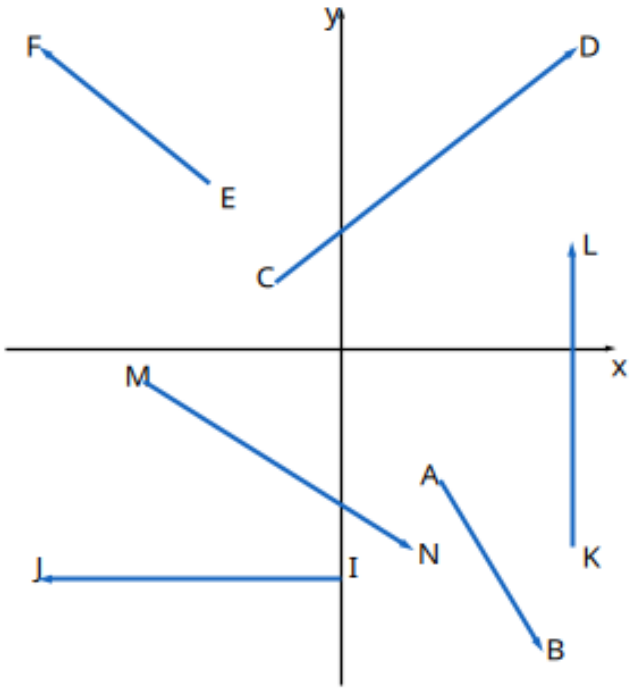
Grade 12 Calculus and Vectors Exam Review Lesson (Unit 5)

This document was composed and formatted by Annie Bernatchez.

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Vectors Exam Review – Unit 5: Cartesian Vectors

1) Write the coordinates of each Cartesian vector. Then find its magnitude.



2) Given $\vec{u} = [2, -1]$ and $\vec{v} = [5, -7]$, evaluate each expression.

a) $2\vec{v}$	**b)** $\vec{u} - \vec{v}$
c) $3\vec{u} + 5\vec{v}$	**d)** $4\vec{u} - 2\vec{v}$

3) Consider the points $A(2, -7)$, $B(-4, 5)$ and $C(6, 8)$.

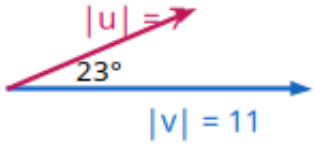
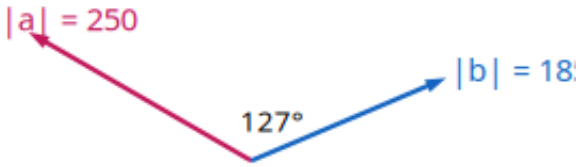
a) Determine $\overrightarrow{AC}$	**b)** Determine $\lvert\overrightarrow{AB}\rvert$	**c)** Determine the perimeter of $\triangle ABC$

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4) Determine the value of k so that the vectors in each pair are collinear.

a) $\vec{u} = [2,\ k]$, $\vec{v} = [-12,\ 30]$	**b)** $\vec{u} = [-4,\ 6]$, $\vec{v} = [30,\ k]$

5) Calculate the dot product of each pair of vectors.

a) $\lvert\vec{u}\rvert = 7$, $\lvert\vec{v}\rvert = 11$, angle between them $23°$ 	**b)** $\lvert\vec{a}\rvert = 250$, $\lvert\vec{b}\rvert = 185$, angle between them $127°$ 
c) $\vec{u} = [-8,\ 9]$ and $\vec{v} = [1,\ -7]$	**d)** $\vec{u} = -5\hat{i} + 11\hat{j}$ and $\vec{v} = 7\hat{i} - 2\hat{j}$

6) Write a 250 N force applied at $60°$ to the horizontal as a Cartesian vector.

7) Evaluate, given vectors $\vec{u} = [2,\ -3]$ and $\vec{v} = [3,\ 1]$.

a) $3\vec{u} + 2\vec{v}$	**b)** $\lvert\vec{u}\rvert$	**c)** $\vec{u} \cdot \vec{v}$	**d)** $\lvert\vec{u} + \vec{v}\rvert$

8) Calculate the angle θ between the vectors.

a) $\vec{u} = [-1,\ 8]$ and $\vec{v} = [3,\ -5]$	**b)** $\vec{u} = [3,\ -7]$ and $\vec{v} = [6,\ -1]$

9) Determine the projection of $\vec{u}$ on $\vec{v}$.

