Student Number

0	0	0	0	0	0	0
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9

Full Name

Completely fill ONE bubble per column.
Use blue or black pen only.
Do not make any other marks in the grid.

School of Mechanical and Manufacturing Engineering

MMAN1300 – ENGINEERING MECHANICS 1

2018 S2 Block Test 1

Instructions:

- Time allowed: 45 minutes
- Total number of questions: 3
- Answer all the questions in the test
- Answer all questions in the spaces provided
- The 6 marks allocations shown are worth 6% of the course overall
- Candidates may bring drawing instruments, rulers and UNSW approved calculators to the test
- Print your name, student ID and all other requested details above
- Record your answers (with appropriate units) in the ***ANSWER BOXES*** provided

Notes:

Your work must be complete, clear and logical

Do not skip steps, sign conventions, units and relevant diagrams and clearly state the final answers

No part of this paper is to be retained by candidates until handed back after marking

2PGWE7GO 0

Equation Sheet

Linear motion

$$v = \frac{ds}{dt} \qquad a = \frac{dv}{dt} \qquad vdv = ads$$

Constant linear acceleration equations ($t_o = 0$)

$$v = v_o + at \qquad v^2 = v_o^2 + 2a(s - s_o) \qquad s = s_o + v_o t + \frac{1}{2}at^2$$

Angular motion

$$\omega = \frac{d\theta}{dt} \qquad \alpha = \frac{d\omega}{dt} \qquad \omega d\omega = \alpha d\theta$$

Displacement, velocity and acceleration components

Rectangular coordinates

$$\mathbf{r} = x\mathbf{i} + y\mathbf{j} \qquad \mathbf{v} = \dot{x}\mathbf{i} + \dot{y}\mathbf{j} \qquad \mathbf{a} = \ddot{x}\mathbf{i} + \ddot{y}\mathbf{j}$$

Normal and tangential coordinates

$$\mathbf{v} = v\mathbf{e_t} \qquad \mathbf{a} = a_t\mathbf{e_t} + a_n\mathbf{e_n} \qquad v = \omega r \qquad a_t = \dot{v} = \alpha r \qquad a_n = \frac{v^2}{\rho} = \omega^2 r$$

Relative motion

$$\mathbf{r}_A = \mathbf{r}_B + \mathbf{r}_{A/B} \qquad \mathbf{v}_A = \mathbf{v}_B + \mathbf{v}_{A/B} \qquad \mathbf{a}_A = \mathbf{a}_B + \mathbf{a}_{A/B}$$

Equation of motion (Newton's 2nd law)

$$\sum \mathbf{F} = m\mathbf{a}$$

Work-Energy

$$W_{1-2} = \Delta T + \Delta V_g + \Delta V_e \qquad W_{1-2} = F\Delta s \text{ and/or } M\Delta\theta$$

$$\Delta T = \frac{1}{2}m\left(v_2^2 - v_1^2\right) \text{ and/or } \frac{1}{2}I\left(\omega_2^2 - \omega_1^2\right)$$

$$\Delta V_g = mg(h_2 - h_1)$$

$$\Delta V_e = \frac{1}{2}k\left(x_2^2 - x_1^2\right) \quad \text{for a linear spring}$$

For a rigid body in plane motion

$$\sum \mathbf{F} = m\mathbf{a} \qquad \sum M = I\alpha$$

Mass moment of inertia $I = \int r^2 dm$

Centroid of a cross-section:

$$\bar{x} = \frac{\int xdA}{\int dA} = \frac{\sum_i x_i A_i}{\sum_i A_i} \quad , \quad \bar{y} = \frac{\int ydA}{\int dA} = \frac{\sum_i y_i A_i}{\sum_i A_i}$$

DATA: Acceleration in free fall due to gravity g = 9.81 m/s^2