UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

UNIVERSITEIT VAN JOHANNESBURG

**DEPARTMENT OF PURE AND APPLIED MATHEMATICS**

**MODULE** **MAT1C2E** (CALCULUS SECTION)
BIO & ENVIRO MATHS AND STATS

**CAMPUS** **APK**

**EXAM** **NOVEMBER 2015**

**DATE:** 13 NOVEMBER 2015 **SESSION:** 08:30 – 10:30

**ASSESSOR:** MR. T. MOHUBEDU

**INTERNAL MODERATOR:** MR. V. VAN APPEL

**DURATION:** 60 MINUTES **MARKS:** 40

SURNAME AND INITIALS: _____

STUDENT NUMBER: _____

CONTACT NUMBER: _____

**Please read the following instructions carefully**

1. Answer all questions on the paper in pen.
2. This paper consists of 9 pages including the cover page.
3. **Show all calculations.**
4. **Calculators are allowed.**

1 Find the composition $f \circ g$ if $f(x) = x^2 + 1$ and $g(x) = 1 - x$. [1]

2 Simplify $\log_3 4 - \log_3 12$ (using laws of logarithm) [2]

3 Find the equation of the straight line that is passing through the points $(1, -1)$ and $(-5,\ 4)$. [2]

4 The temperature of a room ($T$ ) is a function of how far the window is open ($W, in\ cm^2$) according to T (W )$= 30- 2.5$W . How long you sleep ($S$, measured in hours) is a function of the temperature according to $S(T) = 10 - 0.2T$

4.1 What is the maximum temperature of the room? [1]

4.2 Find the formula of how long you sleep as a function of how far the window is open. [2]

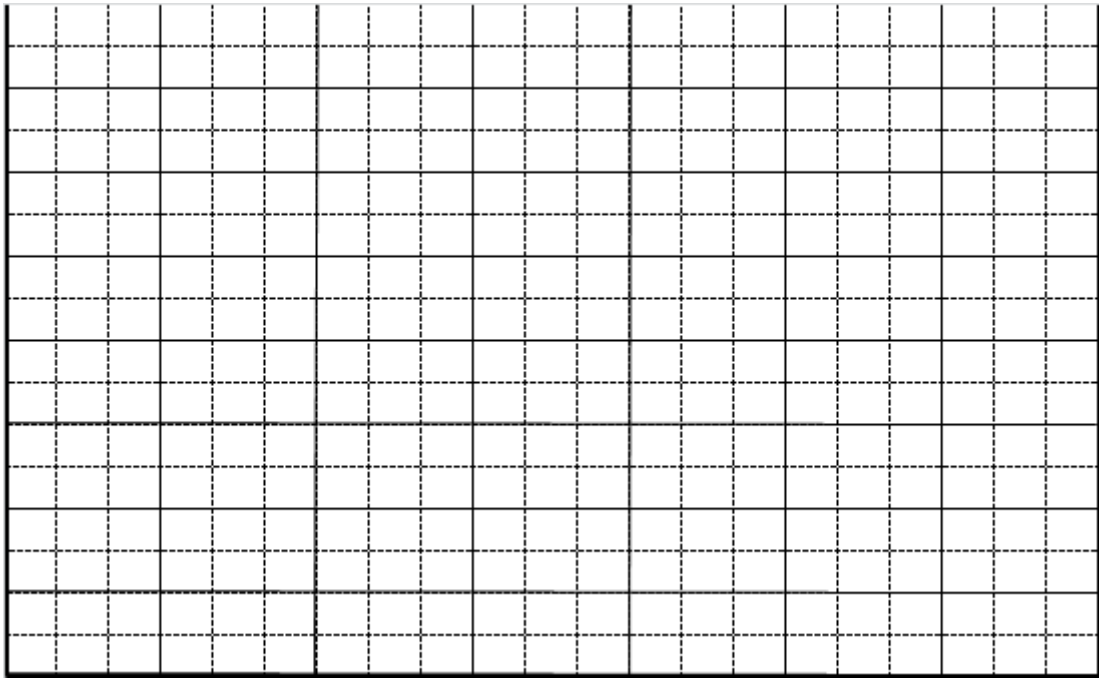
4.3 How long would you sleep if the window was 8 $cm^2$ open? [1]

5. Suppose a population $V(t)$ of viruses $(in\ millions)$ in an infected person is dying according to $V(t) = 20.1e^{-0.5t}$ where time t is measured in hours.

