PARCC

Partnership for Assessment of
Readiness for College and Careers

Math
Fall Block Operational 2015

High School

Released Items

1. The expression $(x-3)^2 + x - 23$ can be written as a product of its factors.

Select **all** factors that apply.

☐ A. $(x-2)$

☐ B. $(x-3)$

☐ C. $(x-7)$

☐ D. $(x+1)$

☐ E. $(x+2)$

☐ F. $(x+3)$

2. Consider the polynomial expression:

$x^4 - 8x^2 + 16$

Select **all** expressions that are equivalent to the given expression.

☐ A. $(x^2 - 8)(x^2 - 2)$

☐ B. $(x^2 - 4)^2$

☐ C. $8 - 3x^4 + x^2 + 4x^4 + 8 - 9x^2$

☐ D. $-(-16 - 8x^2 - x^4)$

☐ E. $(x^3 + x) - (6x + 2x) + 16$

3. The quadratic function $f(x) = x^2$ is graphed in the xy-coordinate plane.

Part A

What transformations to the graph of f would result in the graph of
$h(x) = -x^2 - 3$?

- ○ A. reflection over the x-axis and translation down 3 units

- ○ B. reflection over the x-axis and translation up 3 units

- ○ C. reflection over the y-axis and translation down 3 units

- ○ D. reflection over the y-axis and translation up 3 units

Part B

The quadratic function $y = k(x)$ is graphed in the xy-coordinate plane and has its vertex at $(-2, 0)$. Which could be the equation of k?

- ○ A. $k(x) = (x - 4)^2$

- ○ B. $k(x) = (x - 2)^2$

- ○ C. $k(x) = (x + 2)^2$

- ○ D. $k(x) = (x + 4)^2$

4. Mark exercised on a treadmill for 1 hour. He walked first and then jogged. He wanted to find out what fraction of the hour he spent walking and what fraction of the hour he spent jogging. He remembers that he set the treadmill at a rate of 3 miles per hour when walking and at a rate of 7 miles per hour when jogging. The treadmill showed that the total distance he walked and jogged was 6 miles.

Let x represent the time, in hours, that Mark walked, and let y represent the time, in hours, that he jogged. A system of two equations can be used to represent a model of the situation described.

Part A

Which equation is one of the two equations needed to represent the model?

- ○ A. $7x + 3y = 1$

- ○ B. $3x + 7y = 1$

- ○ C. $7x + 3y = 6$

- ○ D. $3x + 7y = 6$

Part B

Which equation is the other needed equation to represent the model?

- ○ A. $x + y = 1$

- ○ B. $x + y = 6$

- ○ C. $x + y = 60$

- ○ D. $3x + 7y = 60$

Part C

What fraction of an hour did Mark spend walking? Write your answer as a decimal.
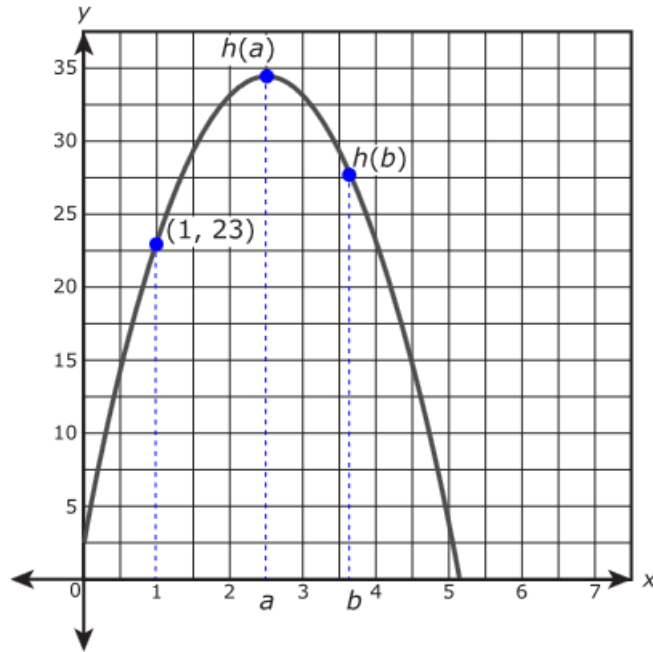
Enter your answer in the box.

