= Year 12 **= Vectors** **= Worksheet 5**

1. Find $\frac{d}{dx}[\,x^2\,\mathbf{i} - \sqrt{x}\,\mathbf{j}]$.	2. Given $\mathbf{F} = x\,\mathbf{i} - y^2\,\mathbf{j}$, where x and y are functions of t, find $d\mathbf{F}/dt$.
3. Find $\int[\,x^2\,\mathbf{i} - \sqrt{x}\,\mathbf{j}]\,dx$.	4. The position of a particle is given by $\mathbf{r}(t) = 3\cos(2t)\,\mathbf{i} - 4\sin(2t)\,\mathbf{j}$ at time $t \geq 0$. Find the magnitude and direction of its velocity at $t = \frac{3\pi}{8}$.
5. Refer to the particle in Q4. Find its acceleration and show that it is towards the centre of the path.	6. The position of a particle is given by $\mathbf{r}(t) = \tan t\,\mathbf{i} + \sec^2 t\,\mathbf{j}$, where $0 \leq t < \frac{\pi}{2}$. Find the magnitude and direction of its velocity at $t = \frac{\pi}{4}$.
7. The position of a particle is given by $\mathbf{r}(t) = a\cos(nt)\,\mathbf{i} + a\sin(nt)\,\mathbf{j} + bt\,\mathbf{k}$, where $a, b > 0$. Describe its motion.	8. The acceleration of a particle moving in a plane is given by $\mathbf{a} = -5\mathbf{j}$. Initially it is at $\mathbf{r} = 14\mathbf{i}$, and has a velocity of $7\mathbf{i} - 10\mathbf{j}$. Find the cartesian equation of its path including domain.
9. The position vectors of particle A and B are $\mathbf{r}_A = \frac{t}{5}\mathbf{i} + e^{\frac{t}{5}}\mathbf{j}$ and $\mathbf{r}_B = t\,\mathbf{i} + \log_e(t)\,\mathbf{j}$ respectively, where $t > 0$. Find the time when the two particles are closest.	10. Refer to Q9. Find the closest approach of the two particles.
11. Refer to Q9. Find the closest distance between the paths of the two particles.	Numerical, algebraic and worded answers.

1. $2x\,\mathbf{i} - 1/2\sqrt{x}\,\mathbf{j}$
2. $dx/dt\,\mathbf{i} - 2y\,dy/dt\,\mathbf{j}$
3. $x^3/3\,\mathbf{i} - 2x^{3/2}/3\,\mathbf{j} + \mathbf{c}$
4. $5\sqrt{2}$; $-0.6\,\mathbf{i} + 0.8\,\mathbf{j}$
5. $\mathbf{a} = -4\mathbf{r}$
6. $2\sqrt{5}$; $\sqrt{5}/5\,\mathbf{i} + 2\sqrt{5}/5\,\mathbf{j}$
7. Upward circular helix, radius a, period $2\pi/n$, ascending speed b
8. $y = -5/98\,x^2 + 10$, $[14, \infty)$
9. $t \approx 1.127$
10. 1.448
11. $\sqrt{2}$