University of British Columbia

Science 1 Math/Phys
First Midterm

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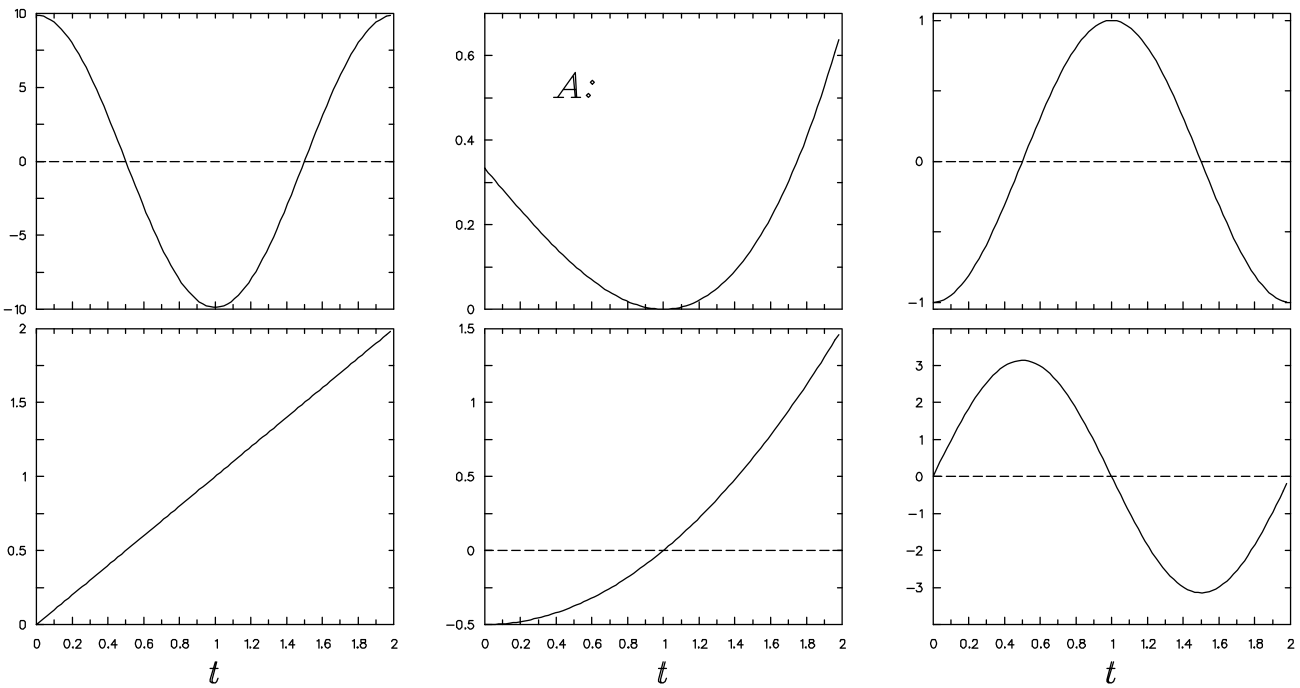
No memory aids allowed.

1 Derivatives [40 marks]

1. Carefully state the Chain Rule for finding the derivative of the composition of two functions. Be sure to include any necessary hypotheses.
2. Use the Chain Rule on the function $[f(x) + g(x)]^2$, where f and g are differentiable functions, to find the derivative of $f(x) \cdot g(x)$.
3. Use the Product Rule you proved in part (*b*) on the function $h(x) = f(x)/g(x)$ to prove the Quotient Rule. What conditions must f and g satisfy?

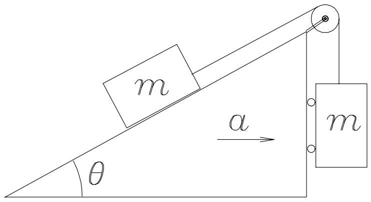
2 Shapes of Curves [30 marks]

Shown below are six graphs describing the motion of two different objects, A and B, in one dimension. The horizontal axis is the same for each graph and represents *time* over the range from 0 to 2 *s*. The vertical axes are either distance x [in m], speed v [in m/s] or acceleration a [in m/s^2], with only the numerical values indicated. There is one and only one graph of each of $x(t)$, $v(t)$ and $a(t)$ for each of the two objects.



1. *Which is which*? Indicate on each graph which function it describes for which object [*e.g.* "A: $v(t)$"]. One graph is already labelled with an A to get you started.
2. Describe the motion of both A and B as completely as possible <u>in words</u>. (No numbers or algebraic symbols allowed!)

3 Accelerated Atwood [30 marks]



Two rectangular blocks of equal mass m are connected by a massless string passing over a pulley as shown. The entire apparatus is moving horizontally to the right with a constant acceleration a. There is *no friction* between *any* of its components.

1. Draw a free body diagram for each rectangular block with all forces and coordinate axes clearly labelled.
2. If $\theta = \pi/6$ (that's 30° to non-physicists), then *for what value of* a *will the blocks not move up or down*?