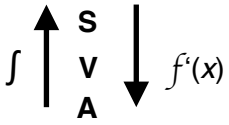
NAME:_____ DATE: 03/27/2018

ASSIGNMENT: Particle Motion *[non-calc]*
DIRECTIONS: A helpful mnemonic for solving these physics problems in calculus is to write the following on your paper:



S (displacement) is the integral of V (velocity) is the integral of A (acceleration)
A (acceleration) is the derivative of V (velocity) is the derivative of S (displacement)

2.) The velocity v m s^{-1} of a particle at time t seconds, is given by $v = 2t + \cos 2t$, for $0 \leq t \leq 2$.

(a) Write down the velocity of the particle when $t = 0$.

(1)

When $t = k$, the acceleration is zero.

(b) (i) Show that $k = \frac{\pi}{4}$.

(ii) Find the exact velocity when $t = \frac{\pi}{4}$.

(8)

(c) When $t < \frac{\pi}{4}$, $\frac{dv}{dt} > 0$ and when $t > \frac{\pi}{4}$, $\frac{dv}{dt} > 0$.

Sketch a graph of v against t.

(4)

(d) Let d be the distance travelled by the particle for $0 \leq t \leq 1$.

(i) Write down an expression for d.

(ii) Represent d on your sketch.

(3)
(Total 16 marks)

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(a) $v = 1$ A1 N1 1

(b) (i) $\frac{d}{dt}(2t) = 2$ A1

$\frac{d}{dt}(\cos 2t) = -2\sin 2t$ A1A1

Note: *Award A1 for coefficient 2 and A1 for –sin 2t.*

evidence of considering acceleration = 0 (M1)

e.g. $\frac{dv}{dt} = 0, 2 - 2\sin 2t = 0$

correct manipulation A1

e.g. $\sin 2k = 1,\ \sin 2t = 1$

$2k = \frac{\pi}{2}\left(\text{accept } 2t = \frac{\pi}{2}\right)$ A1

$k = \frac{\pi}{4}$ AG N0

(ii) attempt to substitute $t = \frac{\pi}{4}$ into v (M1)

e.g. $2\left(\frac{\pi}{4}\right) + \cos\left(\frac{2\pi}{4}\right)$

$v = \frac{\pi}{2}$ A1 N2

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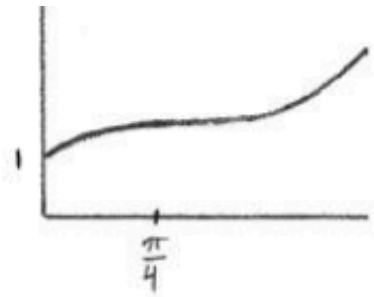


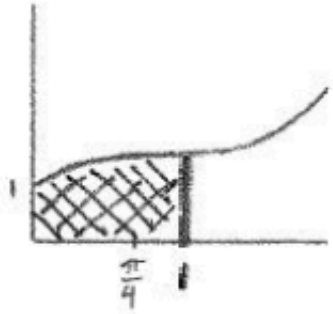
A1A1A2 N4

Notes: *Award A1 for y-intercept at (0, 1), A1 for curve having zero gradient at* $t = \frac{\pi}{4}$, *A2 for shape that is concave down to the left of* $\frac{\pi}{4}$ ***and*** *concave up to the right of* $\frac{\pi}{4}$. *If a correct curve is drawn without indicating* $t = \frac{\pi}{4}$, *do not award the second A1 for the zero gradient, but award the final A2 if appropriate. Sketch need not be drawn to scale. Only essential features need to be clear.*

(d) (i) correct expression A2

e.g. $\int_0^1 (2t + \cos 2t)\,dt, \left[t^2 + \frac{\sin 2t}{2}\right]_0^1, 1 + \frac{\sin 2}{2}, \int_0^1 v\,dt$

(ii)



A1

Note: *The line at t = 1 needs to be clearly after* $t = \frac{\pi}{4}$.