The Contrapositive Worksheet 1 Solutions

Question 1

Let P be "n is a multiple of 12" and let Q be "n is a multiple of 3". The given statement is $P \Rightarrow Q$, whose contrapositive is

$$\neg Q \Rightarrow \neg P.$$

This says that if n is not a multiple of 3, then n is not a multiple of 12, as in option A.
The answer is **A**.

Question 2

The given statement is the contrapositive of

$$\text{in Paris} \Rightarrow \text{in France}.$$

Options A, C and D all express this implication or its contrapositive. Option B reverses the implication: being in France does not guarantee being in Paris.
The answer is **B**.

Question 3

The statement says

$$x > 7 \Rightarrow x > 2.$$

Its contrapositive is

$$x \leq 2 \Rightarrow x \leq 7,$$

which is option C. The other options reverse the direction of the implication or of its contrapositive.
The answer is **C**.

Question 4

The given statement is

$$\text{not a mammal} \Rightarrow \text{not a dog},$$

which is the contrapositive of

$$\text{dog} \Rightarrow \text{mammal}.$$

Options A, B and C are equivalent forms. Option D is the inverse and is false, since many animals that are not dogs are still mammals.
The answer is **D**.

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Question 5

The statement is

$$\text{equilateral} \Rightarrow \text{isosceles.}$$

Its contrapositive is

$$\text{not isosceles} \Rightarrow \text{not equilateral,}$$

which is option A. The converse and inverse do not follow.
The answer is **A**.

Question 6

The given statement is the contrapositive of

$$\text{Monday} \Rightarrow \text{weekday.}$$

Options A, C and D express this implication or its contrapositive. Option B is the converse: a weekday need not be Monday.
The answer is **B**.

Question 7

The statement is

$$\text{square} \Rightarrow \text{rectangle.}$$

Its contrapositive is

$$\text{not a rectangle} \Rightarrow \text{not a square.}$$

The phrase "not a rectangle only if not a square" in option C expresses exactly this implication.
The answer is **C**.

Question 8

The given statement says

$$\text{not red} \Rightarrow \text{not a heart,}$$

which is equivalent to

$$\text{heart} \Rightarrow \text{red.}$$

Options A, B and C are equivalent forms. Option D is the inverse: a card can be a diamond, so it can be not a heart while still being red.
The answer is **D**.

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Question 9

The statement is

$$\text{multiple of } 10 \Rightarrow \text{even}.$$

Its contrapositive is

$$\text{not even} \Rightarrow \text{not a multiple of } 10,$$

which is option A. The other options reverse this implication.
The answer is **A**.

Question 10

The given statement is

$$\text{not under } 18 \Rightarrow \text{not } 15,$$

the contrapositive of

$$\text{age } 15 \Rightarrow \text{under } 18.$$

Options A, C and D are equivalent. Option B is the converse: being under 18 does not force a person to be exactly 15.
The answer is **B**.

Question 11

The statement is

$$x = 3 \Rightarrow x^2 = 9.$$

Its contrapositive is

$$x^2 \neq 9 \Rightarrow x \neq 3,$$

which is option C. The converse is false because $x = -3$ also gives $x^2 = 9$.
The answer is **C**.

Question 12

The given statement is

$$\text{not a bird} \Rightarrow \text{not a penguin},$$

which is the contrapositive of

$$\text{penguin} \Rightarrow \text{bird}.$$

Options A, B and C are equivalent. Option D is the inverse: many animals that are not penguins are nevertheless birds.
The answer is **D**.

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Question 13

The statement says

$$x < -4 \Rightarrow x < 1.$$

Its contrapositive is

$$x \geq 1 \Rightarrow x \geq -4,$$

which is option A. The other options reverse the original implication or the contrapositive.
The answer is **A**.

Question 14

The given statement is

$$\text{not two-wheeled} \Rightarrow \text{not a bicycle},$$

which is the contrapositive of

$$\text{bicycle} \Rightarrow \text{two-wheeled}.$$

Options A, C and D are equivalent. Option B is the converse: a vehicle with two wheels need not be a bicycle, since it could be a motorcycle.
The answer is **B**.

Question 15

For $n > 2$, the statement is

$$\text{prime} \Rightarrow \text{odd}.$$

Its contrapositive is

$$\text{not odd} \Rightarrow \text{not prime},$$

which is option C. An odd integer need not be prime, so the converse and inverse are not equivalent.
The answer is **C**.

Question 16

The given statement is

$$\text{not a trapezium} \Rightarrow \text{not a parallelogram}.$$

Its contrapositive is

$$\text{parallelogram} \Rightarrow \text{trapezium}.$$

Options A, B and C are equivalent to the given statement. Option D reverses the implication and is not equivalent. For example, a trapezium with exactly one pair of parallel sides is not a parallelogram, but it is still a trapezium.
The answer is **D**.

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Question 17

The statement is

$$\text{multiple of } 8 \Rightarrow \text{multiple of } 4.$$

Its contrapositive is

$$\text{not a multiple of } 4 \Rightarrow \text{not a multiple of } 8.$$

Option A expresses this using "only if". The other options reverse the implication.
The answer is **A**.

Question 18

The given statement is

$$\text{not 31 days} \Rightarrow \text{not January},$$

which is the contrapositive of

$$\text{January} \Rightarrow \text{31 days}.$$

Options A, C and D are equivalent. Option B is the converse: March, May, July, August, October and December also have 31 days.
The answer is **B**.

Question 19

The statement is

$$\text{square} \Rightarrow \text{diagonals of equal length}.$$

Its contrapositive is

$$\text{diagonals not of equal length} \Rightarrow \text{not a square},$$

which is option C. A rectangle can have equal diagonals without being a square, so the converse is false.
The answer is **C**.

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Question 20

Let P be the statement that a student is permitted to complain that the worksheet is too long, and let Q be the statement that the student has reached Question 20.
The given statement is

$$P \Rightarrow Q.$$

Its contrapositive is

$$\neg Q \Rightarrow \neg P.$$

Option B expresses $P \Rightarrow Q$, while options C and D express its contrapositive. Option A instead states

$$Q \Rightarrow P,$$

which is the converse and is not equivalent. Reaching Question 20 does not necessarily give a student permission to complain, although by this point they may feel that it should.
The answer is **A**.
No rest for you ambitious souls! :)