antider. ↑ s v a ↓ deriv

Calculus - Complete on a separate sheet of paper Name_____

#26 Motion Part 2 Classwork Date_____ Period____

A particle moves along a horizontal line. Its $\boxed{\text{position function}}$ is $s(t)$ for $t \geq 0$. For each problem, find the velocity function $v(t)$, the acceleration function $a(t)$, the times t when the particle changes directions, the intervals of time when the particle is moving left and moving right, and the times t when the acceleration is 0.

1) $s(t) = t^3 - 4t^2 - 60t$

① $s \to v$ take derivative of s

② $s \to a$ take 2nd deriv. of s OR 1st deriv of v.

③ change direction means v changes sign

$v = 0$ sign chart v + − → solution value of t

0 v=0

④ $v < 0$ ⑤ $v > 0$ → solution (a,b) from t=a to b

$a < t < b$

⑥ $a(t) = 0$ → solution value of t

A particle moves along a horizontal line. Its $\boxed{\text{position function}}$ is $s(t)$ for $t \geq 0$. For each problem, find the position, velocity, speed, and acceleration at the given value for t.

2) $s(t) = t^3 - 23t^2 + 120t$; at $\boxed{t = 2}$

① $s \to s$ plug in $s(2) = \#$

② $s \to v$ take deriv. then plug in $v(2) = \#$

③ $v \to$ speed take absolute value of ↗ $|v| =$ speed

④ $v \to a$ take derivative, plug in $a(2) = \#$

A particle moves along a coordinate line. Its $\boxed{\text{velocity function}}$ is $v(t)$ for $t \geq 0$. For each problem, find the position function $s(t)$.

→ initial condition the position is 0 at time = 0

3) $v(t) = 4t^3 - 42t^2$; $\boxed{s(0) = 0}$

① $v \to s$ take antiderivative

$$\int v(t)\,dt = \underbrace{s(t)}_{\text{stuff w/ } t} + \underbrace{C}_{\text{constant}}$$

Alternately

variable →

$$\int_0^t v(u)\,du = \underbrace{s(t)}_{\text{stuff w/ } t} - \underbrace{s(0)}_{\text{given}}$$

start t ↗

A particle moves along a coordinate line. Its acceleration function is $a(t)$ for $t \geq 0$. For each problem, find the position function $s(t)$ and the velocity function $v(t)$.

① ②

4) $a(t) = -6t + 16$; $s(0) = 0$; $v(0) = 0$

② $a \to v$ take antideriv.

$$\int_0^t a(u)\,du = \underbrace{v(t) - v(0)}_{\text{velocity function}}$$

① $v \to s$ take antider

$$\int_0^t v(u)\,du = \underbrace{s(t) - s(0)}_{\text{position function}}$$

A particle moves along a coordinate line. Its acceleration function is $a(t)$ for $t \geq 0$. For each problem, find the velocity at the given value for t.

①

5) $a(t) = 6t - 2$; $v(0) = -56$; at $t = 6$

initial condition

end t

① $a \to v$ take antiderivative

$$\underbrace{\int_0^6 a(t)\,dt}_{\#} = \overbrace{v(6)}^{\text{want to know}} - \underbrace{v(0)}_{\text{given}}$$

start t

graph → use geom + area

table → geometry + area

function → calc → by hand

A particle moves along a coordinate line. Its velocity function is $v(t)$ for $t \geq 0$. For each problem, find the position and velocity at the given value for t.

6) $v(t) = -3t^2 + 46t - 120$; $s(0) = 0$; at $t = 5$

Same except letters

$$\underbrace{\int_0^5 v(t)\,dt}_{\text{accumulation of distance during 5 sec}} = \underbrace{s(5)}_{\text{position end at}} - \underbrace{s(0)}_{\text{position I start at}}$$

want given

A particle moves along a coordinate line. Its velocity function is $v(t)$ for $t \geq 0$. For each problem, find the displacement of the particle and the distance traveled by the particle over the given interval.

① ②

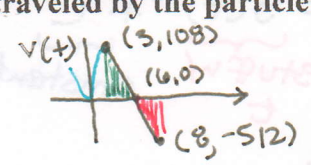
7) $v(t) = -4t^3 + 24t^2$; $3 \leq t \leq 8$

start stop

$0 = -4t^3 + 24t^2$

$0 = -4t^2(t-6)$

$t = 0, 6$



① + ② are both measuring position so $v \to s$ take antiderivative

① $\int_3^8 v(t)\,dt$

② $\int_3^8 |v(t)|\,dt$ ← break into pieces + take make them all positive area

$$= \int_3^6 v(t)\,dt - \underbrace{\int_6^8 v(t)\,dt}_{-2}$$

or $+\int_8^6$