MCV 4U - Unit 7 Test
Applications of Vectors

Name: _____
Date: _____

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Fill in the blanks with the most appropriate answer:

1.   A force vector has a magnitude of 23 N and makes an angle of $35°$ with the x-axis.
        What is the magnitude of its vertical component?   1. _____

2.   An airplane has an airspeed of 400 km/h and is heading due west. If it encounters a wind
        blowing north at 120 km/h, how many degrees north from west is the resultant velocity of
        the plane?   2. _____

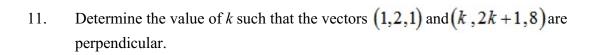3.   Is the following set of forces acting on an object, at equilibrium?
        6 N, 7 N, 10 N   3. _____

4.   Suppose that $|\vec{a}| = 4$. What is $\vec{a} \cdot \vec{a}$?   4. _____

5.   Suppose $\vec{x} \cdot \vec{y} = 2$, $|\vec{x}| = 2$ and $|\vec{y}| = 2$. What is the angle between the vectors
        $\vec{x}$ and $\vec{y}$?   5. _____

6.   For what value of s is the line segment connecting the origin with (3, s) and the line
        segment connecting the origin with (18, 6) perpendicular?   6. _____

7.   Suppose $\vec{a}$ and $\vec{b}$ are vectors such that $\vec{a} \times \vec{b} = (1,0,2)$. What is $\vec{b} \times (-2\vec{a})$?
                                                                   7. _____

8.   How much work is done sliding a desk 5 m across the floor against a frictional force of
        120 N?   8. _____

9.   Which of the following pairs of vectors are perpendicular to each other?

   a. (1, 3, 2) and (2, 6, 4)   c. (4, 14, 18) and (6, 21, 27)
   b. (13, 4, 2) and (2, 5, 3)   d. (5, 4, 3) and (3, 4, 5)

10.   Suppose $\vec{a} = (4, 6, 10)$ and $\vec{b} = (6, 9, 15)$. What is $\vec{a} \times \vec{b}$?

   a. (24, 54, 150)   c. (1, 1, 1)
   b. (0, 0, 0)   d. (3, 2, 0)

11. Determine the value of k such that the vectors $(1,2,1)$ and $(k, 2k+1, 8)$ are perpendicular.
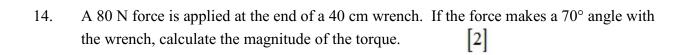
[3]

12. Determine the angle (nearest degree), for the vector $\vec{a} = (6, -2, -3)$ with the x-axis.

[3]

13. Determine the value of k such that the scalar projection of $\vec{a} = (k, 0)$ on $\vec{b} = (1, \sqrt{3})$ is 4.

[3]

14. A 80 N force is applied at the end of a 40 cm wrench. If the force makes a 70° angle with the wrench, calculate the magnitude of the torque. $[2]$

15. An airplane has an airspeed of 570 km/h and is heading in a direction of $N\ 20°\ E$ when it encounters a wind from $N30°W$. The resultant ground velocity has a direction of $N\ 45°\ E$. How long does it take for the plane to travel 1180 km. [5]

16.   A mass of 8 kg is suspended by two strings, 18 cm and 21 cm long, from two points that are 28 cm apart and at the same level. Determine the tension in each of the strings.   [5]

17.   The vectors $\vec{a}$ and $\vec{b}$ are unit vectors that make an angle of 60° with each other. If $\vec{a} - 3\vec{b}$ and $m\vec{a} + \vec{b}$ are perpendicular, determine the value of m.   [4]

18.	Determine the area of the triangle formed by the points A (3, -1, 2), B (-4, 0, 5) and C (1, -2, 3).	[4]

19.	Without doing any calculation, explain why one might conjecture that two vectors of the form $(a,b,0)$ and $(c,d,0)$ would have a cross product of the form $(0,0,e)$?	[2]

20. Prove the following theorem for dot product of algebraic vectors:

in R^3, if $\vec{a} = (a_1, a_2, a_3)$ and $\vec{b} = (b_1, b_2, b_3)$,

then $\vec{a} \bullet \vec{b} = a_1 b_1 + a_2 b_2 + a_3 b_3$. [6]