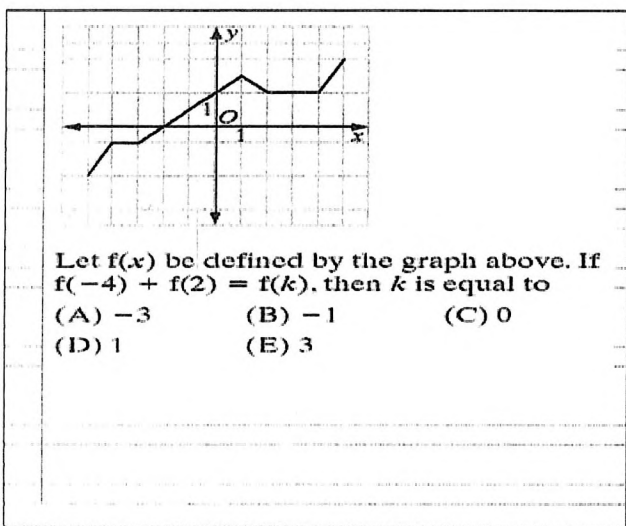
a) Write $f(x)$ in terms of x .

b) Find $f(7)$.

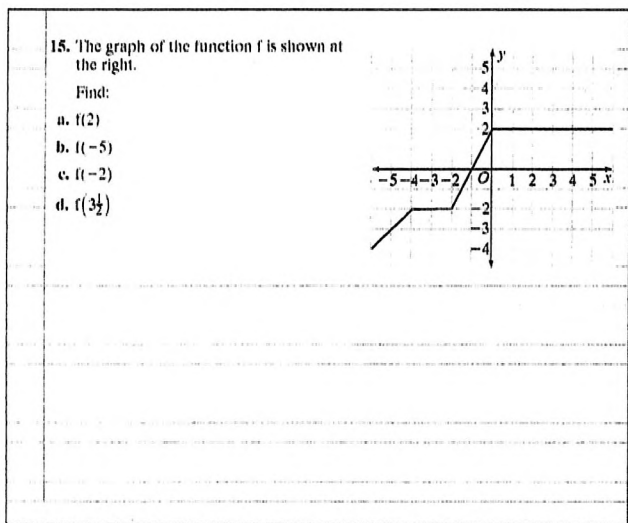
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Day 2 Classwork/Homework

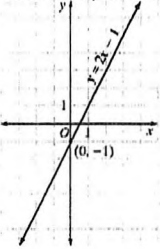
- 1) Given the function $f(x) = (x + 1)^2$, find the value of $f(-2)$.
- 2) Given the function $g(x) = x^2 - 2x + 1$, find the value of $g(-1)$.
- 3) If $g(x) = x^{-\frac{3}{2}}$, find $g(4)$.
- 4) If $f(x) = x^{-\frac{1}{2}}$, find $f(9)$.
- 5) If $f(x) = \frac{1}{2}x^2$, what does $f(2) - f(-2)$ equal?
A) -2 C) 0
B) 2 D) 1
- 6) Given the function $g(x) = x^2 - 2x + 1$, find the value of $g(1)$.
- 7) If $f(x) = |x^3 - 3|$, then $f(-1)$ is equivalent to
A) -2 C) 2
B) 4 D) 0
- 8) Given the function $f(x) = 3x - 2$, find the value of $f(0)$.
- 9) If $f(x) = x^2 + 3x - 5$, find the value of $f(3)$.
- 10) Given the function $f(x) = 3x - 2$, find the value of $f(-1)$.
- 11) Given the function $g(x) = x^2 - 2x + 1$, find the value of $g(3)$.

Day 3 Linear Functions and Direct Variation

Recall that a relation is a **function** if no two ordered pairs have the same first element. We can test for a function using the **vertical line test**.

Definition:

A function f is said to be **one-to-one** or (1-1) if no two ordered pairs have the same **second** element.



Write down 4 readable points, is this set of ordered pairs one-to-one?

Can you think of a way to decide if a function is 1-1 just by looking at the graph?

HORIZONTAL LINE TEST



Oct 14-9:58 AM

Determine if each of the following functions is one-to-one.

a. $y = 4 - 3x$

b. $y = x^2$

c. $y = |x + 3|$

Oct 14-10:48 AM

Direct Variation

When the ratio of two variables is a constant, we say that the variables are directly proportional or that the variables vary directly. Every direct variation of two variables is a linear function that is one-to-one.

ex. Jacob can type 55 words per minute.