5.1 Calculate the time at which the number of viruses will reach 5.0 million. [2]

5.2 Find the equation of the line $\ln(V(t))$ after transforming the variables to create a semilog plot. [2]

5.3 Sketch the graph of $\ln(V(t))$ as a function of t for $0 \leq t \leq 6$. [1]



6 A population follows the discrete – time dynamical system $b_{t+1} = rb_t$ with $r = 1.5$ and $b_0 = 2.0 \times 10^3$.

6.1 Find the solution of the system. [1]

6.2 When will the population reach $1.0 \times 10^4$? [2]

7 A population has a doubling time of $4.5$ years and an initial size of $5 \times 10^6$.

7.1 What is the population in 9 years? [1]

7.2 Find the equation for population size $P(t)$ as a function of time. [2]

8 The size (in $cm$) of an organism at time $t$ (in $hours$) is given by $S(t) = 0.1\, e^t$.

8.1 Find the average rate of change in size during the second hour. [2]

8.2 Hence find the equation of the secant line connecting the base point $t_0 = 1.0$ and $t_0 + \Delta t$ for $\Delta t = 1.0$. [1]

8.3 Find the equation of time as a function of the size of the organism. [2]

9 Find the limit $\lim_{t \to 0} \frac{\cos t}{x - 1}$ [1]

10 Set up a table to estimate the limit: $\lim_{t \to 0} \frac{\sin(2t)}{t}$ [2]

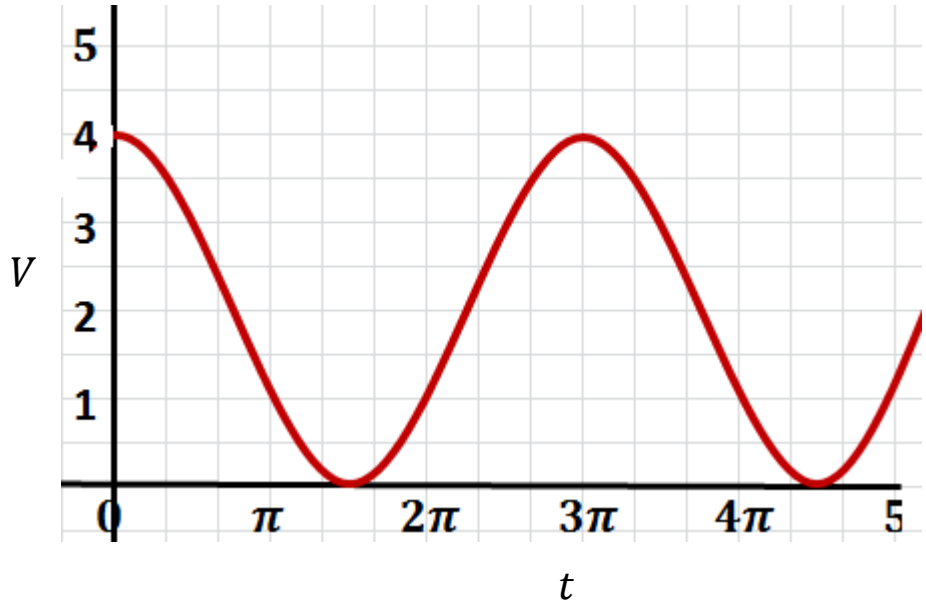
10 Given $f(x) = 4 - x^2$

10.1 Find $f'(x)$ [1]

10.2 Find the critical values of $f$. [3]

10.3 Give the interval of increase and decrease increase. [1]

11 Consider the given sinusoidal graph of $V$.



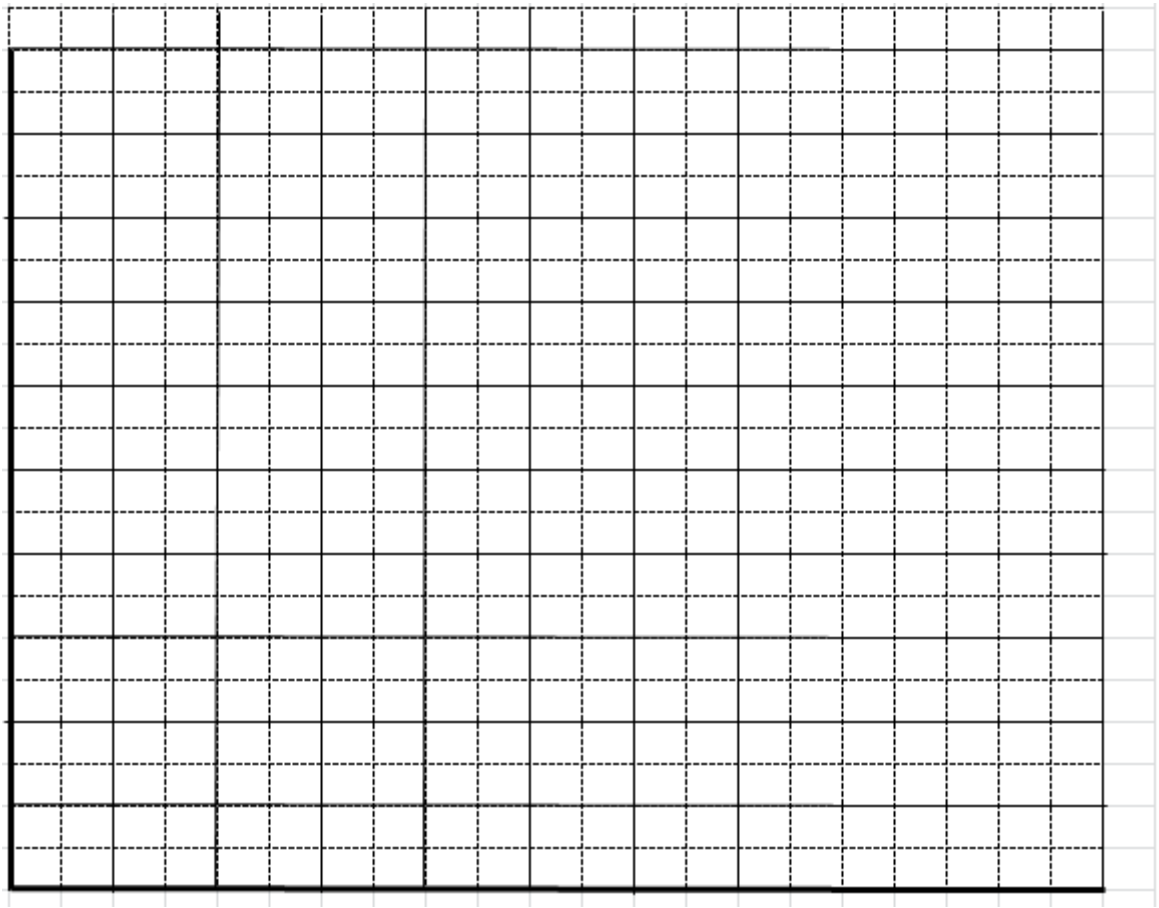

11.1 Find the average, amplitude, period and the phase. [2]

11.2 Write the equation of $V$. [1]

12 Given $h(t) = 4 + 3\cos(\pi t - 1.571)$

12.1 Write $h$ in standard form [1]

12.2 Sketch the graph of $h$. [3]



---------TOTAL 40--------