Calculator allowed. Show work. Give exact answers or round to 3 significant figures.

1. On the Northwest coast, the depth of water at time t hours after midnight is given by
$d(t) = 9.3 + 6.8\cos(0.507t)$ meters.

a. What is the depth of water at 8:00 am?

$t = 8$. $d(8) = 9.3 + 6.8\cos((0.507)(8)) = 5.15$ m.

b. What is the rate of change in the depth of water at 8:00 am?
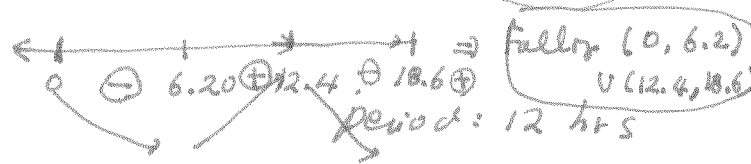
$\dfrac{d(t)}{dt} = (-0.507)(6.8)\sin(0.507 t) \Rightarrow t = 8 \Rightarrow \dfrac{dd}{dt}\Big|_{t=8} = (-0.507)(6.8) \cdot \sin(0.507 \cdot 8)$

$= \boxed{2.73 \ \frac{m}{s}}$

c. What time period of a day is the tide falling? Support your answer with sign diagram.

$\dfrac{dy}{dt} = 0 = -3.4\sin(0.507 t) = 0$

$0 = \sin(0.507 t) \Rightarrow 0, \pi, 2\pi, 3\pi.$

$t = 0, 6.20, 12.4$

falling $(0, 6.2)$
$\cup (12.4, 18.6)$
period: 12 hrs

2. A particle moving on the x-axis has position after an elapsed time of t seconds: $s(t) = t^3 - 9t^2 + 24t$.

a. Find the velocity of the particle at time t.

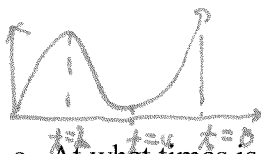$v(t) = 3t^2 - 18t + 24$

b. Find the acceleration at time t.

$a(t) = 6t - 18 = 0 \Rightarrow t = \boxed{3}$

c. Find the position of the particle at the times when it reverses direction.

$3t^2 - 18t + 24 = 0$ $3(t^2 - 6t + 8) = 0 \Rightarrow 3(t-2)(t-4) = 0$
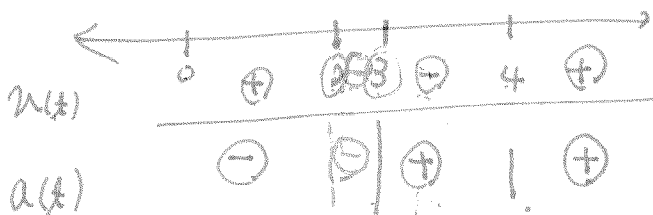
$\boxed{t = 2, \ t = 4}$
$s(2) \qquad s(4)$

d. What is the total distance traveled by the particle during the first 8 seconds?

Total distance $= |s(0) - s(2)| + |s(2) - s(4)| + |s(4) - s(8)|$

$= |0 - 20| + |20 - 16| + |16 - 128| = \boxed{136 \text{ units}}$

e. At what times is the particle's speed increasing and decreasing.

speed increasing: $(2,3)$
$\cup (4, \infty)$

speed decreasing: $(0, 2) \cup$
$(3, 4)$