

# Quiz 5

## Math 251

Name: KEY

Show *all* your work (algebraically or geometrically) for each ~~and simplify~~. No credit is given without supporting work.

1. [5] A particle moves according to the law of motion  $s = f(t) = t^3 - 12t^2 + 36t$  for  $t \geq 0$ , where  $t$  is measured in seconds and  $s$  in feet. Answer the following questions:

(a) Find the velocity at time  $t$ .

(+1)  $v(t) = 3t^2 - 24t + 36$

(b) Find the total (not the net, but *total*) distance the particle moved in the first 8 seconds.

Don't  
Do the  
computations!  
Get to the  
point where  
you only  
have to do  
arithmetic

when/does the particle change direction? } (+1)  
happens at  $v(t) = 0$   
 $0 = 3(t^2 - 8t + 12) = 3(t - 6)(t - 2)$   
 $\Rightarrow t = 2$  and  $t = 6$  } (+1) found

$$|f(2) - f(0)| + |f(6) - f(2)| + |f(8) - f(6)|$$

Abs/order (+1)  
Split up (+1)

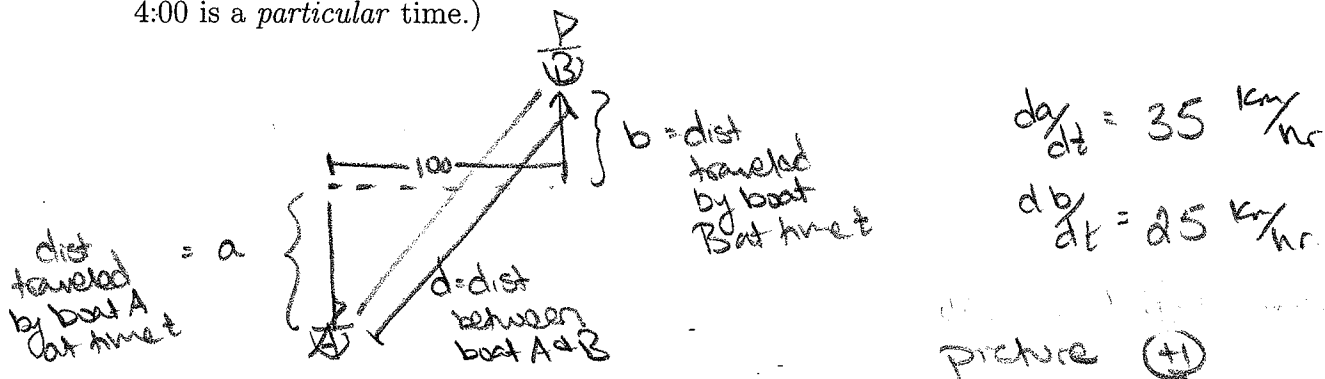
$$= |(2^3 - 12 \cdot 2^2 + 36 \cdot 2) - 0| + |(6^3 - 12 \cdot 6^2 + 36 \cdot 6) - (2^3 - 12 \cdot 2^2 + 36 \cdot 2)|$$

$$+ |(8^3 - 12 \cdot 8^2 + 36 \cdot 8) - (6^3 - 12 \cdot 6^2 + 36 \cdot 6)|$$

2. [5] At noon, ship A is 100km west of ship B. Ship A is sailing south at 35 km/h and ship B is sailing north at 25 km/h. How fast is the distance between the ships changing at 4:00pm?

(a) Draw a picture of the situation for any time  $t$ . Assign variable names to quantities in the picture that you think you might be useful.

(I did not ask for a picture at a particular time, but at some unspecified time  $t$ ! 4:00 is a particular time.)



(b) What is the unknown? Write this down using the notation we've developed for this class.

$$\left. \frac{dd}{dt} \right|_{\text{at 4pm}} \quad (+)$$

(c) Find an equation relating the quantities you introduced in part (a).

$$100^2 + (a+b)^2 = d^2 \quad (+)$$

(d) Finish solving the problem.

$$\frac{d}{dt} (100^2 + (a+b)^2) = \frac{d}{dt} (d^2)$$

$$2(a+b) \left( \frac{da}{dt} + \frac{db}{dt} \right) = 2d \frac{dd}{dt} \quad (+)$$

$$\frac{60(a+b)}{d} = \frac{2(a+b)(35+25)}{2d} = \frac{dd}{dt}$$

$$\left. \left. \left. \left. \left. \left. \frac{dd}{dt} \right|_{\text{at 4pm}} = \frac{60(140+100)}{\sqrt{100^2 + 240^2}} \right\} \text{eval } (+) \right\} \frac{2 \cdot 35}{10} \right\} \text{der } (+)$$