## ***BASIC TYPE OF DIFFERENTIAL EQUATIONS FROM NCEA PAPERS.***

***1***

An object is oscillating in a straight line through the origin.

Its velocity is given by $\frac{ds}{dt} = \sin\left(\frac{t}{2} - \frac{1}{2}\right)$

where $t$ is the time in seconds

and $s$ is the distance in metres from the origin.

The object passes through the origin one second from the start.

Find an equation for the distance of the object from the origin at any time $t$.

2

A scared cat runs in a straight line along the top of a wall from one end in such a way that its velocity at time $t$ is given by:

$v = 3 - 3\sin 3t, \quad 0 \le t \le 5$

where $v$ = velocity in metres per second
and $t$ = time in seconds.

Calculate the distance travelled by the cat during the first four seconds.

3

A spaceship fires its rocket engines and starts to accelerate.
The acceleration of the spaceship can be modelled by

$$a(t) = \frac{320\,000}{16\,000 - 400t} \quad \text{for } 0 \le t < 40$$

where $a$ is the acceleration in m s$^{-2}$
and $t$ is the time in seconds after the spaceship fires its engines.

The spaceship was initially stationary.

What is the velocity of the spaceship after 30 seconds?

4

A tank initially contains 10 litres of water.

It is filling at the rate of $\frac{50}{(t+1)^2}$ litres/minute where $t$ is the time in minutes.

How much will it contain after one hour?

5

The velocity, $v$, of an object in metres per second is given by the equation $v = 5\sin t + 0.8t$, where $t$ is the time in seconds from the start of the motion.

Find the distance the object travelled in the first 8 seconds of the motion.

6

Solve the differential equation $\frac{d^2y}{dt^2} = 12t - 3$, given that when $t = 1$, $y = 2$ and $\frac{dy}{dt} = 4$.

7

An object is moving in a straight line.

The velocity of the object is given by $v = 6 - \frac{5}{t+1}$, where $t$ is the time measured in seconds from when the object started moving, and $v$ is the velocity measured in metres per second.

How far does the object travel in its 4th second of motion?

8

A large tank initially contains 20 litres of diesel.

The tank is being filled at a rate of $\frac{400}{(t+2)^2}$ litres per minute, where $t$ is the time in minutes since the filling started.

How much diesel will be in the tank 6 minutes after filling started?

9

An object's acceleration is given by the formula:

$$a(t) = 0.6e^{0.2t}$$

where $a$ is the acceleration of the object (m $s^{-2}$)
and $t$ is the time since the start of the object's motion (seconds).

If the object had a velocity of 5 m $s^{-1}$ after 2 seconds, how far did it travel during its fourth second of motion?