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CIT Semester 1 Examinations 2018/19

Note to Candidates:	Check the Programme Title and the Module Description to ensure that you have received the correct examination. If in doubt please contact an Invigilator.
Module Title:	**Maths for Physical Sciences**
Module Code:	**MATH6060**
Programme Title(s):	BSc Anlytcl & Pharma Chem Y1 BSc Hons Anlytcl Chmstry QA Y1 BSc Hons Env Sci & Sus Tech Y1 BSc Hons Instrument Eng Y1 Common Entry Science Levl 7 Y1 Common Entry Science Levl 8 Y1 BSc App Physics & Instrum Y1
Block Code(s):	**SCHEM_7_Y1** **SCHQA_8_Y1** **SESST_8_Y1** **SINEN_8_Y1** **SOMNI_7_Y1** **SOMNI_8_Y1** **SPHYS_7_Y1**
External Examiner(s):	**Dr. James Cruickshank**
Internal Examiner(s):	Mr. Donal O Shea
Instructions:	Answer all four questions. Please show all your calculations and workings.
Duration:	2 Hours
Required Items:	Log/Formulae Tables

1. (a) Solve for x in the following:

(i) $\dfrac{3}{5x-2} = \dfrac{7}{4-3x}$

(ii) $3^{x+2} = 9^{3x-1}$

(iii) $8\, e^{-0.25\, x} = 7$

[10 marks]

(b) The height, $h(t)$, in metres of an object thrown vertically upwards at time t seconds is given by:

$$h(t) \;=\; 90\, t \;-\; 17\, t^2$$

Determine how long it will take for the object to reach a height of 60 m. [6 marks]

(c) Solve for A, B and C in the following system of simultaneous equations:

$$\begin{aligned} 3\,A \;+\; 5\,B \;-\; 2\,C \;&=\;\;\; 17 \\ 4\,A \;+\; 3\,B \;+\; 7\,C \;&=\; -\;\; 10 \\ 5\,A \;-\; 8\,B \;+\; 5\,C \;&=\; -\;\; 13 \end{aligned}$$

[9 marks]

2. (a) Reduce the following equations to linear form and draw a rough sketch of the resulting graph ensuring that all axes and the intercepts are labelled:

(i) $T \;=\; 2\pi \sqrt{\dfrac{l}{g}}$ where g is a constant.

(ii) $N \;=\; N_0\, e^{-\lambda\, t}$ where N_0 and λ are constants.

[12 marks]

(b) During an experiment a student measured the power, **P**, in Watts (W) of a device while varying the applied current, **I**, in Amps (A). The results of the experiment are presented in the table below:

I (A)	2	4	6	8
P (W)	15.2	36.8	72.8	123.2

(i) By plotting a **suitable** graph, show that the measured values obey the equation

$$P \;=\; a\, I^2 \;+\; b$$

(ii) Using your graph, find approximate values for a and b.

(iii) Find the value of P when $I = 5\ A$.

(iv) Find the value of I when $P = 40\ W$.

[13 marks]

3. (a) Convert:

(i) 200° to **radians**.

(ii) $\dfrac{7\pi}{15}$ radians to **degrees**.

[2 marks]

(b) Assuming that $\theta \leq 90^\circ$, if $\sin\theta = \dfrac{5}{13}$, without calculating the value of θ, find the values of $\cos\theta$ and $\tan\theta$. [4 marks]

(c) Solve the following trigonometric equations for $0^\circ \leq \theta \leq 360^\circ$

(i) $\sin\theta = 0.5$

(ii) $\cos 2\theta = 0.7071$

(iii) $5\sin(\theta - 30^\circ) = -4$

[6 marks]

(d) The voltage, $V(t)$, in a certain electrical circuit is given by the sinusoidal function

$$V(t) \;=\; 50\;\sin\left(20\pi\, t + \frac{\pi}{4}\right)$$

(i) Find the **amplitude**, **period**, **frequency** and **phase offset** of this waveform.

(ii) Find the value of the voltage in the circuit at time $t = 0$ *s*.

(iii) Find the value of the voltage in the circuit at time $t = 2$ *s*.

(iv) Find the time at which the value of the voltage in the circuit reaches its first maximum value.

(v) Sketch one full cycle of the function representing the voltage in the circuit.

[13 marks]

4. (a) Given the complex numbers:

$$z_1 = 3 - 4\,i,\ z_2 = -2 + i,\ z_3 = 5 + 12\,i$$

(i) Show these numbers on an Argand diagram.

(ii) Evaluate $2\,z_1 - 3\,z_2$

(iii) Evaluate $\dfrac{z_3}{z_2}$

(iv) Convert z_1 to **polar** form.

[13 marks]

(b) Given the complex numbers:

$$z_4 = 25\angle 60^\circ,\ z_5 = 10\angle -40^\circ$$

(i) Evaluate $z_4\,z_5$

(ii) Evaluate $\dfrac{z_4}{z_5}$

(iii) Convert z_4 to **rectangular** form.

(iv) Write z_4 in **exponential** form.

(v) Evaluate $(z_5)^3$

[12 marks]