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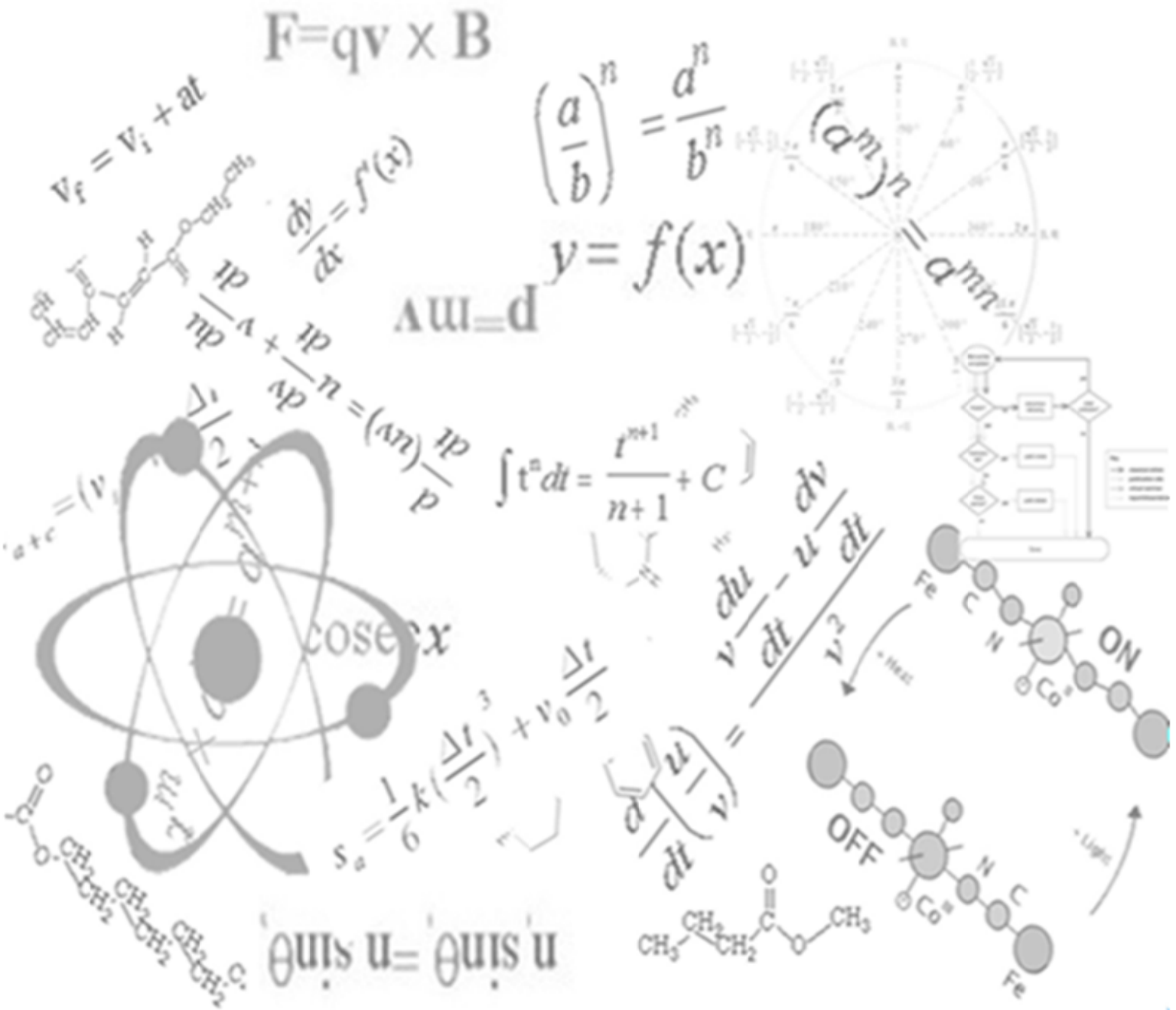
S4S coaching

Year 12- Mathematics Advanced

Applications of Calculus to the Physical World



Applications of Calculus to the Physical World
Exam /38

1. (**4 marks**)

The number of bacteria in a colony is growing at a rate proportional to the current number. Find k, if the size of the colony doubles every half hour. If the colony now has 600 million bacteria, how long ago did the colony contain 3 million bacteria?

2. (**4 marks**)

Water is pumped out of a 25000 litre storage container such that $\frac{DV}{dt} = -1.92t$. Find an expression for V if the tank was initially full. How long before the tank is only 40% full?

3. (**5 marks**)

A particle is moving along a plane and $x=70t+100e^{-\frac{t}{10}}$. Find the intial position, show that it is always moving towards the right and find out what happens to the acceleration eventually.

4. (**3 marks**)

Volume of water in a tank is $V=400-4t+\frac{t^2}{400}$ litres, t in minutes.

i) how much water is in tank after 15 mins?

ii) what is the rate of water flowing out of the tank at 25 mins?

5. (**5 marks**)

Ice is melting at a rate proportional to its mass, $\frac{DM}{dt} = -kM$, after 25 minutes, 15% has melted.

i) show that $M=M_0e^{-kt}$ is a solution to $\frac{DM}{dt} = -kM$

ii) find k

iii) how long will it take for 70% to melt?

6. (**2 marks**)

The population of a species of insects is decreasing at an increasing rate. What does this statement imply about $\frac{DN}{dt}$ and $\frac{D^2N}{dt^2}$

7. (**3 marks**)

The expected amount of physical activity per day for a student of A minutes is given by $A=20e^{kt}$, where t is the year the student is in. in year 7, students are expected to spend 120 mins doing activity per day.

i) Find k (3 dec. plc)

ii) find the rate of the expected amount of time on physical acitivty is spent on by a student in year 10

8. (**4 marks**)

A particle B is moving along a plane, its position is given by $x=e^{\frac{t}{4}} - t$

i) find an expression for V

ii) find the direction the particle is moving in initially

iii) find when the particle comes to rest

iv) find an expression for a.

9. (**3 marks**)

The height of a specific tide can be expressed as:

$H=4+2\cos(\frac{\pi t}{6})$

i) find the rate of change of the height after 10 hours

ii) is the tide ingoing or outgoing after 10 hours? Give reasons.

10. (**5 marks**)

Given $v=e^{3t} - 4e^{t}$ m/s, find:

i) initial velocity and acceleration

ii) Find an expression for x in terms of t if intially the particle is at $x=0$

iii) find the position of the particle at $t=\ln 4$