- Write a function that shows the relationship between the number of words typed, w , and the number of minutes spent typing, m .
 - Is the function one-to-one?
 - If Jacob types for no more than 2 hours at a time, what are the domain and range of the function?
- "Words per minute" can be written as $\frac{\text{words}}{\text{minutes}} = \frac{w}{m} = 55$. This is a direct variation function that can be written as $\{(m, w) : w = 55m\}$.
 - The function is a linear function and every linear function is one-to-one.
 - If Jacob types no more than 2 hours, that is, 120 minutes, at a time, the domain is $0 \leq m \leq 120$ and the range is $0 \leq w \leq 6,600$.

Oct 14-11:08 AM

Square Root Function

$y = \sqrt{ax + b}$, with $ax + b \geq 0$.

- The domain is the set of real numbers greater than or equal to $-\frac{b}{a}$.
- The range is the set of non-negative real numbers.

Example: $y = \sqrt{x}$

This is a function from the set of non-negative real numbers to the set of non-negative real numbers. The range is the set of non-negative real numbers. The function is onto.

Oct 15-11:40 AM

Day 3 Classwork

1) If $f(x) = 4x^0 + (4x)^{-1}$, what is the value of $f(4)$?

2) If $f(x) = (x^{-x} - x^0 + 2^x)$, then $f(3)$ is equal to

3) What is the domain of the function $f(x) = \frac{3x^2}{x^2 - 49}$?

4) If $f(x) = \frac{1}{\sqrt{2x-4}}$, the domain of $f(x)$ is

5) Which equation does *not* represent a function?

[A] $y = x^2 + 5x$

[B] $x = \pi$

[C] $y = |x|$

[D] $y = 4$

Day 4 Composition of Functions

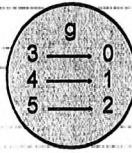
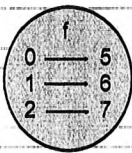
Composite Function - is the combining of two functions f and g , to produce a new function symbolized $f \circ g$.

$f \circ g$ is read "f following g."

$f(g(x))$

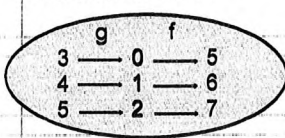
Oct 21-9:03 AM

Are f and g functions?



Evaluate $f \circ g$:

Whats comes first??



Oct 22-8:43 AM



Find the following:

$$(f \circ g)(3)$$

$$(f \circ g)(4)$$

$$(f \circ g)(5)$$

In order for the composite function $f \circ g$ to exist, each member of the range of g must be a member of the domain of f .

Oct 22-9:00 AM

$$f(x) = x^2$$

$$g(x) = 3x$$

$$h(x) = x - 1$$

Find:

a) $f \circ g(1)$

b) $h \circ f(3)$

c) $g(f(-2))$

Oct 22-9:03 AM

Name: _____

Day 4 CW/HW

- 1) If $f(x) = x - 3$ and $g(x) = x^3$, then $f(g(3))$ is
A) 24 C) 0
B) 30 D) 6
- 2) If $f(x) = 2x$ and $g(x) = x - 4$, what is the value of $f(g(3))$?
A) -6 C) 6
B) -2 D) 2
- 3) If $f(x) = 2x$ and $g(x) = x - 4$, what is the value of $g(f(3))$?
A) 2 C) -6
B) 6 D) -2
- 4) If $g(x) = x + 3$ and $f(x) = x^2 - 2$, find the value of $f(g(-3))$.
- 5) If $f(x) = x - 3$ and $g(x) = x^2$, what is the value of $(f \circ g)(2)$?
- 6) If $f(x) = 3x - 1$ and $g(x) = x^2 + 1$, evaluate $(g \circ f)(-1)$.
- 7) If $f(x) = 3x$ and $g(x) = 7x - 1$, what is $(f \circ g)(4)$?
- 8) If $g(x) = x + 3$ and $f(x) = x^2 - 2$, find the value of $g(f(-1))$.
- 9) If $g(x) = x + 3$ and $f(x) = x^2 - 2$, find the value of $f(g(3))$.
- 10) If $g(x) = x + 3$ and $f(x) = x^2 - 2$, find the value of $g(f(3))$.
- 11) If $f(x) = 3x^2$ and $g(x) = \sqrt{2x}$, what is the value of $(f \circ g)(8)$?
A) 144 C) 48
B) 16 D) $8\sqrt{6}$
- 12) If $g(x) = |x - 3|$ and $h(x) = x^2 + 2x$, what is the value of $h(g(2.9))$?
A) -0.99 C) 0.99
B) 0.21 D) -0.21