[ ]

Part D

What fraction of an hour did Mark spend jogging? Write your answer as a decimal.

Enter your answer in the box.

[ ]

5. Melissa launches a rocket from a 3-meter-tall platform. The height, h, of the rocket, in meters, can be modeled by the given graph.

Melissa knows that $h(1) = 23$ meters and $h(a) = 34.25$ meters.

What is a reasonable estimate of the average rate of change of the height of the rocket, in meters per second, between a and b seconds? Explain your reasoning.

Enter your answer and your explanation in the space provided.
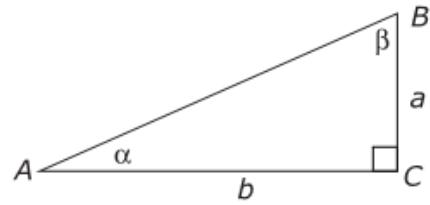
▶ Math symbols

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6. The triangle below is a right triangle.

Select **all** the equations that are true.

- [ ] A. $\cos\beta = \dfrac{a}{\sqrt{a^2+b^2}}$

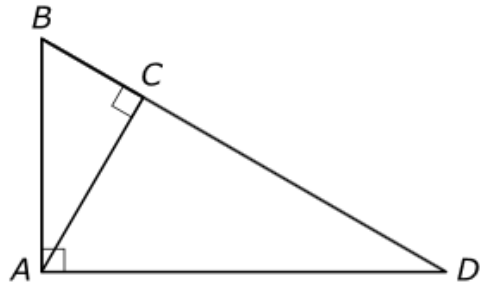- [ ] B. $\cos\beta = \dfrac{b}{\sqrt{a^2+b^2}}$

- [ ] C. $\cos\beta = \sin(90° - \alpha)$

- [ ] D. $\cos\beta = \sin\alpha$

- [ ] E. $\cos\beta = \dfrac{1}{\sin\alpha}$

- [ ] F. $\cos\beta = \sin(\alpha - 90°)$

7.

Right triangle *ABC* is similar to triangle *DBA*. Drag and drop each of the trigonometric values that is equal to one of the given ratios into the correct box.

$\sin(\angle BAC)$ $\sin(\angle ABC)$ $\sin(\angle ADB)$ $\cos(\angle BAC)$ $\cos(\angle ABC)$ $\cos(\angle ADB)$

$\dfrac{AC}{AB}$	$\dfrac{BC}{AB}$

8. Line m and line k lie on the xy-coordinate plane, and line m is perpendicular to line k. Which of these statements **could** be true?

Select **all** statements that apply.

☐ A. Line m and line k intersect.

☐ B. Line m and line k have the same slope.

☐ C. The sum of the slopes of lines m and k is 0.

☐ D. Line m creates an acute angle at the intersection with line k.

☐ E. The product of the slopes of lines m and k is -1.

9. For spirit week, a high school club is making wristbands from paper. The wristbands are designed to have a height of 1.8 centimeters and a maximum diameter of 7.5 centimeters.

Part A

How many square centimeters of paper are required to make each wristband? Round the answer to the nearest tenth.

Enter your answer in the box.

☐

Part B

What is the greatest number of wristbands that can be made from a rectangular piece of paper that measures 18 centimeters by 85 centimeters?

Enter your answer in the box.

☐

10. The figure shows triangle ABC inscribed in a circle.
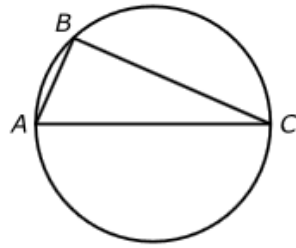
$\overline{AC}$ is a diameter of the circle.

$AB = 12$ inches, and $BC = 28$ inches.

Part A

What is the measure of angle A, to the nearest tenth of a degree?

Enter your answer in the box.

Part B

What is the perimeter of triangle ABC, to the nearest tenth of an inch?

Enter your answer in the box.