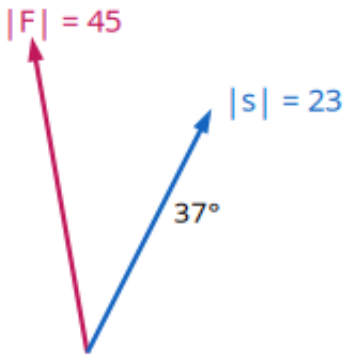
a) $\lvert\vec{u}\rvert = 95$ and $\lvert\vec{v}\rvert = 275$, and the angle between $\vec{u}$ and $\vec{v}$ is $13°$.	**b)** $\vec{u} = [6,\ -5]$ and $\vec{v} = [7,\ -11]$

10) For vectors $\vec{c} = [2,\ -7]$ and $\vec{d} = [9,\ 12]$

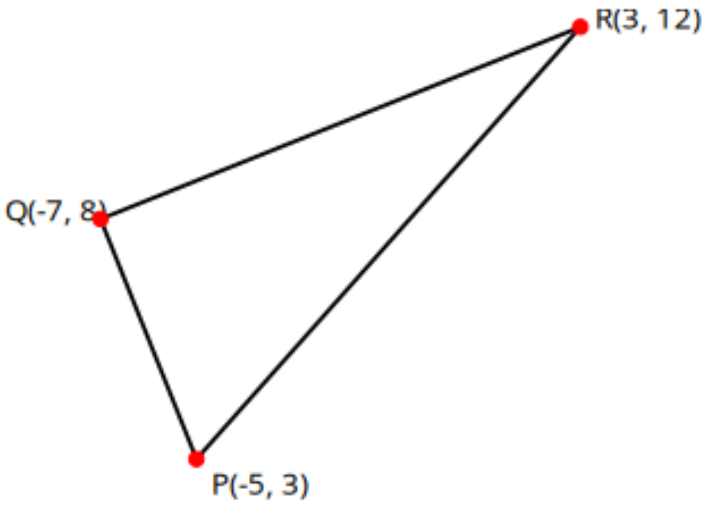
a) determine the magnitude of the projection of $\vec{c}$ on $\vec{d}$	**b)** determine the vector projection of $\vec{c}$ on $\vec{d}$

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11) Determine the work done by each $\vec{F}$, in Newtons, for an object moved along the vector, $\vec{d}$, in metres.

a) $\vec{F} = [18, 23]$ and $\vec{d} = [9, 12]$	**b)** $\lvert\vec{F}\rvert = 45$, $\lvert\vec{s}\rvert = 23$, angle between them $37°$ 

12) Determine if $\triangle PQR$ with vertices $P(-5, 3)$, $Q(-7, 8)$ and $R(3, 12)$ is a right triangle. If so, identify the right angle.



13) Determine the exact magnitude of the vector $\overrightarrow{AB}$ joining $A(3, 8, -11)$ and $B(7, -3, 15)$.

14) For each of the following calculate the angle between the two vectors.

a) $[0, 1, -2]$ and $[-3, 1, 4]$	**b)** $[1.5, 20, 0]$ and $[-20, 1, 10]$

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15) Given $\vec{c} = [-6, 4, 0]$, $\vec{d} = [0, -5, -7]$, and $\vec{e} = [3, 1, 2]$.

a) $10\vec{c} - 10\vec{d}$	**b)** $2\vec{c} \cdot 3\vec{d} - 2\vec{c} \cdot 4\vec{e}$
c) $(3\vec{d} - 4\vec{e}) \cdot 2\vec{c}$	**d)** $\vec{c} \times \vec{d}$
e) $\vec{d} \times \vec{e}$	**f)** $\vec{c} \times \vec{c}$

16) If $\vec{u} = [5, 7, 9]$ is orthogonal to $\vec{v} = [1, t, 1]$, determine t.

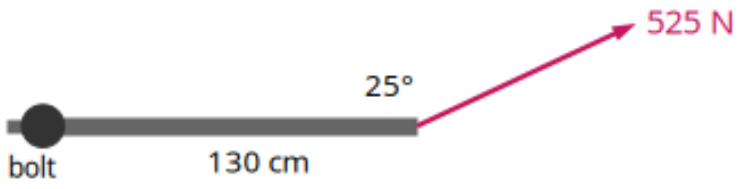
17) Determine the area of the parallelogram bound by the vectors $\vec{a} = [7, 11, 4]$ and $\vec{b} = [3, -2, 5]$.