f^{-1} is the inverse of f under composition

$$f: \underline{x} \rightarrow y \qquad f^{-1}: y \rightarrow \underline{x}$$

ex. $f = \{(1,6) (2,7) (3,0)\}$ find f^{-1}

ex. $g = \{(4,8) (5,8) (6,9)\}$ find g^{-1}

Oct 25-9:20 PM

ex. $f = \{(1,6) (2,7) (3,0)\}$ find $f^{-1} = \{(6,1) (7,2) (0,3)\}$

ex. $g = \{(4,8) (5,8) (6,9)\}$ find $g^{-1} = \{(8,4) (5,8) (9,6)\}$

Is f a function? Is f^{-1} a function?

Is g a function? Is g^{-1} a function?

How can we tell if a function's inverse is going to be a function?

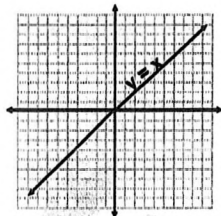
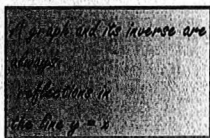
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Ways to find the Inverse:

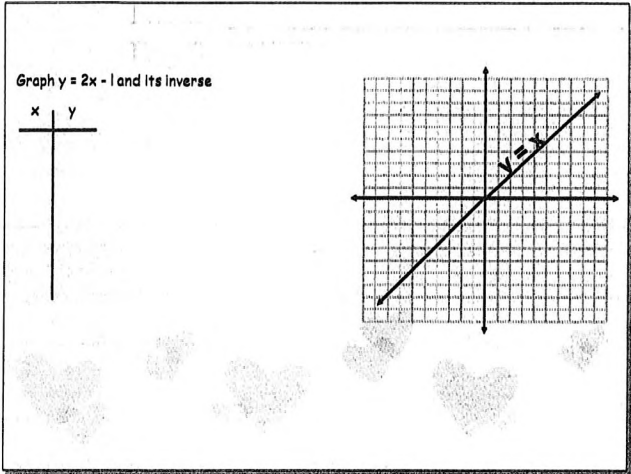
1. ordered pairs- switch x & y

$$h(x) = (14, 32) (-21, 18) (49, 0) \quad h^{-1}(x) =$$

2. coordinate graph-switch x & y and plot new points



Oct 25-9:43 PM



Oct 25-9:55 PM

3. Rule of the Inverse

ex. find the inverse of $f(x) = 2x - 4$

The composition of a function and its inverse is the identity function: $f(f^{-1}(x)) = x$

Oct 25-10:00 PM

Find the inverse of the following:

$f(x) = -3x + 5$ $g(x) = \frac{1}{3}x + 10$ $h(x) = \frac{x + 2}{7}$

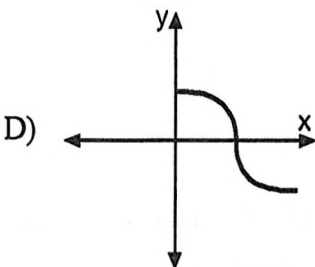
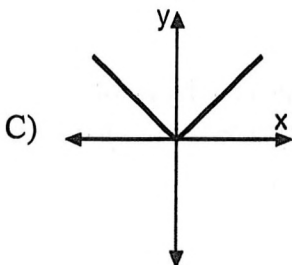
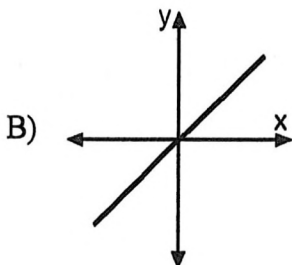
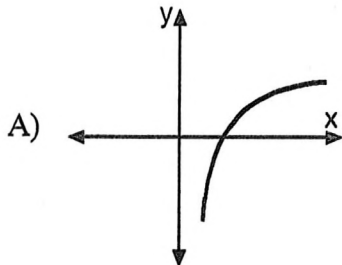
Oct 26-8:36 AM

Let $f(x) = 8x$. The graph of $g(x)$ is the graph of f shifted 4 units down and 6 units to the right. Write an expression for $g(x)$. And find $g^{-1}(x)$.

