PART A

1) In a mathematical expression, what is a variable?

2) Why do we use algebraic expressions in mathematics?

3) For each of the following, state the operations, in order, that are applied to the variable.

a) $5x$ b) $t+8$ c) $3x-7$ d) $-2(m+5)$ e) y^2+3 f) $-5x^2+10$ g) $\frac{p^3}{4}-7$

4) Create an algebraic expression to represent each of the following.

a) A number x is tripled and then 19 is subtracted from the result.
b) The variable y is squared and then the result is increased by 10.
c) The variable n is decreased by 6 and then the result is multiplied by -8.
d) A number p is increased by 70 and then the result is divided by 6.

5) State the number of terms in each of the following algebraic expressions.

a) $4x+3$ b) y c) $6x^2-7x+12$ d) $-7m$ e) $8x^2y^5z^3$ f) $9x^5-8xy+4y^3+6$

6) Determine the value of each of the following for $x=2$.

a) $x+25$ b) $8x$ c) $6x+5$ d) $4-10x$ e) $\frac{x}{2}+12$ f) $-3(x-4)$ g) $\frac{x-16}{7}$

PART B

7) Evaluate each expression for the given value of the variable.

a) $-5x+12$ for $x=-3$ b) $-8+20k$ for $k=-4$ c) $7x^2-1$ for $x=3$

d) $-3x^2+6x-2$ for $x=2$ e) $\frac{t-24}{3}$ for $t=6$ f) $-4(3t-10)$ for $t=-9$

g) $(7u+4)^2$ for $u=1$ h) $\frac{3}{5}x+7$ for $x=10$ i) $9-8r$ for $r=\frac{2}{3}$

8) Evaluate each expression at the given variable values.

a) $2xy$ for $x=-2, y=3$ b) $-3a^2+4ab-2b^2$ for $a=0, b=-1$

c) $-4x^2yz^3$ for $x=2, y=3, z=-1$ d) $\frac{4q-3p}{2r}$ for $p=4, q=2, r=-2$

9) A balloon starts at a height of 2 m and rises at a rate of 3 metres per second. Therefore, its height after t seconds is given by the equation $h=2+3t$. Use this equation to determine the balloon's height after 10 seconds.

10) The formula for the area of a circle with radius r is $A = \pi r^2$. Determine, to one decimal place, the area of a circle that has a radius of 6 cm.

11) The formula for the volume of a cube that has edge lengths of s is $V = s^3$. Determine the volume of a cube that has edge lengths of 8.3 cm.

12) An airplane has an initial altitude of 3000 feet and descends at a rate of 400 ft/min. Therefore, the aircraft's altitude after t minutes is given by the equation $A = 3000 - 400t$.
   a) Use the equation to determine the plane's altitude after 5 minutes.
   b) Use the equation to determine the plane's altitude after 90 seconds.
   c) Create a similar algebraic equation for the aircraft's altitude, but where t is measured in seconds instead of minutes.
   d) Use your equation from part (c) to determine the plane's altitude after 225 seconds.

13) The height above the ground, in metres, of a ball that has been thrown into the air is modelled by the equation $h = -4.9t^2 + 22.5t + 1.6$, where t represents the number of seconds after the ball is thrown.
   a) Determine the height of the ball 3 seconds after it is thrown.
   b) For $t = 4.66$, the expression on the right side of the equation above works out to approximately 0. What does this result mean in the context of the given situation?
   c) For both $t = 1.06$ and $t = 3.53$, the expression $-4.9t^2 + 22.5t + 1.6$ works out to approximately 20. Interpret these results in the context of the given scenario.
   d) Explain why we would likely not use negative values for t.
   e) For values of t that are above 4.7, the expression $-4.9t^2 + 22.5t + 1.6$ works out to negative values. What do these results mean in the context of the given situation?