11. What extraneous solution results when the equation $\sqrt{\frac{15}{4} - x} = x$ is solved for x?

Enter your answer in the box.

$x = \boxed{}$

12.

$$\begin{cases} f(x) = x^2 - 5x \\ g(x) = 2\left(3^x\right) \end{cases}$$

The function h is defined by $h(x) = 3g(x) - f(2x)$, where f and g are defined as shown. Complete the equation for $h(x)$.

Enter your answers in the boxes.

$h(x) = \boxed{} (3^x) + \boxed{} x^2 + \boxed{} x$

13. Heat engines transform thermal energy (heat) into mechanical energy. Some of the heat escapes into the environment and is called waste heat. The efficiency E of a heat engine with an input of 18,000 calories and a waste heat output of W calories is found using the function $E(W) = \frac{18,000 - W}{18,000}$.

Part A

What is the function W that will find the waste heat output given an engine efficiency E with an input of 18,000 calories?

Enter your answers in the boxes.

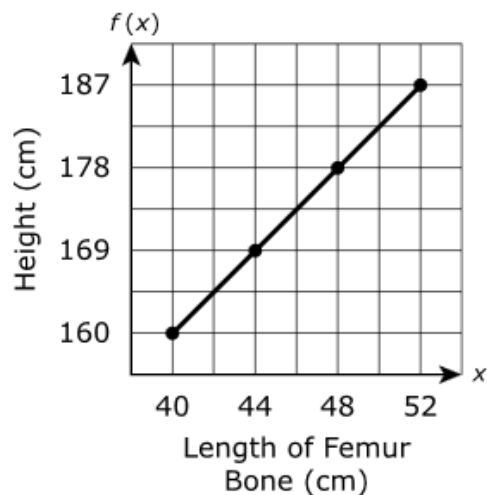The function is $W(E) = \boxed{} E + \boxed{}$.

Part B

Based on the same input, how many calories of waste heat output are there for a heat engine with a given efficiency of 0.45 ?

Enter your answer in the box.

$\boxed{}$ calories

14. The linear function shown in the *xy*-coordinate plane models the relationship in adult men between the length *x* of the femur bone and height $f(x)$. All measurements are given in centimeters (cm).

f (x)

Height (cm)

187

178

169

160

40   44   48   52

Length of Femur
Bone (cm)

The equation of the model is $f(x) = \frac{9}{4}x + 70$, and the domain of the function is restricted to $40 \le x \le 52$.

Part A

Which function represents the inverse of $f(x)$?

- A. $f^{-1}(x) = \frac{4}{9}x - 280$

- B. $f^{-1}(x) = \frac{4}{9}x - 70$

- C. $f^{-1}(x) = \frac{4x-70}{9}$

- D. $f^{-1}(x) = \frac{4x-280}{9}$

Part B

Which statement **best** describes $f^{-1}(x)$?

- A. The function $f^{-1}(x)$ models height as a function of the length of the femur bone.

- B. The function $f^{-1}(x)$ models the length of the femur bone as a function of height.

- C. The function $f^{-1}(x)$ models the ratio of height to the length of the femur bone.

- D. The function $f^{-1}(x)$ models the ratio of the length of the femur bone to height.

15. Members of a city council are considering purchasing new hybrid buses for the city's transit system. Diesel buses are currently being used in the city. The table gives the purchase price and miles per gallon for each type of bus.

	Diesel Bus	Hybrid Bus
Purchase price	$400,000	$500,000
Miles per gallon	5	7

Both types of buses use diesel fuel that costs an average of $4.20 per gallon.

Part A

The operating cost of a bus includes the purchase price and the total cost of the fuel used. Determine the number of miles driven, to the nearest mile, after which the operating cost of a hybrid bus would be less than the operating cost of a diesel bus. Justify your answer.

Enter your answer and your justification in the space provided.

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Part B

The buses will be in operation every day of the year for 6 hours per day and will travel at an average speed of 32 miles per hour. Determine the number of years it would take for the savings in fuel costs to equal the additional cost in the purchase price of a hybrid bus. Justify your answer.

Enter your answer and your justification in the space provided.

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