Oct 26-8:45 AM

Name: _____
Day 5 CW/HW

- 1) Which function is *not* one to one?



- 2) Given: set $A = \{(1,2), (2,3), (3,4), (4,5)\}$

If the inverse of the set is A^{-1} , which statement is true?

- A) A and A^{-1} are not functions.
B) A and A^{-1} are functions.
C) A is not a function and A^{-1} is a function.
D) A is a function and A^{-1} is not a function.

- 3) Which equation defines a function whose inverse is *not* a function?

- A) $y = |x|$ C) $y = -x$
B) $y = 2^x$ D) $y = 3x + 2$

- 4) What is the inverse of the equation $y = 3x - 2$?

- A) $y = 3x + 2$ C) $y = \frac{x+2}{3}$
B) $y = x$ D) $y = 2x - 3$

- 5) What is the inverse of the equation $y = 3x$?

- A) $x = \frac{y}{3}$ C) $y = 3$
B) $y = \frac{1}{3}x$ D) $x = 3$

- 6) What is the inverse of the function $y = 2x - 5$?

- A) $y = 2x + 5$ C) $y = \frac{1}{2}(x + 5)$
B) $y = 5 - 2x$ D) $y = \frac{1}{2}(x - 5)$

- 7) The inverse function of $\{(2,6), (-3,4), (7,-5)\}$ is

- A) $\{(2,-6), (-3,-4), (7,5)\}$
B) $\{(6,2), (4,-3), (-5,7)\}$
C) $\{(-2,6), (3,4), (-7,-5)\}$
D) $\{(-6,-2), (-4,3), (5,7)\}$

- 8) If $(-3, 1)$ is in the function $f(x)$, which of the following points will be in the function $f^{-1}(x)$?

A) $(-1, 3)$ C) $(1, -3)$
 B) $(3, -1)$ D) $(3, 1)$

- 9) The inverse of the function $y = x^2 + 9, x \geq 0$ is

A) $y = \sqrt{x - 9}$ C) $y = -\sqrt{x + 9}$
 B) $y = \pm\sqrt{x + 9}$ D) $y = \sqrt{x + 9}$

- 10) Write the inverse of the given function:

$$\{(a, b), (c, d), (e, f), (g, h)\}$$

- 11) Find f^{-1} , the inverse of the given function:

$$f(x) = \{(8, 2), (1, 7), (4, 3), (5, 1)\}$$

Questions 12 through 15 refer to the following:

For the given relation(s),

- (a) state the inverse.
 (b) state whether or not the inverse is a function.
[Justify your answer.]

- 12) $\{(3, 2), (4, 3), (5, 8), (6, -1)\}$

- 13) $\{(1, 2), (1, 3), (1, 4), (1, 5)\}$

- 14) $\{(1, 1), (2, 1), (3, 1), (4, 1)\}$

- 15) $\{(x, y) \mid y = 6x - 2\}$

- 16) The graph of any function and the graph of its inverse are symmetric with respect to the

A) graph of the equation $y = -x$
 B) graph of the equation $y = x$
 C) y-axis
 D) x-axis

- 17) Given the function $f(x) = \{(3, 1), (2, 6), (-3, 5)\}$. Find f^{-1} , the inverse of function f .

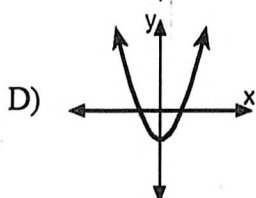
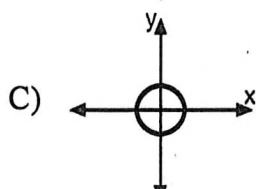
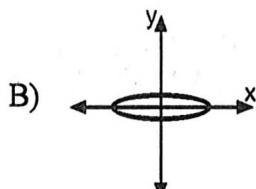
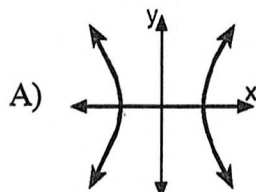
- 18) Write the inverse of the given function:

$$\{(5, 3), (-2, 4), (7, -2)\}$$

Name: _____

Review for Function Test

- 1) Which graph illustrates a quadratic relation whose domain is *all* real numbers?



- 2) The function $f(x) = \frac{1}{x-3}$ is defined for *all* real numbers except when x is

- A) -3 C) 3
B) 0 D) $-\frac{1}{3}$

- 3) Given the real valued function $f(x) = \frac{1}{\sqrt{x-3}}$, which number is in the domain of $f(x)$?