PART C

14) Evaluate each expression at the given values.

a) $\frac{2}{3}x + \frac{1}{4}$ for $x = \frac{1}{2}$ b) $-y^2 + 2y - 3$ for $y = \frac{1}{3}$ c) $4 + 3n - 2n^2$ for $n = -\frac{2}{3}$

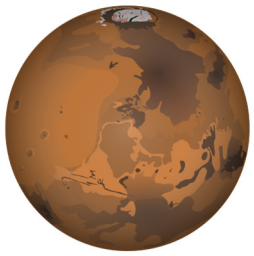
15) The sum of the interior angles of a polygon can be found by subtracting 2 from the number of sides and multiplying the result by 180°.
   a) Determine an algebraic expression to represent the sum of the interior angles for a polygon with n sides.
   b) Use your expression from part (a) to determine the sum of the interior angles for an octogon.
   c) A *regular polygon* has equal side lengths and equal interior angles. Determine the value of each interior angle in a regular hexagon.
   d) The sum of the interior angles for a particular polygon is 1440°. How many sides does this polygon have?
   e) For a given regular polygon, each interior angle is 156°. How many sides does the polygon have?

16) The height of an object thrown into the air can be represented by the following equation:

$$h = -\frac{1}{2}gt^2 + v_0 t + h_0$$

- g represents the acceleration due to gravity in metres per square second
- t represent the time in seconds
- v_0 represents the initial velocity (speed) of the object in metres per second
- h_0 represents the initial height of the object in metres

a) On Earth, where the acceleration due to gravity (g) is about 9.8 m/s^2, an object is thrown into the air from a height of 3 metres with an initial velocity of 28 m/s. Determine the height of the object 2 seconds after it is thrown.
b) Repeat part (a) for an object thrown upwards on Mars, where the acceleration due to gravity is roughly 3.7 m/s^2.



17) The population of a small town is represented by the equation $P = 1300(1.04)^t$, where t is the number of years since 2005.
a) Determine the population of the town in the year 2010.
b) Determine the population of the town in the year 2005.
c) In what year will the population reach 1800?

ANSWERS

1) A variable is a symbol (usually a letter) used to represent an unspecified number. It may represent several possible values that can be used in its place, or it may represent an unknown value that must be found.

2) We use algebraic expressions to model real world situations in a way that is efficient for calculation and convenient for further manipulation. They provide an effective way to describe patterns and relationships, and to communicate mathematical thinking.

3) a) The variable x is multiplied by 5.
b) 8 is added to the variable t.
c) The variable x is multiplied by 3 and then 7 is subtracted from the result.
d) 5 is added to the variable m and then the result is multiplied by -2.
e) The variable y is squared and then 3 is added to the result.
f) The variable x is squared and then the result is multiplied by -5 and increased by 10.
g) The variable p is cubed and then the result is divided by 4 and decreased by 7.

4) a) $3x-19$ b) y^2+10 c) $-8(n-6)$ d) $\dfrac{p+70}{6}$

5) a) 2 b) 1 c) 3 d) 1 e) 1 f) 4

6) a) 27 b) 16 c) 17 d) -16 e) 13 f) 6 g) -2

7) a) 27 b) -88 c) 62 d) -2 e) -6 f) 148 g) 121 h) 13 i) $\dfrac{11}{3}$

8) a) -12 b) -2 c) 48 d) 1 **9)** 32 m

10) 113.1 cm^2 **11)** 571.787 cm^3

12) a) 1000 feet b) 2400 feet c) $3000-\dfrac{20}{3}t$ d) 1500 feet

13) a) 25 m b) The ball hits the ground 4.66 seconds after it is thrown.
c) The ball passes through a height of 20 m twice; once on its way up (1.06 seconds) and once on its way down (3.53 seconds).
d) t represents the number of seconds that have passed since the ball was thrown. Therefore, the smallest possible t value is 0. Negative t values do not make sense in the context of the given situation.
e) Negative results indicate that either the ball has travelled below ground level or, more likely, that the model is not valid for the given time. In this case, the model likely only applies to time values from 0 seconds through 4.66 seconds.

14) a) $\dfrac{7}{12}$ b) $-\dfrac{22}{9}$ c) $\dfrac{10}{9}$

15) a) $(n-2)\times 180°$ b) 1080° c) 120° d) 10 e) 15

16) a) 39.4 m b) 51.6 m

17) a) 1582 b) 1300 c) 2013