18) A triangle has vertices $A(2, 5, -1)$, $B(4, 1, -3)$, and $C(-5, -6, 4)$. Find the area of the triangle.

19) Calculate the area of the parallelogram $ABCD$ where $A(4, 6)$, $B(5, 6)$, $C(11, 15)$, and $D(-2, -3)$

20) Find the volume of the parallelepiped defined by $\vec{a} = [1, 0, -4]$, $\vec{b} = [8, -7, 9]$, and $\vec{c} = [2, 3, -4]$

21) A 525 N force is applied to the end of a 130 cm wrench and makes an angle of $25°$ with the handle of the wrench. What is the torque on the bolt at the other end of the wrench if the force is applied in a clockwise direction?



22) Find a unit vector parallel to $\vec{p} = [-8, 2, -3]$

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23) Given $\vec{a} = [3,\ 4,\ -2]$, $\vec{b} = [2,\ -7,\ 1]$, and $\vec{c} = [-6,\ 5,\ 4]$, evaluate each expression

a) $\vec{a} + \vec{c} \times \vec{b}$	**b)** $(\vec{a} + \vec{c}) \times \vec{b}$
c) $\lvert -2\vec{b} \times \vec{c} \rvert$	

24) A storage box is dragged 7 m along a smooth, level floor by a 43-N force, applied at $38°$ to the floor. Then, it is pulled 3.5 m up a ramp inclined at $24°$ to the horizontal, using the same force. The storage box is then dragged a further 6 m along a level platform using the same force again. Determine the total work done in moving the storage box.

25) A rock climber pulls himself 21 m up the side of a cliff with a force of 5.2 N, at an angle of $11.2°$ to the vertical. What is the work done?

Answer Key

1) $\overrightarrow{AB} = [3,\ -5]$, $\lvert\overrightarrow{AB}\rvert = \sqrt{34}$; $\overrightarrow{CD} = [9,\ 7]$, $\lvert\overrightarrow{CD}\rvert = \sqrt{130}$; $\overrightarrow{EF} = [-5,\ 4]$, $\lvert\overrightarrow{EF}\rvert = \sqrt{41}$; $\overrightarrow{IJ} = [-9,\ 0]$, $\lvert\overrightarrow{IJ}\rvert = 9$; $\overrightarrow{KL} = [0,\ 9]$, $\lvert\overrightarrow{KL}\rvert = 9$; $\overrightarrow{MN} = [8,\ -5]$, $\lvert\overrightarrow{MN}\rvert = \sqrt{89}$ **2)a)** $[10,\ -14]$ **b)** $[-3,\ 6]$ **c)** $[31,\ -38]$ **d)** $[-2,\ 10]$ **3)a)** $[4,\ 15]$ **b)** $6\sqrt{5}$ units **c)** ≈ 39.4 units **4)a)** -5 **b)** -45 **5)a)** ≈ 70.88 **b)** $\approx -27\,833.94$ **c)** -71 **d)** -57 **6)** $[125,\ 216.5]$ **7)a)** $[12,\ -7]$ **b)** $\sqrt{13}$ **c)** 3 **d)** $\sqrt{29}$ **8)a)** $\theta \approx 156.2°$ **b)** $\theta \approx 57.3°$ **9)a)** $\approx 92.57\,\hat{v}$ **b)** $\frac{97}{170}[7,\ -11]$ **10)a)** 4.4 **b)** $\left[-\frac{66}{25},\ -\frac{88}{25}\right]$ **11)a)** 438 J **b)** ≈ 826.59 J **12)** Yes; the right angle is at Q **13)** $\sqrt{813}$ **14)a)** $\approx 127.9°$ **b)** $\approx 91.3°$ **15)a)** $[-60,\ 90,\ 70]$ **b)** -8 **c)** -8 **d)** $[-28,\ -42,\ 30]$ **e)** $[-3,\ -21,\ 15]$ **f)** $\vec{0}$ **16)** $t = -2$ **17)** $\sqrt{6707}$ units^2 **18)** $\sqrt{1070}$ units^2 **19)** 9 units^2 **20)** 151 units^3 **21)** ≈ 288.4 N·m, into the material (bolt is being tightened) **22)** $\left[-\frac{8}{\sqrt{77}},\ \frac{2}{\sqrt{77}},\ -\frac{3}{\sqrt{77}}\right]$ **23)a)** $[36,\ 18,\ 30]$ **b)** $[23,\ 7,\ 3]$ **c)** $2\sqrt{2309}$ **24)** ≈ 586.5 J **25)** ≈ 107.1 J

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