- A) -1 C) 2
B) 7 D) 3

- 4) The domain of $f(x) = x^2 + 2x + 1$ is $-3 \leq x \leq 3$. The *largest* value in the range of $f(x)$ is

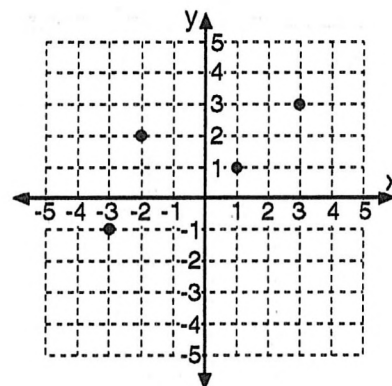
- A) 20 C) 16
B) 4 D) 3

- 5) For which value of x is the function

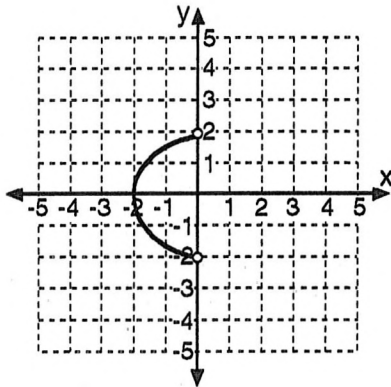
$$g(x) = \frac{2x^2 + 3x + 1}{x - 1} \text{ undefined?}$$

- 6) Given the function $g(x) = 3x - 3$ with a domain of $\{x \mid -2 \leq x \leq 4\}$, find the range.

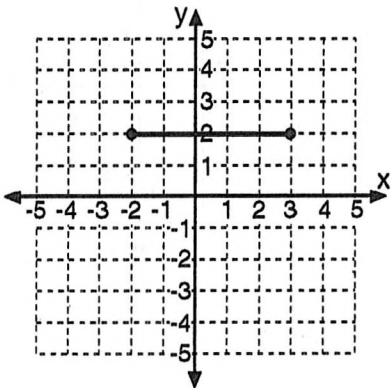
- 7) For the graph of the relation below,
(a) state the domain.
(b) state the range.
(c) state whether or not the relation is a function.
[Justify your answer.]



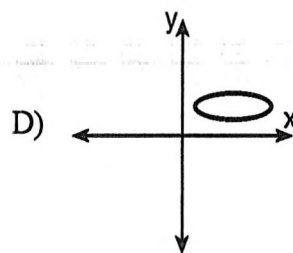
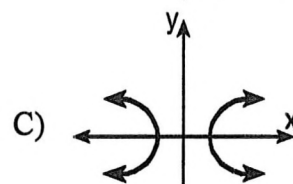
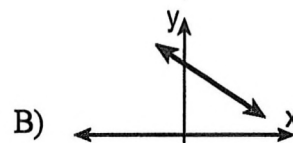
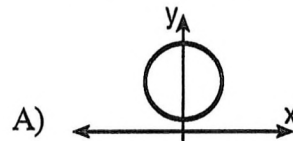
- 8) For the graph of the relation below,
- state the domain.
 - state the range.
 - state whether or not the relation is a function.
- [Justify your answer.]



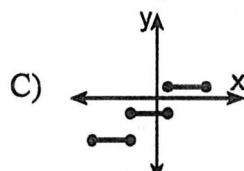
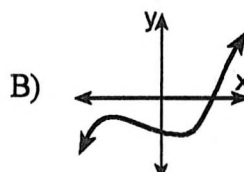
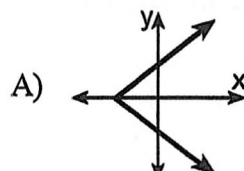
- 9) For the graph of the relation below,
- state the domain.
 - state the range.
 - state whether or not the relation is a function.
- [Justify your answer.]



- 10) Which graph of a relation is also a function?

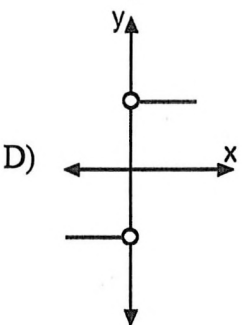
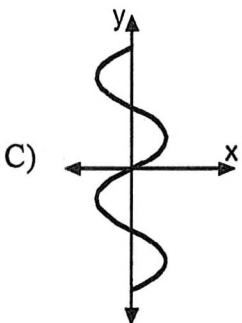
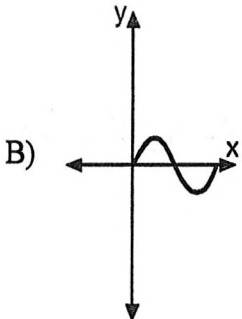
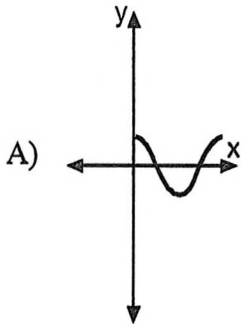


- 11) Which graph of a relation is also a function?



- D) all of the above

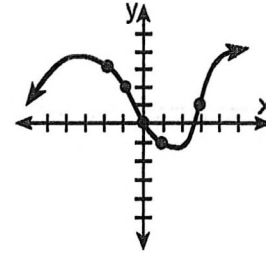
- 12) Which graph of a relation is *not* a function?



- 13) The relation defined by the set of ordered pairs $\{(0,2), (-2,2), (1,4), (0,-1)\}$ is *not* a function. Which of the ordered pairs listed below, if omitted from this relation, will make the resulting set a function.

- A) $(1,4)$ C) $(-2,2)$
B) $(0,-1)$ D) $(4,1)$

- 14) If the graph below is the graph of $y = f(x)$ what is the value of $f(1)$?

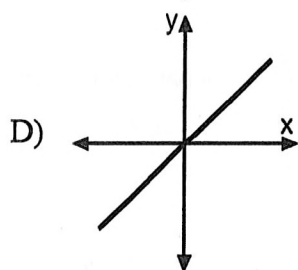
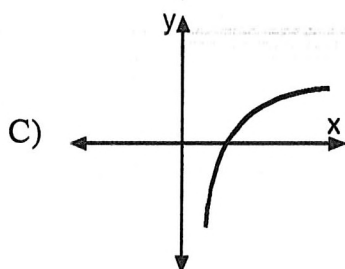
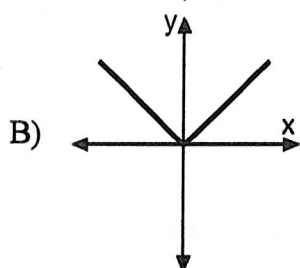
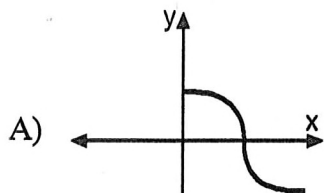


- A) -1 C) -2
B) 2 D) 1
- 15) Given the function $f(x) = (x + 1)^2$, find the value of $f(-2)$.
- 16) Given the function $f(x) = 3x - 2$, find the value of $f(-1)$.
- 17) If $f(x) = x^2 + 3x - 5$, find the value of $f(3)$.
- 18) If $g(x) = \sqrt{x}$ and $h(x) = x^3 - 1$, what is $g(h(4))$?
A) 5 C) $\sqrt{63}$
B) $\sqrt{11}$ D) 7
- 19) If $f(x) = 2x$ and $g(x) = x - 4$, what is the value of $f(g(3))$?
A) 6 C) -2
B) 2 D) -6
- 20) If $f(x) = 5 - 2x$ and $g(x) = |x - 3|$, what is the value of $f(g(3))$?
A) -1 C) 5
B) 7 D) 1

- 21) If $g(x) = |x - 3|$ and $h(x) = x^2 + 2x$, what the value of $h(g(1.4))$?

A) 6.40 C) 5.76
B) 0.46 D) -0.46

- 22) Which function is *not* one to one?



- 23) What is the inverse of the equation $y = 3x + 2$?

A) $x = \frac{1}{3}y + \frac{2}{3}$ C) $x = 3y + 2$
B) $y = \frac{1}{3}x - 2$ D) $3y = x + 2$

- 24) What is the inverse of the function $x + 2y + 3 = 0$?

A) $2x - y + 3 = 0$
B) $y = -2x - 3$
C) $2y + x + 3 = 0$
D) $y = -\frac{1}{2}x - \frac{3}{2}$

- 25) The inverse function of $\{(2,6), (-3,4), (7,-5)\}$ is

A) $\{(6,2), (4,-3), (-5,7)\}$
B) $\{(2,-6), (-3,-4), (7,5)\}$
C) $\{(-6,-2), (-4,3), (5,7)\}$
D) $\{(-2,6), (3,4), (-7,-5)\}$